PROCEEDINGS

Riga (Latvia)

6-8 November 2018

at the Baltic Studies Centre

BSC BALTIC STUDIES CENTRE

With the support of

INRA SCIENCE & IMPACT

WAGENINGEN UR For quality of life

IFRIS Institute For Research and Innovation in Society

LIST OF PARTICIPANTS

Name of presenting author	Email	Co-Authorship
Adamsone Anda	anda@lza.lv	Anda Adamsone-Fiskovica and Mikelis Grivins
Barbier Marc	marc.barbier@inra.fr	Marc Barbier and Claire Lamine
Bremmer Bart	Bart.Bremmer@innovatiesocioloog.nl	Boelie Elzen, Bram Bos, Barbara van Mierlo and Bart Bremmer
Cerf Marianne	marianne.cerf@inra.fr	Juliette Brun, Marie-Hélène Jeuffroy, Jean-Marc Meynard, Caroline Pénicaud and Marianne Cerf
Cristiano Simona	simona.cristiano@crea.gov.it	Patrizia Proietti and Simona Cristiano
de Krom Michiel	Michiel.deKrom@pbl.nl	Michiel de Krom and Hanneke Muilwijk
Koutsouris Alex	koutsouris@aua.gr	Alex Koutsouris and Eleni Zarokosta
Levidow Les	L.Levidow@open.ac.uk	Les Levidow
Matti Cristian	cristian.matti@climate-kic.org	Cristian Matti, Fabrizio Rossi and Valerio Bruschi
Megyesi Boldizsár	megyesi.boldizsar@tk.mta.hu	Boldizsár Megyesi
Potters Jorieke	Jorieke.Potters@wur.nl	Jorieke Potters, Chris Blackmore and Herman Schoorlemmer
Poux Xavier	xavier.poux@asca-net.com	Xavier Poux, Claire Bernard-Mongin, Diana Dumitras, Maria Isabel Ferraz de Oliveira, Fabrice Gouriveau, Dimitris Goussios, Irina Herzon, Mugurel Jitea, Yanka Kazakova, François Lerin, Magnus Llung, Angela Lomba, Vali Mihai, James Moran, Teresa Pinto-Correia and George Vlahos
Rizzo Davide	davide.rizzo@unilasalle.fr	Davide Rizzo, Fatma Fourati, Lucian Ceapraz, Mariia Ostapchuk, Hanitra Randrianasolo, Anne Combaud, Mehdi Jaber and Michel Dubois
Salembier Chloé	chloe.salembier@inra.fr	Chloé Salembier, Jean-Marc Meynard, Blanche Segrestin and Benoît Weil
Spaeth Philipp	spaeth@envgov.uni-freiburg.de	Philipp Spaeth and Doerte Peters
Toffolini Quentin	quentin.toffolini@inra.fr	Quentin Toffolini, Lorène Prost, Marie-Hélène Jeuffroy and Jean-Marc Meynard
Triboi Roxana Maria	roxana.triboi@gmail.com	Roxana Maria Triboi
Tziva Maria	m.tziva@uu.nl	Maria Tziva
Vermunt Dorith	d.a.vermunt@uu.nl	Dorith Vermunt, Simona Negro, Frank van Laerhoven and Marko Hekkert

Scientific Committee

Scientific Commmitee	Email
Boelie Elzen	boelie.elzen@wur.nl
Talis Tisenkopfs	Talis.Tisenkopfs@lu.lv
Baiba Rivza	rivzab@llu.lv
Marianne Cerf	marianne.cerf@inra.fr
Marc Barbier	marc.barbier@inra.fr
Les Levidow	L.Levidow@open.ac.uk

Invited persons

Invited persons	
Ms Laimdota Straujuma	Former prime minister of Latvia
Hans-Joerg Lutzeyer	Research Programme Officer European Commission, DG Research and Innovation
Frederike Praasterink	Professor Future Food Systems at HAS University of Applied Sciences

TABLE OF CONTENTS

PS5: MULTI-STAKEHOLDER APPROACHES AND INNOVATION SUPPORT FOR SUSTAINABLE AGRICULTURE

Navigating through the Spiral of Innovations: Lessons from bottom-up innovative initiatives in rural Greece
Alex Koutsouris and Eleni Zarokosta

Innovation support services: an evidence-based exploration of their strategic roles in the Italian AKIS
Patrizia Proietti and Simona Cristiano

Knowledge production in agricultural demonstrations: matching the perspectives of stakeholders
Anda Adamsone-Fiskovica and Mikelis Grivins

PS6: MULTI-STAKEHOLDER APPROACHES AND INNOVATION SUPPORT FOR SUSTAINABLE AGRICULTURE

Shedding light on and sharing farmers' innovative practices: lessons from R&D initiatives in support of innovation
Chloé Salembier, Jean-Marc Meynard, Blanche Segrestin and Benoît Weil

How co-design processes can contribute to and renew the scientific knowledge production?
Quentin Toffolini, Lorène Prost, Marie-Hélène Jeuffroy and Jean-Marc Meynard

Exploring the future contribution of multidisciplinary research to the development of coupled innovations between agriculture and food processing, towards sustainable food systems
Juliette Brun, Marie-Hélène Jeuffroy, Jean-Marc Meynard, Caroline Pénicaud and Marianne Cerf

PS7: ASSEMBLING INNOVATIVE PRACTICE AND CONTRASTED INCENTIVES: INNOVATION CLUSTER AND POLICY INSTRUMENT

The case of a French cluster for agritech innovation
Davide Rizzo, Fatma Fourati, Lucian Ceapraz, Mariia Ostapchuk, Hanitra Randrianasolo, Anne Combaud, Simon Ritz, Mehdi Jaber, Michel Dubois

Building legitimacy in and with agroecological transitions. Results and learnings from a collaborative observatory of social dynamics in innovative agricultural and rural projects
Marc Barbier and Claire Lamine

PS1: ANALYSIS AND STIMULATION OF TRANSITION PROCESSES

Destabilizing unsustainable agri-food systems? A critical discussion of (non-) options for German governmental

Philipp Spaeth and Doerte Peters

Perspectives on sustainable food: a discursive analysis of the public debate and food policy in the Netherlands

Michiel de Krom and Hanneke Muilwijk

THE DESTABILISATION OF UNSUSTAINABLE (AGRI-) FOOD SYSTEMS

Assessing and jumping a gap in the literature

AUTHORS: PHILIPP SPÄTH, DÖRTE MARIE PETERS, VIVIEN RIENER

Abstract

The German Federal Ministry of the Environment has commissioned us (as part of a consortium led by NAHhaft, Berlin) to explore the potential of a sustainability transitions approach with respect to the German food system and to identify possibilities of political interventions.

As one part of this endeavour, we review to what extent the literature on socio-technical transitions discusses the possibility to destabilise unsustainable regimes not only indirectly by fostering niche innovations, but also directly by some sort of destructive interventions. It has repeatedly been identified as an omission of the transitions literature that a bias towards constructive niche building has led scholars to neglect and under-research potentials for and constraints to the intentional destabilisation of entrenched regimes in support of alternative, e.g. more sustainable configurations (cf Smith et al. 2010, Turnheim & Geels 2013).

In this paper, we report on a systematic reviewing of various strands of transitions literature for strategic thoughts that go beyond niche creation. To what extent are different subsets of this literature discussing political strategies of directly destabilising entrenched regimes? We find that the topic is hotly debated in conceptual papers and very often illustrated with examples from the energy regime. Indeed, there is only a small handful of papers that discuss potentially destructive strategies with regard to the (agri-)food system. What may be the reasons for this? Does it make sense at all to imagine political interventions which aim at the de-stabilisation of the entrenched agro-industrial production, commodified global trade and source-ignorant consumption of food? If yes, what principles could inform such strategizing? What particularities of the sector would have to be considered?

KEY-WORDS

REGIME DESTABILISATION, EXNOVATION, SUSTAINABILITY TRANSITIONS, (AGRI-)FOOD SYSTEM

INTRODUCTION

"In contrast to the large body of research on path-dependency and lock-in in socio-technical dynamics, relatively little is known about processes and mechanisms for accelerating the unlocking of sociotechnical regimes. How do regimes open up, erode or decline? A related issue here is with the roles and strategies of particular actors in these processes. Taking public policy, we observe a reluctance to seriously consider how to unsettle and unlock established regimes. Perhaps links to the decline of politically salient industries makes it too great a risk. But what are the conditions in political economy that allow an accelerated dismantling of unsustainable socio-technical structures, at the same time as creating space for sustainable alternatives to develop?" (Smith et al. 2010:445)

This research builds on the assumption that the literature on socio-technical transitions can inspire and inform political debates about feasible and necessary political interventions in favour of a sustainability transition in the agri-food sector (e.g. in Germany). Most of the transitions literature revolves around "innovations" and the fostering of niches in order to challenge and transform unsustainable regimes. This may be well explained by the

greater attractiveness of "positive", "constructive" interventions in the political sphere and by the widespread practice of uncritically promoting "innovation" as a political objective in itself. However, the slow pace at which sustainability transitions unfold in practice, if at all, calls for a renewed debate about possibilities and limitations to broaden political approaches and include more direct and "destructive" interventions in order to create the needed space and conditions for long identified sustainable practices to gain hold. Pursuing a managerial approach or hoping for better policies to be implemented by a strong state, which is not entangled with the given regimes, would of course be naïve, ignorant of overwhelming historical evidence and additionally at odds with some basic assumptions of the socio-technical transitions approach. Particularly the cognition that the policy horizon of governments is usually co-evolving with the regimes, and the fact that radical policy objectives are therefore not only difficult to implement, but also unlikely to be developed in the first place, imply rather modest perspectives on governance. But as we, academic observers of the (agri-)food regime, clearly recognise the necessity of a radical sustainability transition, would it not make sense to at least imagine and propagate possible destructive interventions, that we assume are most effective (and least harmful) for destabilising the unsustainable (agri-)food regime?

As a basic step in this direction, we review the burgeoning transitions literature for strategic thoughts that go beyond niche creation. Our leading question is: To what extent is transitions literature discussing political strategies of directly destabilising entrenched regimes, and hence transgressing the usual niche-building strategies? What policy recommendations are developed for different sectors, and what basic principles are discussed for the identification of most effective measures?

The endeavour to collect such thoughts is particularly challenging, because international scholars use very different terms when addressing the question of directly destabilising regimes. Interestingly, many German scholars recently use the term "exnovation", defined e.g. as "the purposive termination of existing (infra)structures, technologies, products and practices" (Heyen et al. 2017:326). However, this term is not yet widely used by other than German authors (see the respective finding below). To identify respective strategic considerations in the international transitions literature, we therefore have to search for keywords like "destabilisation", "discontinuation", "disruption", "unlocking", "abandonment", and "phasing out" of regimes.

Given our task to support transformative ambitions with regard to the German agri-food system, we first focused on literature that refers to the term "food system". However, we found that only two texts, that in a significant portion address the (agri-)food system, also reflect on some sort of exnovation strategies (in the broadest sense) (Kuokkanen et al. 2018, Cohen and Ilieva 2015), while nearly all detailed discussions of strategies for direct destabilisation are illustrated with examples from the energy sector.

Our ultimate aim is to identify promising exnovation strategies for supporting a sustainability transition of the German (agri-)food system. As there is very little discussion of destabilisation strategies with explicit reference to this sector yet, we hence aim to collect guidance from generic conceptual literature and may carefully translate strategies from other fields, especially from energy transition studies. We hence also reviewed the much larger body of work, which relates to the term "energy system" and addresses some sort of direct destabilisation strategies.

METHODS

We conducted a systematic literature search using the databases and search engines of Google Scholar and Science Direct in parallel. Our progressive free text search with Boolean operators delineated bodies in three consecutive steps in order to reflect our specific research interest:

First, we identified literature that relates to the governance of socio-technical transitions. Given that any search on Science Direct is confined to a maximum of eight effective operators, we carefully selected the following search term, already using five operators, for this first step of filtering:

(transition OR transform) AND "socio-technical" AND regime AND "multi-level perspective" AND governance

In a second step, we formed subsets of this body of transition literature by additionally searching for indicators of a sectoral orientation. At this step, we hence added either "*food system*" or "*energy system*" to the search term described above, at the beginning of the term, and followed by the operator "*AND*".

In a third step, we searched the sector-indexed bodies of literature for indications that strategies beyond niche management are discussed. For this purpose, we did a first sifting of often cited texts and collected

substantives that are used to paraphrase actions which aim at the direct and intentional weakening of regimes or explicitly at exnovation. Of these terms, we found that the following are used most often within transition studies: "*destabilisation*"[1], "*discontinuation*", "*disruption*", "*dismantling*", "*unlocking*", "*abandoning*", and "*phasing out*" (of regimes). In a series of consequent queries, we alternately added one of these strings at the beginning of the term used in step 2, followed by the operator "*AND*".

The most relevant sets of texts have then been searched for thoughts on strategies and limitations to direct destabilisation of regimes. Additionally, they have been categorised (tagged) according to various qualitative criteria: like frameworks applied (MLP, TIS, Social Practice Theory) or focus (conceptual, methodological, empirical). Due to the great number of retrieved texts, an assessment according to these criteria has not been possible yet.

As both Google Scholar and Science Direct are not transparent about the ways their search engins work, results often do not correspond with the logic that the operators AND/OR suggest. The order of operators within search terms e.g. influences results. Our queries therefore can only give a rough estimation of relative quantities. For more exact results, different search tools (and hence smaller repositories) would have to be used, such that subsequent queries can be conducted within search results.

FINDINGS

Quantiative findings of our literature review

In step 1, we retrieved 5.000 publications of the Google Scholar database and 411 publications from Science Direct that are related to the governance of socio-technical transitions2. Adding "energy system" to the search term, we found 1.850 publications in Google Scholar and 209 publications in Science Direct. Alternatively including "food system" in the term, we retrieved 395 publications in Google Scholar and 39 publications in Science Direct.

	transition governance	**AND energy system**	**AND food system**
Google Scholar	5000	1850	395
Science Direct	411	209	39

Table 1: Sectoral split of transition governance literature

Even if less pronounced, this confirms a bias that has been found earlier, that around 39% of "key transitions studies" address the energy regime, but only 3% the food regime (Markard et al. 2012:961)

When skimming the identified literatures, we found that only 113 of the 395 publications in Google Scholar and 12 of the 38 publications in Science Direct that responded to the search term that included "food system" actually had the (agri-)food system as main focus. These 119 publications (six appear in both searches) serve as the basis for our qualitative analysis regarding direct destabilisation strategies in the food system literature (see below). Until today, we were able to analyse half of this body regarding thoughts on direct destabilisation of regimes.

Skimming the complete bodies of roughly 2000 and 410 texts, with reference to "energy system" or "food system" respectively, we searched for the occurrence of our indicators for the discussion of direct destabilisation strategies. See table 2 below for the number of retrieved texts when searching for the individual indicator terms. In the two subsets of texts either featuring "energy system" or "food system", of all our index verbs,

1 In step 3, all possible spelling variants were tested, e.g. deinstitutionali**z**ation, deinstitutionali**s**ation, de-institutionali**z**ation, de-institutionali**s**ation.

2 The search was conducted on October 15, during office hours, using a desktop computer within the domain of the University of Freiburg. We are aware, that these factors influence the results. For the search term used, please refer to the methods section.

"destabilisation" occurred in the greatest number, in 1620 texts (1365 and 255 times, respectively), while "disruption" occurred in 973 (804 and 169) texts and "abandonment" in 523 (402 and 121) texts.

Energy system		**Food system**	
destabilisation	1365	destabilisation	255
disruption	804	disruption	169
abandonment	402	abandonment	121
phase-out	355	discontinuation	74

Table 2: Retrievals of indicator strings for direct destabilisation strategies

Some of these texts mention in passing that direct destabilisation of regimes may be possible, often citing Geels & Schot 2007 and Smith et al. 2005. Nearly all texts, however, clearly focus on constructive niche supporting strategies, when it comes to political strategies at all (see e.g. White & Stirling 2013; Beers et al. 2014; Longhurst 2015; Hermans et al. 2016; Belmin et al. 2018; Ingram 2018; Rut & Davies 2018). An explicit discussion of direct destabilisation strategies in the food sector is only found in Kuokkanen et al. 2018. We discuss this text in detail below.

Besides, Cohen & Ilieva 2015 develop a "strategic practice management approach for cities", as a policy approach for (metropolitain) city governments "and advocates" which aims at an intentional shaping of social practices in support of socio-technical transitions, which may be considered a hybrid approach to semi-directly destabilising existing regimes by transforming particular social practices as key regime elements.

While we find a near perfect absence of strategies for directly destabilising regimes in the literature that refers to "food system", most texts which do discuss such strategies refer to the ongoing or past energy transitions for illustration. In the debate about energy transitions, it has developed into a kind of common place, that until now, niche building strategies have not delivered enough momentum and that some sort of destabilisation of entrenched regime elements is a prerequisite to a fundamental transition, additionally to landscape level changes (such as Fukushima). Often the German Energy transition is used as an example, where adding renewable electricity generation capacity without supportive changes to energy market mechanisms fell short of driving lignite out of the market (Leipprand & Flachsland 2018). Incumbents to the fossil regime here continue to benefit from externalising costs of fossil fuels with support of the regime (ibid.). Consequently, we find a high number of articles in the "energy system" related subset of transitions literature, that address some sort of direct destabilisation strategy, often citing Turnheim & Geels 2013.

27 of these "energy system" related texts as retrieved in Google Scholar relate explicitly also to the term „exnovation". Interestingly, these texts are all authored by German scholars, with only four exceptions (Swilling & Annecke 2012; Stirling 2014; Rosenbloom 2018; and GAMBHIR et al. 2018); and ten of them display 2018 as their publication year.

If we search for texts which relate to transition studies and simultaneously to one or more of the five most often retrieved index strings for direct destabilisation strategies (i.e. destabilisation, disruption, abandonment, discontinuation and phase-out), we find a nearly steady increase in numbers over the last 12 years to over 300 publications per year (see figure 1).

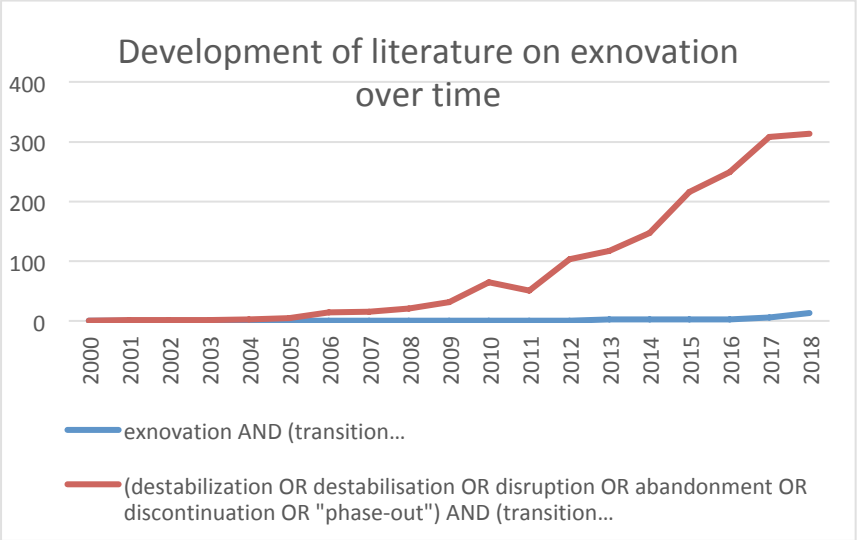


Figure 1: Number of transition governance publications with reference to "exnovation" (blue) and a set of other words that may indicate the discussion of direct destabilisation strategies (orange). Own assessment on basis of Google Scholar queries.

Qualitative findings of literature search

In the only text identified as discussing the question how direct regime destabilisation could be achieved in a "food sector", Kuokkanen et al. 2018 address prospects for a sustainability transition in the Finnish food system. Following Turnheim & Geels 2013, they distinguish two dimensions of the "selection environment" which is responsible for the stability of the regime. As is recognised in the long pedigree of innovation studies, relevant for the uptake or oppression of new technologies and practices are not only pressures that emerge in markets (economic dimension of selection environments) but also other pressures that are linked e.g. to normative expectations (e.g. what is considered comfortable, just, environmentally sound etc.) or perceptions of appropriate behaviour or political feasibility (socio-political dimension of selection pressures). These selection environments are a central part of the regime. At the same time, they are not set in stone, but they are constantly re-produced in an interplay of actors and are thus in flux. Kuokkanen et al. 2018 consequently direct our attention to the very process in which these landscapes are formed, in order to identify prospects for strategic action that may help destabilise a regime:

"[T]here are various routes to influencing the selection environment: through the market, legislation, public support campaigns, and civil society. […] Institutional actors such as policy makers or NGO's aim to generate acceptance, legitimacy, and interest from the private sector to align with their discourse coalition." (Kuokkanen et al. 2018:1517)

We assume, that the internal influence of regime actors on the selection environment is much more direct and influential than that of opposing actors like NGOs. However, in case consumers' market power is mobilised, partial shifts in selection environments may be achieved, as e.g. boycotts or labelling campaigns try to demonstrate.

Yet, in this paper, we want to focus on a particular type of actor, state agencies, and the resources they may mobilise for influencing selection environments. In this respect, Kuokkanen et al. state:

"Policy makers also set the framework for the economic environment and hence influence the feasibility of different solutions and technologies. In a market economy, it is common that policy makers sympathize with businesses and often identify with their problems and goals (Geels, 2014a,b) because they compete for international investments in the global arena. Hence, unsurprisingly, the agenda of actor networks that promote a techno-economic discourse often has leverage." (Kuokkanen et al. 2018:1517)

The precondition for any strategic action towards direct destabilisation of such selection environments hence is to map and understand the narratives at play as well as the discourse coalitions which support them and particularly the ways in which state authority is captured to stabilise an entrenched regime (Späth et al. 2016).

Contemporary literature on (environmental) governance points us at the importance of usually contested problem definitions for the way policies are developed. The literature on transitions and technological change additionally highlight the role that shared visions can play in the coordination of actor coalitions (Berkhout 2006; Späth & Rohracher 2010).

All this adds to a confirmation, that we need to thoroughly analyse discursive developments in order to identify promising strategies for direct destabilisation of regimes. Strategic action clearly depends on a thorough understanding of the ways in which competing storylines shape behaviour within the respective industries, in our case the (agri-)food industry (cf Bommert & Linz 2018).

What Kuokkanen et al. vaguely indicate as a possibility, but do not elaborate on, is a systematic assessment of how particularities of the food system may shape the opportunity structures for destabilising its selection environments: "In the sustainability transition that bridges production and consumption, such as the food system, the selection environment has various dimensions, and thus, it is unlikely that regime destabilization occurs as a coherent and coordinated system transformation. In other words, not all parameters in the selection environment change simultaneously or in a planned way by the same actor network groups." (p.1521)

There may be some more conclusions that could be drawn from a systematic characterisation of (agri-)food systems, where e.g. end-users are more actively involved than in the contemporary energy systems, and where producer-consumer relationships vary from very close to non-existent. What key elements of this regime would need to be challenged simultaneously, in order to have a chance to effectively weaken the respective selection environments? What are the most relevant scale levels of intervention into what we can understand as a nested system of (agri-)food systems? We are going to tentatively sketch some ideas in the discussion section.

What is specific about (transitions of) the (agri-)food system?

The global demand for food is estimated to increase for at least another 20 years due to a continuing population and consumption growth (Godfray et al. 2010). The need to feed 9 billion people will further challenge the transgressed planetary boundaries (regarding e.g. changes to nitrogen and phosphorous cycles, freshwater use, biodiversity and land-use change). It also puts into question that the current, 'productivist' industrial food system can be sustained any longer (Rockström et al. 2009; Kahiluoto et al., 2014; Steffen et al., 2015; Kuokannen et al. 2018). But not only its environmental effects make the food sector an important field for transitions research; it is rather fundamental to human health and social equity (Cohen and Ilieva 2015). Respectively, food is highly relevant in people's everyday life and social practice, and its aquiring can be seen as one of the most fundamental practices for humans (ibid.). The allocation and consumption of food, however, can hardly be studied in isolation, as it is so tightly linked with agricultural production. This is why many authors address an integrated agri-food system, including different subsystems: (food) production, processing, distribution, consumption,and disposal (Stierand 2008). This comprehensively defined (agri-)food system again overlaps with many other systems, like those that provide energy, water or means of transportation. When the required sustainability transition of the (agri-)food system is discussed, individual technologies and infrastructures are less in focus than in other sectors like energy, and have thus received less attention (Kuokannen et al. 2018, Markard et al. 2012). Instead, the importance of particular practices in production and consumption has been recognized (cf Cohen and Ilieva 2015, Hinrichs 2003, 2014). This may also shape particular opportunities for governance, as there is widespread recognition of the importance of consumers' choices, societal involvement, and entrepreneurial innovation.

Because a sector specific literature on direct destabilisation has only started to emerge at this moment – we are still searching for any explicit thoughts except for ours and those of Kuokkanen et al. 2018 – we are also searching for guidance in texts that address other systems, and find the most explicit considerations regarding direct destabilisation in the field of energy.

Similar to Kuokkanen et al., Stegmaier et al. 2014 argue for a predominantly discursive analysis, when framing "the discontinuation of socio-technical systems […] as a problem of interpretation and action for governance makers" (p.116). Based on a review of governance literature, the authors develop a "tentative heuristic for the study of discontinuation governance". They develop and illustrate their conceptual thoughts with an example from European energy efficiency regulation: The phasing-out of energy inefficient household lighting, which they consider "an exceptional case in which resistance was relatively small and coalitions among actors broad" (p.123). Based on this case, the authors identify the following "six procedural dimensions of dedicated discontinuation governance (not to be understood as subsequent steps) and related core governance problems" (p.119f):

(i) Aligning problem perceptions through increasingly structured interaction,

(ii) setting and keeping the problem on the political agenda, in combination with

(iii) building, maintaining and changing advocacy coalitions,

(iv) mobilising existing/ new governance instruments,

(v) politically binding and legitimate decision-making", and

(vI) govering socio-technical aftercare.

Especially the aspect of "aftercare" may be informative of intentional destabilisation strategies, as it indeed makes sense, if possible, to "control the loose ends of 'undead' regime and system parts" (p.122), especially when resistance can be expected and when a rather long-term transition process can be planned (on this point see also our discussion of Heyen et al. 2017 below).

For a successful governance of exnovation processes, Heyen et al. 2017 suggest paying attention to different categories of (i) actor interaction, (ii) policy instruments for termination, (iii) policy instruments for socio-economic adjustments and (iv) time horizons.

(i) As possible actor interactions, they discuss broad *coalitions* of government actors, environmental groups and innovators of sustainable alternatives which may jointly pursue exnovation strategies; *coercion*, which usually goes along with profound conflicts with the affected actors; and *consensus*, meaning that the terms of an exnovation are negotiated with stakeholders.

(ii) Regarding different policy instruments for termination, they discuss *incentives* (e.g. subsidies and public investment), as an early and basic step towards exnovation; *bans* (e.g. regulatory bans or withdrawal of permits), as direct exnovation instruments; and *standards* (e.g. efficiency requirements or pollution limits), as a rather indirect path to exnovation.

(iii) With policy instruments for socio-economic adjustments, governments can lessen social and economic hardships of companies, employees, and communities and therewith support the change towards new business models. However, as *direct financial compensation of companies* can be problematic, Heyen et al. (2017) suggest linking compensation payments to the switch to new sustainable technologies. Furthermore, they point to *career and re-education programmes* for employees, and to *support for structural change* from higher political levels, if the economic prosperity and public budgets of an entire region are threatened.

(iv) Heyen et al. distinguish also three different time horizons for exnovations: *Short-termed exnovation* processes are possible when respective investments are minimal, alternatives are easily available and/or if a long transition period is not ecologically acceptable. By contrast, an *extended transition period* can help in reducing resistance. Both processes can either entail a *fixed or a flexible end date*.

Kivimaa & Kern 2016, lastly, develop four regime destabilising (destruction) functions (besides seven creative niche support functions) (p. 207ff), named:

"control policies (D1)",

"Significant changes in regime rules (D2)",

"Reduced support for dominant regime technologies (D3)"

and "Changes in social networks, replacement of key actors (D4)".

These functions are tested by analysing 'low energy' policy mixes in Finland and the UK in an attempt "to explicitly conceptualise policy mixes for sustainability transitions". Their key argument is "that policy mixes for sustainability transitions should incorporate instruments addressing two dimensions: those aimed at creating niche-innovations and building effective innovation systems around them, and those aimed at destabilising currently dominant regimes creating openings for a speedier take-off and sustained growth of niche innovations to replace incumbent (high energy) technologies. We therefore pro-pose to expand the concept of 'motors of innovation' to 'motors of creative destruction' to incorporate attention to the required destabilisation processes of incumbent regimes" (p.215).

DISCUSSION

Even considering the fact, that – according to our own assessment – socio-technical transitions are discussed five times3 more often with regard to the "energy system" than to the "food system", the sheer absence of strategic considerations regarding any direct destabilisation of the current unsustainable (agri-)food system is striking. Although the food system and the respective regime may arguably be more complex than the energy regime, and although it is special with regard to the visible relevance to all human beings, we do not see a principal reason in the character of the system that made thinking about possibilities to directly destabilise an unsustainable agri-food system illegitimate or futile.

However, we should be very cautious when transferring considerations regarding the destabilisation of energy regimes to the agri-food system.

And of course, a managerial approach to transition management is at least as inappropriate with regard to the (agri-)food system as with regard to other systems. We should not hope that whole governments, neither on a national nor on EU level, will commit to sustainability in a way that they dare to implement policies bluntly aiming at the destabilisation of entrenched regimes. To repeat: according to the evolutionary idea of transition studies, these regimes have co-evolved with governments and many societal and political factors. All actors, including academic observers, are entangled with the entrenched regime. To wait for a 'philosophers king' to materialise is hence futile. However: Any regime is also constantly in flux and contestation, and hence there is the possibility of intentionally influencing this change. Reflexivity and rigorous analysis is one factor that can leverage the influence (of policymaker-observer-alliances) on selection environments:

"It might be difficult to know the precise consequences of a policy measure perfectly in advance, but the centrality of certain actors in the reproduction of regime and niche socio-technical configurations, and their likely responses to governance interventions, does suggest we can develop informed expectations about the contribution of various policies to sustainability transitions. Governance schemes that take socio-technical complexities into account, and yet retain a sense of which niche-regime-landscape reproduction processes are significant for transitions, and that target their policy attention on the key players accordingly, are more likely to generate effective transition policy." (Smith et al. 2010:445). If rigorous analysis along these lines would be combined with creative imagination of possible interventions, this may add to a new form of reflexive governance.

Drawing inspiration from the cited literatures, and building on the work that has been conducted to describe the European and German (agri-)food systems, we dare to propose some tentative thoughts on possible actions which could add to the destabilisation of the unsustainable agri-food systems in effect today:

We should probably consider that the system currently is not stable. Rather, we see massive trends of market concentration and an unprecedented push into industrial forms due to the fact that commodification and financialisation of agro-industrial production has led to tremendous increases in land price, which, together with shrinking margins destroyed the business case of small and medium sized farms in several (European) countries.

Destabilisation could therefore try to halt this effect. Easy access to land has been identified a crucial factor in the financialisation of the sector. This may be a factor that governments may be inclined to target: Stricter regulation of land acquisition may be easily argued for in a climate in which "land grabbing" has been problematised, now increasingly reaching wider publics, and in which "food security" has been put on the political agenda as well.

A second focal point of action of many sustainability actors already is, and from our perspective rightly so, the regulation of pesticides. Limiting the use and availability of this input factor might have repercussions in several agro-industrial practices. The same holds for the use of antibiotics, which, if strictly regulated, would significantly increase costs of mass animal farming, as it would make many practices and standards impossible to maintain. This would favour many alternative approaches at once. The chances for tight regulation of these substances, again, seem to be favourable, since the threat that pesticides, and even more so antibiotics in farming pose to the health of humans, has already been scandalised in some European countries. A new food scandal may be used as a window of opportunity by some policy entrepreneurs, in order to forge a strong alliance in favour of an agricultural production which avoids putting humans at risk.

[3] Compared with the assessment of "key texts" by Markard et al. in 2010, who counted 3% food vs. 39% energy related works, the bias towards energy seems to be less pronounced in a more comprehensive search of transition studies, or may have reduced since 2010.

A partly similar argument can be made for a strict regulation of fertiliser usage. Costs that water users have to bear due to intense usage of fertilisers have recently been problematised in Germany.

In all of these cases, direct negative effects (threats or costs) can be identified, that all people e.g. in Germany have to face due to an agro-industrial practice. The fact that agro-industry is ever more driven by some multi-national companies may increasingly be communicated in order to weaken the identification of rural populations with these agro-industrial practices, which they may be invited to differentiate from their own and seemingly traditional practices of agriculture, that they know from small scale conventional farms.

All these areas, where strict regulation would target high-input agriculture, a long-term phasing-out strategy would in principle be possible. However, depending on the nature of the arguments that are mobilised in their support (threat to human health, or rather unfair allocation of costs and benefits), an exnovation of antibiotics may be more successful if organised in a rather immediate, even rushed way, while a limitation of fertiliser use may be pursued on basis of a long-term phasing-out strategy that allows for a smoother transition and hence minimises opposition by farmers.

CONCLUSIONS AND OUTLOOK

We consider it necessary that many elements of a currently unsustainable (agri-)food system are directly destabilised in order to improve the chances that more sustainable practices are mainstreamed. Such practices currently exist in niches, but constructive support of these niches seems not to achieve the destabilisation of the regime in any appropriate timeframe, hence motivating our search for possibilities for direct destabilisation.

Searching for respective inspiration in the transitions literature, we find that the topic is discussed for several years now, but not with reference to the (agri-)food system. We reflect on particularities of the system, but do not find a principle reason why direct destabilisation should be less relevant to this system than to others. Respective strategies should, however, reflect these particularities and need to be very context specific.

We identified some remarkable gaps in the literature, but also reviewed some texts that discuss generic principles for the design of policy mixes in support of direct destabilisation. Yet we warn against naïve simplifications and a managerial approach, which would be doomed to fail. What we are pointed to is a thorough analysis of effective storylines and related discourse coalitions. Despite all limitations and the principle entanglement of all actors, the storylines and coalitions can be influenced on basis of reflexive analysis. Thorough analyses of discourses are rarely used to inform policy choices. There need to me much more detailed and robust analyses than e.g. the one by Bommert & Linz 2018 to form a basis for strategic action e.g. on the side of individual government agencies in order for them to strategically influence the national discourse regarding how the (agri-)food system and the environment should be governed. And besides rigid analysis, new, systematic ways of collective imagination may additionally help with the identification of particularly vulnerable elements of unsustainable regimes.

This very sketchy work in progress has not yet delivered an example of how well the transitions literature can inform strategies for directly destabilising elements of the current (agri-)food system. But we are convinced, and hope to have given preliminary indications, that such work is possible and, indeed, timely.

We acknowledge funding of this research by the German Ministry of the Environment under Grant ….

AFFILIATION

Philipp Späth,

is associate professor (PD) and heads a small research group on Urban Environmental Governance at Freiburg University. Trained as a geographer and political scientist, he has obtained a PhD in 'Science and Technology Studies' in 2009 and habilitated in 'Environmental Governance and Urban Studies' in 2016. His main research interest lies on potentials and limits to the governance of socio-technical change. He recently edited the volume "The Politics of Urban Sustainability Transitions" (Routledge) together with Jens S. Jensen and Matthew Cashmore.

Institutional contact: Institute of Environmental Social Sciences and Geography, Albert-Ludwigs University Freiburg, Tennenbacherstr. 4, 79100 Freiburg, Germany spaeth@envgov.uni-freiburg.de

Dörte Marie Peters,

is postdoc researcher at the Chair of Sustainability Governance at Freiburg University. She holds a PhD in Environmental Social Sciences, an M.A. in Sustainable Development and a B.A. in Political Science and Literary Studies.

Vivien Riener,

is graduate assistant at the Institute of Environmantal Governance at Freiburg University. She is about to complete her M. Sc. in Global Transformation at the Institute of Geography in Freiburg and holds her B. Sc. in Forestry and Environmental Protection.

REFERENCES

Beers, P. J., Hermans, F., Veldkamp, T. & Hinssen, J. (2014). "Social learning inside and outside transition projects: Playing free jazz for a heavy metal audience." *NJAS - Wageningen Journal of Life Sciences* **69** (0): 5-13.

Belmin, R., Casabianca, F. & Meynard, J.-M. (2018). "Contribution of transition theory to the study of geographical indications." *Environmental innovation and societal transitions* **27**: 32-47.

Berkhout, F. (2006). "Normative expectations in systems innovation." *Technology Analysis and Strategic Management* **18** (3/4): 299-311.

Bommert, W. & Linz, M. (2018). "Landwirtschaft am Scheideweg - Nur eine ökologische Landwirtschaft kann zehn Milliarden Menschen ernähren".

Cohen, N. & Ilieva, R. T. (2015). "Transitioning the food system: A strategic practice management approach for cities." *Environmental Innovation and Societal Transitions* **17**: 199-217.

GAMBHIR, D. A., GREEN, F. & PEARSON, P. J. (2018). "Towards a just and equitable low-carbon energy transition."

Geels, F. W. & Schot, J. (2007). "Typology of sociotechnical transition pathways." *Research Policy* **36** (3): 399-417.

Godfray, H. C. J. et al. (2010). "*Food security: the challenge of feeding 9 billion people*". *Science* **327**, 812–818.

Hermans, F., Roep, D. & Klerkx, L. (2016). "Scale dynamics of grassroots innovations through parallel pathways of transformative change." *Ecological Economics* **130**: 285-295.

Heyen, D. A., Hermwille, L. & Wehnert, T. (2017). "Out of the Comfort Zone! Governing the Exnovation of Unsustainable Technologies and Practices." *GAIA - Ecological Perspectives for Science and Society* **26** (4): 326-331.

Hinrichs, C. (2003). "The practice and politics of food system localization". *Journal of Rural Studies* **19** (1): 33-45.

Hinrichs, C. C. (2014). "Transitions to sustainability: a change in thinking about food systems change?" Agriculture and Human Values 31 (1): 143-155.

Ingram, J. (2018). "Agricultural transition: Niche and regime knowledge systems' boundary dynamics." *Environmental innovation and societal transitions* **26**: 117-135.

Kahiluoto, H., Kuisma, M., Kuokkanen, A., Mikkilä, M. & Linnanen, L. (2014). "*Taking planetary nutrient boundaries seriously: can we feed the people?*" *Glob. Food Secur.* **3**, 16–21.

Kivimaa, P. & Kern, F. (2016). "Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions." *Research Policy* **45** (1): 205-217.

Kuokkanen, A., Nurmi, A., Mikkilä, M., Kuisma, M., Kahiluoto, H. & Linnanen, L. (2018). "Agency in regime destabilization through the selection environment: The Finnish food system's sustainability transition." *Research Policy* **47** (May): 1513-1522.

Leipprand, A. & Flachsland, C. (2018). "Regime destabilization in energy transitions: The German debate on the future of coal." *Energy research & social science* **40**: 190-204.

Longhurst, N. (2015). "Towards an 'alternative' geography of innovation: Alternative milieu, socio-cognitive protection and sustainability experimentation." *Environmental Innovation and Societal Transitions* **17**: 183-198.

Markard, J., Raven, R. & Truffer, B. (2012). "Sustainability transitions: An emerging field of research and its prospects." *Research Policy* **41** (6): 955-967.

Rockström, J. et al. (2009). "A safe operating space for humanity". *Nature* **461**, 472–475.

Rosenbloom, D. (2018). "Framing low-carbon pathways: A discursive analysis of contending storylines surrounding the phase-out of coal-fired power in Ontario." *Environmental Innovation and Societal Transitions* **27**: 129-145.

Rut, M. & Davies, A. R. (2018). "Sharing foodscapes: shaping urban foodscapes through messy processes of food sharing." *Messy Ethnographies in Action. Vernon Press, Wilmington, DE*: 167-175.

Smith, A., Stirling, A. & Berkhout, F. (2005). "The governance of sustainable socio-technical transitions." *Research Policy* **34** (10): 1491-1510.

Smith, A., Voß, J.-P. & Grin, J. (2010). "Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges." *Research Policy* **39** (4): 435-448.

Späth, P. & Rohracher, H. (2010). "'Energy regions': The transformative power of regional discourses on socio-technical futures." *Research Policy* **39** (4): 449-458.

Späth, P., Rohracher, H. & Radecki, A. v. (2016). "Incumbent Actors as Niche Agents: The German Car Industry and the Taming of the "Stuttgart E-Mobility Region"." *sustainability* **8**: 1-16.

Steffen, W., et al. (2015). "Planetary boundaries: Guiding human development on a changing planet". *Science* **347**(6223):1259855.

Stegmaier, P., Kuhlmann, S. & Visser, V. R. (2014). "The Discontinuation of Socio-Technical Systems as Governance Problem". In: J. Edler and S. Borrás. *Governance of Systems Change; Edler, J., Borrás, S., Eds***:** 111-131.

Stierand, P. (2008). "Stadt und Lebensmittel - Die Bedeutung des städtischen Ernährungssystems für die Stadtentwicklung". *Dissertation TU Dortmund*; Dortmund, URL: http://speiseraeume.de/downloads/SPR_Dissertation_Stierand.pdf

Stirling, A. (2014). "15 From Sustainability to Transformation: Dynamics and Diversity in Reflexive Governance of Vulnerability." *Vulnerability in Technological Cultures: New Directions in Research and Governance*: 305.

Swilling, M. & Annecke, E. (2012). "Just Transitions: Explorations of Sustainability in an Unfair World. ". Cape Town, UCT Press.

Turnheim, B. & Geels, F. W. (2013). "The destabilisation of existing regimes: Confronting a multi-dimensional framework with a case study of the British coal industry (1913-1967)." *Research Policy* **42** (10): 1749-1767.

White, R. & Stirling, A. (2013). "Sustaining trajectories towards Sustainability: Dynamics and diversity in UK communal growing activities." *Global Environmental Change* **23** (5): 838-846.

MULTIPLICITY OF PERSPECTIVES ON SUSTAINABLE FOOD

Moving beyond discursive path dependency in food policy

MICHIEL DE KROM & HANNEKE MUILWIJK

KEY-WORDS: SUSTAINABLE FOOD SYSTEMS, FOOD POLICY, DISCOURSES, FRAME REFLECTION, THE NETHERLANDS

INTRODUCTION

The notion that a transition towards a more sustainable food system is urgently needed, is gaining ground throughout Europe (e.g. EEA 2017; Maye & Duncan 2017). Yet, opinions differ substantially on what sustainable food production and consumption exactly entail, and on how the transition to such sustainable production and consumption should be managed (Lang & Haesman 2015; Béné 2019). Should we for instance move towards more localised food systems, or improve the eco-efficiency of global food production and trade? Should we principally invest in technological innovations, or rather in social innovations? And should we rely on green market dynamics, or instead on a strong environmental state? Profound differences of view permeate public debates on sustainable food and agriculture, but these differences tend to be backgrounded when policy decisions are being made (Candel et al. 2014; De Krom et al. 2014). The Dutch government, for instance, has repeatedly stated that it aspires to make the Netherlands the world leader in sustainable food production and consumption – thereby suggesting that the definition of sustainable food is not contested, but instead universal and given (LNV 2009; EZ 2017). In this paper, we argue that such a discursive closure is unproductive because it reinforces existing dominant perspectives on sustainable food and agriculture, and overlooks the transformative potential of alternative perspectives. We therefore aim to contribute to uncovering discursive path dependencies in current agro-food policy making, so as to trigger reflexivity and open up the political debate on this matter.

To meet this aim, we will analyse the public debate and food policy in the Netherlands as a case study (Yin 2009). Drawing conceptually on insights from the literature on (food) paradigms, discourses and framing (section 2), we will begin by analytically distinguishing five perspectives on sustainable food and agriculture that structure the Dutch public debate (section 3). These perspectives tell fundamentally different, yet internally coherent stories on the causes of the current agro-food system's unsustainability, solutions to overcome this unsustainability, and the types of knowledge and actions that are required to adequately assess and address these problems and solutions. Subsequently, we will analyse which of these perspectives informed the Dutch food policy (with a focus on policy documents issued between 2015, when the Dutch government introduced a new food policy framework, and 2017). We will show that two out of the five perspectives were dominant in guiding the Dutch food policy (section 4). In a final empirical section (section 5), we will discuss the results of two focus groups that we have organised with civil servants who have been involved in drafting and implementing the Dutch food policy, so as to observe the type of discussion and reflection that our presentation of the five perspectives and their position in the Dutch policy elicited. We will conclude the paper (section 6) by discussing the implications of our findings for our understanding of the discursive politics of sustainable agro-food transitions.

PERSPECTIVES ON SUSTAINABLE FOOD: ANALYTICAL FRAMEWORK

This research builds on the interpretive tradition in the social sciences, which "assumes the existence of multiple socially constructed realities instead of a single reality, governed by immutable natural laws" (Hajer & Versteeg 2005, 176). Accordingly, interpretative research focuses on the way in which social groups make sense of social and environmental phenomena, rather than on the characteristics these phenomena themselves. To study such sense-making frameworks, various concepts have been developed, among which 'paradigms', 'discourses' and 'frames' are arguably the most well-known (Arts & Buizer 2009). Below, we briefly discuss these concepts and clarify how they feed into our notion of a 'perspective on sustainable food'.

The concept '*paradigm*' (Kuhn 1970; Lang & Haesman 2015) denotes a set of fundamental cognitive assumptions on the basis of which problems and solutions are conceived and intellectually approached. As one paradigm tends to dominate thinking in domains of science (Kuhn 1970) and food policy (Lang & Haesman 2015), it takes a 'revolution' to establish a 'paradigm-shift'. The concept '*discourse*' (Foucault 1984; Hajer 2009, 60) signifies an ensemble of ideas and concepts through which meaning is ascribed to phenomena, "and that is produced in and reproduces in turn an identifiable set of practices". Discourses affect practices when they become dominant and are subsequently internalised (by individual agents) or institutionalised (e.g. in policies). At the same, discourses are (re)produced in practices when actor-coalitions actively or tacitly support them in their sayings and doings. The concept '*frame*' (Goffman 1974; Entman 1993; Schön & Rein 1994), finally, refers to a selection of aspects of a phenomenon that shapes the way in which agents understand and aim to overcome problems in relation to this phenomenon. Studies into framing have shown that frames are often tacit rather than discursive and, hence, escape explicit reflection (Goffman 1974; Schön & Rein 1994).

Drawing selectively on the above conceptual insights, in this paper we introduce the notion of a 'perspective on sustainable food'. We define such a 'perspective' as a more or less coherent set of answers on the questions: to what degree and why is the current agro-food system unsustainable? What type of knowledge is needed to adequately assess and address agro-food problems of sustainability? And what does a sustainable agro-food system look like and how can this future be attained? Importantly, perspectives are not just representations; they more or less strongly shape agro-food policies and practices, depending on their dominance in public and political debates and the concomitant degree to which they influence stakeholders' personal and policy decisions. As the perspectives inform stakeholder positions in debates but are often left implicit, we consider it important to reveal these perspectives and enable a reflection on them.

We have chosen to use the concept 'perspective' instead of 'discourse', 'frame', or 'paradigm', for the following reasons. First, we do not aim to study which actor coalitions advocate particular positions, nor wish to focus on particular food-related issues or controversies, as is characteristic for discourse and frame analyses (e.g. Dessein et al. 2013; Candel et al. 2014; De Cock et al. 2016). Instead, we leave open the possibility that stakeholders subscribe to – and, hence, recognize themselves in – different perspectives in relation to different issues. Second, we have chosen not to work with the concept 'paradigm' because studies into paradigms tend to juxtapose a limited number of fundamentally opposing sense-making frameworks (e.g. Lang & Haesman 2015). In this study, we aim to reveal also more nuanced, yet no less relevant differences in perspectives.

In line with this latter aim, we have sought to analytically distinguish stakeholder perspectives on sustainable food according to multiple themes that feature in the scientific literature on sustainable food and agriculture. We adopted these multiple themes to move beyond binary readings of issues of food and sustainability that tend to dominate the scholarly debate (e.g. agro-industry vs. agro-ecology, expert knowledge vs. lay knowledge, global vs. local, and fast vs. slow food). The themes that we have selected are:

- Knowledge and innovation: what type of (scientific and/or 'lay') knowledge is key to gaining a proper understanding of sustainability problems? And what type of (technological and social) innovation is needed to achieve a more sustainable food future (e.g. Tovey 2008; Busch 2009)?
- Governance philosophies and key agents of change: to what extent have public and/or private governance arrangements contributed to sustainability problems? And what role is ascribed to governmental agents, market actors, and members of civil society in establishing a more sustainable food future (e.g. Havinga et al. 2015; Vatn 2018)?
- Geographical scale: what role do (global, regional, local) geographies of food production, trade and consumption play in causing and overcoming food system unsustainability (e.g. Oosterveer and Sonnenfeld 2012; Sonnino 2013)?

- Food images: what does sustainable food look, smell and taste like? Is it 'natural' and unprocessed, or rather processed to improve aspects like nutritional value and shelf-life? And is the sustainability of food measured according to the biophysical attributes of the production process and the food product itself, or are socio-cultural and economic relations of food also taken into account (Dagevos & Van Ophem 2013; Korthals 2017)?
- The nature of changes necessary: to what degree do current agro-food policies and practices need to be changed to achieve sustainable development? Are moderate reforms required, or can only a radical transformation of the agro-food system lead the way to a sustainable future (Hopwood et al. 2005)?

Drawing on these thematic distinctions, in the following section we will analytically distinguish five perspectives on sustainable food that figure prominently in the Dutch public debate on sustainable food and agriculture.

FIVE PERSPECTIVES ON SUSTAINABLE FOOD IN THE DUTCH PUBLIC DEBATE

We have analytically distinguished five perspectives on sustainable food based on our personal reading of the Dutch public debate of the last decade. To substantiate the perspectives and put them in a wider context, we have drawn on Dutch and international agro-food studies literature. By distinguishing the five perspectives, we do not intend to give the definite answer on the question of which visions on food and sustainability exist in Dutch society. Instead, we aim to reveal the existence of nuanced yet fundamental differences between multiple perspectives on sustainable food, so as to trigger a reflection amongst stakeholders on the perspective that they and others subscribe to.

In the following five sub-sections, we briefly discuss the perspectives. Table 1. provides an overview of the analytical distinctions between the five perspectives according to the themes that we have set forth in our analytical framework.

i. Business-as-usual: producer-led incremental change

This perspective stipulates that the current global agri-food system is successful in producing plenty of affordable food, but does face a number of environmental and human health problems. These problems are not systemic but can largely be addressed by global market forces – which have made the current agri-food system successful in the first place. Global specialisation and trade will facilitate improved eco-efficiency (Wästfelt 2018). Residual ecological and human health problems may be addressed by governmental interventions, as long as these do not disturb the level playing field in international trade – e.g. by pricing externalities or enhancing legal minimum standards for food production (Oosterveer and Sonnenfeld 2012). Food is principally valued according to its taste, price and convenience and consumers are, accordingly, not willing to pay a premium for sustainable food (Ritzer 2000).

ii. Technological optimism: promoting techno-scientific solutions

This perspective centres on the question of how to sustainably feed a rapidly growing and increasingly affluent world population. In answering this question, it focuses on technological innovations that may carry the seeds of a "revolution comparable to the introduction of the tractor and chemical products in the 1950s", such as smart farming and precision farming technologies, nano-technologies and gene-editing techniques (Fresco & Poppe 2016, 15; Schönfeld et al. 2018). Agro-technological innovations have been key to the post-World War II food system and its aim of fighting hunger. Facilitating technological innovations that help to sustainably feed the growing world population does, accordingly, not require radical systemic changes. Rather, it necessitates continued governmental and corporate support for establishing successful agro-technological innovation systems (Hekkert et al. 2007). Food is principally approached as 'fuel' for the world population and valued for its nutritional value. Consumers are satisfied with the food they find in stores, which has often been processed to enhance their nutritional value, safety and shelf life.

iii. Alternative food politics: re-connecting producers and consumers in local networks

This perspective holds that the current "faceless and essentially placeless food system" entails a myriad of fundamental problems, including environmental pollution, low animal welfare and low farmer income (Delind

2013, 391). Overcoming these systemic problems requires a move away from anonymous global agri-food chains that are insensitive to local social and ecological realities, towards 'alternative' local or regional food networks in which producers and consumers can be re-connected (Papaoikonomou & Ginieis 2017). By re-connecting food production and consumption at a local or regional scale, farmers and consumers re-gain the possibility to act according to local ecological and cultural needs. Producers and consumers are key agents of change as they are to establish and support alternative food initiatives. Governments are asked to actively promote local or regional food sovereignty by public regulation of production methods and markets (Candel 2014). Food is far more than its biophysical properties: it is a matter of culture and belonging. Buying food in alternative food networks is not just an economic transaction but an expression of social engagement and ecological citizenship (Lockie 2009).

ective	*Problem definition*	*Key solution(s)*	*Nature of change necessary*	*Geographical scale*	*Key agents of change*	*Knowledge and innovation*	*Food image*
ess-as-usual	Environmental and human health problems are side-effects of overall efficient production methods. Sustainability problems are not systemic but signal a lack of full market efficiency.	Market selection pressures will incite food producers to increase their eco-efficiency and sustain their supply base. Governments should address residual problems and protect a global level playing field.	Continuous market-induced improvements in established food production processes will suffice to attain a sustainable food system.	Global specialisation and trade facilitate improved eco-efficiency, cost reduction and lower prices.	Globally operating agro-companies; transnational food corporations.	Corporate research and development enables the necessary, predominantly incremental improvements in eco-efficiency.	Food is readily available and affordable; key food attributes are price, taste and convenience.
ogical imism	Current food production practices do no suffice to sustainably feed the rapidly growing – and increasingly affluent – world population in the future.	Technological innovations (e.g. precision farming, gene-editing) will sustainably increase world food production. Governments should actively support technological innovation with targeted policies.	Radical technological innovation is needed. Yet, no radical food system transformation is needed as technological innovation has already been the driver of food system productivity for decades.	Sustainable technologies are not specific to a particular geographic organization of the agro-food system. Techno-scientific knowledge itself is more or less 'universal' and may travel across the globe.	Agronomists, techno-scientists.	Techno-scientific knowledge is key to achieving long-term food system sustainability.	Food is 'fuel'; the key food attribute is nutritional value. Products may be processed to increase its nutritional value, shelf life and safety.
native olitics	The current food system suffers from multiple fundamental problems that are inherent to its global, industrial, and essentially homogenous and anonymous operation.	Food producers and consumers should be re-connected in local and regional networks. Governments and NGOs should actively promote the rise of alternative food networks.	A fundamental transformation of the current food system is required, from global agri-food chains towards food networks that incorporate local ecological and cultural needs.	Local or regional food networks – such as community supported agriculture, box schemes and farmers' markets – enable the re-connection of producers and consumers.	Local food producers and consumers, which may collaboratively set up, and support alternative food networks.	Appropriate knowledge is context-specific. Besides natural and social scientific knowledge, local knowledge is highly valued.	Food is part of local culture; food quality and authenticity are highly valued. Food is more than a product: it connects consumers with producers and ecological regions.
litical erism	The conventional food systems' focus on economic efficiency and enhancing food quantity has resulted in food scares, which raised consumer concerns on multiple issues.	The consumerist turn: consumer demand reforms the conventional productivist food system. Providing transparency through labelling arrangements and ICT applications is key in facilitating reflexive consumer choice.	The food system is being reformed as consumer demand is now the key guiding principle in organizing food supply chains (rather than the wish to optimise agricultural production based on agronomic principles).	Transparency tools such as labelling schemes and ICT applications bridge large distances (in place and time) between producers and consumers.	Consumers, whose concerns inform the design of food production practices.	Access to knowledge and information is key to reflexive food choices. The type of knowledge and information that is considered most relevant differs according to different consumer concerns and sub-cultures.	Food is valued according to a large variety of qualities, which depend on consumers' specific values. In the fragmented foodscape, food choices are an expressional of one's identity and political preferences.
grated olitics	The food system is complex: various sustainability problems interconnect, which cannot be traced back to a single cause or driving force.	Only an integrated approach of the various sustainability problems can foster a more sustainable food system. All food system parties should be involved in devising holistic solution.	A policy reform is needed, from the current fragmented towards a more integrated approach. Incremental changes in food production and consumption practices should eventually lead to radical systemic change.	Multi-level governance is key to achieving food system sustainability. Sustainability problems should be addressed at the appropriate scale.	Governments are in a key position. They can call various food system stakeholders to the table and adjust the political and regulatory context in which the food system operates.	To adequately grasp food system complexity, knowledge should be inter- and trans-disciplinary. It is important to integrate the knowledge and viewpoints of food system actors.	Food is part of a diet, that meets multiple sustainability and human health criteria.

Table 1: Key analytical distinctions between five perspectives on sustainable food that feature prominently in the Dutch public debate

iv. Political consumerism: consumers as key agents of change

This perspectives stresses that a series of food scares (from mad cow disease to horsemeat scandals) has triggered consumer awareness of downsides of the productivist food system and its focus on enhancing economic efficiency through intensification and agronomic rationalisation. Consumers are no longer *a priori* satisfied with the food that the system delivers, but demand – and are willing to pay for – premium food qualities and attributes. A 'consumerist turn' has occurred: consumer choices now steer food production practices rather than the other way around (Spaargaren et al. 2012). Transparency about food attributes is key in empowering consumers to make reflexive food choices. Labelling schemes are established examples of informational governance tools that enable consumers to include social and ecological considerations in their purchasing decisions. New ICT-developments (including blockchain technologies) radicalise the possibility to provide food transparency and contribute to a fragmentation of consumer concerns (Soma et al. 2016). In view of the growing amount of food labels and claims, governments have a role to play in ensuring the correctness of information provided. In the fragmented foodscape, food choice becomes an expression of one's identity and lifestyle politics (Jallinoja et al. 2018).

v. Integrated food politics: food systems thinking

This perspective starts from the observation that the current food system entails a range of fundamental problems, including local and global environmental deterioration, 'unfair' trade and malnutrition. To adequately address these problems, it is crucial to consider their interdependence and to anticipate synergies and trade-offs between possible solutions. Doing so requires the involvement of representatives of all parties that collectively constitute the food system, such as in round tables and multi-stakeholder dialogues and agreements. In this perspective, governmental agents are the key agents of change as they are in the position to bring the various parties to the table, and to adjust the regulatory and political context in which food production, trade and consumption practices are enacted. To govern effectively, governments need to operate at multiple levels, from cities and regions to the EU. Foodstuffs and their attributes are not valued in isolation but as part of a diet. Diets that are simultaneously healthy, animal friendly and socially an ecologically sustainable become the new social norm (Lang & Heasman 2015; UNEP 2016; EEA 2017).

THE POSITION OF THE FIVE PERSPECTIVES ON SUSTAINABLE FOOD IN THE DUTCH FOOD POLICY

Having distinguished five perspectives that feature prominently in the Dutch public debate on sustainable food, in this section we investigate the position of these perspectives in the Dutch food policy. We do so by focussing on three policy documents (EZ 2015; 2016; 2017) that have been issued between 2015, when the Dutch government introduced a new food policy framework entitled "the Food Agenda for safe, healthy and sustainable food"[4] (EZ 2015), and 2017, when we began to conduct our analysis.

The national government's 'Food Agenda' was an initiative from the ministries of Economic Affairs (which was responsible for agriculture from 2012-2017); Public Health; Foreign Trade and Development Cooperation; and Infrastructure and Environment. It was drafted in response to a report of the Netherlands Scientific Council for Government Policy entitled 'Towards a food policy' (WRR, 2014), which argued in favour of a cross-sectoral, integrated approach to food-related issues. Historically, the Dutch government has been particularly strong on supporting agricultural production and innovation, which has contributed to making the Netherlands one of the world's largest agricultural producers[5], as well as "world leaders in agricultural innovation" (Viviano 2017). By drafting the food agenda, the government aimed to "move from an agricultural policy towards a food policy" (EZ 2016, 1). Along with this new policy orientation, it defined a new national ambition: "to become world leader in safe, healthy and sustainable food and sustainable agriculture and horticulture" (EZ 2017, 1).

The 'integrated food politics' perspective, as advocated by the Netherlands Scientific Council for Government Policy, informed the rationale to devise the Food Agenda. This becomes clear from the involvement of the multiple ministries in drafting the agenda, the title reference to safe, healthy *and* sustainable food, and statements that purport that "the government wants to work in a more integrated way" (EZ 2016, 1). However, when looking into the actual policy measures and initiatives that are being proposed and financially supported in the

[4] All quotes from Dutch policy documents have been translated by the authors.
[5] The Netherlands exports 65 billion Euros worth of vegetables, fruit, flowers, meat and dairy products each year (https://www.government.nl/topics/agriculture).

Food Agenda, it becomes evident that two other perspectives that have traditionally informed Dutch agricultural policy, continue to dominate in the new food policy: 'business-as-usual' and 'technological optimism'.

In line with the 'business-as-usual' perspective's focus on producer-led change, much policy support and economic resources are devoted to "Dutch companies to [help them] introduce, scale-up and market very promising new products" (EZ 2016, 4). Intentions to promote shifts in food *consumption* (such as lowering salt and sugar intake, and replacing animal proteins with plant proteins) are principally addressed by relying on voluntary *business* initiatives and supporting *technological innovations* (salt and sugar replacements, and "the development of alternative protein sources like pulses, seaweeds, algae, insects and cultured meat" [EZ 2015, 10]). The dominant position of 'technological optimism' becomes furthermore clear in a section called "Knowledge and innovation" (EZ 2016, 26-27), which is fully devoted to natural scientific and techno-scientific developments – rather than also social innovations. The continued reliance on 'business-as-usual' thinking and 'technological optimism' is well-captured in the following statement, which qualifies the Dutch world leadership ambition: "By focussing on sustainability, health and transparency in *food production*… but also on the export of *knowledge and technology*, the Netherlands can continue to play a distinctive role in international markets" (EZ 2016, 4, our emphasis).

As the reference to transparency in the last quote already indicates, 'business-as-usual' and 'technological optimism' were dominant but not the only perspectives that were informing the Food Agenda. Developing food transparency – as implicated in the 'political consumerism' perspective' – was deemed important to help Dutch companies to market their 'unique, premium and distinctive' sustainable food internationally. Furthermore, the government aimed to provide Dutch consumers "with good and understandable information" on the food they eat by developing information campaigns, clearer labelling requirements and a 'food information app' (EZ 2016, 7). It should also be noted that 'integrated food politics' thinking was not totally absent in the operationalisation of the Food Agenda. Most notably, it inspired the organisation of a national food summit in 2017 (EZ 2017) in which various food system parties participated – although this summit has been criticised for predominantly attracting established food industry parties and thus supporting 'business-as-usual' interests (e.g. Untied 2017).

One perspective that is almost totally absent in the Food Agenda is the 'alternative food politics' perspective. The problem of farmers' low incomes and limited market power in the current agri-food system – which features prominently in the 'alternative food politics' perspective – is recognised in the new Dutch food policy. However, this problem is not addressed by re-organising producer-consumer relations as suggested in the 'alternative food politics' perspective, but rather by focussing on market competition legislation and farmer participation in innovation trajectories (which once again underscores the dominance of market-oriented and technologically oriented thinking) (EZ 2016, 21-22). The 'alternative food politics' perspective is difficult to reconcile with the two dominant perspectives and this has contributed to the virtual absence this line of thinking in the Dutch food policy in the period under study.

RESULTS OF FOCUS GROUPS WITH DUTCH CIVIL SERVANTS: FOSTERING REFLECTION ON DISCURSIVE PATH DEPENDENCIES IN FOOD POLICY MAKING

In this third and final empirical section, we present the results of two focus groups in which we have discussed our findings with civil servants who have been involved in drafting and implementing the Dutch food policy. We organised the focus groups for two main reasons: to test the robustness of our analyses of the public debate and food policy; and to investigate the type of reflection that our findings elicited. As described in our analytical framework, we anticipated that perspectives inform stakeholders' positions in public and policy debates, but tend to remain elusive rather than the object of discussion themselves. By organising the focus groups, we aimed to investigate whether this anticipation was correct, and to explore the added value of fostering explicit reflection on the position of perspectives in food policy making.

The two focus groups took place in May and June 2018 and involved in total nine participants. The first one contained three civil servants from the current Ministry of Agriculture;[6] the second one contained six civil servants from the ministries of Agriculture, Economic Affairs, and Public Health. To acquaint the participants with our findings, we presented our analyses in a Dutch-language report (De Krom and Muilwijk 2018) that the participants received beforehand, as well as orally at the start of the focus groups. The focus group discussions

[6] In 2017, the merger of the ministries of Economic Affairs and Agriculture was made undone.

centred on three main topics: the robustness of our findings, the dynamics that determine the dominance of perspectives in policy design, and the usefulness of explicit reflection on these discursive dynamics. The group discussions lasted for approximately 90 minutes and were recorded, transcribed, coded and analysed by the authors.

Both focus groups started with critical assessments of our delineation of the five perspectives. Some participants initially doubted whether the five perspectives cover the entire Dutch public debate: "the perspectives are clearly recognisable, but I lack the overview to know whether there's sixth or seventh or eighth or ninth one".7 Others, instead, raised arguments against analytically distinguishing one or more of the perspectives from the others. Some participants, for instance, were against considering 'political consumerism' a separate perspective because the perspective would rest on a notion of a "consumer that doesn't actually exist", and because consumers play an important role in each perspective. Notably, such critical remarks did not fundamentally undermine our analysis but instead tended to inspire other participants to defend our categorisation. In doing so, the participants came to a first important point of reflection: some of the perspectives represent blind spots for the national policy officials. According to one of the participants, such a blind spot explains why his colleagues considered the 'political consumerism' perspective non-distinct: "My 14-year-old daughter and her friends are only into food blogs. They don't watch tv. We watch tv, but they don't. We live in separate worlds… There's already a huge vegan youth culture that we just don't know about".

A similar line of reasoning emerged in relation to the 'alternative food politics' perspective. The following excerpt is taken from a discussion between two participants (P1 and P2): P1: "Yes, I do recognise the five perspectives… I do encounter all five of them. But in the national debate, I don't really see advocates of those alternative food networks." P2: "You are stuck in your own bubble when you only look at things from your national perspective. 'Regional sustainability' is developing very strongly right now."

The fact that some of the perspectives represent blind spots in national policy circles goes some way in explaining why these perspectives are less identifiable in the Dutch Food Agenda than others. Yet, participants were eager to clarify that it was not simply a matter of them being unaware of the existence of particular perspectives. Rather, they lacked attention for some of the perspectives in their role as a civil servant: "It really depends on your role. As a father and as someone who enjoys food, I approach it differently than as a policy officer". What is more, our finding that the 'integrated food politics' perspective was eventually backgrounded in the drafting of the Food Agenda cannot be explained by considering this perspective a blind spot, as it was put on the national agenda by the Netherlands Scientific Council for Government Policy and had inspired the drafting of the Food Agenda in the first place.

In searching for an explanation for the dominance of the 'business-as-usual' and 'technological optimism' perspectives at the expense of the other perspectives, participants came to a second main point of reflection: that the dominance of these two perspectives have been firmly institutionalised in Dutch agro-food policies and in the ministries that are responsible for it. Participants contended that "the entire system, all our thinking, is based on it [the two dominant perspectives]. If you look at the regulation, that's all based on policies from the '60s and the '70s and we just continue to build on that" – which makes it difficult to integrate new perspectives in agro-food policy. Furthermore, participants stated that "the entire ministry [of Agriculture] has just fundamentally been built on these [dominant] perspectives". This would become evident in the fact that most employees are educated in the same school of thought "which I always call 'classical agriculture'", and in "the way the Ministry is organised. We are organised according to sectors... So that integrated approach is just not part of the DNA of the organisation."

All in all, the participants of both focus groups supported our categorisation of perspectives on sustainable food and our food policy analysis, and considered the exercise of reflecting on discursive dynamics in food policy making useful. They held that their tacit ascriptions to the two dominant perspectives were understandable yet undesirable, as the new food policy was devised to be more integrated, and valuable policy input could be derived from the other non-dominant perspectives as well. When being asked what the participants took home from the focus groups, most answered that they wanted to relate more reflexively to the various perspectives in their future work and to move beyond the current discursive path dependency in their work. As one participant phrased it: "The overall conclusion is that two perspectives are highly dominant and that there's little room for the other perspectives. That's a harsh message for us. I think that the conclusion is correct and it can all be well-explained. But it is our task to break through that".

[7] All quotes from the focus groups are the authors' translations.

REFLECTION

In this paper we have presented a nuanced, non-binary categorisation of perspectives that structure the public debate on sustainable food in the Netherlands. We have used this categorisation to analyse recent developments in Dutch food policy and have revealed that despite intentions to renew the rationale of this policy, it continued to principally draw on two long-established (global market-oriented and technological optimist) perspectives. We have discussed these findings with Dutch civil servants in focus groups and found that our analyses triggered reflection amongst these policy officers on their own perspectival biases as well as on discursive path dependencies in Dutch food policy making. Notably, whilst our findings are specific to the Netherlands, similar discursive path dependencies likely play a role in food policy making in other polities. Accordingly, similar analyses of public debates and food policies in other countries may contribute to forestalling non-reflexive discursive closure in food policy making.

The existence of multiple perspectives on sustainable food and their differentiated positions in Dutch food policy clearly show that the definition of sustainable food is not universal or given, but rather a matter of political contention. Behind a seemingly clear and unambiguous definition of sustainable food and agriculture as implicated in the Dutch ambition to become world leader in this matter, there looms a multiplicity of perspectives and political choices. Bringing this to the attention of civil servants resulted in their willingness to more reflexively engage with the different perspectives that are at play in society. The question that this raises is how policy makers can best relate to the diverse – and, at points, arguably incompatible – perspectives? While it is beyond the scope of this paper to thoroughly investigate this question, we do want to finish by offering three different approaches that are brought forward in political science literature.

A first approach, which is typical for the Dutch (neo-)corporatist tradition, centres on searching for consensus between advocates of the different perspectives (Vink et al. 2015). In line with this approach, explicit reflection on conflictive perspectives may contribute to overcoming discursive deadlocks and establishing joint understandings and solutions (Schön & Rein 1994; Benard & de Cock Buning 2013). A second approach is to openly choose between options that are advanced by advocates of the different perspectives. According to this 'radical democratic' approach, an outright battle between supporters of the different perspectives will help to sharpen ideas and, accordingly, enhance the productivity of political debate (Mouffe 2009; Machin 2013). A third approach is to come up with so called 'clumsy solutions'. This approach starts from the notion that all perspectives make valid knowledge claims that are overlooked by the others, and therefore seeks to "creatively combine all opposing perspectives on what the problems are and how they should be resolved" (Verweij et al. 2006, 817) – even if such solutions are conflicting in terms of policy coherence or consistency (Candel 2016).

Crucially, these three approaches have in common that they do not 'hide' different perspectives behind a seeming consensus about the definition of 'sustainable food', but instead explicitly recognise all perspectives that exist in the public debate on sustainable food futures. Such explicit recognition may not only shed light on innovative ideas to foster sustainable food systems, but may also contribute to a broader social support base for policy choices.

Acknowledgements

The authors gratefully acknowledge the useful comments of Jeroen Candel, Hans Dagevos, Hiddo Huitzing, Peter Oosterveer and Henk Westhoek on earlier (Dutch language) versions of this paper.

REFERENCES

Arts, B. & M. Buizer (2009) 'Forests, discourses, institutions; a discursive- institutional analysis of global forest governance', *Forest Policy and Economics* 11, 340-347.

Benard, M. & T. de Cock Buning (2013) 'Exploring the potential of Dutch pig farmers and urban-citizens to learn through frame reflection', *Journal of Agricultural and Environmental Ethics* 26(5), 1015-1036.

Béné, C., P. Oosterveer, L. Lamotte, I. Brouwer, S. de Haan, S. Prager, E.

Talsma & C. Khoury (2019) 'When food systems meet sustainability – Current narratives and implications for actions', *World Development* 113, 116-130.

Busch, L. (2009) 'What kind of agriculture? What might science deliver?', *Natures Sciences Sociétés* 17, 241-247.

Candel, J., G. Breeman, S. Stiller & C. Termeer (2014) 'Disentangling the consensus frame of food security: The case of the EU Common Agricultural Policy reform debate', *Food Policy* 44, 47-58.

Candel, J. (2016) *Putting food on the table: The European Union governance of the wicked problem of food security*, Wageningen: PhD thesis Wageningen University.

Dagevos, H. & J. van Ophem (2013) 'Food consumption value: Developing a consumer-centred concept of value in the field of food', *British Food Journal* 115(10), 1473-1486.

De Cock, L., J Dessein & M. de Krom (2016) 'Understanding the development of organic agriculture in Flanders (Belgium): A discourse analytical approach', *NJAS-Wageningen Journal of Life Sciences* 79, 1-10.

De Krom, M. & H. Muilwijk (2018) *Perspectieven op duurzaam voedsel, pluriformiteit in debat en beleid*, The Hague: PBL Netherlands Environmental Assessment Agency.

De Krom, M., J. Dessein & N. Erbout (2014) 'Understanding relations between science, politics, and the public: The case of a GM field trial controversy in Belgium', *Sociologia Ruralis* 54(2), 21-39.

Delind, L., B. (2013) 'Critical reflection and civic discourse within and across the alternative food movement', *International Journal of Sociology of Agriculture & Food* 20(3), 391-396.

Dessein, J., B. Bock & M. de Krom (2013) 'Investigating the limits of multifunctional agriculture as the dominant frame for Green Care in agriculture in Flanders and the Netherlands', *Journal of Rural Studies* 32, 50-59.

EEA (2017) *Food in a green light: A systems approach to sustainable food*, Copenhagen: EEA.

Entman, R. (1993) 'Framing: Toward Clarification of a Fractured Paradigm', *Journal of Communication* 43(4), 51-58.

EZ [Ministry of Economic Affairs] (2015) Voedselagenda voor veilig, gezond en duurzaam voedsel [Food agenda for safe, healthy and sustainable food], 20 oktober 2015.

EZ [Ministry of Economic Affairs] (2016) Voortgang voedselagenda voor veilig, gezond en duurzaam voedsel [Progress food agenda for safe, healthy and sustainable food], 21 november 2016.

EZ [Ministry of Economic Affairs] (2017) Slotverklaring Nationale Voedseltop 26 januari 2017 [Final declaration of the national food summit of 26 January 2017], 23 februari 2017.

Foucault, M. (1984) *De wil tot weten: Geschiedenis van de seksualiteit*, Nijmegen: SUN.

Fresco, L. & K. Poppe (2016) *Towards a Common Agricultural and Food Policy*, Wageningen: Wageningen University & Research.

Goffman, E. (1974) *Frame Analysis: An Essay on the Organization of Experience*, New York: Harper Colophon Books.

Hajer, M. & W. Versteeg (2005) 'A decade of discourse analysis of environmental politics: Achievements, challenges, perspectives', *Journal of Environmental Policy & Planning* 7(3), 175-184.

Hajer, M. (2009) *Authoritative governance: Policy making in the age of mediatization*, Oxford: Oxford University Press.

Havinga, T., F. van Waarden & D. Casey (eds.) (2015) *The changing landscape of food governance: Public and private encounters*, Northampton, Massachusetts: Edward Elgar Publishing.

Hekkert, M., R. Suurs, S. Negro, S. Kuhlmann & R. Smits (2007) 'Functions of innovation systems: A new approach for analysing technological change.' *Technological forecasting and social change* 74(4), 413-432.

Hopwood, W., M. Mellor & G. O'Brien (2005) 'Sustainable development: Mapping different approaches', *Sustainable Development* 13: 38-52.

Jallinoja, P., M. Vinnari & M. Niva (2018) 'Veganism and Plant-Based Eating: Analysis of Interplay between Discursive Strategies and Lifestyle Political Consumerism.' In M. Boström, M. Micheletti & P. Oosterveer (eds.), *The Oxford Handbook of Political Consumerism*, 10.1093/oxfordhb/9780190629038.013.52.

Korthals, M. (2017) 'Ethics of Dietary Guidelines: Nutrients, Processes and Meals', *Journal of Agricultural and Environmental Ethics* 30(3), 413-421.

Kuhn, T. (1970) *The Structure of Scientific Revolutions*, Chicago: University of Chicago press.

Lang, T. & M. Heasman (2015) *Food Wars: The Global Battle for Mouths, Minds and Markets*, Abingdon: Routledge.

Lockie, S. (2009) 'Responsibility and agency within alternative food networks: Assembling the "citizen consumer"', *Agriculture and Human Values* 26(3), 193-201.

Machin, A. (2013) *Negotiating climate change: Radical democracy and the illusion of consensus*, London: Zed Books.

Maye, D. and J. Duncan (2017) 'Understanding sustainable food system transitions: practice, assessment and governance', *Sociologia Ruralis* 57(3), 267-273.

Mouffe, C. (2009) *The Democratic Paradox*, London: Verso.

Oosterveer, P. & D. Sonnenfeld (2012) *Food, Globalization, and Sustainability*, New York: Routledge.

Oosterveer, P. (2015) 'Sustainable Food Governance by Governments and

Markets : The Case of Sustainable Seafood Provision', *European Journal of Risk Regulation* 6(4), 525-531.

Papaoikonomou, E. & M. Ginieis (2017) 'Putting the farmer's face on food:

Governance and the producer–consumer relationship in local food systems', *Agriculture and Human Values* 34, 53–67.

Ritzer, G. (2000) *The McDonaldization of society*, Thousand Oaks, CA.: Pine Forge Press.

Schön, D. & M. Rein (1994) *Frame Reflection: Toward the Resolution of Intractable Policy Controversies*, New York: Basic Books.

Schönfeld, M., R. Heil & L. Bittner (2018) 'Big Data on a Farm—Smart Farming.' In: T. Hoeren & B. Kolany-Raiser (eds.), *Big Data in Context*, Cham: Springer, 109-120.

Soma, K., C. Termeer & P. Opdam (2016) 'Informational governance: A systematic literature review of governance for sustainability in the Information Age', *Environmental Science & Policy* 56: 89-99.

Sonnino, R. (2013) 'Local foodscapes: place and power in the agri-food system', *Acta Agriculturae Scandinavica Section B – Soil and Plant Science*, 63, 2-7.

Spaargaren, G., P. Oosterveer & A. Loeber (2012) 'Sustainability transitions in food consumption, retail and production', In: G. Spaargaren, P. Oosterveer & A. Loeber (eds.), *Food practices in transition: Changing food consumption, retail and production in the age of reflexive modernity*, London: Routledge, 1-34.

Tovey, H. (2008) 'Introduction: Rural Sustainable Development in the Knowledge Society Era', *Sociologia Ruralis* 48(3), 185-199.

UNEP (2016) *Food Systems and Natural Resources*, Paris: UNEP

Untied, Y. (2017) Nationale Voedingstop blijkt feestje voedingsindustrie [National Food Summit turns out to be a food industry party], *Follow The Money* 27 January 2017, accessed via https://www.ftm.nl/artikelen/voedingstop-blijkt-feestje-voedingsindustrie?share=1.

Van Gorp, B. & M. van der Goot (2012) 'Sustainable food and agriculture: Stakeholders' frames', *Communication, Culture and Critique* 5, 127-148.

Vatn, A. (2018) 'Environmental Governance–From Public to Private?' *Ecological Economics* 148, 170-177.

Verweij, M., M. Douglas, R. Ellis, C. Engel, F. Hendriks, S. Lohmann, S. Ney,

S. Rayner & M. Thompson (2006). 'Clumsy solutions for a complex world: The case of climate change', *Public administration* 84(4), 817-843.

Vink, M., D. Benson, D. Boezeman, H. Cook, A. Dewulf & C. Termeer (2015) 'Do state traditions matter? Comparing deliberative governance initiatives for climate change adaptation in Dutch corporatism and British pluralism', *Journal of Water and Climate Change* 6(1), 71-88.

Viviano, F. (2017) 'This Tiny Country Feeds the World: The Netherlands has become an agricultural giant by showing what the future of farming could look like', National Geographic, September issue.

Wästfelt, A. (2018) 'Shifts in agriculture praxis: Farm modernisation and global integration'. In: J. Zeunert & T. Waterman, *Routledge Handbook of Landscape and Food*, Abingdon: Routledge, 117-126.

Yin, R. (2009) *Case study research: Design and methods, 4th edition*, Thousand Oaks: Sage.

AFFILIATIONS

Michiel de Krom

Dr. Michiel de Krom is affiliated to PBL Netherlands Environmental Assessment Agency. At PBL, he conducts policy-relevant research into sustainable food transformations, with a specific focus on the involvement of policy makers, consumers and food supply chain actors in governing agri-food change. He has published widely on these issues in various international scientific journals. Recent publications include: 'Farmer participation in agri-environmental schemes: Regionalisation and the role of bridging social capital' (*Land Use Policy*, 2017); '"Fairtradization": a performative perspective on fair trade markets and the role of retail settings in their enactment' (*Consumption Markets & Culture*, 2017, with R. Geysmans & L. Hustinx), and 'Discursive representation within the institutional void: the rise and fall of a governance network on sustainable food in Belgium' (*Sociologia Ruralis*, 2018, with M. Crivits, J. Dessein & T Block).

PBL Netherlands Environmental Assessment Agency, PO box 30314, 2500 GH The Hague, The Netherlands;
michiel.dekrom@pbl.nl

Hanneke Muilwijk

Hanneke Muilwijk is affiliated to PBL Netherlands Environmental Assessment Agency as a researcher and project manager Food. She was trained in both chemistry and political philosophy. At PBL, she studies food-related issues using a systems approach with a focus on actors and their behaviour. The current food system presents major challenges in terms of sustainability and governance. Her work is strongly interdisciplinary and angled towards the science-policy interface.

PBL Netherlands Environmental Assessment Agency, PO box 30314, 2500 GH The Hague, The Netherlands;
hanneke.muilwijk@pbl.nl

PS2: ANALYSIS AND STIMULATION OF TRANSITION PROCESSES

Urban pastoralism as element of sustainable productive green infrastructure

Roxana Maria Triboi

The driving forces of institutionalisation: the spread of organic farming in Romania

Boldizsár Megyesi

Agroecological alternatives to Brazil's Green Revolution: which territorial development?

Levidow Les

URBAN PASTORALISM AS ELEMENT OF SUSTAINABLE PRODUCTIVE GREEN INFRASTRUCTURE

ROXANA MARIA TRIBOI

«The New is simply the long forgotten Old» (old Russian saying)

ABSTRACT

In an increasing urban context, that marginalized both physically and culturally the agriculture practice, there is a need for a new approach to projects and policies to integrate a steady and productive vision. The agri-food system crisis at a global level encourage us to reflect on more sustainable, resilient and local adapted solutions of managing the territory, and therefore an emphasis on bottom-up initiatives, cultural and productive tradition, empirical transmitted know-how, the specificity of the socio-economic conditions, marginal, informal and spontaneous uses of land are gaining more attention. The urban-rural interface is generally considered a space of friction between opposite contexts and functions, but also can be a platform for a productive green infrastructure that would generate important ecosystem services like landscapes and biodiversity conservation, locally just food and the preservation of cultural traditions and local identity delivered to the city. For example, ecological corridors recreated and managed by pastoralism can become, in addition to biodiversity reservoirs, also platforms for leisure, cultural and gastronomic activities. Multifunctionality of productive spaces and practices can enhance the quality of urban life.

The pastoralism is a pattern of subsistence, that survived in its close to original form even today in an increasingly urbanized environment. Marginalized by agriculture intensification, then industrialization and at last urbanization this productive practice managed to survive in the contexts, spaces and interstices unexploitable by the other dominant functions. Its capacity of adaptation to harsh and changing conditions generated its resilience. Its feature of interdependency between animal, shepherd and environment along with its independency from urban infrastructure and mechanization permitted its survival despite its criticized low productivity by transforming marginal in productive and biodiverse. Historically ignored by policies, a reconsideration of this practice is necessary especially when interacting with the urban context.

In Romania, due to a combination of factors like chaotic fragmentation of the periphery, development and urban gaps or wasteland, the abandonment of agricultural exploitation of arable land, pastures developed and prospered mostly in the green pockets of urban peripheries. Urban pastoralism represents the most important expression of city-agriculture interaction in this geographical region, a fact supported by a long tradition in shepherding and transhumance, favorable physical and climate conditions and socialist regime central management that spontaneously generated a resistance to food crisis by informal productive practices and distribution chains. This phenomenon translates in the periphery of Bucharest by the informal presence of flocks of few hundred to thousands of sheep and goats (number that permits an economic efficiency) that grazed thousands of hectares of ancient socialist farm land fragmented by city chaotic sprawl in search of modernity and nature. Ignored or marginalized by local authorities and residents, the presence of sheep is motivated only by economic interest and the capacity of shepherds of identifying and exploiting marginal opportunities. They have an important contribution to the local food production, in extend to ecological and cultural services. The lack of recognition

along with urbanization pressure and concurrency of formal food distribution chains (especially from large scale ones) fragilizes this phenomenon.

In France, urban pastoralism turned from an experiment to an ecological management of green spaces. Animals are used as tool with low environmental negative impact for maintaining urban areas. Supported mainly by public funds, and a positive reputation cultural and pedagogical activities are complementary to the grazing functions. Mostly developed as an eco-practice based on a social demand of nature in the city, the transition toward a more self-sufficient economical model is complicated.

While traditionally understood as a rural phenomenon, the pastoralism values both the social, economic, ecological and agricultural dimensions of urban territories and with appropriate recognition and management can be transformed into an important tool for sustainable urban planning.

Its significant role as part of the green infrastructure and local food system that provides ecosystem services to the city is yet to be recognized and integrated into the local urban policies.

KEY-WORDS: PASTORALISM, LOCAL FOOD SYSTEM, GREEN INFRASTRUCTURE, ECOSYSTEM SERVICES, SUSTAINABLE URBAN PLANNING

INTRODUCTION: URBAN PASTORALISM AN OXYMORON?

"Urban pastoralism" it represents an expression that designs our search for an ideal living environment where nature and technology are harmoniously coexisting, as an answer to challenges like urbanization, industrialization or ecological crisis by solving classical dichotomies like urban and pastoral.

"Urban pastoralism" evokes a concept and a phenomenon, but also the clash between the two of them.

The concept of "urban pastoralism" is based on pastoral ideal and captures the antagonistic nature of the American Ideology of space, an idealization of rural life and contact with nature merged with a modern technical orientation. One form of its materialization beside the original North American city design (like Philadelphia and Washington) is "Suburbia" as a "middle landscape", a compromise between city and nature, urban and rural life, sense and sensibility, idyllic and oppression, past and future....

Even if this 'formula' it is mainly used in United States, the concept is common to western Europe also and one of its expression is the city garden city movement initiated in 1898 by Sir Ebenezer Howard in the United Kingdom, a pioneer method of green urban planning in which self-contained communities are surrounded by "greenbelts", containing proportionate areas of residences, industry, and agriculture.

Today the preoccupation for transition toward a post-carbon, post-global, post-industrial, post-capitalist more sustainable society revived the same question of defining the path toward ideal life context in which present antagonisms are solved. Solutions like agroecology, circular economy, urban agriculture, local community-based initiatives, integrated approaches try to answer the crisis generated by the passage from "domestic coordination" (pre-industrial society) to "market coordination" and globalization.

Somehow, this questioning can be considered as a return, by resuscitation of sustainable practices that where experienced and refined during past millennials in a rapidly changing new context.

"The New is simply the long forgotten Old"

In an increasing urbanized context, "urban pastoralism" translate into the search for a new equilibrium in theory and practice.

The phenomenon of urban pastoralism defines the practice of extensive grazing of open urban spaces by small ruminants that relies on short or medium transhumance and on local resources of feed. The coexistence and friction between the two functions is a common feature globally but in the Global North stopped mid XX century due to regulations to be recently revived on a new form due to the demand for nature in the city. If in the Global South, economic and cultural situation currently sustain its historical

presence, in transition contexts such as Eastern Europe, a new form developed based on the traditional one, and generated the encounter between American vision of urban pastoralism translated in modern suburbia with traditional shepherds, prisoners of urban sprawl. The innovation would be the new form of resilience of this practice facing challenges never experienced before.

URBAN PASTORALISM AN INNOVATIVE SYSTEM?

As assessed in the previous chapter urban pastoralism is an old phenomenon with different features depending of the context and period. Why it should be considered innovative?

First, the discrete reversibility of classical ratio urban/pastoral, in which the pastoral practice infiltrates the city, after millennials of marginalization and domination by urban functions. Second, the proximity of the two functions and therefore the intensity of their interaction which validates the resilience feature of pastoralism. Third, the potential of enhancing its positive impact on urban environment due to the general accepted desire of reconnecting the oppressive city to nurturing nature and reconciliating classical dichotomies in order to achieve the ideal of "urban pastoralism", by reconfiguration of its vision. Today pastoral ideal and pastoral practice intersect in the fringe of the city which became a platform for experimentation for nature and community-based solutions as a answers to uncontrollable urban growth and globalization. Introducing unpredictability, marginal, spontaneous and temporary features in urban land management it is also a innovative approach based on a long tradition of practicing pastoralism that faced through history numerous challenges and transitions.

The current way of practicing it is an adapted form never experienced before regardless of its context. The urban sprawl experienced in the late part of XX century it's a very aggressive process that invested the agricultural and rural periphery while ignoring its specificity and generated a great quantity of unexpected marginal land, an important challenge for local authorities, especially in Eastern Europe. Never before the urbanization process inflated so quickly so much land extremely complicated to managed. Based on traditional organization or on new interpretation, urban pastoralism succeeded in a spontaneous way to seize the opportunity of 'wasteland' presence in multifunctional and biodiverse and to respond to municipality poor administration. The innovative part is the delicate and complicated adaptation of an archaic practice to numerous constrained generated by urban function and a changing environment, based mainly on the empirical know-how the capacity of adaption of the animal. The coexistence of the two functions is very intense due to physical proximity. If in France the contemporaneousness is accepted based on the demand of nature, ecological management of the land, in Romania the vicinity is a characterized by friction or ignorance. The harmony is difficult to achieve even if supported by resilience of pastoralism or desire for animal presence in the city. The challenge is therefore the sustainable corroboration and organization that could enhance the positive impact of pastoralism in the city. By adding connectivity to urban 'gaps', the pastoral activity created a new network of green infrastructure superposed on the grey one, as traditionally the transhumance path did at much higher level.

There is an important body of research that demonstrates that pastoralism it is a sustainable practice when not intensive, that responds to the agroecology principles and represents the main factor of maintaining open landscape, high value pastures, biological corridors or other fragile ecosystems (like garrigues in south of France). The diminution or extinction of this activity is responsible for important negative changes in landscape configuration, land management use or biodiversity that are starting to be noticed and hardly reversible. The consequences are still not enough considered, and their increase will have to be addressed sooner or later. The presence of pastoralism in the city it is an incentive not only for transforming 'green' urban spaces in sustainable ones but also for transforming the 'grey' territory in a greener one. It concerns less the sustainability of agricultural system and more that of urban system.

The important role of planners is to mediate that kind of tensions and antagonism in order to support the transition toward a more sustainable pattern of existence. The redefinition of urban ideal and the practical integration of a resilient productive practice in its organization could represent a path toward achieving sustainability.

How can we envision pastoralism management in order to conciliate him with urban functions and enhance its ecosystem services as green infrastructure element? By comparing case studies from Romania and France, some important lessons are to be drawn in order to improve the current way of practicing pastoralism. Concertation, communication, multifunctionality features in Romania, and the implementation

of a more complex and circular model in France would enhance its sustainability and validate it as an important tool for urban management.

BETWEEN TRADITION AND MODERNITY

The coexistence of the pastoral and urban function it is not recent, and we must consider that pastoral society existed before the agricultural one and supported the general development of the humanity and therefore of urban settlements.

In order to talk about pastoral practice in the urban environment we have to approach the pastoralism features and evolution.

The pastoralism is one of the subsistence patterns that started ten thousand years ago before sedentarization and manage to survive in its original form mainly because the interdependence between shepherds, animals and environment. The difficulty of intensifying it by mechanization and connection with modern infrastructure, and therefore its criticized low productivity, maintained it in a marginal category of status and land use comparing with agriculture, industrialization and urbanization. At the same time, the increasing frictions between the dominant functions generated new categories of 'marginal' land and reoriented this practice toward a more urban context, against its specificity.

The mobility feature is a significant characteristic, generated by the need of finding and not producing feed, in a logic of economy of resources. Its territorial dimension (visible in the transhumance path map of South of Europe before the WWII for example) is materialized in a widely developed interconnected network of paths that was ignored until now. Its capacity to exploit distant and dispatched resources is also one of the reasons that this practice survived until recently. Pressure factors like redefinition of frontiers after WWII, increasing infrastructure related to industrialization, urbanization, land use policies had a negative impact on this parallel ignored network and led to its extinction in most of the cases.

The map of transhumance corridors from Romania is a striking fact, with the thousands of kilometers from the few nuclides in the Carpathians radiating throughout Eastern Europe and even to Asia in the Caucasus Mountains. Herds made up of thousands of sheep crossed border after border until the installation in suitable places. In addition, the vocabulary specific to pastoral practice in its distant regions is clearly of Romanian origin, testimony of the installation of Romanian shepherds before.

This little-known story bears witness to the marginal condition of pastoralism and its resilience at the same time.

Considered as not very productive, competing with agriculture, especially in its intensive and mechanized form, pastoralism has the reputation of a retrograde practice, reminiscent of a world that has almost disappeared, that of "domestic coordination" specific to pre-industrial rural society, often stimulating the feeling of nostalgia for a lost paradise.

Pastoralism practice is often confused with grazing or animal farming, but its mobility and interdependency of elements features are differentiating it from other forms of animal production. Therefore, this practice resilience and specificity especially in exploiting marginal land has generally (when not intensive) a positive impact on environment, and its contribution to sustainability as a green infrastructure and food system element.

In all models of practicing it, pastoralism relies on the know-how, mobility, marginal uses of land and its capacity to manage unpredictability.

THE REALITY OF URBAN PASTORALISM IN ROMANIA AND FRANCE

The quantification of this phenomenon is extremely complicated and laborious for obvious reasons. The study of pastoral activity presence in the urban area is almost little developed until now, also, thanks to the exclusion from public policies that forged its marginal status. Also, the a high dynamic of tits development, makes it difficult an overall assessment of this practice importance and dimension.

The main case-studies are restricted to Bucharest and its periphery, but in order to better framed the subject at a global level, the French perspective is also illustrated. Numerous bibliographical sources on connected themes or empirical data from interviews, discussions or observations from other countries such as Netherlands or United States was used in order to better frame the phenomenon at a global level.

Romanian current expression of urban pastoralism

The study focuses on Romania, a country with a long tradition of pastoralism and one of the main sheep farming countries in Europe (EUROSTAT, 2018). The study area is represented by Bucharest and its peri urban area. Here, pastoral activities persisted despite a rapid decrease in the importance of agriculture after the fall of communism, the continuous agricultural land take by urbanization and a recent shift in regional development objectives, which prioritize the peri-urban area for the development of industry and services (Ilfov County, 2014).

The radical change of property land management due the process of "de-collectivization" at the beginning of the 90 and the uncontrolled expansion of the city over the rural and agricultural suburbs created a chaotic mix of urban areas. The last economic crisis slowed down the residential and service sectors taking over agricultural land (especially ancient state farms) and allowed the installation and expansion of sheep and goats flocks in the "residual spaces", while land remained uncultivated. Other factors participated to the development of this phenomenon like: the natural flow of the transhumance who traditionally provided flock related products through informal networks and stop since 2010, the availability of shepherds with 'know-how' and ability to expand activity in coherence with resources opportunity, the persistence of informal networks, the capacity of function in an informal, spontaneous and marginal way.

The difficulty of quantifying this phenomenon is obvious since local municipalities ignores at best this activity and shepherds are accepting their marginal status by fear of extinction of their activity. The most important gathered data comes from detailed study of 8 most significant pastoral installations in Bucharest that varies from 200 to 3000 animals. The Google map study of Bucharest's belt driveway in the pastoral seasons allows the observation of this practice in the interstitial spaces between inarticulate residential and service areas and easy identification of shelters and path of herds. The main source of official data is APIA (Agency for Payments and Intervention in Agriculture) that receives the European funding demands. We must consider that the shepherd interviews determined that not all flock owners applied for subvention. Still for a general show that until 2012 the number of goats and sheep had an upward trend (almost 45 000). The numbers contradict the local land use rules that restrict any animal raising on the city territory and therefore, for local municipalities the livestock presence is inexistent. A simple estimation of dairy products based on the numbers mention above leads us to a 1-million-euro market of cheese in the capital.

The eight studied sheepfolds (i.e., coded as S1 to S8 in Table 1) are located around the city, half of which are concentrated in the northern and north-eastern parts of the study area. The sheepfolds are located either in the remaining "pockets" of agricultural land surrounded by recently urbanized land (S2 to S7), or in areas where built-up development was less prominent due to restrictions imposed by natural or anthropic factors (S8 is located in a flooding area; S1isinthevicinity of a landfill). Most of the sheepfolds started their activity during the communist period when they were allowed to use marginal, usually less or unproductive land (e.g., located on high slopes, near wetlands or along rivers). Most of them were tolerated by the communist regime as large numbers of privately-owned livestock were o□cially forbidden.

The shepherds saw the dissolution of the former state-owned farms as an opportunity to expand their pastoral activities either by using the abandoned agricultural land, by buying land or by franchising it from the municipalities. The size of the flocks fluctuated over time, with an increase after 1990 and a peak for several sheepfolds just before the economic crisis in 2008, which corresponds to the expansion of abandoned land (Gradinaru et al., 2015). Currently, the size of active sheepfolds varies between 400 and 2500 sheep, while mainly involving between one and three workers. The interviews revealed that pastoral activity in the study area has a strong cultural component. The shepherds were all male, aged between 36 and 79 years old, with six of them over 50 years old. Seven out of the eight shepherds come from families where pastoralism is a traditional family activity.

Most of shepherds declared during the interviews that pastoral activities were economically profitable, although, initially, they were mainly sustained by informal trade. Currently, the sheepfolds are involved in both short and long food supply chains, with di□erences emerging in relation to the types of distributed

products (Table 1). Dairy products are used for the local market, family and network, while sheep and meat products are mainly distributed on the international market, particularly Arabic countries. In addition to the financial input received from the commercialization of products, the activity is also complemented by subsidies received from the government through the Common Agricultural Policy schemes. Grazing land is private abandoned land, franchised from the municipalities or owned by the shepherds. The grazing areas vary between 30ha and 2500ha and mainly depend on the size of the flock. Parts of the land are used to produce forage for the cold season and to supplement the grassland. Designated protected areas located in the study area are not used for grazing, as they include forests and lakes; grazing in public urban parks is not performed either. The interviews revealed that abandoned agricultural land is informally used for grazing in order to compensate for the decreasing pasture area, allowing the shepherds to expand their flock. However, interviewees were reluctant to mention the size of the used areas. The interviews revealed that the proximity between the sheepfolds and residential areas leads to the occurrence of environmental conflicts (including o□cial complaints) with urban residents. Causes of the conflicts include negative impacts on the landscape and smells, as well as the failure to comply with legal sanitary requirements. Particularly, urban expansion leads to an increase in the number of conflicts, as new built-up areas are located closer and closer to the sheepfolds.

Three categories of threats confronting pastoral activities, which correspond to social, economic and environmental aspects, were identified and ordered based on their magnitude: a) lack of interest in the continuation of family traditions, b) the pressure imposed by urban expansion on grazing land, c) lack of trained personnel. Although the sheepfolds currently employ between one and three workers, all the interviewees reported di□culties in finding people willing to engage in sheep herding, which seems to reflect the reluctance of "outsiders" to engage in pastoral activities. Besides that, in many cases, there are no prospects for family members to take over the business as they have more profitable and prestigious jobs. Continuous urban expansion leads to high insecurity regarding the availability of grazing land, particularly as abandoned land, which is temporarily used for grazing, will most probably be converted into built-up areas. The studied sheepfolds either have responded to these threats with various adaptation measures (as identified in the case of S7, S3, S2, S6 and S4) or were profoundly a□ected by them, which finally led or will lead to their closure (S8, S5 and S1). Adaptation measures include the combined use of land with di□erent property regimes (i.e., partnerships with large real estate owners, land buying or franchises from municipalities), commerce orientation towards international markets (particularly for meat, which is less popular on the local market), or even a reduction in sheepfold activity when there is less demand for associated products. In terms of the future, interviewees declared their intention to adopt measures to comply with the requirements for more profitable

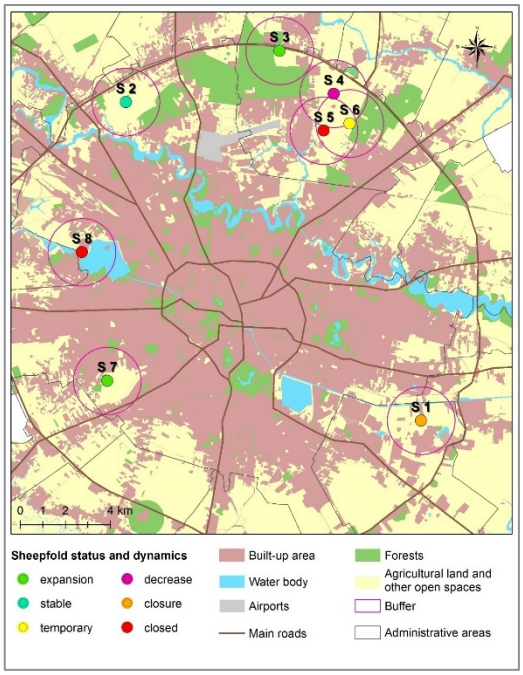


Figure 1 : Sheepfold status and dynamics and extent of the landscape dynamics analysis

Figure 2 : Urban Shepherd and the flock in the North part of Bucharest in 2017

Sheepfold	1	2	3	4	5	6	7	8
Number of sheep and goats								
Before 1989	3000	526	350	300	100	0	350	0
Maximum reached	3000	5000 (in 2007)	1200	800 (in 2015)	620 (in 2013)	1400	700 (in 2006)	200
Currently	400	2500	460	550	0	1400	620	0
Grazing area Surface	130 ha	750 ha	30 ha	200 ha	200 ha	250 ha	2500 ha	50 ha
Property regime	Public and abandoned land	Private and concession	Public and private	Private	Private and abandoned land	Private	Private and abandoned land	Public and abandoned land

Figure 3 : Relevant data on the sheepfolds studied in Bucharest area in 2017

Romanian urban pastoralism specificity

The adaptation in an organic manner of the traditional way of practicing the pastoral activity (due to a long established custom) to a constraining urban context is characterized by the management of the totality of actions regarding the flock and producing dairy products (Ex: 1 sheep = 1 lamb +5 months x 50 cl milk), the exploitation of private, public and mostly abandonned agricultural land (issue from desintegration of ancient stae farm in the vecinity of the city), the use of informal chain of food distributionand economic reliance on sheep and lambs export to arrabic countries and difficult acces to European subsudies. The economic viability of the flock fluctuates around 500 sheep and that along with the disponibility of few hundred hectars of wasteland in urban 'gaps' justifies the important size of pastoral installation in Bucharest and its surroundings. Also, the lack of collaboration between the flock owners and other concern actors like local authorities or residents along with the ignorance of the importance of communication tool and co-constructed management plans participate to the fragile and marginal status of their activity that the shepherds usually accept like a fatality.

Discussion

The pastoral activities conducted in the study area could contribute to all three pillars of urban sustainability. Economically, the sheepfolds contribute to both short and long food supply chains, providing the city with dairy products and meat, while the extra meat products are exported to specialized markets. Pastoral activities are not just economic, but also a family tradition and, as interviewees reported, a way of life. Most of the shepherds are part of a long line of shepherds, with roots outside Romania.

However, the main motivation behind the practice remains financial; thus, it cannot be considered as a hobby compared to other forms of urban agriculture (e.g., community gardening). In terms of intensity, pastoral practices in the study area can be classified as extensive agriculture. Although it was di□cult to estimate the magnitude involved, interviews revealed that pastoral activities contribute to some form of management over otherwise abandoned agricultural land. Improvements could be made with regard to the

environmental pillar, where, currently, the main issue concerns the conflicts caused by the sheepfolds' close proximity to residential areas and lack of compliance with sanitary requirements.

The novelty of this study derives from the focus on the historical evolution of pastoralism and the various forms of adaptation in order to respond to the pressure of urbanization. By investigating pastoralism using mixed research methods which combine interviews with shepherds, document analysis and land cover dynamics assessments, a better understanding of cultural, economic and environmental aspects was attained. As findings on pastoralism cannot always be generalized, our research could open the path for investigations of the local livelihood options of pastoralists.

The findings show that the type of pastoralism practiced in Bucharest and its peri-urban is consistent with the conditions for sustainable pastoralism identified by Tessema et al. (2014). The sheepfolds have adopted various forms of adaptation in order to respond to the pressure of urbanization and the market: they have access to legal land tenure systems and markets, the activity is based on traditional knowledge and values, and some sheepfolds adopt an integrated approach to land management through the use of abandoned lands. Overall, there is no strategy for conflict management, either on the side of the shepherds or from the local authorities.

Without a proper reconsideration of the sheepfolds' environmental impacts (e.g., odors, sanitary aspects), conflicts between pastoral activities and urban residents could persist and possibly lead to the closure of the sheepfolds. para2 : to be used for all the others paragraphs of the section

The French perspective on urban pastoralism

In France, the demand for nature, the search for sustainability support the reinterpretation of this archaic practice in a 'modern' way based on concertation between actors, elaborated management plan a good communication. Practiced at a smaller scale (few douzaines until one hundred animals), the difficulty of developing this activity relies more on the 'know-how' and constraints of working with animals in an extensive way and in urban environment.

Urban pastoralism turns, from experiment in an ecological management of "free land".

Although grazing was devalued after the Second World War due to mechanical or chemical maintenance, now a significant number of local authorities, public and private structures are using herds for maintaining lawns, pastures, vacant land, river beds ...But, the main utility of the urban pastoralism is the grazing without the cultural aspects that persist in the Eastern European context, it is used mainly for the green spaces in urban areas in an institutionalized form and with proper management, that rules out "spontaneous" form and it is mostly a top-down at best an horizontal approach.

Reintroduction "eco"-pastoralism in the city fall into concepts and policies on sustainability and biodiversity such as Green-Blue Grid and the National Biodiversity Strategy (2010-2020), therefore the interest of local authorities and urban planners to integrate ecological grazing in urban policies or landscape ecological management.

According to "Entretien Nature & Territoire", a private structure that accompanies local authorities to install urban pastoralism projects, the evolution of this practice it is exponential from 20 cities (in 2000) to 150 (in 2013).

For some the main interest of reinterpretation of this practice is not the social, ecological, economical or pedagogical but cultural: «cognitive and cultural rupture that represents the reintroduction of animals in the city ... Animals have now their place in the city, replacing mechanic. Coexistence is possible. » (François Léger, AgroParisTech).

In the lack of well-established precedents in modern cities, the approach of this practice is a work in progress because of the necessity of the technical expertise of managing a flock, at large or small scale.

In some cases, the animals are loaned free of local authorities, businesses or associates. Host structure provides the fence / fencing and shelter and commits to check every day. Organizers are also often call for volunteers who are trained in the care and management of animals.

This green space maintenance costs drops dramatically; the popularity of municipal institution increases.

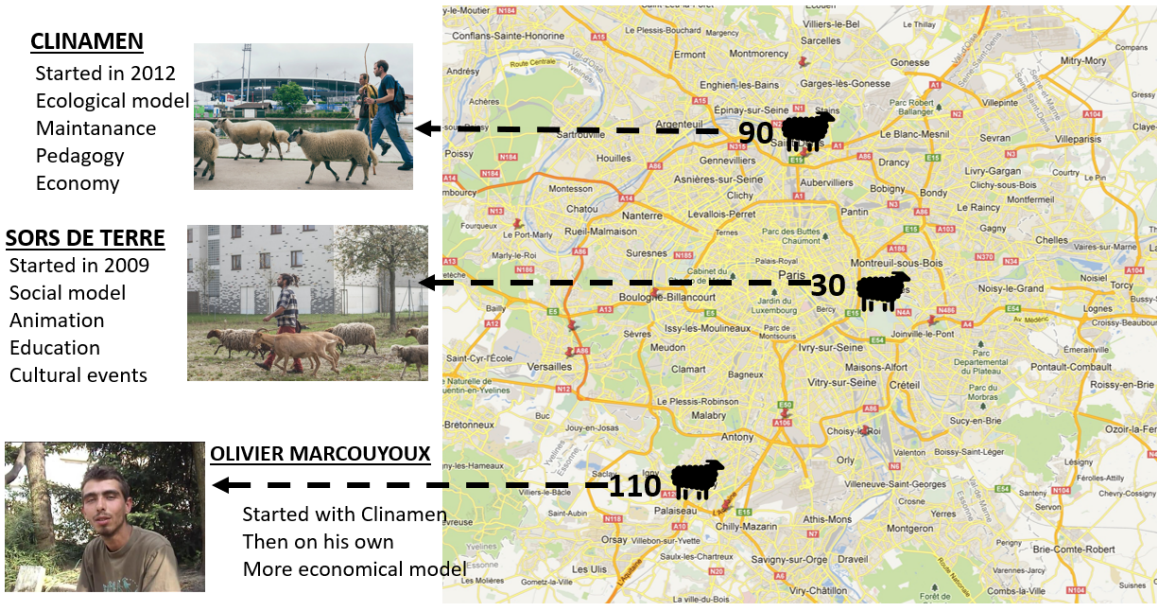


Figure 4 : Exemplification of Urban Pastoralism structures in Paris area in 2017

The possible exchange between the two models of urban pastoralism practices

By comparing case studies from Romania and France, some important lessons are to be drawn in order to improve the current way of practicing pastoralism at a global level whatever the framework of the activity is based on traditional model or innovative modern management plans.

Concertation, communication activities could participate to superior capacity of meeting market demands and public support and therefore a more secure economic viability and legitimacy in Romanian context.

In order to adapt to present demand of secure and safe food along with high quality, biodiverse, multifunctional and esthetic green spaces, the presence of large-scale sheepfold on urban territory has to integrate land management plan that are co-constructed with concern actors based on a common vision of a sustainable urban life quality.

Integrating cultural, pedagogical events to their activity is possible and can participate to better public appropriation, understating and acceptance of this archaic practice perceived as retrograde and incompatible with urban context.

In France, the implementation of a more complex and circular model inspired from the Eastern Europe traditional model can enhance the economic sustainability and legitimacy of pastoral activities in Global North cities. The empirical know-how of managing the totality of flock related activities and products (grazing technique, slaughtering, processing of products …) based on a circular and economic management of resources will participate to a better integration in local food system and generate more independency from public subsidies and therefore a better economic viability, autonomy, stability and durability.

URBAN PASTORALISM AS AN ELEMENT OF SUSTAINABLE PRODUCTIVE GREEN INFRASTRUCTURE

When practicing in a sustainable way, pastoralism encourages flora and the diversity of landscapes. Compared to extensive grazing practices, pastoralism can be much closer to wildlife grazing patterns, thus imitating natural ecosystem interactions and functional roles (CBD, 2010).

Creating a multifunctional landscape is one of the most important features of green infrastructure in terms of ecosystem services, especially near or within urban areas under intense land pressure.

.

The rethinking of the qualities and multifunctionality of this resilient and ecological way of production as a transforming vector of green areas in green infrastructure is an opportunity to increase and improve ecosystem services in alarming decline especially in urban areas.

The benefits of pastoral activities in urban areas are multiple: establishing biological corridors, developing biodiversity in general, articulating unused green lots, providing a picturesque landscape, creating a mosaic of habitats and preserving a variety of backgrounds, maintaining a diverse flora through restorative management and differentiated methods, the decrease of environmental impact of artificial (carbon reduction, zero processing, natural fertilization, zero waste, zero noise….), maintenance of difficult access areas (wetland, brush, undergrowth, etc.)preventing reforestation, supporting short supply circuits (milk, cheese, meat), ensuring the social dimension of green space and providing a pedagogical function on agriculture and food. The quality of the products obtained and processed in sometimes improvised structures can be challenged (in the case of Bucharest for example), although in reality the problematic cases are extremely rare due to the management technique specific to the ancestral pastoral tradition and the local culture of the informal or formal food circuits in which relationship between the producer and the consumer is a close, durable and reliable relationship and therefore a collaboration between stakeholders such as authorities, planners and practitioners is necessary to improve the conditions of operation and the reputation of pastoralism

Reducing the environmental footprint for management public green spaces by green waste removal, natural fertilization of soils, eliminating the noise generated by mechanical equipment, and probably the decrease of management costs, especially in difficult accessible places are also important factor for encouraging the grazing inside the cities that is especially appreciated in the Western Europe context.

Because in Romania the management of green public spaces is badly managed by public authorities, the expansion of urban grazing in public green spaces as a regulated practice may allow higher benefits from the urban areas left un-used (commercial and industrial complexes on the outskirts, the roadsides, etc.).

CONCLUSION

A pattern of subsistence developed before agricultural practice, pastoralism coexists in its original form in a delicate equilibrium with nature, fact that justifies the development of the concept of pastoral ideal. Today this practice restores the biodiversity and productive feature of polluted, degraded and marginalized urban land. Mediating this classical antagonism between urban and pastoral or city /nature with today tools like strategy, policies, regulation, participatory methods can reduce the friction and improve benefits generated by their coexistence.

The appreciation of cultural and patrimonial value of this practice, the use of "construction designated land" and private and public properties as pasture areas by urban planners and policy makers by creating new types of zoning that includes such forms of temporary or permanent land use, the identification of the resulted and maintenance management of ecological corridors could transform urban pastoralism in an important tool for sustainable urban planning and for creating unity in a very fragmented and heterogenic landscape, because it values both the agricultural, social, economic and ecological dimension of urban lands.

The current attitude of ignoring or marginalizing this phenomenon can have negative consequences: the persistence of conflict of interest's issues and negative ecological effects caused by spontaneous grazing that might lead to its extinction.

Urban pastoralism participates to sustainability pillars thanks to its resilience and multifunctionality by transforming urban gaps in green infrastructure and providing important ecosystem services to the city.

REFERENCES

Aubron C., Peglion M., Nozières M., Boutonnet J., « Démarches qualité et pastoralisme en France », Journal of Alpine Research | Revue de géographie alpine [En ligne], 102-2 | (2014)

Bories O., Eychenne C., Chaynes C., Des troupeaux dans la ville : représentations et acceptation sociales d'une démarche d'éco-pâturage dans la première couronne toulousaine (Cugneaux), Openfield numéro 7, juillet 2016

Czechowski D., Hauck T., Hausladen G., "Revising Green Infrastructure: Concepts Between Nature and Design" (2017)

Darly, S., « Des moutons dans la ville : quelles externalités environnementales des pratiques d'élevage ovin en milieu urbain ? », Pour, vol. 224, no. 4, 2014, pp. 285-290.

Enhancing Europe's Natural Capital - COM (2013)

Garric, A., Des moutons pour tondre en ville, vrai gain pour l'environnement, Le Monde, 12.04.2013.

Gradinaru S., Triboi R., Ioja C. I., Artmann M., "Contribution of agricultural activities to urban sustainability: Insights from pastoral practices in Bucharest and its peri-urban area, Habitat International (2018)

Hartman S., "Contesting Environmental Imaginaries Nature and Counternature in a Time of Global Change", Series: Studies in Environmental Humanities, Volume: 4 (2017)

Hirshhausenn von B.," Les nouvelles campagnes roumaines Paradoxes d'un"retour" paysan" (1997)

Huband S., Mccracken D. I., Mertens A.: Long and short-distance transhumant pastoralism in Romania: past and present drivers of change (2010)

Juler C, După coada oilor: long-distance transhumance and its survival in Romania. Pastoralism: Research, Policy and Practice 2014

Kermode S., "English Pastoral Poetry: From the Beginnings to Marvell".(1952).

Machor J., "Pastoral Cities: Urban Ideals and the Symbolic Landscape of America", (1987)

Oteros-Rozas, E., R. Ontillera-Sánchez, P. Sanosa, E. Gómez-Baggethun, V. Reyes-García, and J. A. González. 2013. Traditional ecological knowledge among transhumant pastoralists in Mediterranean Spain. Ecology and Society 18(3): 33.

Pastoralism and the green economy – a natural nexus, IUCN, UNEP 2014

Raymond Williams, "The Country and the City". Oxford U P, (1973)

Salomaa , A , Paloniemi , R , Kotiaho , J S , Kettunen , M , Apostolopoulou , E & Cent, "Can green infrastructure help to conserve biodiversity? "Environment and Planning C: Politics and Space, vol. 35 , no. 2 , pp. 265-288 (2017)

Secretariat of the Convention on Biological Diversity. Pastoralism, Nature Conservation and Development: A Good Practice Guide. Montreal, (2010)

Stanilov K.:Taking stock of post-socialist urban transformation. A recapitulation. In: Stanilov K. (ed.)," The Post-Socialist City. Urban Form and Space Transformation in Central and Eastern Europe After Socialism". Dordrecht: Springer (2003)

Sustainable Pastoralism and the Post 2015 Agenda Opportunities and barriers to pastoralism for global food production and environmental stewardship (2015)

Tessema, W.K., Ingenbleek, P.T.M. & van Trijp, H.C.M. Agron. Sustain. Dev. 34: 75. (2014)

Triboi R., "Urban pastoralism as environmental tool for sustainable urbanism in Romania and Eastern Europe", Green Urbanism (2017)

http://www.fabriques-ap.net

http://www.ecopaturage.com

http://www.ecolopop.info/2012/12/le-retour-en-force-de-leco-pastoralisme/16059

AFFILIATION

Roxana Maria Triboi

A Romanian urban planner with more of 15 years' experience in urban and landscape planning in Romania and France, a PhD student since 2013 on urban pastoralism in Romania at "Ion Mincu" University of Architecture and Urban Planning Bucharest, as well as a member of research groups (Le Notre, Aesop Food Planning Group, Food Geographies Working Group and Alternative food supply networks in Central and Eastern Europe group).

https://www.sciencedirect.com/science/article/pii/S0197397518305307

"Ion Mincu" University of Architecture and Urbanism, 18-20 Academiei St., 010014, Bucharest, Romania

Roxana.triboi@gmail.com

THE DRIVING FORCES OF INSTITUTIONALISATION:

The spread of organic farming in Romania

AUTHOR: MEGYESI, BOLDIZSÁR

Abstract

The paper aims to explore the factors enabling the spread of organic farming, using the example of Romania. Based on the existing literature, three main driving forces were identified in the development of the organic sector: (1) the social movement characteristics of organic farming, in which environmental issues and human well-being are the most important; (2) the market for organic products; and (3) the agricultural and rural policies supporting organic farming. The existing literature focuses on the policy context for the institutionalisation of organic farming, especially in the European Union, and also on the acceptance of rules for this type of farming. Based on a qualitative case study, in this paper, it will be argued that the three driving forces are present simultaneously, thus it is worth analysing them together to understand the contemporary development of the organic sector.

KEY-WORDS: ORGANIC FARMING, INSTITUTIONALISATION, ROMANIA, ORGANIC MOVEMENT, ORGANIC MARKETS, RURAL POLICY

INTRODUCTION

The development of the organic sector has been extensively studied in the scholarly literature (Acs et al., 2005; Kaltoft, 1999; Michelsen, 2001; Rigby et al., 2001; Stolze and Lampkin, 2009). Most of these papers focus on statistics, for example, the proportion of certified organic farms; the development of certified organic areas; the development of policies enabling the spread of organic farming. In addition, the attitudes and characteristics of farmers are frequently discussed issues. Michelsen (2001) offers an institutional analysis to describe the co-evolution of organic agriculture, agricultural and rural policies together with the food market in Europe. His article focuses on policy instrument, but also mentions the role of markets in the spread of organic agriculture. Moschitz et al (2015) analyse the institutional development of organic farming in Czechia (2015), and compare the Polish and Czech organic sector (Moschitz and Stolze, 2010).

The literature also includes a focus on the farming sector, including farmers' motivation to convert to organic principles (Fairweather, 2004; Kerselaers et al., 2007; Lamine and Bellon, 2009) and on attitudes toward organic methods (Padel, 2001; Storstad and Bjørkhaug, 2003; Sullivan et al., 1996; Zagata, 2009). Although the literature on farmers' motivation to convert is very rich, the content of these papers is less complex. Most of them analyse the effects of agricultural and rural policies on farmers' attitudes and decisions (Ploeg and Renting, 2000; Pugliese,

2001; Van Der Ploeg et al., 2000). Fewer papers give insight into farmers' attitudes and values toward nature, the environment, animal health and human health (Tovey, 1999, 1997). There is little in the literature which analyses economic factors (Duram, 2005). Finally, papers analysing the complex influence of a wider range of factors are almost non-existent. An exception is the seminal article by Darnhofer et al on farmers' motivation to convert to organic farming. The authors used a qualitative methodology to explore the interrelated factors behind a complex set of decisions (Darnhofer et al., 2005, p. 40). They separated 15 criteria into a decision-tree, aiming to understand farmers' decisions concerning organic farming.

In the following paper, we would like to present the driving forces behind institutionalization of organic farming using the development of the Romanian organic sector as an example. This paper argues that there are three main driving forces behind the spread of organic farming. The first point to be discussed is that organic farming originally had a strong (social) movement character (Tovey, 1997). The second driving force under discussion is the market. Although farmers' motivation to use organic methods and consumers' willingness to pay for organic products may be different, markets can play an important role in the growth of the organic sector. The third driving force of the spread of organic farming, according to the literature, is linked to agricultural and rural policies (Michelsen, 2001; Rigby et al., 2001; Sutherland et al., 2012). The second part of this paper identifies the stakeholders from the organic sector in Romania, and the sector's development over the last two decades. The final part of the paper discusses the influence of the different driving forces on the institutionalisation of the Romanian organic sector, concluding by pointing out that although movement and market forces had appeared earlier in the Romanian organic sector, followed by policy forces, all of these forces remain present, and influence institutionalisation.

The research in this paper has made use of qualitative methods: secondary data analysis; document-analysis; semi-structured interviews (Gerring, 2006; Kvale, 1994; Yin, 2009) conducted with organic producers, decision-makers, members of control bodies and civic associations.

THEORETICAL BACKGROUND

The literature on farmers' motivation to convert to organic principles has been used to develop the analytical framework. The literature on farmers' motivation differentiates between ethical, economic and policy factors of conversion. The paper will argue that ethical factors, like sustainability, environmental or health concerns, are typical in the social movement phase of organic farming.

Social movement and the organic sector

The idea that organic farming is a social movement is widespread. As Pernille Kaltoft writes, „*organic farming – the movement and its ideology – challenges the way in which sociological theory conceives of the nature-culture relation*" (Kaltoft, 2001, p. 146). Other authors argue that organic farming had only been a movement during certain periods (Padel, 2001; Tovey, 1999, 1997). As it became an accentuated element of rural development policy (Pugliese, 2001), and as it diverged from farmers' usual practices and wide-spread knowledge, it changed profoundly (Seppänen and Helenius, 2004; Vogl et al., 2005).

Tovey (1997) claims in her article that organic farming movements started as social movements, and were aimed at influencing rural and agricultural policies at the micro level, while producing „a cognitive change in society" at the macro level (Tovey, 1999, p. 35). In Ireland at this time, organic farmers were mainly enthusiastic amateurs, having dense networks with townspeople (Tovey, 1999, p. 35).

The organic farmers' movement in Ireland fundamentally changed in the 1990s, being institutionalised as a result of several changes. It became an element of agricultural and rural policy, and became widespread both among farmers and consumers. Rural and agricultural policy-makers expected that organic farming would help to reduce the use of chemicals, increase biodiversity and enhance rural livelihoods (in terms of social justice). As it became widespread both among producers and consumers, certification had to be institutionalised when personal contact between producers and consumers became difficult. As Tovey prognosticated:

«The 'organobureaucrats' will become another species of state agents and those who want a 'real alternative' may have to withdraw, regroup and start again. » (Tovey, 1999, p. 57)

As this analysis will show later, the Romanian organic sector also faces this problem, and shows resemblances to Tovey's prediction.

Kaltoft analyses organic farming as being a process of modernization, arguing that the relationship between producers and consumers is becoming impersonal. Organic products have become commercialised and most conventional goods are sold in supermarkets (2001). In her typology, post-modern farmers are reflexive and choose organic farming as a way of life for themselves. They are usually townspeople, and some of them have been taking part in the organic movement for a long time (Kaltoft, 2001, p. 154). The desire to reflect health and environmental problems appear most frequently among organic farmers who have made organic farming a social movement. McMahon (2005) analysed the attitudes of biodynamic farmers, finding similar results: their entire lives have mirrored their views on farming (McMahon, 2005).

Padel (2001) also had similar findings: she analysed organic farming in terms of a technology change (adoption/diffusion model developed by Rogers (1983)), and presented five types of organic farmers: innovators; early adopters; early majority; late majority, and laggards (Padel 2001). Innovators are young townspeople with a university degree, but without agricultural experience. They organise themselves as a movement, having an intensive nationwide relationship with each other, meeting with similar-minded (organic) farmers to share knowledge and experiences. They often have other sources of income as well: for them organic farming is lifestyle. Despite this, early adopters are open-minded local people, ready to try new methods. They are opinion leaders within their community, but less active in social movements. They have decided to convert to organic principles because of the problems of animal health and plant protection caused by conventional farming (Padel 2001). In other words, at the beginning, and for certain farmers termed by Padel as innovators and early adopters, organic farming has been a social movement, while early majority and laggard farmers have had different motivations to convert, as the next chapter will discuss.

The role of economic factors in organic farming

The economic reasons for conversion are less frequently analysed in the scientific literature. Duram points out that in the late 1990s, a market-led expansion of organic farming could be seen in the United States; the main pulling factor was exports, and the „*consumers who increasingly favour reduced pesticide use*" (Duram, 2000). Despite this, farmers themselves saw the market of organic products as being volatile and uncertain. While the spread of organic agricultural market trends seems to be influential in the case of the United States (DuPuis, 2000; Duram, 2005), and South Asia according to the literature, in European countries, economic factors are less important.

Darnhofer et al also analysed the role of economic factors in farmers' decisions. They found that two criteria are ahead of the economic criteria: farmers consider environmental aspects and the role of agricultural methods (2005, p. 44) first, and only after that consider whether they should forgo some of their income for environmental benefits. Despite this research, their methods do not allow us to compare the importance of the different criteria; even the authors emphasise that *„their willingness to risk some income to farm in an environmentally friendly way does not imply that, in the long run, they expect a lower net income as organic farmers.* » (Darnhofer et al., 2005, p. 45). Accordingly, organic farming is supposed to generate lower incomes than conventional farming. Data from the United States (Duram, 2000, pp. 36–37) suggest that this is not necessarily so.

Vasile et al (2015) compared organic and conventional farming using the results from a case-study conducted in North-Western Romania in a large-scale farm, and found that organic farming can be profitable (Vasile et al., 2015, p. 263). Having a closer look at their analysis, it becomes clear that even without subsidies for organic farming, the production of organic wheat is profitable both during and after conversion. The authors claim in their conclusions „*that the economic efficiency is slightly higher in organic system compared to conventional*» (Vasile et al., 2015, p. 265). The paper analyses profitability both at farm and crop level over a three-year period. The case-study was conducted in a mixed farm, producing both conventional and organic products. This is a special case, and so, the results cannot be generalised. A further obstacle of generalisation is that the authors neglected to analyse the profitability of organic soybean, maize and sunflower production, which is an important issue, as organic methods require crop-rotation, thus the production of several different crops.

Patil et al.(2014) use a more precise methodology to compare the economic indicators of organic and conventional agriculture. They argue that profitability depends on the type of crop, and the quantity of fertilizers used; as a consequence, organic agriculture spreads „*not because of higher profits, but because it requires fewer financial inputs, and places more reliance on the natural and human resources available»* (Patil et al., 2014, p. 49).

According to the literature, the market is not a primary factor in the decision of farmers to convert to organic methods, although economic consequences are always considered before and during conversion. Kerselaers et al (2007, p.681) argue that the economic success of converting to organic farming is dependent on

the type and characteristics of the farm. Darnhofer (2005) claims that organic farming enables farmers to overcome economic problems. As pointed out in the research of Patil et al (2014), farmers can reduce the costs of input, increase added value, and find niche markets by converting to organic farming.

The role of agricultural and rural policies in organic farming

Organic farming became a rural development tool in the early 1990s (Häring et al., 2009; Oostindie et al., 2010), as agricultural policies shifted from production-oriented view to environmental and social issues. Michelsen (2001) presents a detailed and precise analysis of how the organic movement and the European policy-makers abut (with) each other (2001, pp. 9–11). As the Common Agricultural Policy changed, and agri-environmental measures appeared among subsidies, organic farming became a subsidised agricultural method (Lampkin et al., 1999; Padel et al., 2010). In the literature on farmers' motivations to convert, the role of rural policies in conversion appears first of all as a source of additional income. The question whether it can also be an incentive to influence farmers' attitudes toward environmental and health issues is a less-studied area.

Offermann et al (2009) analysed the effect of direct payment on conventional and organic farming, and of support payment on organic farming in the case of Western-European and Eastern-European countries. They found that both types of payment play a decisive role in farm revenues, and that environmental support influences the profitability of organic farms even in the new EU member states (Offermann et al., 2009, p. 278). Not surprisingly, more than half of the organic farmers interviewed would like to see an increase in organic farming support payments, but also, several farmers mentioned the necessity of other types of support, for example, in marketing, processing and inspection (Offermann et al., 2009, p. 279). In Padel's analysis (2001), we also saw that late adopters have economic reasons to convert. In the European context, the most important economic factors are subsidies, besides the improved market positions, and savings on fertilisers. Other articles have also shown that the area of organic farms have increased rapidly as subsidies appeared (Meredith and Willer, 2014).

Papers analysing farmers' motivation to convert argue that organic farming subsidies usually play a minor role in decisions to convert to organic farming (Darnhofer et al., 2005; Kubala et al., 2008; Locke, 2006; Mccann et al., 1997). Other papers analysed more generally the role of agri-environmental policies, finding that „economic interests are an important, but not the only, determining factor for farmers' decision-making" (Siebert et al., 2006).

The existing literature shows that rural and agricultural policies have made organic farming attractive mainly because of subsidies, which several authors have criticised. There are papers analysing how the attitudes of farmers toward organic farming have altered as a result of policy changes. (Egri, 1999; McCarthy et al., 2007; Storstad and Bjørkhaug, 2003; Sullivan et al., 1996; Wilson and Hart, 2001). Such authors argue that a long-term change of European agricultural policy toward sustainability can only be reached through a change in farmers' attitude toward environmental and health problems.

SCOPE AND RESEARCH QUESTIONS

The paper has three aims: first to analyse the development of organic farming in Romania, secondly to describe the main institutions involved in organic farming in the country, and thirdly to analyse the role of the previously discussed driving forces in the development of the organic sector. It gives a detailed description of the stakeholders and institutions involved in Romanian organic farming, their interests, networks and relationships. In addition, the legislative framework influencing the sector and the market for organic products is presented. Because of the lack of long-term statistical data the analysis of market development is also based on expert interviews. After analysing the expansion of organic farming in Romania, the paper will consider whether the driving forces of institutionalisation and the expansion of the organic sector in Romania can be generalised to other contexts.

METHODS

The paper is based on qualitative methods: secondary data analysis; document-analysis; and semi-structured interviews (Kvale 1994, Yin 1994, Gerring 2007). Semi-structured interviews were conducted with key-informants of the sector: decision-makers; members of control bodies and civic associations; scholars; and organic producers and traders. During the research, more than 21 interviews were conducted between June 2013 and March 2015.

The first step of the research was a detailed document analysis. Three types of documents were analysed: the existing literature, and legal and official texts and web-pages of relevant organisations (control bodies, civic associations and the Ministry for Agriculture and Rural Development) to find the relevant documents, and identify the key informants. The method of the document analysis was content-analysis. Some of the organizations have since disappeared, and web-pages have become obsolete; also documents have disappeared. In these cases, the research used information from the members of the organisations. The most relevant legal texts were also identified and used during the document analysis. Besides this, the snowball technique was used to map the stakeholders involved in the Romanian organic sector. The stakeholder map was based on these data. It consisted of around two dozen people: leaders of the main certification bodies, civic associations, decision-makers, and scholars.

Originally, we aimed to reach all the stakeholders and conduct semi structured interviews with them. In the end, because of time constraints and refusals, we conducted 21 interviews with stakeholders (The interviews were conducted by the author, RG and DH). The interviewees represented different organisation types: public agencies; organic farming organisations; general farmers' unions; extension services; research institutions; certification bodies; farmers' associations; and the trading sector. The interviews were type written and analysed using a semi-open coded method. The original codes and categories were defined based on the research questions, and were modified during the analysis of the interviews. After the first round of analysis of the interviews, the consistency of the codes and categories were checked.

THE ROMANIAN ORGANIC SECTOR

The first part of this section presents the main dynamics of organic producers, the main civic movements engaged in Romanian organic farming and the control bodies. The second part of this section briefly presents the policy environment and market of organic farming in Romania. Finally follows a stakeholder analysis of the Romanian organic sector focusing on the organic farmers, the organic farming civic associations and the control bodies of organic agriculture.

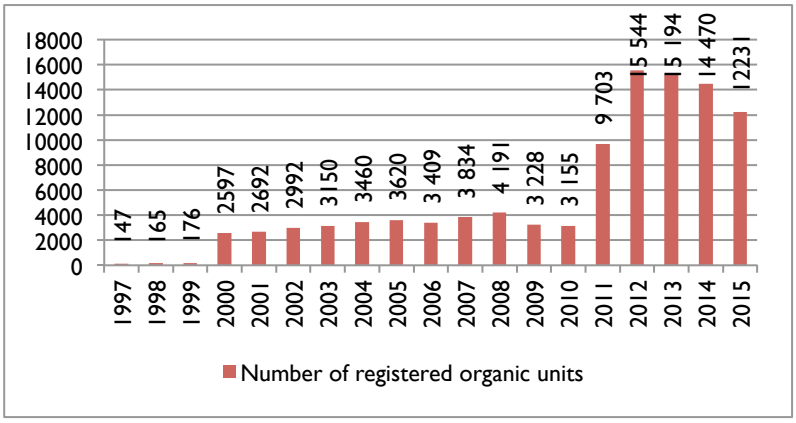
Main trends of organic farming

In the following chapter, we present the main dynamics of the Romanian organic sector, the development of certified farm units and areas, the main civic associations; then we continue with the analysis of the motivations of civic movements engaged in Romanian organic farming.

The dynamics of producers

The number of registered organic farm units changed very slowly in the first 14 years in the history of Romanian organic farming and rapid growth can be seen between 2010 and 2012. According to experts, before 2000 there were around 1,800–2,000 organic farms in Romania or less, while the organically farmed land was around 10,000 hectares. By 2006, this number had doubled (see Figure 1) and reached 3,409 farm units. When the subsidies were announced in 2004, the number of organic farms continued to rise to over 4,191 (in 2008), but many operators did not have sufficient knowledge of organic methods, or lacked resources, thus, around 1,000 farmers stopped organic farming. This decrease stopped in 2011, when subsidies were announced again by the government and in two years, the number of organic farmers grew five times bigger, and reached 15,544 in 2012. Since then, this number stagnated and decreased again With a fall in state funding came a fall in the number of organic farm units. The disappointed farmers stopped certification and using organic methods, as the following figure shows.

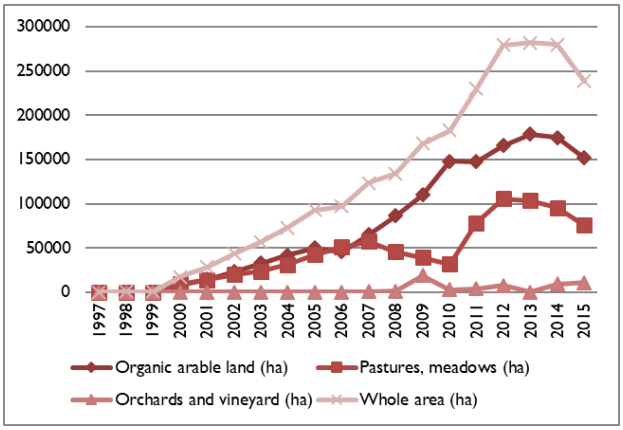
1st figure: Number of organic farms in Romania between 2000–2015



Data source: MADR and expert interviews, own compilation

In the five years after 2010, the number of producers rose sharply, along with the amount of certified organic land. While the amount of arable land had almost tripled since EU accession, the area of certified pastures and meadows doubled during the same time. After 2012, the last announcement of subsidies, the increase of certified organic land came to an end, and in 2015 it started to decrease.

2nd figure: Amount of organic agricultural area in Romania, 2000–2015 (in hectares)



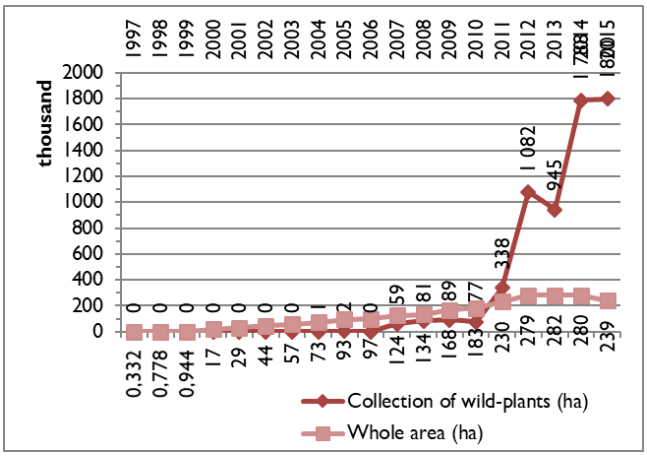
Data source: MADR and expert interviews, own compilation

According to expert interviews, farmers have diversified their activity. Initially, most produced cereals (wheat, spelt, corn, millet), vegetables (mainly pea, later also soya, lentils, beans), technical plants (sunflower, flax, colza, potato), grapes and wine. This diversification has meant a shift from production to processing the raw material (especially for small farmers).

Typical animals kept, according to organic rules, are sheep, cattle, chicken (for eggs and meat) and pigs. It is worth noting that the number of cattle varies year by year, „largely depending on the state support" – as an expert said. According to the same expert, the explosion of the number of animal species being produced started in 2008. One of the most important reasons for this is the rising demand for organic animal products at the export markets.

The typical organic farmer has very little land, and has contact with a trader, according to the interviewees. Other important types of organic product are mushrooms and berries collected from forests and bought up by an intermediate agent, who sells the products to Italian and French processors. The certification of collected wild mushrooms and berries became important after 2010, as the following figure shows. Since 2010, the certified area has become 20 times larger.

3rd figure: Amount of organic agricultural area and collection of certified organic wild plants in Romania between 2000–2014 (in hectares)



Data source: MADR and expert interviews, own compilation

Civic movements

Civic movements have been important actors from the beginning of the Romanian organic sector. These institutions are active in various fields: in the education of farming practices; in the popularisation of organic farming among farmers and the general public; in lobbying; and most recently in marketing.

The first summit on organic agriculture in Romania was held in 1992, organised by the Bioterra Association. In the first period of organic farming in Romania, the association must have been the most important institution of the sector. It had several roles: it promoted the idea of organic farming; had seminars; organised exchange programs with its Hungarian and Swiss partners; participated in research projects; and from 1999, it started the control and certification of organic farming (at this time, it was accepted by the IFOAM, according to the homepage of the organisation). In the early 2000s, the Association, together with its members, founded one of the first inspection and certification bodies, the SC Ecoinspest Srl (Ecoinspect). In the late 1990s, the network of the Bioterra Association changed: the Association built a good relationship with Swiss organisations: the Christliche Ostmission and the bio.inspecta AG. Since then, its main activities have been networking, the education of farmers, and lobbying.

Another noteworthy civic association in the sector is the Romanian Association for Sustainable Agriculture (Asociatia Romana de Agricultura Durabila (ARAD)), founded in 1998 by probably the most influential Romanian scholars of organic agriculture. The organisation had general goals. It aimed to represent organic farmers at the government level; to promote sustainable farming standards; to give theoretical and practical training for farmers, and also „to preserve and rehabilitate the cultural values of Romanian village"8. In 2001, the same scholar, together with other different organisations and stakeholders of the organic sector, established the National Federation of Ecological Agriculture (Federatia Nationala de Agricultura Ecologica). The Federation aimed to join with different associations, foundations, scientific organisations, and farmers' organisations concerned with organic farming. According to the document analysis, the Federation was not able to become the most important organisation in safeguarding the interests of the stakeholders of the sector.

Since then, two civic organisations have been founded, both aiming to promote and market organic products, as the homepages and the analysis of their activity show. One of them (R. EcoR Partener) also includes in its name, „Resource Center for the Promotion and Marketing of Organic Products".

The Bio Romania Association (Asociația Operatorilor din Agricultura Ecologică Bio România, Association of Organic Farmers Bio Romania) aims at raising awareness of sustainable development in rural Romania, to educate and inform consumers about the benefits of organic agricultural products in regards to human health, and nature, by promoting the consumption of certified organic products. An analysis of the homepage shows that marketing and commerce of organic food is the most important activity of the organisation.

8 Quotation from the home-page of the Association.

One of the youngest civic movements linked to organic and small-scale farming is the EcoRuralis Association (Associatia EcoRuralis), a member of the Via Campesina movement. This organisation is not exclusively interested in the issues of the organic sector: the main aim of the association is to link small-scale producers (smallholders) and consumers. The main target group are smallholders and traditional farmers, and their representatives. According to their documents and an interview conducted with a member of this association, they are active at the national and European levels, and wish to strengthen the capacity of small farmers and protect their rights, fight against GMO, empower smallholders, and promote organic and traditional agriculture as an alternative to industrial and environmentally harmful farming. Their aim is to develop a system „beyond organic"; they do not care about certification, but believe that direct producer-consumer relations help build trust between them. They have a complex box-scheme, where consumers visit the producers on-site, and help them collect produce. They aim at improving the social conditions of producers and provide healthy food for townspeople.

At the beginning, civic associations were the main actors of organic farming, as the above analysis shows. Although there are still a lot of civic organisations in the organic sector, most of them are very fragile. Several organisations have been established to access to different development funds, but after the project, the organisation went bankrupt: „*Many associations have been formed since 2004, mostly farmers' or producers' organizations because this is a structure preferred by state subsidies and EU funds.*" (leader of a control body). Our analysis shows that civic movements around organic farming work alone; they cannot represent the sectors' long-term aims and interests toward central policy-making, thus their influence on the institutionalization of organic farming decreased in the last decade. Furthermore, new organisations have broader aims, as the case of EcoRuralis Association shows, and it caused conflicts as this interview extract shows:

«we do not care about certification; we know about a lot of fraud, and small-scale farmers cannot afford it, but we believe, that we can connect smallholders and consumers. They meet regularly, and then they will trust each other. » (leader of a civic association)

Control bodies

Between 2001 and 2015, several control bodies were founded: most of these were small, functioned only for a few years, and specialised in certifying certain products, but there were some bigger ones, certifying different products (see Figure 4).

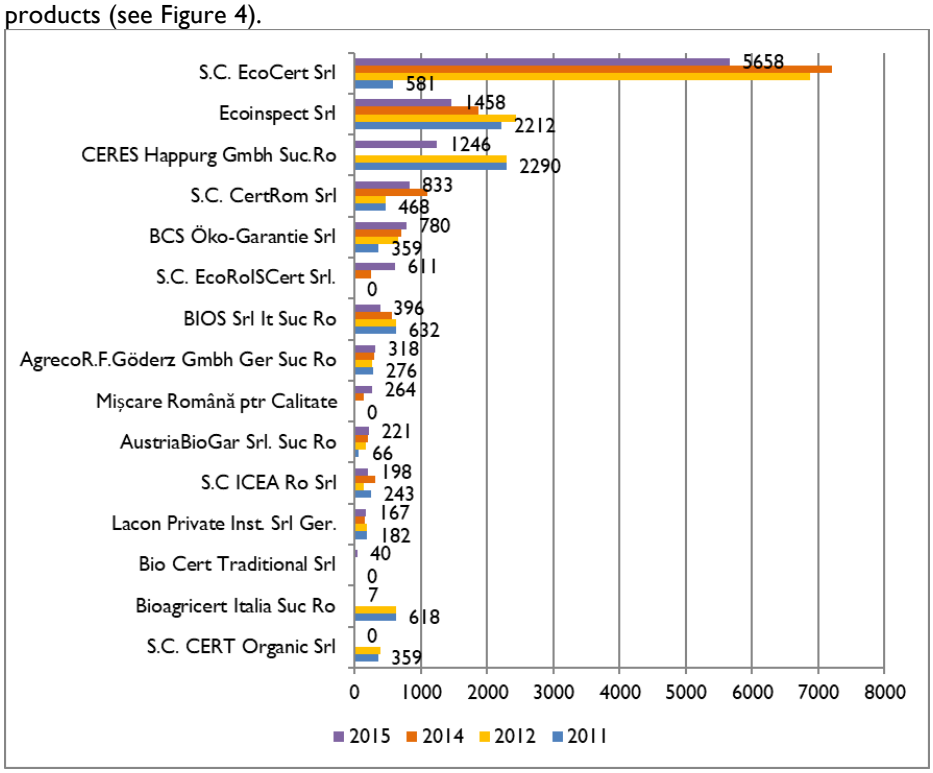


Fig. 4. Number of partners by certification body (2011–2015). Data source: MADR and expert interviews, own compilation

By 2015, more than 24 control bodies had been founded in Romania, although by the end of 2015, only 13 had been accredited. Most of the companies are subsidiaries of Italian, French, German or Austrian control bodies.

There are three main types of control bodies in Romania: in the first type we can list the ones which work in close cooperation with civic associations; in the second, we listed the control bodies which are almost fully dependent on their Western-European parent companies, and focus on only a few products, like oil-seeds or wild mushrooms and berries; the third type has been founded in the last few years, focuses on the Romanian market, and is growing quickly.

A control body of the first type is owned by a civic association, and it was among the first control bodies in Romania. It is still one of the biggest control bodies, controlling more than 2,000 farm units, independent (not owned by another Western-European control body), although a Swiss and a Hungarian control body contributed significantly to the development of the inspection and certification system of the Romanian company, which was founded and gained international accreditation in 2004 as a result of the Swiss-Romanian cooperation, at the end of a long administrative process.

The biggest certification body is an example of the second type. Another similar control body of the second type started its operation in 2005, having been licensed and accredited by a German control body. In 2012, it had more than 2,200 partners, most of whom collected wild berries and mushrooms; but by 2015, it had only 37 partners.

One of the newly established Romanian control bodies is an example of the third type. It is the most dynamic certification body, quickly expanding its activity. It is interested in all kinds of certification – not only in the certification of organic production – similar to other private certification companies.

The figure shows that since 2001, 11 certification bodies have ceased operations in Romania, and almost every year, new ones have been established. In addition, the changes in partner numbers are dynamic, and according to expert interviews, these changes are linked to the changes of market. At the beginning the Italian, French, German or Austrian control bodies were certifying the activity of traders and farmers from the country of origin, but as the market changed, and the Romanian policies required local registration of the control bodies new, mostly Romanian based companies appeared.

Legislation of organic farming in Romania

The history of organic agriculture in Romania can be traced back to the early 1990s. The first decree on organic farming appeared almost a decade later; it was issued in 2000 (O.U.G nr. 34 / 2000), becoming law in 2001 (Legea nr.38/2001). As our interviewees reported, Romania „*simply translated the EU (and sometimes the Swiss) legislation*". Another interviewee, a former decision-maker, says: „*we wrote the decree; translated from the German, English original.*" In the same year, the Bureau for Organic Farming in the Ministry for Agriculture and Rural Development was established at the Ministry of Agriculture. The first subsidies for organic agriculture appeared in 2004, when also a research strategy was developed. Because of the changes in the legislative background, the institutionalisation of the organic sector continued. The cooperation of the Swiss government with the Ministry of Agriculture and Rural Development had a great impact. As an interviewee pointed out:

«Between 2004 and 2008 there was a cooperation between the Romanian MADR and the Swiss Government to implement the program 'Organic certification in Romania between 2004–2008' („«Certificare ecologică în România pentru perioada 2004–2008»).» (president of a civic association)

The program was a great help in the institutionalisation of organic agriculture in Romania.

Between 2005 and 2007, subsidies for organic agriculture were available through the SAPARD (Measure 3.3) program, in the form of agri-environmental support. Since 2007, there have been subsidies from different EU sources for organic agriculture (National Rural Development Plan, Development Plan for Fishery, etc.). In 2010, the Ministry announced subsidies for organic farming; as we discussed above, this was very attractive for farmers. The conversion subsidy for farmers, according to the Government's decision (759/2010 to improve the quality of agricultural products – R.73/2010 privind imbunatirea calitatii produselor agricole prin HG nr. 759/2010), planned to create a €3 million subsidy for farmers who promised to use organic methods and certify their activity. The sum of the subsidy was pre-defined, regardless of the number of farmers who applied. The decision-makers planned to share the money according to farm size. However, in 2010, several farmers decided to commence organic farming; thus the average subsidy per farm units became low. Participants expected a subsidy of around

€1,500 per farm unit; later this was only around €200–300 per farm unit, as there were a large number of applicants. As a result, many farmers ceased organic farming.

Policy-making has a strong influence on the institutionalisation and development of organic farming in Romania, as the analysis states.

Market and market actors of organic farming in Romania

The main products of the Romanian organic farms are wheat, corn, wild berries and mushrooms (Meredith and Willer, 2014; Yussefi-Menzler, 2010, pp. 54 & 145). The main market of these products is Western Europe. This is also a reason for the presence of the different Italian, French and German control institutions. Domestic markets in Romania are weak and under-developed, as we will show.

According to expert estimations, more than 60% of agricultural products are exported (as raw material), but only less than 10% of processed food is exported. Estimations say that the future growth of processed food export is round 10%, as significant investment will be directed towards food production equipment and infrastructure (large deposits, areas of production, equipment to improve productivity).

Most products exported to Western-European countries comprise collected wild mushrooms and berries on the one hand, and arable crops on the other. Usually, commercial companies work together with control bodies to organise the collection of mushrooms and berries, or the production of sunflower, wheat or other arable crops.

An interesting example is the case of the LaDorna (a member of Lactalis Group) dairy company, which has been producing UHT organic milk since 2001. The company wanted to produce organic milk products and bought a Romanian dairy company, organising certification for the farmers. In Romania, small-scale cow-keeping is still widespread. The dairy companies collect the milk from the so-called milk-collecting stations and process it. LaDorna had to persuade farmers to produce organic milk. At this time, there were only a very few institutions in Romania, thus they contacted the Hungarian control institute, and later a German one to ensure certified organic raw material. More than 500 small-scale dairy farms started organic farming with the help of LaDorna. Originally, the company sold all its organic products in Western Europe. Nowadays, they also sell to the domestic Romanian market.

The domestic Romanian market of organic products is weak and segmented. It is also a problem that consumers do not acknowledge the quality of organic products, and are unwilling to pay for them. Control organisations have reported that food processors do not ask for the certification of their products, even though they use organic raw material, because consumers do not pay a surplus for organic products, compared to traditional or small-scale farmer products. This means that consumers are distinguishing only between local small-scale products and mass products (Nistor, 2015), and are ignoring organic certification. The case of the LaDorna also suggests this: in its quality policy, the largest organic milk producer does not emphasise the role of organic products (according to its homepage).9

There are no official statistical data on the Romanian organic market. According to expert interviews, and field work, the main types of market for certified organic products are the following: specialised shops; basket schemes (usually part of a community supported agriculture initiative); on-site selling on farms; online markets; hypermarkets and supermarkets (usually owned by international companies).

Specialised shops usually sell organic products alongside healthy, natural or reform foods and products. As an interviewee (the owner of a specialised shop) reported, around 80% of the products are imported. Also, other interviewees estimated that 75–80% of certified products are imported:

> «If you buy a certified organic cake, or pasta in a bio-shop, it has probably been produced in Germany, although the raw materials are of Romanian origin. In the case of dried mushrooms, it is the same: they collect it here, then process in Italy and import it back here. » (owner of a local organic shop)

Specialised shops are not very popular. According to one interviewee:

> «they are separate and the efforts, such as online selling of these products or separate organic stores are not very popular. » (leader of a control body)

[9] http://ladornagroup.ro/ro/about/Responsabilitate/Calitatea-produselor (accessed: 24-02-2017)

Certain hypermarkets and some of the supermarkets also sell organic products, but most of the processed foods are imported. There are usually separate stands for certified organic products. «*The fruit and vegetable stands are still missing, as they are much more expensive than the regular ones*» remarked one interviewee. Specialised shops and hypermarkets integrate the organic market into the conventional food market. This processing and marketing of organic food contributes to the sector becoming part of the modern, industrialised food-supply chains, thus leaving behind the original sustainability aims of organic production. These phenomena support the conventionalisation thesis.

Basket programs are closer to the original aims of organic agriculture. The programs have been initiated by townspeople, and the consumers are enthusiastic, young townspeople, as in other Central Eastern European countries (Balazs, 2012; Benedek and Balázs, 2014; Bilewicz and Śpiewak, 2015). The initiatives are also successful in rural areas, but in several cases, some of the programs lack the sufficient number of products and producers. The products are not necessarily organic:

> «it's not the organic certification that's important, but the link between the producer and consumer. Anyone can get a certification, but if you see how the vegetables are produced, then you can trust them, and to see the vegetables, you have to be in relationship with the actual farmer. » (leader of a civic association)

According to our interviewees, on-farm selling, and open-air farmers markets are existing markets for organic products, but they are not typical. Organic farmers using these latter market channels have to compete with non-certified small-scale producers. Organic markets are a marginal part of the whole-food market. Despite it, stakeholders agree that one of the main driving forces of organic production in Romania are the markets, through the export of raw materials: wheat, sunflower, berries and mushrooms.

Stakeholder networks

In the following, we will briefly present the main networks of the above-presented stakeholders. There are cooperation patterns among the stakeholders. Certain control bodies and civic organisations work in close cooperation. One of the longest-standing relationships is between the Bioterra Association and the SC. Ecoinspect Srl control body; the former is the owner and founder of the latter. This is a tried and tested institutional setting: a civic organisation hand-in-hand with a non-profit enterprise, both working for the development of organic farming. They were active in the development of forming the legislative framework of organic farming, as showed above.

The cooperation between the R-EcoR and the ABG Romania (a control body) is more recent, having started in 2010. The aim of this particular network is similar. Together, the organisations are more effective and successful in projecting and reaching their goals of influencing policy-making and promoting organic farming.

The third cooperation is between the ARAD and an agricultural research institute, the NARDI. In this case, the cooperation aims at training rural entrepreneurs (mainly in Calarasi county) to become organic farmers. These organizations are also actively involved in policy-making.

We found that the most important civic organisations in the Romanian organic sector try to cooperate with the policy makers, or with market actors. In the long-term it changes the original characteristics of the civic associations, and new ones are formed as we could see in the case of EcoRurarlis Association. Their case shows that there are similar processes in Romania to Western-Europe (Lamine, 2005; Tovey, 1999). As organic farming civic movements are institutionalized, new food movements appear linked to organic farming movements.

Despite the involvement of the civic organisations in policy-making, interviewees argued that there is conflict between policy-making and stakeholders in the organic sector. The weak representation of organic farming in the Ministry of Agriculture and Rural Development and in the development plans shows that there is a lack of interest on the part of the Ministry towards organic agriculture. Policy-makers do not ask for help from representatives of the civic associations. As an interviewee states: „*there cannot be seen much interest coming from the politicians or the state in promoting this sector.*» (president of a civic organisation). Stakeholders have very little information concerning decision-making. One common experience is that decision-makers promise something, but later the decision is not implemented, thus policies, influencing the organic sector are unpredictable. The stakeholders of the different sectors and the different stakeholders of each sector can hardly cooperate.

DISCUSSION AND CONCLUSIONS

We presented how organic farming appeared in Romania in the 1990s. The development of the sector was influenced at the beginning by environmental and health concerns, which are typical in organic movements (Tovey 1999). Later, at the end of the nineties, market factors strengthened. It is also clear that in the case of both market- and movement-related factors, the external effect was strong: the first association was inspired by Swiss and Hungarian organisations, while the trading companies exported agricultural raw materials to Western-European markets. The policy influence became stronger during the EU accession process, as our analysis proved.

In the *first phase,* until 2005, the effects of environmental concerns, health issues and market had been stronger. The changes in the organic area also reflect the effects of the different driving forces. Until 2005, the area of organic farming had grown modestly, but continuously. Since 2007, after a slight decline, it started to grow rapidly, and in 2012 reached 2.1% of the total agricultural land of Romania. However, this is still less than half of the average of the European Union (5.6%) (Meredith and Willer, 2014). Actors and representatives of civic organisations who have been active in the organic sector for more than two decades mentioned environmental and health issues when they were asked to discuss organic farming. They argued that these are the most important elements of this agricultural method. Scholars have tended to emphasise environmental concerns, the benefits of organic farming methods on the soil and biodiversity. Activists mentioned the long-term positive effects on human health. In the Romanian case, we also found that movement elements find new paths if they feel forced to leave the organic sector (Koesling et al., 2012; Tovey, 1999, 1997), as the case of Eco Ruralis shows.

As we presented above, the market has played an important role in the development of the Romanian organic sector from the middle of the 1990s, and market influence became decisive in 2001. In this period the export of raw materials such as arable crops and wild-plants influenced the institutionalization of the sector as the changes in the number of control bodies also show. The buyers are trading companies, purchasing raw products and exporting them mainly to Germany, Austria and Italy. Farmers started certification when they needed to as they had a more secure market this way. Several experts argued that „the most important factor motivating someone to start a business in ecological agriculture is the market – the possibility to sell. It is the market that comes first." According to our analysis, the Romanian organic sector was led by the market between 2001 and 2010. At that time, the opinion and work of the stakeholders from the organic sector was almost neglected by policy-makers, as argued above. A reason for this was the lack of legitimacy of the representatives of organic farmers among policy-makers, but also a lack of acceptance of the organic sector by mainstream agriculture represented in decision-making.

Until the beginning of the *third phase* in 2011, organic producers had been working without any state support, although there were several (promised) policy interventions between 2007 and 2010, which influenced the development of organic farming. Some experts estimate that the role of state subsidy in the increase in the number of producers was not significant, but the dynamics of the organic field and the experience of certification bodies show that policy interventions did have an effect. The number of organic farm units increased after decisions were made regarding subsidies, and rapidly decreased as farmers realised that subsidies would hardly be able to cover the costs of certification. As the dynamics of organically farmed land and the number of controlled producers shows, the conversion subsidies were attractive, but did not result in lasting change. Many farmers stopped the certification process when they realised that the subsidies did not cover certification costs, and they would not be able to sell products at a higher price.

There are three limitations which prevent us from generalising our findings: organic farming and the organic movement only started in Romania after the changes of the regime; and until 2007 and EU accession, the organic movement had almost no policy support. The organic movement had to face several threats, like the presence of GM-plants (see Greenpeace, n.d.). This almost century-old agricultural method appeared in the country from abroad, and still shows the effects of external impacts. The short history and the strong external impacts on the sector strictly limit the generalisation of our results. The difficulty of finding exact data on the organic market is a further limitation for our paper. The third limitation is that the sector is changing rapidly.

Despite this, we argue that the three driving forces which have been presented have influenced the development of the organic sector, and that these driving forces impact on this development simultaneously. However,their effect is stronger in certain periods: the social movement characteristic seems to be the first, then market forces appeared, followed by the impacts from policy-making. A third important finding is that the driving forces have not disappeared, and can be described simultaneously. The explanation can be that the market remains an important factor and policies have short-term effects. Our interviews show that movement

characteristics persist or return even in an institutionalised organic sector. Our findings re-enforce the arguments of Darnhofer et al. (2005). They also found that the most important factor influencing farmers' decisions to convert to organic principles is whether farmers accept organic farming as a viable farming system.

Policy interventions have had a strong effect, but as we saw in the Romanian case, financial subsidies alone have had only short-term effects and farmers also need support in marketing and counselling (Offermann et al., 2009). Itis still doubtful whether such initiatives will lead to long-term change in attitudes toward organic agriculture (Wilson and Hart, 2001). Such problems of policy formulation may be avoided if the representatives of the organic sector had the possibility to influence policy-making (Favilli et al., 2015; Häring et al., 2009). Our case-study also showed that institutionalisation has over-shadowed the social movement characteristic of organic farming. New groups have appeared which have declared principles and aims similar to the former, original principles of organic farming, but the new groups have had a more sensitive approach toward social inequalities and injustice, aiming to empower producers and provide more affordable and healthier food for everyone.

REFERENCES

Acs, S., Berentsen, P.B.M., Huirne, R.B.M., 2005. Modelling conventional and organic farming: a literature review. NJAS - Wagening. J. Life Sci. 53, 1–18. doi:10.1016/S1573-5214(05)80007-7

Balazs, B., 2012. Local Food System Development in Hungary. Int. J. Sociol. Agric. Food 19, 403–421.

Benedek, Z., Balázs, B., 2014. Az élelmiszertermelés relokalizációjának térbeli-társadalmi különbségei Magyarországon. Tér És Társad. 28, 63–76. doi:10.17649/TET.28.4.2644

Bilewicz, A., Śpiewak, R., 2015. Enclaves of activism and taste: Consumer cooperatives in Poland as alternative food networks. Socio.hu 145–166. doi:10.18030/socio.hu.2015en.145

Darnhofer, I., 2005. Organic Farming and Rural Development: Some Evidence from Austria. Sociol. Rural. 45, 308–323. doi:10.1111/j.1467-9523.2005.00307.x

Darnhofer, I., Schneeberger, W., Freyer, B., 2005. Converting or not converting to organic farming in Austria:Farmer types and their rationale. Agric. Hum. Values 22, 39–52. doi:10.1007/s10460-004-7229-9

DuPuis, E.M., 2000. Not in my body: BGH and the rise of organic milk. Agric. Hum. Values 17, 285–295. doi:10.1023/A:1007604704026

Duram, L.A., 2005. Good Growing: Why Organic Farming Works. Bison Books, Lincoln.

Duram, L.A., 2000. Agents' perceptions of structure: How Illinois organic farmers view political, economic, social, and ecological factors. Agric. Hum. Values 17, 35–48. doi:10.1023/A:1007632810301

Egri, C.P., 1999. Attitudes, Backgrounds and Information Preferences of Canadian Organic and Conventional Farmers: Implications for Organic Farming Advocacy and Extension. J. Sustain. Agric. 13, 45–72. doi:10.1300/J064v13n03_05

Fairweather, J.R., 2004. Understanding how farmers choose between organic and conventional production: Results from New Zealand and policy implications. Agric. Hum. Values 16, 51–63. doi:10.1023/A:1007522819471

Favilli, E., Rossi, A., Brunori, G., 2015. Food networks: collective action and local development. The role of organic farming as boundary object. Org. Agric. 5, 235–243. doi:10.1007/s13165-015-0118-2

Gerring, J., 2006. Case study research: principles and practices. Cambridge University Press.

Greenpeace, n.d. Briefing - ROMANIA: a playground for the genetic engineering industry? [WWW Document]. Greenpeace Int. URL http://www.greenpeace.org/international/en/press/releases/briefing-romania-a-playgrou/ (accessed 2.18.16).

Häring, A.M., Vairo, D., Dabbert, S., Zanoli, R., 2009. Organic farming policy development in the EU: What can multi-stakeholder processes contribute? Food Policy, Development of organic farming policy in Europe 34, 265–272. doi:10.1016/j.foodpol.2009.03.006

Kaltoft, P., 2001. Organic Farming in Late Modernity: At the Frontier of Modernity or Opposing Modernity? Sociol. Rural. 41, 146–158. doi:10.1111/1467-9523.00174

Kaltoft, P., 1999. Values about Nature in Organic Farming Practice and Knowledge. Sociol. Rural. 39, 39–53. doi:10.1111/1467-9523.00092

Kerselaers, E., De Cock, L., Lauwers, L., Van Huylenbroeck, G., 2007. Modelling farm-level economic potential for conversion to organic farming. Agric. Syst., Special Section: sustainable resource management and policy options for rice ecosystemsInternational symposium on sustainable resource management and policy options for rice ecosystems 94, 671–682. doi:10.1016/j.agsy.2007.02.007

Koesling, M., Løes, A.-K., Flaten, O., Kristensen, N.H., Hansen, M.W., 2012. Farmers' reasons for deregistering from organic farming. Org. Agric. 2, 103–116. doi:10.1007/s13165-012-0030-y

Kubala, J., Grodzinska-Jurczak, M., Cichon, M., Nieszporek, K., 2008. Motivations for organic farming among farmers from Malopolska Province, Poland. Int. J. Environ. Sustain. Dev. 7, 345–361. doi:10.1504/IJESD.2008.021904

Kvale, S., 1994. Ten Standard Objections to Qualitative Research Interviews. J. Phenomenol. Psychol. 25, 147–173.

Lamine, C., 2005. Settling Shared Uncertainties: Local Partnerships Between Producers and Consumers. Sociol. Rural. 45, 324–345. doi:10.1111/j.1467-9523.2005.00308.x

Lamine, C., Bellon, S., 2009. Conversion to organic farming: a multidimensional research object at the crossroads of agricultural and social sciences. A review. Agron. Sustain. Dev. 29, 97–112. doi:10.1051/agro:2008007

Lampkin, N., Foster, C., Padel, S., 1999. The Policy and Regulatory Environment for Organic Farming in Europe: Country Reports. Universität Hohenheim, Stuttgart - Hohenheim.

Locke, R., 2006. Decision Modeling: Why farmers Do or Do Not Convert to Organic Farming. Indep. Study Proj. ISP Collect.

Mccann, E., Sullivan, S., Erickson, D., Young, R.D., 1997. Environmental Awareness, Economic Orientation, and Farming Practices: A Comparison of Organic and Conventional Farmers. Environ. Manage. 21, 747–758. doi:10.1007/s002679900064

McCarthy, M., O'Reilly, S., O'Sullivan, A., Guerin, P., 2007. An Investigation into the Determinants of Commitment to Organic Farming in Ireland. J. Farm Manag. 13, 135–152.

McMahon, N., 2005. Biodynamic Farmers in Ireland. Transforming Society Through Purity, Solitude and Bearing Witness? Sociol. Rural. 45, 98–114. doi:10.1111/j.1467-9523.2005.00293.x

Meredith, S., Willer, H., 2014. Organic in Europe: Prospects and developments. IFOAM EU Group, FiBL and CIHEAM-IAMB.

Michelsen, J., 2001. Recent Development and Political Acceptance of Organic Farming in Europe. Sociol. Rural. 41, 3–20. doi:10.1111/1467-9523.00167

Moschitz, H., Hrabalova, A., Stolze, M., 2015. Dynamics of Policy Networks. The Case of Organic Farming Policy in the Czech Republic. J. Environ. Policy Plan. 0, 1–20. doi:10.1080/1523908X.2015.1113866

Moschitz, H., Stolze, M., 2010. The influence of policy networks on policy output. A comparison of organic farming policy in the Czech Republic and Poland. Food Policy 35, 247–255. doi:10.1016/j.foodpol.2009.12.009

Nistor, L., 2015. Discourses about the meaning of the local food. Investigations in Romanian urban contexts. socio.hu 5, 128–144.

Offermann, F., Nieberg, H., Zander, K., 2009. Dependency of organic farms on direct payments in selected EU member states: Today and tomorrow. Food Policy, Development of organic farming policy in Europe 34, 273–279. doi:10.1016/j.foodpol.2009.03.002

Oostindie, H.A., Ploeg, J.D. van der, Broekhuizen, R.E. van, Ventura, F., Milone, P., 2010. The central role of nested markets in rural development in Europe. Spec. Issue Comp. Anal. Rural Dev. Process. China Braz. Eur. Union 65, 191–224.

Padel, S., 2001. Conversion to Organic Farming: A Typical Example of the Diffusion of an Innovation? Sociol. Rural. 41, 40–61. doi:10.1111/1467-9523.00169

Padel, S., Niggli, U., Pearce, B., Schlüter, M., Schmid, O., Cuoco, E., Willer, H., Huber, M., Halberg, N., Micheloni, C., 2010. Implementation Action Plan for organic food and farming research (Report). Technology Platform TP organics, Brussels.

Patil, S., Reidsma, P., Shah, P., Purushothaman, S., Wolf, J., 2014. Comparing conventional and organic agriculture in Karnataka, India: Where and when can organic farming be sustainable? Land Use Policy, Impact Assessment of Land Use Policies and Sustainable Development in Developing Countries 37, 40–51. doi:10.1016/j.landusepol.2012.01.006

Ploeg, J.D., Renting, H., 2000. Impact and Potential: A Comparative Review of European Rural Development Practices. Sociol. Rural. 40, 529–543. doi:10.1111/1467-9523.00165

Pugliese, P., 2001. Organic Farming and Sustainable Rural Development: A Multifaceted and Promising Convergence. Sociol. Rural. 41, 112–130. doi:10.1111/1467-9523.00172

Rigby, D., Young, T., Burton, M., 2001. The development of and prospects for organic farming in the UK. Food Policy 26, 599–613. doi:10.1016/S0306-9192(01)00023-9

Seppänen, L., Helenius, J., 2004. Do inspection practices in organic agriculture serve organic values? A case study from Finland. Agric. Hum. Values 21, 1–13. doi:10.1023/B:AHUM.0000014021.76147.7d

Siebert, R., Toogood, M., Knierim, A., 2006. Factors Affecting European Farmers' Participation in Biodiversity Policies. Sociol. Rural. 46, 318–340. doi:10.1111/j.1467-9523.2006.00420.x

Stolze, M., Lampkin, N., 2009. Policy for organic farming: Rationale and concepts. Food Policy, Development of organic farming policy in Europe 34, 237–244. doi:10.1016/j.foodpol.2009.03.005

Storstad, O., Bjørkhaug, H., 2003. Foundations of production and consumption of organic food in Norway: Common attitudes among farmers and consumers? Agric. Hum. Values 20, 151–163. doi:10.1023/A:1024069627349

Sullivan, S., Mccann, E., Young, R.D., Erickson, D., 1996. Farmers' attitudes about farming and the environment: A survey of conventional and organic farmers. J. Agric. Environ. Ethics 9, 123–143. doi:10.1007/BF03055298

Sutherland, L.-A., Burton, R.J.F., Ingram, J., Blackstock, K., Slee, B., Gotts, N., 2012. Triggering change: Towards a conceptualisation of major change processes in farm decision-making. J. Environ. Manage. 104, 142–151. doi:10.1016/j.jenvman.2012.03.013

Tovey, H., 1999. „Messers, Visionaries, and Organobureaucrats": Dilemmas of Institutionalisation in the Irish Organic Farming Movement. Irish Journal of Sociology 53–86.

Tovey, H., 1997. Food, Environmentalism and Rural Sociology: On the Organic Farming Movement in Ireland. Sociol. Rural. 37, 21–37. doi:10.1111/1467-9523.00034

Van Der Ploeg, J.D., Renting, H., Brunori, G., Knickel, K., Mannion, J., Marsden, T., De Roest, K., Sevilla-Guzmán, E., Ventura, F., 2000. Rural Development: From Practices and Policies towards Theory. Sociol. Rural. 40, 391–408. doi:10.1111/1467-9523.00156

Vasile, A.J., Popescu, C., Ion, R.A., Dobre, I., 2015. From conventional to organic in Romanian agriculture – Impact assessment of a land use changing paradigm. Land Use Policy 46, 258–266. doi:10.1016/j.landusepol.2015.02.012

Vogl, C.R., Kilcher, L., Schmidt, H., 2005. Are Standards and Regulations of Organic Farming Moving Away from Small Farmers' Knowledge? J. Sustain. Agric. 26, 5–26. doi:10.1300/J064v26n01_03

Wilson, G.A., Hart, K., 2001. Farmer Participation in Agri-Environmental Schemes: Towards Conservation-Oriented Thinking? Sociol. Rural. 41, 254–274. doi:10.1111/1467-9523.00181

Yin, R.K., 2009. Case Study Research: Design and Methods. SAGE.

Yussefi-Menzler, M., 2010. The World of Organic Agriculture: Statistics and Emerging Trends 2008. Routledge.

Zagata, L., 2009. How organic farmers view their own practice: results from the Czech Republic. Agric. Hum. Values 27, 277–290. doi:10.1007/s10460-009-9230-9

This study was supported by the Bolyai Postdoctoral Scholarship of the Hungarian Academy of Sciences and the Hungarian Scientific Research Fund (project number PD 116219). The paper is based on research financed by the project entitled 'Addressing socio-economic regional disparities: the potential of organic farming for strengthening rural areas in Bulgaria (Bulgaria Organic)'.

AFFILIATION

Boldizsár Megyesi

Affiliation: Research fellow at the Institute for Sociology, Centre for Social Sciences, Hungarian Academy of Sciences, since 2004, and visiting fellow at the Hétfa Research Institute since 2009. He holds a Ph. D. in Sociology from Eötvös Loránd University, Budapest. His main scientific interests rural studies, effects of development policy, climate change, and changing food production and consumption.

He participated in several EU financed and Hungarian researches: on climate change (GILDED – Governance, Infrastructure, Lifestyle Dynamics and Energy Demand: European Post-Carbon Communities), energy use (PENNY – Psychological social & financial barriers to energy efficiency. Horizon2020 project) on rural studies (Effects of agricultural policies on small-scale farming and food self-provisioning OTKA-116219) and several other research projects.

Mike, Károly – Megyesi, Boldizsár (2018) Communities after markets. The long road of winemakers to self-governance in post-communist Hungary. In: Geoforum (88)1 pp. 129–137 https://doi.org/10.1016/j.geoforum.2017.11.021

Jan Vávra, Boldizsár Megyesi, Barbora Duží, Tony Craig, Renata Klufová, Miloslav Lapka, Eva Cudlínova (2017) Food Self-provisioning in Europe:: An Exploration of Sociodemographic Factors in Five Regions RURAL SOCIOLOGY Paper 10.1111/ruso.12180. 31 p. http://dx.doi.org/10.1111/ruso.12180

Megyesi Boldizsár, Mike Károly (2016) Organising collective reputation: An Ostromian perspective In: INTERNATIONAL JOURNAL OF THE COMMONS 10:(2) pp. 1082-1099.

Institutional contact: Centre for Social Sciences, Hungarian Academy of Sciences, H-1095, Hungary, Budapest, Tóth Kálmán u. 2., Megyesi.Boldizsar@tk.mta.hu

AGROECOLOGICAL PRACTICES AS TERRITORIAL DEVELOPMENT:

an analytical schema from Brazilian case studies

LES LEVIDOW, DAVIS SANSOLO AND MONICA SCHIAVINATTO

Abstract

Agroecology is being widely promoted as an alternative to the hegemonic agro-food system, while also being used for 'greening' it. To clarify a transformative role, some advocacy organizations and researchers have elaborated the concept 'territorial development'. This defines specific trajectories as social relations of power and thus a conflictual space, involving dynamics of territorialization, deterritorialization and reterritorialization. Drawing on Brazilian case studies, this paper presents an analytical schema of how agroecological practices are appropriated for diverse trajectories of territorial development. The schema helps to enrich the concept, as a stronger basis for agroecology practitioners to construct multi-stakeholder expansion strategies.

KEY-WORDS: AGROECOLOGICAL PRACTICES, TERRITORIAL DEVELOPMENT, SOLIDARITY ECONOMY, SOCIAL TECHNOLOGIES, BRAZIL

INTRODUCTION

In the past couple decades, agroecology has been highlighted, promoted and expanded worldwide, especially counterposed to the Green Revolution model of capital-intensive inputs. This has created dependence on monocultures and ichemical usage, consequently harming ecosystems, health and livelihoods. Such harm has provoked collective resistance, inspiring practitioners to recover and improve agroecological alternatives for a transformative agenda. Rather than focus on 'agroecology' in that political sense, this paper's methods analyse agroecological practices more broadly to identify their diverse forms and roles. It provides an analytical schema of their various appropriations for territorial development.

Brazil has instructive experiences from its widespread alternatives, land conflicts and state support measures. Around the turn of the century, Brazil's main political force struggling for land reform, the Movimento dos Trabalhadores Rurais Sem Terra (MST), began to experiment with agroecological practices as means towards an alternative future (Borsatto and do Carmo, 2013; Silva, 2011). Stimulated by the MST and other affiliates, the global movement La Via Campesina eventually linked agroecology with food sovereignty as a counter-strategy against agribusiness. With support from many civil society groups, this linkage established a common political agenda for interventing in local, national and global arenas (Holt-Giménez and Altieri, 2011, 2013; Holt Giménez and Shattuck, 2011).

Over the past two decades, Brazil's supporters have gained public policies favourable to agroecological practices. Support measures have included the following: the Reforma Agrária for land redistribution and tenure; rural extension services advising family farms on appropriate forms of production and certification; and food procurement policies of public authorities. These measures have aimed to strengthen agroecological and organic production, especially by small-scale producers. At the same time, other public policies have opened new opportunities for agribusiness to find lucrative markets for organic products, whose sales have been rising by 20% every year (Sebrae Nacional, 2017).

In such ways, Brazil's agroecological practices highlight three global tendencies: agroecology as a counter-hegemonic agenda; agroecological production seeking new market niches within a capitalist logic; and

agroecological techniques selectively adapted for 'greening' the conventional agri-system (Holt Giménez and Shattuck, 2011; Levidow, 2015). Together these diverse forms have brought some confusion, even dispute, over the term 'agroecology' and its relation to development.

Some advocacy organizations and researchers have elaborated 'territorial development' as a strategic concept for an agroecological transition which can transform the dominant agricultural system (Pronera, 2016; Schmitt et al., 2017). Since 2014 new opportunities to promote transformative agendas have arisen through the agroecology initiative of the Food and Agriculture Organisation (FAO, 2018). It has hosted several conferences, whose participants advocate 'territorial development processes', including these actions:

Take agroecology to scale through integrated and participatory territorial processes

a. Supporting territorial approaches and planning for agroecology that protect the rights of local communities to land, and that integrate across sectors and reconnect the urban and rural by involving all local actors in an integrative, participatory and inclusive way…

c. Managing conflicts in territories through open multi-sector dialogue that include the concerned parties, including indigenous peoples

d. Support the restoration of territories to respond to the needs of family farmers in marginal areas based on success stories of agroecology that contribute to food sovereignty

e. Ensuring that laws and policies for agroecology have continuity and real impact by continuing to strengthen the participation of civil society organisations, through participatory democracy, to claim their human rights… (FAO, Chair's Summary, 2018: 6).

Those actions mean 'transforming legal and regulatory frameworks at all levels to ensure transitions to agroecology based on integrated and coherent multi-sectoral food policies…' (ibid: 5). Practitioners have been discussing how to gain, strengthen and use support measures from state bodies for transformative aims.

The above concepts will be linked analytically through two main questions: How have diverse trajectories appropriated agroecological practices? How do these relate to territorial development?

To address those questions, the article is structured by four sections: agroecology as territorial conflict; the concept territorial development, with an analytical schema; case studies, with methods for applying and elaborating the schema; and finally the Conclusion on the relevance to agroecological expansion.

AGROECOLOGY AS A TERRITORIAL CONFLICT

During the 20th century there were several agri-movements favouring biological processes; they all sought a long-term sustainability of agricultural activities by managing biodiversity and soil conservation (Ehlers, 1999: 47). Traditional agroforestry systems were seen as agroecological when gaining greater attention in the late 20th century (Brandenburg, 2002; Abreu et. al, 2009, 2012). Agroecological methods attracted greater interest during the 1980-1990s, when various social struggles contested the Green Revolution as the hegemonic paradigm of agri-production. Coming from peasant and indigenous groups, these struggles looked beyond environmental issues to structural transformation of the countryside, markets and society. They increasingly linked environmental sustainability and food sovereignty (Altieri, 2008; Altieri and Toledo, 2011; Rosset, 2003; Martinez-Torrez and Rosset, 2014; De Schutter, 2011).

Analyses of agroecology have likewise expanded since the 1980s (Wezel and Soldat, 2009), e.g. by systematising practices of Mexico's poor indigenous people (Gliessman, 1984). Agroecology was formulated as 'the scientific basis for an alternative agriculture' (Altieri, 1983). Later this was grounded in social agrarian agendas and social movements, especially within resistance to capitalist modernisation (Altieri, 2002; Sevilla Guzmán and Woodgate, 1997).

Studies have elaborated the concept for different dimensions and scales, from the plot/field, to the local, to agroecosystems and more recently entire agro-food systems (Wezel and Soldat, 2009). Agroecology depends on a complex science, organically linked with agrarian social sciences, for understanding and transforming relationships between practitioners and the environment. It has been defined as:

ecological management of natural resources through forms of collective social action which presents alternatives to the current model of industrial management through proposals, emerging from its endogenous potential, which seek a participatory development from the area of alternative production and circulation of its

products, aiming to establish forms of production and consumption which contribute to deal with the social and ecological crisis and thus confront neoliberalism and economic globalisation (Sevilla Gúzman, 2006: 9).

In this antagonistic perspective, agroecology links three aspects: a scientific approach intended to support a transition of current models of rural development and conventional agriculture towards sustainable ones (Caporal and Costabeber, 2002); a practice enhancing traditional experiences and knowledges; and a political approach for transforming socio-economic structures (Sevilla-Guzmán, 2006; Toledo, 1995; Rosset, 2009; Altieri and Toledo, 2011, Delgado & Rist, 2016). In the latter sense, agroecology has a territorial conflict with agribusiness agendas. As a terrain of struggle, agroecology has been disputed materially ('agroecology as farming') and immaterially ('agroecology as framing'), i.e. mobilising practitioners for transformative agendas (Rosset and Martínez-Torres, (2012). At the same time, agroecological practices can either transform the hegemonic agri-food system or else conform to its market pressures, power structures and development models (Levidow et al., 2014).

In the latter sense, prevalent 'development' models have historically defined people's needs for co-opting their aspirations into capital accumulation and its global circuits, while obscuring the power relations. Such a potential now arises from state bodies selectively supporting agroecological practices. 'The outcome will depend on the balance of power in venues where the struggle occurs and on the ability of social movements to eschew the precepts of so-called development' (Giraldo and Rosset, 2018). Or perhaps more subtly, social movements reframing development in counter-hegemonic ways. For an alternative future, it is necessary to identify tensions among different development priorities and trajectories; these may need to be combined, reconciled or adjudicated by specific initiatives.

In those ways, agroecology became situated in contexts of territorial conflict, counterposed to the global hegemonic food system. In such contexts, analyses have outlined diverse forms of management, producers, objectives and societal visions (Le Coq, 2017: 21-22). Rather than presume a singular 'agroecology', this paper uses the term 'agroecological practices' in order to identify their diverse forms and analyse their links with territorial development, as explained next.

TERRITORIAL DEVELOPMENT: ANALYTICAL SCHEMA

As a concept, 'territorial development' has multiple meanings and interpretations. It often denotes trajectories seeking a more just society, especially by promoting a solidarity economy and sustainability (Veloso, 2016). It provides a political perspective on development approaches using natural resources in appropriate ways (Saquet and Spósito, 2008). Various perspectives on the production of agrarian space relate to territorial conflicts.

For example, 'territory results from the content, means and process of social relations' (Saquet, 2013, p. 8.). It produces and is produced by power relations: as societal conflict, territory mediates relations of production (Saquet, 2013). Nature and culture are constitutive elements of territory, which should be understood as multidimensional, multi-scalar and relational (Raffestin, 1993).

Territory is occupied, appropriated and contested (Raffestin, 1993; Haesbaert, 2004; Fernandes, 2005a; Saquet, 2009). In this sense, territory is a social space of interaction, exchange, cooperation and competition – but also domination, control and power. Through articulations with territory, dominant agents maintain their domination, while subaltern groups seek to resist and overcome that arrangement.

Territory is marked by constant dynamics of territorialization, deterritorialization and reterritorialization (TDR) through the following dynamics: When capital accumulation produces space, it deterritorializes family farms, which try to reterritorialize themselves through new strategies to take control of resources: 'On the one hand, from its logic and principles, capital destroys and recreates the peasantry. On the other hand, the peasantry also recreates itself, breaking with the logic and principles of capital' (Fernandes, 2005b: 9). 'This contradictory and paradoxical movement promotes development; the market, the state and society conflict and gather to overcome their problems, while creating others and still prolonging others (Fernandes, 2005b: 43).

In particular, agribusiness and family agriculture undergo conflicts conflicts over development, generating territorialization and deterritorialization processes, transforming the actors in the process (Fernandes, 2013, p.27). This perspective helps us to understand relationships established in producing space (Lefebvre, 2000), from access and use of land, capitalist relations and its conflicts. Difficulties result 'from acute territorial conflicts,

mainly between actors of the market and civil society around, for example, the constitution of markets, the appropriation of land and antagonistic trajectories of regional development' (Leite and Delgado, 2011: 54).

For agroecology in particular, territorial approaches have been elaborated. Agroecology can be expanded by strategically linking three parameters: markets, institutions and knowledge-systems (Ranaboldo y Venegas, 2007: 15-16). Each parameter articulates a vertical scale-up of institutional support measures with a horizontal scale-out or expansion of agroecological practices (Gonsalves, 2001; Rosset and Altieri, 2017).

For agroecological alternatives to the hegemonic model, a Colombian NGO facilitates a 'strategic reading of territory'. Communities participate firstly in evaluating the baseline situation and their current trajectories. Then they identify new opportunities in local, national and global arenas; these may depend on cooperating with allies and using or constructing public policies (IMCA, 2014). Thus the exercise can clarify multi-stakeholder strategies for future trajectories.

This article draws on and extends those earlier perspectives. In the schema here, agroecological practices are analysed through four parameters: i) origin and aims; ii) work organization and product certification for market access; iii) relationships with the agro-food system and public policies; and iv) knowledge and technological innovation. Taking each parameter in turn:

Origins and aims

For the territorial role of agroecological practices, it is important to know their origin and their practitioners' aims in their specific political-economic context. This illuminates territorial conflicts between the hegemonic agribusiness model and such practitioners, which may involve diverse actors, e.g. organic producers linked with capitalist markets, family farmers, landless peasants, traditional communities, etc. Relevant aspects include: the processes which generated the agroecological practices, their symbolic content, their novel practices contesting or else accommodating the hegemonic agri-system, e.g. through new market niches. Also relevant is whether/how those practices link scientific and political aspects aiming to aiming to transform the system.

Organization of labour and product certification for market access

Here we analytically link two aspects of agroecological initiatives: organization of labour for a production process (Pires and Novaes, 2016) and certification of its products for accessing specific markets. The Social and Solidarity Economy expresses interdependencies across economic activities (Schütz and Gaiger, 2006; Singer and Souza, 2000). This model promotes cooperative relationship which improve capacities and means of subsistence, especially through short supply chains, bringing producers closer to consumers.

Market access has been crucial for agroecological practices as territorial development, promoting a transition towards sustainable production. The concept of 'solidarity economy' has been adopted to promote and expand Brazil's agroecological systems (FAO, 2017; Pronera, 2016). Since the 1990s various organisations of civil society (NGOs, social movements and networks) have been promoting participatory forms of certification under producers' control, counterposed to official forms of organic certification (da Costa et al, 2017: 290; Schwab and Collado, 2017: 2). Short food chains have been promoted by agencies such as the Assessoria e Serviços a Projetos em Agricultura Alternativa (AS-PTA), aiming to overcome rural poverty, as well as by the Rede de Agroecologia Ecovida. For support measures from public policies, see the next sub-section.

Relationships with the hegemonic system and public policies

Latin American countries have a power imbalance in governance arrangements, especially in its policies for agricultural and rural development. These privilege powerful economic actors, at the same time as excluding small-scale producers or other social sectors (Piadal 2013: 87-89). These power asymmetries generally promote market liberalization, with a doubtful contribution towards alleviating (IFAD, 2016: 87). In many cases, it worsens socio-economic inequality, marginalises the poorest and reinforces low-quality work. That power imbalance has been redressed partly by agroecological systems, especially when supported by public policies as regards land tenure, extension services, organic certification schemes, public procurement rules, etc. (FAO, 2017).

In Brazil agroecology has obtained significant support from public policies, especially from the 2003-2016 governments led by the Partido dos Trabalhadores. Such policies responded to joint demands of peasants, indigenous and traditional communities. Some local authorities have complemented or stimulated support roles of national bodies. NGOs also made an important contribution to such support, both directly and indirectly through demands on state bodies (Schmitt et al., 2017).

Since 2004 the Programa Nacional de Assistência Técnica e Extensão Rural (Pronater ou PNATER) has promoted farm-level experiments and adoption of appropriate technologies for family agriculture. Since 2009 the Política Nacional de Segurança Alimentar e Nutricional devised actions under four pillars: availability (production

of quality foods); stability of provision (accessible quantity and quality of food throughout the year); access to food by the entire population; food use (secure transport and management). It includes the nutritional and food security of traditional communities and (previously) landless settlers of the Reforma Agrária.

Through the 2003 Organics Law and its 2007 regulations (Decreto 6.323/2007), Brazil's rules have recognised the difficulties of small-scale producers in achieving certification for their products and so included participatory forms. Such producers have found institutional markets through government programmes for public procurement, especially schools (Programa de Aquisição de Alimento – PAA; and Programa Nacional de Alimentação Escolar – PNAE). Support measures for commercialising organic and agroecological products emphasise family farms (CIAPO, 2013).

Knowledge and technological innovation

Agroecological practices have been 'restoring local self-reliance, conserving and regenerating natural resource agrobiodiversity, producing healthy foods with low inputs, and empowering peasant organizations' (Altieri and Toledo, 2011). Agroecological systems have attracted new investment of several kinds, maintaining traditional knowledges and integrating these with scientific knowledge (Delgado and Rist 2016). Such systems encompass syntropic methods, whereby competition amongts organisms give rise to cooperation, as a basis for agroforestry and permaculture; these methods play roles in regenerating ecosystems (Agenda Gotsch, n.d.) Other innovations include short food-supply chains (innovative low-cost intermediaries), renewable energy (solar, wind), etc.

When these methods are consolidated, appropriated by the producers and replicated, they have been called 'social technologies': their design and use promotes social aims such as collective capabilities, inclusion, socio-economic equity and women's leadership (Dagnino, 2009; Fressoli and Dias, 2014; ITS, 2004; Serafim et al., 2013). Their diffusion has been promoted by various support measures (e.g. CRATS, 2016). Social innovation depends on a collective effort which links teaching, an educational process and work. It goes beyond the limits of an immediate situation, facilitating more diverse forms of production (Pires and Novaes, 2016, p.116). In the latter two initiatives under study here, the well-known concept was broadened to *tecnologias socioambientais*, i.e. socio-environmental technologies.

CASE STUDIES: DIVERSE FORMS OF TERRITORIAL DEVELOPMENT

As above, the methods looked for diverse cases of agroecological practices, rather than focus on 'agroecology' as a political agenda. To answer the questions in the Introduction, this article compares four cases of agroecological methods in São Paulo state.

Case selection: As a reason for the case selection, each initiative has publicly promoted itself as a showcase for environmentally sustainable methods which could be widely extended for a better societal future. Consequently, each initiative has substantial documentary material and/or promotional films available on websites; one also has academic studies. Each welcomed a long visit by the research team. Although all use agroecological methods, each emphasises more specific terms, e.g. organic, biodynamic, agroforestry (in three of the cases). They all exclude agrochemical inputs, while recycling nutrients and reproduce their own seeds for new cultivation. Yet the four have marked differences in other respects, especially their relationship to the hegemonic regime.

Methods: Before visiting the four sites in September 2017, the research team collected information on their origins, aims, experiences, internal organisation and external relations. These materials informed our site-specific interview questions. At all four sites we also asked general questions such as: 'What future are you creating? How is this future more sustainable and inclusive?', including environmental, economic and social aspects. Other questions asked about land issues, agricultural methods, public policies, technological innovation, social technologies, etc. Each site had a semi-structured interview of at least two hours, followed by a site visit of several hours. In addition to the four sites, we also interviewed retail outlets for short food-supply chains and support groups for policy interventions, e.g. the Instituto Giramundo Mutuando. Interviewees' commments gave us key words, especially linkages between them, for more internet searches. Many literature citations, and all empirical material below, come from Portuguese-language sources; they have been translated by the authors. At the end the Glossary has translations of institutional names.

Our analytical schema emerged iteratively while analysing and comparing the initiatives. The analysis below is structured by the four parameters in the previous section; likewise the summary Table (see here under). In this way, the pilot study provides an analytical schema which has wider relevance to territorial development dynamics and trajectories.

Table: Agroecological practices as territorial development: Table of four parameters

INITIATIVE **i) origin and aims**	**ii) work organization and product certification for market access**	**iii) relationships with the hegemonic system and public policies**	**iv) knowledge and technological innovation**
Fazenda da Toca Itirapina Commercial aim: a business with an industrial farm converted it into an organic one, seeking to combine profits with nature conservation and land recovery.	Conventional division of labour differentiates between waged manual workers and professional staff. Organic label is certified by *auditoria* to sell 'healthy products' or their ingredients. Fruits mainly become primary materials for processing by the four dominant companies.	Abandoned the industrial agri-model of the previous farm. Recovers land through Sistemas Agroflorestais (SAF) on a large scale. Uses public policies for organic products through long supply chains within the hegemonic food system.	Agricultura Sintrópica was adapted by Ernst Gotsch for Sistemas Agroflorestais (SAF) on a large scale. Professional teams construct and adapt relevant knowledge. Hosts courses and visits from other farms to spread its agroforestry methods.
Estância Demétria Botucatu Long before the Green Revolution, the owners acquired land to test, improve and demonstrate biodynamic methods. Contributes to a cluster of organic farms.	Families share methodologies to improve biodynamic processes. Their intensive labour is combined with waged labour. Products are certified by the Associação Biodinâmica. With Demétria's label, the products depend on consumer support at its own São Paulo shop and organic fairs.	Biodynamic methods conserve biodiversity, yet with a paradoxical effect: Nearby land gains commercial value for real-estate companies to build expensive condominiums (for capital accumulation), thus limiting scope to expand the organic cluster.	Steiner's methods are adapted to intensify natural processes: 'produce while caring for nature'. Recycles natural resources between animals and crops. Organises knowledge interchange amongst farmers and scientists; neighbourhood facilitates an *intelectualização*.
Assentamento Mário Lago Ribeirão Preto MST pursues socio-environmental aims. Seeks to consolidate its settlement by conserving natural resources and generating income. Horizontal structure: 'Families cooperate and enjoy'	Work teams take turns in doing tasks and learning skills. Products are certified by a participatory Organização de Controle Social (OCS). Established short supply chains for a solidarity economy; market access depends on support from civil society and public authorities. Markets include: subscriptions, fairs, and schools. Raised funds for fruit-processing equipment.	After a long occupation, the settlement was legalised by INCRA. Gained a Projeto de Desenvolvimento Sustentável (PDS), with a Termo de Ajustamento de Conduta (TAC) to recover the land and so protect the acquifer on which Ribeirão Preto depends. Gained extra markets from govt procurement programmes.	Agricultura Sintrópica has been adapted for Sistemas Agroflorestais Agroecologicos (SAFAS) with a participatory management. Constructs social technologies for water capture, storage and treatment. Participates in Projeto Agroflorestar to spread its agroforestry methods to other settlements in the state.
Fórum de Comunidades Tradicionais (FCT) Ubatuba/Paraty FCT demands *justiça socioambiental*: facilitates a collective organization of diverse communities (quilombolas, indigenous and caiçaras) to defend their territories: 'Preserve and Resist' through agroforestry.	Work continues on a traditional family basis. FCT develops Turismo de Base Comunitária (TBC) to expand short supply chains for a solidarity economy. Without official certification, agroforestry products are commercialized collectively: via schools, fairs, other regional markets, and its own Restaurantes Quilombos.	With support from government programmes (AMAVEL), Projeto Juçara repopulates the juçara tree and sells the pulp. But land access faces threats from real-estate expansion, proposing to revise the ecological zoning with greater Federal power over such decisions. Opposing such changes, the FCT demands protection for the communities' way of life. .	Sistemas Agroflorestais (SAF) from traditional knowledge dialogue with new knowledge (from NGOs, universities and scientists), as a form of action-research. TBC creates social technologies for implementation on a larger scale, e.g. processing juçara into food products and recovering polluted beaches.

Origins and aims

In all the materials for the initiatives, a prominent feature was their visions and means for a more sustainable future, but with diverse motivations and understandings of the concept. These differences are crucial for how agroecological practices relate to territorial development.

1st initiative: Fazenda Toca is owned by the Diniz family, the former owner of the business group Pão de Açúcar. Toca has been developed 'between native woodlands, residents' villages, research plots for regenerative agriculture and the Instituto Toca, which is devoted to applying, developing and disseminating a culture of 'thinking and living organic' (*pensar y viver orgânico,* Fazenda Toca, n.d). An original idea was to develop large-scale production models as regenerative practices and agroforestry cultivation, aiming to create biodiversity, at the same time as a lucrative business through organic products.

According to the materials analysed and interview with Fazenda Toca, sustainability and profit are closely linked. 'The real purpose of Toca... is clearly that of profit' (interview with the proprietor, Pedro Paulo Diniz, *Época Negocios*, 2017). This means adapting to the hegemonic agri-food system. The initiative originated from the search for economic profitability in an area formerly producing orange monocultures within the agribusiness model. As this illustrates, the ideological discourse of sustainable development has created new spaces to reproduce the capitalist mode of production (Whitacker, 2012, p. 83).

2nd initiative: Estância Demétria is among numerous organic farmers whose products are commercialized in traditional organic markets in São Paulo. Unusually, its production model adapts biodynamic methods, which can be considered as agroecological practices. The original mentor, the Austrian philosopher Rudolf Steiner, has promoted biodynamic concepts since 1924 (Casa, 2008), long before the Green Revolution and its critiques. Stimulated by concepts from anthroposophy, his model was developed through biodynamic practices in the USA, Germany and Switzerland (Matos, 2010).

From those origins, Estância Demétria has sought to construct a mode of life which monitors and internalises natural processes, aiming to produce healthy products. Its methods are meant to be popularised and extended: 'My responsibility is to conscientize customers, friends and the entire world about the necessity to create the conditions so that this Earth can sustain healthy agriculture for the next generations' (interview, 03.09.2017). Demetria's practitioners seek to recover sustainable, healthy interactions between society-nature. They seek to maintain biodynamic methods in their fields and to construct market niches which guarantee adequate profitability for such methods. At the same time, they perceive no need or task to transform the hegemonic system.

3rd initiative: The Assentamento Mário Lago resulted from an occupation led by the Movimento dos Trabalhadores Sem Terra (MST). Like other land occupations, these have been carried out by peasants who were previously deterritorialized by agribusiness and had sometimes migrated to plantations as labourers or to cities. In this case the struggle was a joint action with a social movement, the Promotoria do Meio Ambiente da Comarca de Ribeirão Preto, against an agribusiness, Fazenda da Barra (Cassin & Nali, 2016). After long judicial proceedings against it, the land was expropriated by the Instituto Nacional de Colonização e Reforma Agrária (INCRA), a Federal agency administering the Reforma Agrária.

Environmental issues motivated a Plano de Desenvolvimento Sustentável (PDS), which sought to recover the land's role in recharging the Aquiferio Guarani on which the nearby Ribeirão Preto depends. Its recharge capacity had been degraded by sugarcane cultivation under the previous owner, especially by agrochemicals and pollutants. To address these environmental problems, the Assentamento reached an agreement, a Promotoria de Conflitos Fundiários do Meio Ambiente. Under its Termo de Ajustamento de Condutas (TAC), 35% of the ex-Fazenda da Barra would be dedicated to a Reserva Legal, restoring agroforestry in Áreas de Preservação Permanente (Cassin & Nali, 2016, p.362). This prohibited the use of agrochemicals, anyway complementing the Assentamento's decision to abandon the industrial methods of the previous landowners.

Thus the space was reterritorialized for socio-environmental objectives. Under the TAC, settlers were organised in several groups composed of 8-22 families, totalling 260 families. As the overall aim, 'Families cooperate and enjoy… generating a great abundance of food and water' (Cooperafloresta, 2016a). To create such abundance, the Assentamento Mário Lago eventually became a space for training, qualifications and education. The settlers have been seeking expertise to address the difficulties of water scarcity, financial loans, agri-inputs and means for an alternative form of agriculture: agroecology, especially agroforestry systems.

4th initiative: The Fórum de Comunidades Tradicionais (FCT) in the Costa Verde region, especially the towns of Ubatuba and Parati, has brought together communities of quilombolas (former escaped slaves), indigenous people and caiçaras (indigenous-origin name for coastal residents, often engaged in farming or fishing). Their territory has been urbanized especially by civil construction projects associated with second homes and/or

tourism. Meanwhile the nature conservation policy has created various protected areas which overlap with land of traditional communities. Both those arrangements expropriate communities of their lands and ways of life (Ferreira & Carneiro, 2005), territorializing the space in ways deterritorializing their resource base.

As a form of resistance, residents organized themselves as the Fórum de Comunidades Tradicionais (FCT), seeking to maintain, protect and regenerate their territory. Demanding *justiça socioambiental* (socio-environmental justice), the Fórum gives a greater public visibility to their culture and way of life, seeking to counter their social exclusion. Extending the area's traditional agroforestry, they initiated Sistemas Agroflorestais (SAFs) seeking to link environmental conservation with their forms of life, given that these were partly dependent on officially protected areas. Their counter-hegemonic struggle bears imprints of its historical and geographical context: the struggle to remain on the land takes inspiration from their agroforestry traditions, in dialogue with new forms of knowledge (Delgado & Rist, 2016). 'To unite three ethnic groups, with their different cultures and modes of life, is not easy. But we have taken important steps….' (FCT coordinator Vagner Nascimento, interview iin Nonada, 2017).

Together the above cases illustrate three agroecological trajectories: a) environmental sustainability linked with financial profitability (Fazenda da Toca); b) environmental sustainability linked with the society-nature interface (Demétria); c) socio-environmental sustainability linked with people's collective rights, seeking to reterritorialize space in response to capitalist territorialisation (Assentamento Mário Lago and FCT).

Organization of labour and product certification for market access

Fazenda da Toca operates a conventional division of labour, differentiating between waged manual workers and professional staff. For management tasks, a Board of Directors sets the pathways for production and commercialization, likewise all logistics of transport and markets. Its markets have a conventional long food chain. Products gain certification by *auditoria*, i.e. third-party validation for its own brand, *Toca Orgânico*. Products are sold as 'healthy food' from healthy processes: 'We cultivate and harvest true food and create a better world which eats well' (Fazenda de Toca Orgânica, n.d.).

The farm produces fruits, dairy products and eggs on a large scale. Although it has a juice plant, the fruits are mainly sold as primary materials for processing into pulp. The final products are commercialized at various sites: wholesale (by food-processing companies) and retail (by supermarkets and shops in general). A large part of the production goes to São Paulo municipality, especially through four large companies which control the processing and sales of fruit in the state. Thus the Fazenda reinforces the hegemonic system of long supply chains.

Estância Demétria gains biodynamic certification through participatory systems. All families and staff take part in the cultivation work, thus getting 'callouses on their hands' (interview, 03.09.2017). Their products are commercialized through short food-supply chains, e.g. the farm's on-site Instância Demétria, organic fairs in São Paulo, Demétria's Bioloja shop there and in smaller quantities at other sales points. All these markets depend on consumers who support biodynamic practices. All its processed products bear the Demétria label, though commercialization is done individually: each family there is responsible for selling its own products. For the slow pasteurization prior to producing cheeses and yoghurts, hygiene certification is done by the Serviço de Inspeção Estadual (SIE).

Assentamento Mário Lago likewise commercializes its products through short food-supply chains based on solidarity from consumers. It obtains organic certification through an Organização de Controle Social (OCS); 'social control' means that within each group 'there is a relationship of organization, commitment and trust amongst the participants' (MAPA, 2008). Several NGOs had built a campaign demanding that the Agriculture Ministry authorise such a system. Afterwards an NGO produced films promoting the new OCS system amongst small-scale farmers:

Farmers participate by managing the system and by visiting each other, peasant-to-peasant, which they call 'peer-to-peer'. The visits construct knowledge and verify that the standards have been followed. This interchange doesn't happen with systems of *auditoria* [third-party]… Peasants also prefer OCS because it has less bureaucracy; they have an allergy to bureaucracy (interview, Instituto Giramundo Mutuando, 04.09.2017).

This participatory process depends on peasants' shared knowledge and political support from civil society organisations (for the broader context, see Martinéz-Torres and Rosset, 2014). Moreover, OCS has a much lower cost, enabling access to family farmers. This facilitates commercialization and greater access to consumers. By contrast, commercial organic products are available 'only to those who can pay' the premium price (Hashimoto, 2017: 253).

For Mário Lago's short food chains, its products are sold collectively through Community-Supported Agriculture (CSA); consumers pay a subscription to receive weekly food boxes. Similar products are also commercialized in fairs, shopping centres and stalls nearer the centre of Ribeirão Preto. The Assentamento discusses and decides collectively on the contents and prices of the boxes. It also sells food through local authority arrangements for public procurement mandated by the Federal government (PAA and PNAE). Work teams rotate across the various tasks: cultivation, food boxes, prices, transport, even security, thus constructing a horizontal organization.

The FCT has developed and promoted agroforestry systems inside the Mata Atlântica, where agricultural work continues on a family basis. Without official certification, its products are commercialized collectively: through school food procurement (PAA and PNAE), public fairs, various regional markets and at its own restaurants, e.g.Quilombo do Campinho. As a novel feature, the FCT has created a Turismo de Base Comunitária (TBC), community-based tourism, for expanding short supply chains for a solidarity economy. The restaurant and its agroforestry products provide a showcase for the TBC, in turn highlighting the communities' role in conserving the forest.

Relationships with the hegemonic system and public policies

This parameter has two aspects: 1) how the initiatives accommodate and/or transform the hegemonic political-economic system; and 2) how the initiatives depend on or utilise public policies; two cases in particular have a strong dependence.

As regards the first question, the four cases illustrate alternatives to the Green Revolution through different relationships with the dominant agrofood system. Fazenda da Toca abandoned chemical inputs that had been used in the former production system, by adapting Sistemas Agroflorestais (SAF) for large-scale production. It uses public policies (PNAPO) to supply organic ingredients for the major food-processing companies.

Estância Demétria seeks to conscientize individuals to establish a healthier relationship between society-nature and, at the same time, to establish new market niches which provide a stable economic base. It is located within a cluster of diverse organic farms, whose environmental conservation attracts urban residents seeking a better quality of life. This has generated a paradoxical effect: the rising land value has transformed the district into a site of luxury condominiums, thus limiting any further agricultural expansion (interview, 03.09.2017). As urban-type development territorializes the cluster's vicinity, it faces constraints or even a threat of being deterritorialized.

The two final cases (FCT and Mário Lago) arose from struggles of traditional communities and social movements, respectively. They work from a collective vision drawing on community experiences in struggling for land and food sovereignty. Thus their territorial conflicts with the hegemonic system has some potential to transform it.

As regards the second aspect:

Assentamento Mário Lago is situated on a former monoculture sugarcane plantation which had been deforested and degraded by the former owners. As a site for recharging the Aquífero Guarani, the land's future sustainability was guaranteed by a partnership between the MST and the Ministério Público Estadual (MPE). The MST signed a Termo de Ajuste e Conduta (TAC) which dedicated 35% to a Reserva Legal, higher than the 20% stated in legislation; at least 15% must be used for Sistemas Agroflorestais Agroecológicos (SAFAS); see the next section). The TAC prohibits the use of chemical inputs and large animals (interview, 05.09.2017).

Alongside the TAC, the Assentamento also signed a Projeto de Desenvolvimento Sustentável (PDS) with the Ministério Público. This committed the Assentamento to environmental improvement of the land (Nunes and da Silva, 2016). Like other MST settlements with PDS agreements, Mário Lago has a cooperative structure which

facilitates access to government support measures, especially food procurement sales and technical assistance (Retratos, 2016).

The FCT illustrates how traditional communities confront various threats from dominant policies. Urbanisation, tourism and nature protection measures have been expanded throughout coastal areas, dispossessing communities from their traditional lands and ways of life (Ferreira & Carneiro, 2005). As a form of resistance, the FCT has organised activities around nature conservation, agroforestry and political defence. The Federal agency SEMEIA carries out government policy on improving public access to conservation areas, potentially by privatising the management, so the FCT has counterposed a community version of the public interest, e.g. criticising 'the myth of untouched nature'.

In 2016 large real estate companies proposed to change the ecological zoning of the Litoral Norte (ZEE-LN). A proposed constitutional amendment (PEC 215), moreover, would transfer from state bodies to the Federal Congress any final decision on control over the lands of traditional communities. In response to this dual threat, the FCT asserted the communities' land rights and demanded a guarantee that any changes do not jeopardise their ways of life; to gain wider support, it organised protests and spoke at public hearings (Nonada, 2017). In various ways the FCT has sought to reterritorialize its space through collective activities which can prevent, or at least limit, being deterritorialized by urbanization; see next section.

Knowledge and technological innovation

Fazenda Toca is an organic agribusiness with a strong research investment in agroforestry. Its methods originated from Agricultura Sintrópica, enhancing symbiotic relationships amongst plants. This had been adapted by Ernst Gotsch to Sistemas Agroflorestais (SAFs) for large-scale fruit production. The Fazenda's professional team adapted this method, based on knowledge of the native flora. Its methods are promoted as a widely relevant innovation for conserving natural resources: 'We are helping to construct an identity, designing strategies to create a positive impact on the planet' (*Época Negocios*, 2017). It offers courses, holds public events and hosts residencies to share its experiences; these include visits by the Assentamento Mário Lago (interview, 04.09.2017).

Estância Demétria produces food through biodynamic agriculture, intensifying natural processes in order to 'produce while caring for nature' (interview, 03.09.2017). Demétria seeks to maintain biodiversity, respecting natural cycles and recycling resources between animals and plants. To promote its aims, it gives courses for the farm labourers and for fellow farmers of the Associação Biodinâmica. It hosts farmers, researchers and students interested to know about the farm's experiences. 'I call this neighbourhood an *intelectualização* [intellectual hub or nexus] of organic agriculture' (interview, 03.09.2017).

As at Estância Demétria, biodynamic agriculture maintains a vision of the farm as an organism in which the specificity of each element must be respected. Beyond this: 'The Estância orients agricultural practices which respect nature as: an interaction between animal and crop production; an astronomic orientation for identifying periods for planting seeds and other cultivation activities; the use of green fertiliser from animal, crop and mineral substances' (Casa, 2008. p.12), thus recycling resources.

Assentamento Mário Lago has adapted Agricultura Sintrópica for socio-environmental objectives through Sistemas Agroflorestais Agroecológicos (SAFAS). The extra word *agroecológicos* denotes the systematic knowledge-exchange networks building the wider agroecology movement. Extending SAFAS, reforestation serves as much to produce healthy food and provide income as to recover the land; the latter role fulfils the Federal agreement to help replenish the aquifer. Through the government programme of technical assistance, the Assentamento has adapted scientific-agronomic knowledge in its field practices, a focus which helps to avoid disagreements with external technicians. The MST 'has been using the knowledge of technicians who have been trained within its own settlement' (Retratos, 2016: 55).

The Assentamento participates in Projeto Agroflorestar, promoting knowledge for 'a regenerative agriculture which promotes food sovereignty' (Basso, 2016), as well as Projeto Flora, managed by the Instituto Contestado de Agroecologia (ICA). Both projects have been sponsored by the Programa Petrobras Socioambiental. A main task is to 'spread agroecology and agroforestry systems in other settlements in the state' (interview, Mário Lago, 05.09.2017).

The Assentamento's participatory processes seeks continuous improvement: 'Our agroforestry práxis will never be a final technology, ready to be simply adopted; it will always be possible to do it better' (Cooperaflorestar, 2016b: 19). Its main pillars include: participatory planning, cultivation, monitoring, evaluation and training (Nunes and da Silva, 2016: 46). Given the high cost of drip irrigation technology, the small-scale farmers seek alternatives: designing systems with plants better adapted to drought and providing a sufficient productivity (Nunes and da Silva, 2016: 51). As examples, 'We have been working with the problems of of social technologies for capture, storage and treatment of water' (interview, 05.09.2017). All these can be seen as social-environmental technologies.

The FCT has worked in the traditional agroforestry system of the Mata Atlântica to maintain its forests and produce food, linked with tourism. Its Projeto Juçara gained support from the government's Projeto AMÁVEL (A Mata Atlântica Sustentável). Created in 2009 by the Ministério da Agricultura, AMÁVEL has helped farmers to generate income from standing trees while also conserving them. The juçara fruit has an unusually high concentration of beneficial anti-toxins and anti-carcinogens, yet the tree was threatened with extinction by intensive harvesting for timber markets. To protect and repopulate the juçara tree, Projeto Juçara has combined nature conservation with new solidarity markets.

In the medium term Projeto Juçara has sought to become self-sustaining in several ways: selling the fruit pulp in shops and export markets; generating income for owners of protected forests; and likewise for businesses that process the pulp into food products. Its biodynamic agroforestry methods are certified by the Instituto Biodinâmico (IBD). Within Projeto Juçara, the business is a collective self-organization of traditional communities. It seeks to establish short supply chains in three phases: producing primary materials (raw products), transforming them into products, and commercializing them.

For such novel forms of production, the FCT has promoted a dialogue between traditional knowledge and new knowledge from NGOs, universities and scientists, especially through state support programmes. The quilombo community has hosted visits from the the Federal agri-research agency, in particular its 'technological caravan for family agriculture'; this advised residents on converting their artisanal methods into professional ones for large-scale pulp processing and year-round marketing (Embraba, 2017). In the Praia do Sono, a coastal area which had become notorious as a sewer, they have extended permaculture methods as a social technology for ecological clean-up (OTSS, 2018).

From such activities, the FCT's Projeto Juçara won a 2016 competition for its social technology: the *Prêmio Fundação Banco do Brasil de Tecnologia Social.* 'With a socio-environmental perspective, [the FCT is] an incubator of social technology, which we are implementing on a larger scale... We must dialogue with the partners, much along lines of action-research' (interview, FCT, 07.09.2017).

In those ways, the Assentamento Mário Lago and FCT alike define their own basis for a knowledge exchange with agroecological experts, towards improving and applying agroecological systems as an affirmation and tool of their collective struggle for territory.

CONCLUSION

This article has analysed diverse relationships between agroecological practices and territorial development as a conflictual space. Here we understand territory as marked by dynamics of territorialization, deterritorialization and reterritorialization (TDR, as in section 2). Territorial development defines specific trajectories, at the same time as it is defined by them, as social relations of power.

Our analytical schema illuminates how agroecological practices are appropriated for diverse trajectories of territorial development, thus enriching the concept. Case-study initiatives were analysed through four parameters: i) origin and aims; ii) work organization and product certification for market access; iii) relationships with the hegemonic system and public policies; and iv) knowledge and technological innovation (see Table in separate file).

Four initiatives compared as territorial development

Appropriating agroecological practices of various kinds, all four initiatives promote themselves as showcases for environmentally sustainable methods which should be widely adopted. As analysed here, each corresponds with

different aims, trajectories, socio-economic arrangements and potential futures. Fazenda da Toca and Estância Demétria illustrate agroecological practices for niche markets outside any perspective of social struggle. 'We should never confuse agroecology with various ecological agricultures which seek to fill a market niche' (interview, MST, Assentamento Mário Lago, 07.09.2017). By contrast, the other two confront the hegemonic system and depend more on public policies. In particular, case by case:

Fazenda da Toca appropriates agroforestry methods to sell its own-brand certified organic products through conventional markets, seeking better prices and profits for 'healthy food'. Towards accumulating capital, this business territorializes land already degraded by the previous system, improving its environment and enhancing commercial value through long supply chains. It maintains a conventional division of labour and reinforces the main food distributors, thus reproducing the hegemonic system,

Estância Demétria's biodynamic practices have maintained biodiversity in the area and its own economic sustainability through access to market niches. Its products are certified through participatory systems with its own brand and are commercialized in specific markets through short supply chains. It contributes to an organic cluster of nearby organic farms, territorializing a space which promotes methods sustaining biodiversity, but with a paradoxical effect: The nearby land gains commercial value for luxury condominiums, impeding greater cultivation. Thus the space attracts two contradictory forms of territorialization: organic production versus urbanization for capital accumulation; the latter threatens to deterritorialize (or at least constrain) the biodynamic cluster.

The other two cases (Assentamento Mário Lago and FCT) construct a solidarity economy, dependent on their own political capacities to gain support from civil society and to use various public policies. Driven by territorial conflicts, they resist the hegemonic system; they struggle for land, for nature conservation, for food sovereignty. They seek autonomy as subjects of their lives, collectively devising and adapting socio-environmental technologies (*tecnologias socioambientais*) to achieve their objectives.

In particular, attracting workers who had been deterritorialized by agribusiness, Assentamento Mário Lago gained land tenure through the Reforma Agraria. It reterritorializes a peri-urban area which had been degraded by the previous landowners. For its environmental commitments to Federal agencies, as well as its own objectives, it has adapted Sistemas Agroflorestais Agroecologicos (SAFAS) by incorporating technical expertise from state support agencies.

The Fórum de Comunidades Tradicionais (FCT) represents diverse ethnic groups which have been maintaining their space for several centuries through traditional cultivation practices. To defend their territory, the FCT unites those diverse communities through political demands, agroforestry, novel food production and Turismo de Base Comunitario. Its Projeto Juçara has been establishing short food chains for juçara fruit products, aiming to conserve natural resources and increase income on a collective basis. The FCT fights against a rezoning proposal for a real-estate territorialization, which threatens their way of life.

Schema for strategic implications

Let us return to territorial development perspectives from the Introduction, whereby agroecological transition includes the task of 'managing conflicts in territories…' (FAO, 2018). Any policy framework favours some objectives, multi-stakeholder networks and societal futures over others. A mediator cannot neutrally manage such conflicts, as if from outside or above them. Any conflict management warrants a caveat about dominant agendas co-opting social movements into a so-called 'development' within capital accumulation (cf. Giraldo and Rosset, 2018).

A transformative role depends on reterritorializing space, building a solidarity economy and confronting the hegemonic system. The TDR framework provides a basis for clarifying power relations and territorial conflicts – indeed, struggles over the meaning of territory. To build an agroecological transition, it is necessary to identify the actors promoting diverse territorial objectives and development trajectories, which may be complementary or contradictory, thus shaping societal conflicts and alliances.

Starting from our analytical schema, further investigation could identify how each parameter articulates a vertical scale-up of institutional support measures with a horizontal scale-out or expansion of agroecological practices (cf. Gonsalves, 2001). Such analysis would facilitate 'a strategic reading of territory' (IMCA, 2014). This provides a stronger basis for agroecology practitioners to construct multi-stakeholder expansion strategies as a collective struggle over territory. Beyond agroecology, the schema has wider relevance to dynamics and trajectories of territorial development.

REFERENCES

Glossary: Brazilian institutions

A Mata Atlântica Sustentável: Sustainable Atlantic Forest

Áreas de Preservação Permanente: Areas of Permanent Conservation

Movimento dos Trabalhadores Rurais Sem Terra (MST): Movement of Landless Workers

Organização de Controle Social (OCS): Social Control Organization

Plano de Desenvolvimento Sustentável (PDS): Sustainable Development Plan

Política Nacional de Segurança Alimentar e Nutricional: National Food Security Policy

Programa de Aquisição de Alimento (PAA): Food Procurement Programme

Programa Nacional de Alimentação Escolar (PNAE): National Programme of School Food

Programa Nacional de Assistência Técnica e Extensão Rural (PNATER): National Programme of Technical Assistance and Rural Extension

Promotoria de Conflitos Fundiários do Meio Ambiente: Attorney for Environmental Conflicts

Sistemas Agroflorestais Agroecológicos (SAFAS): Agroecological Agroforestry Systems

Termo de Ajustamento de Condutas (TAC): Terms of Compliance Adjustment(?)

REFERENCES

Abreu, L.S. et al. 2009. Trajetórias da agroecologia no Brasil: entre movimentos sociais, redes científicas e políticas públicas, *Rev. Bras. De Agroecologia* 4(2): 1613-14.

Abreu, L.S. et al. 2012. Relações entre agricultura orgânica e agroecologia: desafios atuais em torno dos princípios da agroecologia, *Desenvolvimento e Meio Ambiente* 26: 143-160, jul./dez. 2012. Editora UFPR.

Agenda Gotsch, n.d. Agricultura Sintrópica, http://agendagotsch.com/pt/syntropy

Altieri, M.A. 2002. *Agroecologia: Bases Científicas para uma Agricultura Sustentável*. Guaíba: Agropecuária.

Altieri, M.A. 2008. *Scaling Up Agroecological Approaches for Food Sovereignty in Latin America*.

Altieri, M.A.; Toledo, V.M. 2011. The agroecological revolution in Latin America: rescuing nature, ensuring food sovereignty and empowering peasants, *Journal of Peasant Studies* 38: 587-612.

Basso, J. 2016. *Agroflorestando o mundo de facão ao trator, Cooperafloresta*/Programa Petrobras Socioambiental, http://www.agroecologia.org.br/2016/10/05/agroflorestando-o-mundo-de-facao-ao-trator-livro-sintetiza-construcao-coletiva-do-conhecimento-agroflorestal/, https://docs.wixstatic.com/ugd/e4b2ec_6f67a1a70da04f54b839e2224c3af5ba.pdf

Borsatto, R.S; do Carmo, M.S. 2013. A construção do discurso agroecológico no Movimento dos Trabalhadores Rurais Sem-Terra (MST), Revista de Economia e Sociologia Rural 51(4), Oct./Dec. 2013, http://dx.doi.org/10.1590/S0103-20032013000400002

Brandenburg, A. 2002. *Movimento Agroecológico: trajetória, contradições e perspectivas. Caminhos da agricultura*. ANPPAS. Disponível em: file:///C:/Users/Prof.%20Davis/OneDrive/Documentos/Publica%C3%A7%C3%B5es/LES/8346-1-34495-1-10-20100105.pdf

Brasil. 2003. Lei de Orgânicos n.10.831, 23 de dezembro de 2003.

Casa, J. 2008. Controle fitossanitário no cultivo do tomateiro nos sistemas orgânico e biodinâmico de produção, Botucatu – SP, Universidade Estadual Paulista "Júlio De Mesquita Filho" Faculdade De Ciências Agronômicas, http://www.pg.fca.unesp.br/Teses/PDFs/Arq0277.pdf

Caporal, F. R.; Costabeber, J. A. 2002. *Agroecologia: enfoque científico e estratégico para apoiar o desenvolvimento rural sustentável*. Porto Alegre: EMATER/RS-ASCAR (Série Programa de Formação Técnico-Social da EMATER/RS. Sustentabilidade e Cidadania, texto 5),.

Cassin, M. & Nali, L. 2016. Assentamento Mário Lago: espaço de formação política, qualificação técnica e educação escolar, *Revista HISTEDBR* On-line, Campinas, nº 68, p. 358-370, junho 2016.

CIAPO. 2013. *Brasil Agroecologico: Plano Nacional de Agroecologia e Produção Orgânica (PLANAPO)*. Ministério do Desenvolvimento Agrário. Câmara Interministerial de Agroecologia e Produção Orgânica (CIAPO), 2013, http://www.mda.gov.br/sitemda/sites/sitemda/files/user_img_19/BrasilAgroecologico_Baixar.pdf

Cooperafloresta. 2016a. *Familias assentados reflorestam Ribeirão Preto: Produzimos productos organicos: coopere e usufrua*, www.cooperafloresta.com.br, https://docs.wixstatic.com/ugd/e4b2ec_d07eeebb138d46018cc0048beb9ae298.pdf

Cooperafloresta. 2016b. *Sistemas agroflorestais agroecológicos em assentamentos da reforma agrária*, www.cooperafloresta.com.br, https://docs.wixstatic.com/ugd/e4b2ec_f8589733319d4c48b38500d0c95ce565.pdf, http://www.nonada.com.br/2017/06/o-canto-de-tres-povos/

Nonada. 2017. O canto de três povos: comunidades quilombolas, indígenas e caiçaras se unem para preservar suas culturas, 29 de junho, 2017, http://www.nonada.com.br/2017/06/o-canto-de-tres-povos/

CRATS. 2016. Centro de Referência em Agroecologia e Tecnologias Sociais é inaugurado em Brasília,

https://www.fbb.org.br/pt-br/ra/conteudo/centro-de-referencia-em-agroecologia-e-tecnologias-sociais-e-inaugurado-em-brasilia-4,

Da Costa, M.B.B. et al. 2017. Agroecology development in Brazil between 1970-2015, *Agroecology and Sustainable Food Systems* 41(3-4): 276-295, DOI: 10.1080/21683565.2017.1285382

Dagnino, R.P. 2009. *Tecnologias sociais: ferramenta para construir outra sociedade*. Campinas: Unicamp.

De Schutter, O. 2011. Agroecology and the Right to Food: Report submitted by the Special Rapporteur on the right to food. United Nations Human Rights Council, New York, NY.

Delgado, F.; Rist, S. Ciências. 2016. Diálogo de saberes y transdisciplinariedad: aportes teórico metodológicos para sustentabilidade alimentaria y del desarollo. La Paz, Agruco.

Ehlers, E. 1999. *Agricultura sustentável: origems e perspectivas de um novo paradigma*. Guaíba: Agropecuária,.

Embrapa Noticias. 2017. Caravana Tecnológica leva orientações aos produtores de juçara em Paraty, 20/03/17, https://www.embrapa.br/busca-de-noticias/-/noticia/21372562/caravana-tecnologica-leva-orientacoes-aos-produtores-de-jucara-em-paraty 2017

Época Negocios. 2017. Empresa de produtos orgânicos deixará de produzir sucos e molhos; comunicado afirma que decisão não foi motivada por desentendimento entre Pedro e Abilio Diniz, *Época Negocios,* 24 January, http://epocanegocios.globo.com/Empresa/noticia/2017/01/fazenda-da-toca-de-pedro-paulo-diniz-muda-de-foco-e-encerra-linhas-de-produtos-para-o-varejo.html

FAO. 2017. *Políticas públicas a favor de la agroecología em América Latina y El Caribe*, Eric Sabourin et al. (organizadores). Porto Alegre : Evangraf. Criação Humana , Red PP-AL: FAO.

FAO Chair's Summary. 2018. *FAO's Work on Agroecology: A pathway to achieving the SDGs*, 2018, fao.org/3/i9021en/I9021EN.pdf

FAO. 2018. Chair's Summary, 2nd International Symposium on Agroecology: Scaling-up Agroecology to contribute to the Sustainable Development Goals, 3-5 April 2018, Rome, http://www.fao.org/about/meetings/second-international-agroecology-symposium/en/

Fazenda Toca (n.d.) Nossa História, http://fazendadatoca.com.br/nossa-historia/

Fazenda de Toca Orgânica (n.d.) Produção, http://fazendadatoca.com/

Fernandes, B. M. 2005a. Territorialização da luta pela terra. In.: Motta, M. (org). *Dicionário da Terra*. Rio de Janeiro: Civilização Brasileira.

Fernandes, B. M. 2005b. *Questão agrária : conflitualidade e desenvolvimento territorial*, http://www.reformaagrariaemdados.org.br/sites/default/files/FERNANDES%202004%20quest%C3%A3o%20agr%C3%A1ria%20conflitualidade%20e%20desenvolvimento%20territorial.pdf

Fernandes, B. M. 2013. *Construindo um estilo de pensamento na questão agrária: o debate paradigmático e o conhecimento geográfico v.1-2*: Tese (livre docência) - Universidade Estadual Paulista, Faculdade de Ciências e Tecnologia - Presidente Prudente

Ferreira, H. & Carneiro, M.J. 2005. Conservação ambiental, turismo e população local, *Cad. EBAPE.BR* vol.3 no.3 Rio de Janeiro, http://dx.doi.org/10.1590/S1679-39512005000300004, http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1679-39512005000300004

Fressoli, M. and Dias, R. 2014. *The Social Technology Network: A hybrid experiment in grassroots innovation*, STEPS Working Paper 67, Brighton: STEPS Centre.

Giraldo, O. & Rosset, P.M. 2017. Agroecology as a territory in dispute: between institutionality and social movements, *Journal of Peasant Studies* 45(3): 545-564.

Gliessman, S. R. 2000. *Agroecología: Processos Ecológicos em Agricultura Sustentável.* Porto Alegre: UFRGS.

Gliessman, S. R. (ed.) 1990. *Agroecology: researching the ecological basis for sustainable agriculture*. New York: Springer-Verlag.

Gliessman, S. R. 1984. An agroecological approach to sustainable agriculture. In W. Jackson, W. Berry. and B. Colman (eds.), *Meeting the Expectations of the Land.* Berkeley: Northpoint Press, pp.160-171.

Gonsalves, J.F. 2001. Escalar: lo que hemos aprendido en los últimos talleres, *LEISA: Revista de Agroecología* 17(3): 5-9.

Haesbaert, R. 2004. *O Mito da Desterritorialização: do "fim dos territórios" à multiterritorialidade*. Rio de Janeiro: Bertrand Brasil.

Hashimoto, M. 2017. *Um estudo do processo de recampesinização no assentamento Mário Lago em Ribeirão Preto*.

Holt Giménez, E.; Altieri, A. 2013. Agroecology, food sovereignty, and the new Green Revolution, *Agroecology and Sustainable Food Systems*, 37:1, 90-102.

Holt Giménez, E.; Shattuck, A. 2011. Food crises, food regimes and food movements: rumblings of reform or tides of transformation?, *Jnl of Peasant Studies* 38(1): 109-44.

IFAD. 2016. *Rural Development Report*: *Fostering Inclusive Rural Transformation*, Chapter 1: Structural and rural transformation in Latin America and the Caribbean, Rome: International Fund for Agricultural Development (IFAD), https://www.ifad.org/documents/30600024/530425ec-130b-461d-80ef-b2c5f1eda2f5

IMCA. 2014. *Gestión de procesos económico – productivos de alcance territorial desde el enfoque del desarrollo alternativo. Síntesis del camino*. Instituto Mayor Campesino& Suyusama (Colombia), https://compartedesarrollo.files.wordpress.com/2013/08/borrador-publicacic3b3n-desarrollo-territorial-doc.pdf

ITS. 2004. *Caderno de debate. Tecnologia Social no Brasil*, Sao Paulo: Instituto de Tecnologia Social (ITS).

Le Coq, J-F. et al. 2017. Conceptos de agroecología y marco analítico, em *Políticas públicas a favor de la agroecología em América Latina y El Caribe*, pp.13-32, Eric Sabourin et al. (organizadores). Porto Alegre: Evangraf. Criação Humana , Red PP-AL: FAO.

Lefebvre, Henri. 2000. *A produção do espaço*. Trad. Doralice Barros Pereira e Sérgio Martins (do original: La production de l'espace. 4e éd. Paris: Éditions Anthropos. Disponível em: https://gpect.files.wordpress.com/2014/06/henri_lefebvre-a-produc3a7c3a3o-do-espac3a7o.pdf.

Leite, S., Delgado, N. (coord.) 2011. *Políticas Públicas, Atores Sociais e Desenvolvimento Territorial no Brasil*. Brasília: Instituto Interamericano de Cooperação para a Agricultura (IICA), 2011.

Levidow, L. 2015. European transitions towards a corporate-environmental food regime: agroecological incorporation or contestation?, *Jnl of Rural Studies* 40: 76-89.

Levidow, L., M. Pimbert and G. Vanloqueren. 2014. Agroecological research: conforming—or transforming the dominant agro-food regime? *Agroecology and Sustainable Food Systems* 38(10): 1127–55.

MAPA. 2008. Controle social na venda direta ao consumidor de produtos orgânicos sem certificação. Brasília: Ministério da Agricultura, Pecuária e Abastecimento (MAPA).

Martinéz-Torres, M. E. and Rosset, P.M. 2014. *Diálogo de saberes* in La Vía Campesina: food sovereignty and agroecology, *Journal of Peasant Studies* 41: 979-997, http://dx.doi.org/10.1080/03066150.2013.872632

Matos, A.K.V. 2010. *Revolução verde, biotecnologia e tecnologias alternativas*. Cadernos da FUCAMP, 10(12): 1-17.

MDA. 2005. *Marco Referencial para Apoio ao Desenvolvimento de Territórios Rurais*, Ministério do Desenvolvimento Agrário (MDA), Secretaria de Desenvolvimento Territorial (SDT), http://sge.mda.gov.br/bibli/documentos/tree/doc_214-28-11-2012-11-32-675117.pdf

Nunes, P.J.; da Silva, T. B. 2016. Implantação de sistemas agroflorestais: a experiência do assentamento Mário Lago, Ribeirão Preto, Estado de São Paulo, *Informações Econômicas*, SP, 46(3): 42-53, maio/jun de 2016, http://www.iea.sp.gov.br/ftpiea/publicacoes/ie/2016/tec4-0616.pdf

OTSS. 2018. Saneamento Ecológico da Praia do Sono finaliza mais uma etapa,

Observatório de Territórios Sustentáveis e Saudáveis da Bocaina (OTSS), http://otss.org.br/2018/06/08/saneamento-ecologico-da-praia-do-sono-finaliza-mais-uma-etapa/

PIADAL. 2013. *Agricultura y desarrollo en América Latina. Gobernanza y políticas públicas*. Buenos Aires: TESEO, Panel Independiente sobre Agricultura para el Desarrollo de América Latina (PIADAL).

Pires, J.H.S. and Novaes, H.T. 2016. Estudo trabalho e agroecologia: a proposta política pedagógica dos Cursos de Agroecologia do Mst no Paraná. *Germinal: Marxismo e Educação em Debate*, Salvador, v. 8, n. 2, p. 110-124, dez. 2016.

PRONERA. 2016. *Desenvolvimento Territorial: Desenvolvimento Sustentavel dos Assentamentos Federais*. Brasilia: Programa Nacional de Educação na Reforma Agrária (Pronera).

Rafestin, C. , 1993. *Por uma geografia do poder*. São Paulo: Ática.

Ranaboldo, R. y Venegas, C. 2007. *Escalonando la Agroecología: Procesos y aprendizajes de cuatro experiencias en Chile, Cuba, Honduras y Perú*. Ottawa: IDRC/CDRI.

Retratos de Assentamentos. 2016. Revista do Núcleo de Pesquisa e Documentação Rural (Nupedor) 19(1): 1-384. UNIARA, https://www.uniara.com.br/arquivos/file/nupedor/revista-retratos/edicoes/retratos-1901-2016.pdf

Rosset, P.M. 2003. Food sovereignty: Global rallying cry of farmer movements. Food First Backgrounder 9(4).

Rosset, P.M. 2009. Food sovereignty in Latin America: confronting the new crisis. NACLA. Report on the Americas. May–June, 16–21.

Rosset, P.M. and Altieri, M.A. 2017. *Agroecology: Science and Politics*. Manitoba: Fernwood.

Rosset, P.M. and M.E. Martínez-Torres. 2012. Rural social movements and agroecology: context, theory, and process. *Ecology and Society* 3(17), https://www.ecologyandsociety.org/vol17/iss3/art17/

Rosseto, P. 2014. Comunidades tradicionais se unem por preservação em Ubatuba, *Imprensa Livre*, 02 de Julho 2014, http://www.meon.com.br/noticias/regiao/comunidades-tradicionais-se-unem-por-preservacao-em-ubatuba

Saquet, M. A. 2009. Reterritorialização e Identidade. In.: Medeiros, R. M. V; Falcade, I. (orgs). *Tradição versus tecnologia: as novas territorialidades do espaço agrário brasileiro*. Porto Alegre: Ed. da UFRGS,.

Saquet. M.A. 2013. *Abordagens e concepções de território*. 3° Ed. São Paulo: Outras Expressões.

Saquet. M.A. and Sposito, E.S. 2008. Território, territorialidade e desenvolvimento: diferentes perspectivas no nível internacional e no Brasil, em A.F. Alves et al. (orgs), *Desenvolvimento territorial e agroecologia*, pp.15-32. Grupo de Estudos

Territoriais (GETERR), SP: Editora Expressão Popular Ltda, https://www.macroprograma1.cnptia.embrapa.br/agroecologia/programa-de-formacao-textos-de-apoio/programa-de-formacao-textos-de-apoio/desenvolvimento-territorial-e-agroecologia/view

Schmitt, C. et al. 2017. La experiencia brasilena de construccion de políticas públicas a favor de la Agroecologia, em *Políticas públicas a favor de la agroecología em América Latina y El Caribe*, Eric Sabourin et al. (organizadores). Porto Alegre : Evangraf. Criação Humana , Red PP-AL/FAO, pp.73-122.

Schütz, G. D. and Gaiger, L.I. 2006. O mister de reaprender os vínculos entre a economia e a vida social. In: Zart, Laudemir L. e Santos, Josivaldo C. (Orgs) *Educação e Sócio-Economia Solidária: Interação Universidade–Movimentos Sociais*. Série Sociedade Solidária (Vol. 2). Cáceres-MT: Editora Unemat,

Schwab, F and Collado, Á.C. 2017. *Experiencias Agroecológicas de Comercialización en Brasil*, http://elikadura21.eus/wp-content/uploads/2017/04/58-Schwab.pdf

Sebrae Nacional. 2017. O mercado para os produtos orgânicos está aquecido, 21/09/2017, http://www.sebrae.com.br/sites/PortalSebrae/artigos/o-mercado-para-os-produtos-organicos-esta-aquecido,5f48897d3f94e410VgnVCM1000003b74010aRCRD

Serafim, M.P., de Jesus, V.M., Faria, J. 2013. Tecnologia social, agroecologia e agricultura familiar: análises sobre um processo sociotécnico, *Segurança Alimentar e Nutricional, Campinas* 20(Supl): 169-181, https://periodicos.sbu.unicamp.br/ojs/index.php/san/article/view/8634595#

Sevilla Guzmán, E. 2006. Agroecología y agricultura ecológica: hacia una 're'construcción de la soberanía alimentaria. *Revista Agroecología* 1: 07-18, Espanha.

Sevilla Guzman, E., and Woodgate, G. 1997. Sustainable rural development: From industrial agriculture to agroecology, in *The International Handbook of Environmental Sociology*, eds. M. Redclift and G. Woodgate, 93–94. Cheltenham, UK: Edward Elgar.

Silva, P. G. da. 2011. A incorporação da agroecologia pelo MST: reflexões sobre o discurso e experiência prática (Dissertação). Niterói, UFF, Programa de Pós graduação em História.

Simonetti, M.C.L. et al. 2016. Territoraliades em tensção: a reprodução social no assentamento Reunidas, em B.M. Fernandes e J.M. Pereira, (Orgs), *Desenvolvimento territorial e questão agraria*, pp.203-230. Sao Paolo: Culturaa Academica.

Singer, P. e Souza, A. R. de (Orgs). 2000. *A economía solidária no Brasil: a autogestão como resposta ao desemprego*. São Paulo: Contexto.

Toledo, V.M. 1995. *Peasantry, Agroindustriality, Sustainability*: *The Ecological and Historical Basis of Rural Development*. Interamerican Council for Sustainable Agriculture. Working Paper 3. Morelia, Mexico.

Velloso, T.R. 2016. A trajetória do movimento cooperativista: da vertente de controle estatal para instrumento de promoção de desenvolvimento territorial, in Danilo Uzêda da Cruz (org.), *O mundo rural na Bahia: democracia, território e ruralidades*. Feira de Santana: Z Arte Editora.

Wezel, A., and Soldat, V. 2009. A quantitative and qualitative historical analysis of the scientific discipline of agroecology. *International Journal of Agricultural Sustainability* 7(1), 3–18.

Whitacker, G.M. 2012. Agricultura orgânica: estratégia capitalista para (re)produção do espaço rural. Presidente Prudente, Revista Geografia em Atos, Departamento de Geografia da FCT/UNESP, Presidente Prudente, n. 12, v.1, janeiro a junho de 2012, p.75-94.

AFFILIATIONS

LES LEVIDOW is Senior Research Fellow at the Development Policy and Practice (DPP) Group, Open University, UK, L.Levidow@open.ac.uk He has been researching agri-environmental-resource issues since the late 1980s.

DAVIS SANSOLO and **MONICA SCHIAVINATTO**, Instituto de Políticas Públicas and Relações Internacionais (IPPRI), Universidade Estadual Paulista (UNESP), São Paolo.

PS3: ECOLOGISATION AND ANCHORING PROCESSES

The emergence of niches for nature-inclusive agriculture in Dutch dairy production landscapes: key processes for stimulating change

Dorith Vermunt, Simona Negro, Frank van Laerhoven and Marko Hekkert

Wider uptake of sustainable animal production systems: stimulating anchoring of novel designs

Boelie Elzen, Bram Bos, Barbara van Mierlo and Bart Bremmer

Innovation platform as mechanism for resource mobilization and enabling knowledge spaces for Sustainable Land Use

Cristian Matti, Fabrizio Rossi and Valerio Bruschi

A SOCIO-ECOLOGICAL TRANSITION:

key characteristics of the transition to biodiversity preservation in Dutch dairy meadow landscapes

VERMUNT, D.A., NEGRO, S.O, VAN LAERHOVEN, F.S.J. AND HEKKERT, M.P.

Abstract

In this paper, we argue that nature and biodiversity related transition processes differ from well-studied socio-technical transitions like the transition to sustainable energy and mobility. We analyse the transition to sustainable dairy meadow landscapes in the Netherlands. The main difference with other sustainability transitions is that the actors that need to create change are given: the landowners. In transition heuristics, this implies that change needs to be implemented by regime actors instead of newly emerging niche actors. An important change process is therefore engaging landowners by incentivizing them to switch to alternative models where biodiversity is valued. We observe that actors that are not part of this sector (NGO's) often take the initiative. Upscaling was different in this case. Since collective action is important for biodiversity preservation, upscaling was related to engagement of a critical mass of actors in a biophysical landscape that collectively invested in biodiversity. Another difference with other sustainability transitions is that the role of technology is very modest. Novel and sustainable practices are mainly facilitated by new business models instead of new technology. We discuss these differences with socio-technical transition research based on our empirical cases of nature-inclusive agriculture initiatives in the Netherlands.

KEY-WORDS: SUSTAINABLE LANDSCAPES, BIODIVERSITY PRESERVATION, TRANSITION, REGIME ACTORS, INCENTIVE SYSTEMS

INTRODUCTION

The Netherlands is amongst the top five of dairy producers in Europe, and 53% of agricultural land exists of dairy meadow landscapes (CBS 2010). The Dutch agricultural landscape has changed enormously due to agricultural intensification and increasing scales, which resulted in monocultures of grass, managed through the use of chemical inputs and fertilizer (Runhaar 2017). This has led to severe biodiversity losses, habitat loss and degradation of ecosystem services such soil fertility [(Brouwer et al., 2016; Runhaar 2017). Next to ecological impacts, various economic and societal impacts are taking place. A switch is needed towards more sustainable landscape management, to preserve biodiversity and ecosystem services. Landscapes where these various economic, social and ecological values are combined are described in the new Dutch policy concept of 'nature-inclusive farming', adopted by the Ministry of Economic Affairs (EZ, 2014). However, the shift towards nature-inclusive agriculture (NIA) in meadow landscapes is challenging.

First of all, for a switch towards a landscape where biodiversity and ecosystems are preserved, collective action between actors in the landscape are needed. Landscapes are ecological systems that deliver various (shared) outputs such as ecosystem services and biodiversity, when actors manage it collectively in a sustainable way (Ostrom 2007; Young et al. 2006)). Since biodiversity depends on larger scales and ecological networks in the landscape, and certain ecosystem services only operate at bigger scales, collective management is required on a landscape scale (Tscharntke et al. 2015; Prager 2015). This often poses collective action dilemmas. In the case of dairy meadow landscapes, costs of this investments are private, for instance, less intensive use of the landscape leads to lower production for farmers on the short term, whereas the benefits, such as healthy populations of meadow birds, are shared between actors in a landscape. This leads to tendencies for actors to underinvest, and incentives are often needed to overcome these dilemmas (Ostrom, 2009).

A second difficulty is the lock-in of the primary actors that can implement change; the landowners. High dependencies on external actors in the agri-food chain, and lock-in into economies of scale and maximizing of production limits their freedom to make decisions on management (Smit, Driessen, & Glasbergen, 2009; Runhaar 2017). It is stated that interventions by external stakeholders than the direct landscape users are therefore important to achieve nature conservation (Runhaar 2017).

Various initiatives are currently emerging where different types of actors collectively aim for reconciling production on the one hand, and nature conservation and preservation of ecosystem services on the other hand (Runhaar 2017). Knowledge on how these new initiatives emerge is important, since they can serve as examples on how actors can collectively overcome this lock-in of agri-food chains and dilemmas of underinvestment in the SES. Therefore they could provide the 'seeds of change' that could replace current unsustainable trajectories when they gain momentum. However, it is currently understudied how these initiatives initiate and develop, and which processes are important in the first phases of change.

Understanding change processes is explicitly studied within the field of transition studies. However, this literature is often focusing on niches within socio-technical systems, and processes needed for the uptake and diffusion of (sustainable) technological innovations. We assume that this transition to biodiversity preservation is fairly different. First of all, it is embedded in a socio-ecological system, where the actors that need to implement change are given: the landowners. These landowners are regime actors, who are geographically restricted within a landscape, and therefore engaged in specific relationships with the ecological and social system around them. In socio-technical transitions on the other hand, new entrants often introduce new technologies in niches, and eventually hope that their innovation replaces the regime. Secondly, this transition aims for biodiversity protection in agricultural landscapes, which requires other ways of landscape management and organization. This is therefore a socio-institutional innovation rather than a technological innovation.

This paper aims to understand how transition dynamics unfold in this transition towards biodiversity preservation. We focus on engagement of the landowners, the regime actors, in change processes, and how these actors are incentivized, and we discuss the potential for upscaling of biodiversity conservation in dairy meadow landscapes. This will be studied by a case-study on initiatives for nature-inclusive dairy farming in the Netherlands. By comparing our findings to socio-technical transition research, this paper delivers insights in understanding of these types of socio-ecological transitions towards biodiversity preservation, and how this differs from current ST research. Therefore this study could contribute to transitions research by broadening its scope and applicability.

2. THEORY

2.1 Transition studies

Sustainability transition studies aim to address how complex environmental problems can be solved, through deep-structural, systemic changes within various socio-technical domains, such as transport, energy and agriculture (Elzen et al., 2004; Grin et al., 2010; Geels 2011). Alterations are required in the overall configuration of the STS, which consists of various dimensions: markets, policy, consumer practices, technology infrastructure, scientific knowledge and cultural meaning ((Elzen et al., 2004; Geels, 2004; 2014). Transitions are therefore long-term processes that involve multiple actors (Geels 2011; 2014).

Change within unsustainable systems is often difficult to achieve, because existing systems are locked-in by various mechanisms. This lock-in of unsustainable systems is described within the multi-level perspective (MLP) (Geels 2002; 2005a). The MLP describes and conceptualizes overall patterns within socio-technical transitions for three analytical levels. The socio-technical regime is the level where lock-in of existing systems occurs. It is described as the 'deep structure' that provides stability of existing systems (Geels 2004). This stability is mainly due to a set of rules, such as cognitive routines, current regulations and shared beliefs, and established practices (Rip and Kemp, 1998; Geels, 2002, 2005a). The regime can be pressured through the exogenous socio-technical landscape, which includes societal values, demographic trends and macro-economic patterns (Geels 2011). Radical innovation takes place in niches or so called 'seeds for change' (Rip and Kemp, 1998). Niches are (temporarily) protected spaces, such as subsidized demonstration projects or R&D laboratories, where new technologies can incubate and improve through various processes. Niche-innovations can break through (e.g. enter or replace the regime) when pressures arise from the exogenous socio-technical landscape. Multiple regime dimensions need to be challenged (e.g. regulations, cultural meanings, infrastructure) by multiple actors and

interactions between the various levels, for a transition to occur. The transition literature mainly describes how regimes are destabilized (MLP stream) through for example niche innovations, or how an innovation system around a new technology can be developed (Hekkert et al. 2007).

Within the transition literature, change is often initiated by new entrants who develop new technologies. These actors often create niches, and hope that their novelties change value chains to break through regimes (Bryce and Dyer (2007 in: Ansari and Krop 2012). Regime actors, sometimes referred to as incumbent actors, seldomly introduce radical innovations (Chandy and Tellis 2000) The process of change is often threatening, as it might have adverse effects on their existing business practices (Smink et al. 2015). Kishna et al. (2017) made a distinction between two types of incumbents in the agri-food sector: incumbents with power, and incumbents without power. Within agricultural sectors, most actors are incumbent firms with limited resources, power and size, through which it is more difficult to initiate change (Kishna et al. 2017). Private actors moreover often lack direct incentives to address sustainability problems, as it often concerns collective good problems. Therefore, other types of actors are often needed, such as public authorities and civil society, to change consumer practices or economic frame conditions ((Geels; Elzen et al., 2011; Geels 2004 or 2008). Also NGOs can play an important role, by challenging companies and pushing for change (Levy et al. 2016).

2.2. Socio-ecological system studies: a different context

Change is needed within many unsustainable socio-ecological systems to bring these on more sustainable tracks, in order to protect and sustain biodiversity, ecosystem services and well-being of humans over time ((Clark 2001, Westley et al. 2011, Moore et al. 2014). The socio-ecological system literature highlights the linkages and interdependencies between elements of the social system and the biophysical, ecological system (Ostrom 2007); Young et al. 2006). The SES is a biophysically delineated system, where interactions occur between actors, and between ecological system and the social system.

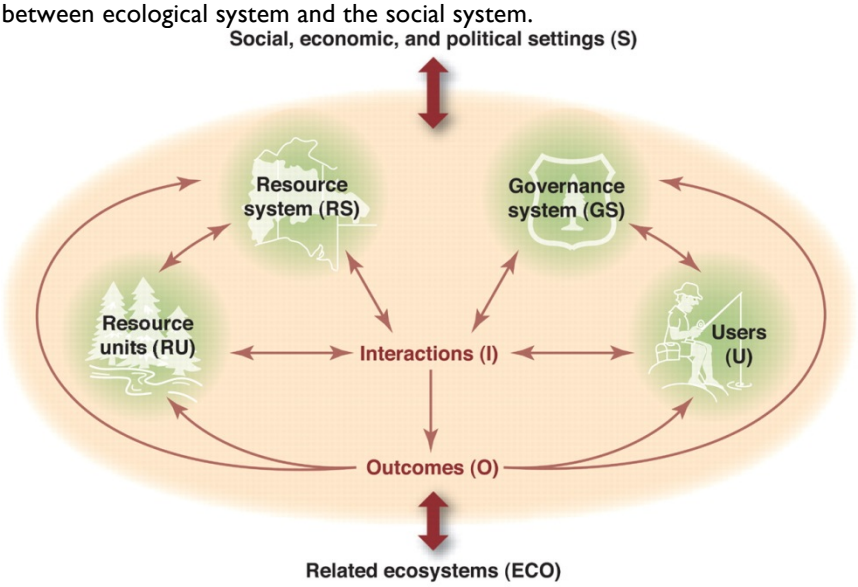


Fig X: Linkages within socio-ecological system (Ostrom 2009)

Since biodiversity and ecosystem services are often common goods and depend on larger scales in the landscape, collective management is required for conservation (Tscharntke et al. 2015; Prager 2015). The SES literature specifically deals with the social dilemmas and struggles that arise from the organization of collective action: actors within SES have the tendency to (1) underinvest in resource systems when the benefits are shared and the costs for the individual, and (2) overharvest resource units when the benefits of harvesting are for individual actors, and the costs of overharvesting are shared. Therefore, conditions for governance systems (e.g. incentives and rules) are important to restrain actors from overusing or underinvesting.

The SES literature mainly tries to understand which factors could explain the likelihood of collective action for sustainable outcomes in SES (Agrawal, 2001; Ostrom 2009). Ostrom (2009) described which variables could explain when actors start to engage in collective action. These variables are often specific for a particular SES, and depends on relationships between actors and the ecological system, and characteristics of actors, and the ecological system under study (Ostrom, 2009; Nagendra and Ostrom, 2014). For instance, whether actors engage depends on the urgency for change in an area. When the ecological system is highly productive, urgency for change may be perceived as low, but when a system is already exhausted, the need for managing it might be

low as well (Ostrom, 2009). The relationships between actors and the ecological system play a role as well: for instance, when actors are dependent on the ecological system for their livelihood, or when actors attach high value to the sustainability of the resource, the likelihood for collective investments in the sustainability of the system become higher. Moreover, actors characteristics play a role: when there is trust between actors, and when actors share the same norms and values, collective action for sustainable outcomes is more likely (Agrawal 2011, Ostrom, 2009). Interactions between actors, as mentioned before, can set conditions for incentives and rules that stimulate sustainable outcomes. Interactions described are information sharing, lobbying activities, networking, monitoring and sanctioning mechanisms, evaluative activities, conflict resolution mechanisms, self-organizing activities and deliberation processes.

3. CASE: DUTCH DAIRY MEADOW LANDSCAPES

Of the Dutch agricultural landscape, 53% consists of meadow landscapes for dairy production (CBS 2010). Grass is the main resource unit that is harvested from this system, since it is used as an input for cow feed. Most farms mainly cultivate and harvest one grass species in their meadows; 'perennial ryegrass', often managed by inputs of fertilizer and pesticides. This individual management of monocultures results in losses of habitat and biodiversity on individual farms, but also results in externalities such as decreasing water quality, soil subsidence and a decline in species richness and abundance (Brouwer et al., 2016; see also EEA, 2015a; 2015b). The most known example is the decline of meadow birds in the Netherlands, such as the Black-tailed Godwit, of which a large part of the European population breeds in this country (Van Der Vliet, et al. 2015 – in Runhaar 2017). Continuation of intensive management of the system (overharvesting), and underinvesting in preservation of ecosystem services and biodiversity will lead to a further degradation of meadow landscapes. Collective investment is therefore needed by the actors involved.

Various actors play a role within this SES. The direct users are farmers, which have the direct influence on how the landscape is managed. Farms have different sizes – but due to enlargement of scales is taking place, through which smaller farmers disappear. However, within this food system, market pressures and regulations influence the extent to which the direct landowners can make decisions on the management of the meadow landscapes. They are highly dependent on, and interact with, external actors in the agri-food chain, such as banks, retailers and food manufacturers (PBL 2014), through which their freedom to change practices is limited (Runhaar 2017). This skewed power division between farmers and actors in the value results in strategies of cost-reduction by farmers – since they are usually 'price-takers' (Assefa et al. 2014; see also Brouwer et al., 2016 in Runhaar 2017). Various new initiatives are emerging, in which incentives are developed for farmers to invest in biodiversity. (Runhaar, 2017). The focus of these arrangements is not exclusively on nature conservation but on sustainable agriculture in a broader sense: soil quality, use of pesticides, water quality, energy, but also biodiversity.

4. METHODOLOGY

4.1 Research design

The aim of this paper is to understand the transition dynamics of this socio-ecological transition where biodiversity is preserved, by focusing on the engagement of landowners, and how this is incentivized. Moreover, we focus on the potential for upscaling. A qualitative multiple-case study is conducted (Eisenhardt (1989)), to generate knowledge and contribute to theory on emergence of change within SES.

4.2. Case selection strategy

Various projects in the Netherlands within dairy farming meadow landscapes are studied where actors experiment with different ways of nature-inclusive landscape management. Cases were selected purposefully and via snowballing methods. Including various initiatives increases the robustness of our theoretical insights (Yin, 2009). Within these cases, we tried to create enough diversity by varying some variables. A combination of cases was chosen where the types of actors differed, and the type of approaches to change differed as well (different *"socio-institutional innovations"*). We varied the cases to the extent of collaboration on a landscape scale: in some,

only a few landowners are still involved, in others, actors already collectively engage on a landscape-scale. The cases are described below:

Case A

In this case, a small group of farmers searched for a way to get a higher price for their milk based on their efforts for nature in Friesland. They collaborated with a dairy consultant, and connected to a new cooperative that was willing to create a separate milk streams that could be valued in the market. A new brand was created by the cooperative, the supply chain actor involved and the farmers. An NGO was involved to legitimize the nature conservation. Currently, a few retailers in the Netherlands sell this product, and the consumer pays 2 cent extra per package for meadow bird conservation. This money is used by the farmers to invest in biodiversity preservation on their dairy farms.

Case B

The NGO and regional coordinator of the agricultural collective initiated this project. The NGO and regional coordinator searched for a way to make conservation of biodiversity in Amstelland sustainable over time, and protect it from urban threats. Two new organizations were developed in this initiative: a new cooperative in which farmers engaged to produce a regional product for the market in Amsterdam, and a new foundation that invests the profits made from this regional product back into the landscape. Permission was needed from the current cooperative of the farmers involved to use 30% of milk for own purpose in their newly established cooperative. In this example, a landscape approach was taken.

Secondly, actors within this case worked on creating favourable leasing conditions of land for farmers, by either buying land or changing land functions from agricultural production land to agricultural nature management, which lowered land prices. This prevented the need for farmers to at the cost of biodiversity due to high land prices. A foundation was developed to buy land.

Case C

In this case, there is a top-down collaboration between three parties: a large cooperative, a bank and an NGO. A large share of the Dutch farmers depend on this cooperative and this bank. Those parties developed an instrument to stimulate biodiversity management, the 'biodiversity monitor', through which farmers that focus on certain KPIs for biodiversity preservation are rewarded. First, actors focused on the development of the biodiversity monitor and identification of factors that contribute to biodiversity (research institutes) and then, implementation of incentivizing farmers is currently done by actors with an influence on farmers, such as the cooperative and bank)

Case D

In this case, a foundation engaged farmers and incentivized them to experiment with new business models for nature-inclusive practices. This foundation cooperated with a landowning organization, that leases land to farmers. In this case, they established conditions for nature-inclusive agriculture that farmers had to adhere to, in order to lease land.

3.3. Data collection and analysis

Qualitative semi-structured were conducted. Interviews allowed us to understand approaches to change in depth. In the interviews, we took into account a few main topics: drivers for change, engagement of actors, incentive models, barrier to change, and potential for upscaling. These topics allowed us to better understand the emergence and potential upscaling of initiatives. Representatives of the different organizations engaged in the projects were interviewed. We aimed for one representative of every organization. Next to this, we held a few context interviews to understand the lock-in within the sector better. In total, about 28 interviews were conducted in the period of October 2017 and June 2018.

Table 1. Overview of nr. of interviews per project

Case	A	B	C	D	Context interviews	Total
Area in NL	Friesland: Idzega	Noord-Holland: Amstelland	All of the NL	Utecht: Vechtse Plassen		
Nr. of interviews	5	5	5	4	9	**28**

Document analysis was used for additional information, but since projects were studied where change was initiated recently (first phases of change) there was often no extensive documentation on the development of the project yet. All interviews were transcribed. Nvivo was used to code all the interviews based on topics of interest described above.

ANALYSIS/RESULTS

In the following section, we discuss three main topics: (1) organization of biodiversity preservation in landscapes (2) the type of actors involved, and how engagement of landowners is incentivized, and (3) potential for upscaling of these innovations.

Socio-institutional innovation: creating value for biodiversity

Biodiversity preservation was mainly said to entail different ways of organization and management of the landscape, by various actors and can therefore be considered mainly a socio-institutional innovation. Different ways of management for example were the creation of meadow birds areas with marshland and puddles, or delayed mowing, to ensure that meadow bird chicks could survive in spring, and planting different types of herb-rich grass that attracted insects and birds. Moreover, next to these different types of management that individual farmers could apply, other cases focused on collaboration in the landscape, by connecting meadow bird reserves via cross-farm collaboration, or by organization actors in the landscape differently to improve connectivity of protected areas for instance. The table below summarized the main approaches per case.

Table 2: approaches for value creation in various cases.

Cases	Creating value for biodiversity in landscape
A	Various indicators for biodiversity developed by farmers and NGO, based on individual farmers that change their management, such as delayed mowing, leaving grassland for marshlands, and sowing herb rich grasses.
B	Landscape approach around core areas for meadow birds, around which buffer areas where farmers farm less intensively, and in the buffer areas farmers take actions of delayed mowing.
C	Indicators for biodiversity conservation for individual farmers. Moreover, indicators are currently developed for biodiversity conservation in landscapes
D	Experimenting with other forms of nature-inclusive management with individual farmers, for example improving soil fertility.

One important challenge with these different types of management of the landscape for biodiversity conservation, was that these actions were said to lower production and income for farmers. Since the current dairy sector was organized around maximum production per hectare, creating marshland areas lowered productive areas. One farmer said to it's cooperative: <<It's a nice story [biodiversity], but my milk is worth less and less [in the market], so the only thing I can do to gain enough income is produce more. You can tell me that I need to produce less, but this will cost me money, so what you need to do is make sure I will earn my money in a different way. That's what it's all about, then everything can be arranged.>>

Types of actors involved and their roles in initiatives

The landowners themselves are the primary actors to implement change. They have weak positions in the supply chain, and are locked-in in current regime structures. Established routines, rules, norms and values influenced how landowners used to manage the landscape. The Dutch dairy regime is focused on efficiency, and maximum production per hectare. Education systems were still focused on how high efficiency could be achieved, and since most farmers had the same education, this was strongly embedded in their business culture and practices. High production levels were often perceived as a status symbol for farmers. Moreover, the actors were dependent on actors around the firm, who also steered towards growth of the farmers, such as their financers, advisors and suppliers. The milk commodity is characterized by bulk production, with two variants: conventional milk and organic milk. Out of the Dutch farmers, 80% delivered milk to the same cooperative in the Netherlands. These barriers were found to make it difficult for farmers to implement change.

Next to landowners, other actors were involved to overcome regime barriers and provide different types of incentives. Agricultural collectives were important landscape actors, that organized the division of subsidies for agricultural nature management amongst farmers in the landscape, and collaborated with farmers to develop landscape management plans in which farmers needed to collaborate to preserve biodiversity. Currently, there are 40 collectives spread over the Netherlands, in which farmers are organized on a regional scale. When subsidy schemes are applied to the region, farmers are often already taking action on a landscape scale for biodiversity conservation. However, subsidy schemes only apply for certain areas in the Netherlands. These collectives had a regional coordinator, who maintained the actual relationships with all the farmers in the area. These actors were very important to build trust between farmers. In case B, the regional coordinator was said to be the key to success of sustainable management, since he knew every farmer on a personal level, and monitored meadow bird populations thoroughly: <<*It's just very important to have someone in the landscape who knows the region, who knows the farmers, who knows which farmers want to collaborate, and who understands how things work. And we have exactly that person in this area.* >>

NGOs were involved in all of the cases, and often contributed by engaging a large network and connecting actors, helping actors with finding resources, and facilitating experimentation and developing market formation. They were often said to increase trust and legitimacy for collaboration, mainly for market actors that demanded nature inclusive products. Value chain actors were involved in two of the four cases (case A and C), and these actors contributed resources to develop knowledge and invest, and market access. The supply chain actors could ensure the production facilities, the presence of a supply chain in which the product could be developed, and could bring in financial resources.

Engaging landowners: overcoming regime barriers

In our cases we found that other actors, such as NGOs, helped farmers to overcome regime barriers to enable change in various ways. Farmers were often bound to certain cooperatives. When farmers wanted to engage in different supply chains, they needed to leave their cooperative, or ask for permission to use a bit of the milk for another supply chain. In case B, permission of the current cooperative of many farmers for this new milk stream was a crucial point. The NGO and the regional coordinator lobbied for a more flexible contract for farmers with the agri-food cooperative, through which they were able to engage with other market actors for nature-inclusive products. Another way of creating opportunities for farmer was by providing financial resources. In the same case, an NGO organized investments for the collective building of a factory. Lastly, these actors organized network structures in which farmers could participate and facilitated pilots and living labs (case D), through which farmers could experiment. Often, these were coordination tasks, that would have been difficult for individual farmers to arrange. NGO: <<A farmer could never had arranged this himself, you know, applying

for subsidies, and arranging permission with the board of their cooperative…thanks to us they now have the opportunity to produce for a new supply chain. We created this space >> (interviewee, case B).

Engaging landowners: incentivizing landowners to engage

Various incentive models were developed in order for farmers to switch management practices. This was done in various ways. One important way was to incentivize farmers with new business models, where biodiversity management was valued in the price. In two cases, the business models that were developed focused on regional products (case A and B). Another way to incentivize farmers was by organizations with an influence on the business of the farmers, such as their cooperatives or banks. Cooperatives could provide a plus on the milk price through bonus-malus schemes, and banks could provide discounts on loans, when farmers invest in biodiversity (case C). Another type of organization that could provide incentives, are landowning organizations, that lease land to farmers. These organizations could provide favourable renting prices to farmers, under the conditions that management was sustainable. Sometimes, no incentives were given, but land was only leased to farmers that applied nature-inclusive practices on their land (case D).

Potential for upscaling

As stated in the introduction, biodiversity conservation in landscapes is mainly useful when organized on a landscape scale, and therefore actors should collectively invest in the landscape to reach positive effects for biodiversity. Upscaling in this case was therefore defined as: the engagement of a critical mass of actors in a landscape that collectively invested in biodiversity. In some of our cases this was already the case (case B), but in others this was still in a pioneering phase, and only a few individual farmers in the landscape were engaged. Although it was mentioned that collective action on a landscape-scale was important, engagement of farmers was often voluntary, and we saw that initiatives often started with a few farmers that were willing to engage, and that they hoped that more farmers would engage. Two main challenges were found regarding upscaling in this case:

No individual upscaling: replication of landowner engagement

First of all, the landowners, the primary actors that needed to implement change, do not have the capacity to scale up individually, since they are geographically restricted to their own land. Upscaling in this case therefore means that individual farmers have to be engaged over and over again. This requires different approaches in different landscapes, and collaboration will have to be developed between a diverse set of local actors (majors, regional developers, city councils) in every landscape. Moreover, the same solutions cannot be implemented everywhere, since it is dependent on many SES characteristics, such as type of soil and type of biodiversity in the landscape.

Mobilizing incentives to engage landowners

Engaging farmers was mainly done by providing incentives, and therefore mobilizing financial resources increase opportunities for engagement. This was sometimes challenging. For example, market demand for new business models was sometimes mentioned as a barrier; when market demand for the product was low, more farmers could not be engaged (case A). Some incentives were specifically based on business models for specific regional products, which provided a scaling dilemma, since the success of the product depends on the region and it could not be scaled up outside of it (case B). Therefore scaling up will involve replication in other areas. Engagement of powerful actors that can provide incentives might engage more farmers and could create acceleration (case A and C). Smaller initiatives on the other hand can create legitimacy for larger parties to engage.

CONCLUSIONS AND MAIN IMPLICATIONS FOR TRANSITION STUDIES

The aim of this paper was to understand how transition dynamics unfold in this socio-ecological transition towards biodiversity preservation, by focusing on engagement of the primary actors that need to implement

change: landowners. Our findings showed how landowners were often hampered to initiate change by various regime barriers, and that external actors, such as NGOs, developed incentive systems that stimulated farmers to engage in change processes, such as new business models for regional products, or favourable conditions to lease land to farmers. We discuss two main differences found compared with current socio-technical transition research.

Types of actors: geographically restricted regime actors vs. new entrants

The primary actors to implement change were landowners. These differed from the niche actors normally studied in ST research, which were often new entrants. Since landowners were often locked-in in regimes, approaches to change in our cases had a higher focus on overcoming regime barriers first to enable change. Landowners had to break free from regime barriers first, before change could be initiated. External actors played an important role in overcoming these barriers.

Type of innovation: socio-institutional innovation vs. technology

The primary change was of socio-institutional order instead of a technological innovation, since it concerned different ways or organization in the landscape. This required a change in management and behaviour from landowners, and development of new institutions, e.g. rules and incentives. New business models focused on a product that was also very different from most technologies, since the product was still milk, which valued biodiversity in the price, but still had the same bulk characteristics and approximately the same taste. Legitimacy for this product was created by the engagement of NGOs, and a label on the product. This is different from many technological innovations, such as solar panels or electric cars, that are intrinsically more distinctive as a product.

Upscaling potential

Since farmers are intrinsically limited to location, individual farmers will not scale up. Moreover, it is not about a (technological) innovation that can be scaled up, but individual farmers will have to be engaged over and over again, by mobilizing sufficient incentives. Upscaling of this socio-institutional innovation was in this case was defined as engaging a critical mass of actors in a landscape that collectively invested in biodiversity. However, collective landscape management was still in a pioneering phase. Main challenges found were the engagement of actors, and mobilizing enough resources to incentivize farmers. Some incentive models themselves faced upscaling difficulties, such as regional business models that would not scale up outside of their own region.

This paper highlights some key characteristics of engaging primary actors for change in the transition towards biodiversity preservation, and discusses some differences with transitions within socio-technical systems. It therefore delivers insights in how these types of socio-ecological transitions towards biodiversity preservation unfold, and contributes to the current transition literature by broadening scope and applicability into a socio-ecological transition context.

References

Agrawal, A. (2001). Common property institutions and sustainable governance of resources. World development, 29(10), 1649-1672.

Ansari, S. S., & Krop, P. (2012). Incumbent performance in the face of a radical innovation: Towards a framework for incumbent challenger dynamics. Research policy, 41(8), 1357-1374.

Assefa, T. T., Kuiper, W. E., & Meuwissen, M. P. (2014). The effect of farmer market power on the degree of farm retail price transmission: A simulation model with an application to the Dutch ware potato supply Chain. Agribusiness, 30(4), 424-437.

Barnes, C., & van Laerhoven, F. (2015). Making it last? Analysing the role of NGO interventions in the development of institutions for durable collective action in Indian community forestry. Environmental Science & Policy, 53, 192-205.

Brouwer,F.,vanBruchem,C.,UdodeHaes,H.,&vanderWeijden, W. (2016). Ontwikkelingen in de grondgebonden landbouw. In G. R. de Snoo, Th.C. P. Melman, F. M. Brouwer, W. J. van der Weijden, & H. A. Udo de Haes (Eds.), Agrarisch natuurbeheer in Nederland. Principes, resultaten en perspectieven (pp. 55– 83). Wageningen: Wageningen Academic.

Bryce, D. J., & Dyer, J. H. (2007). Strategies to crack well-guarded markets. Harvard Business Review, 85(5), 84-92.

Chandy, R. K., & Tellis, G. J. (2000). The incumbent's curse? Incumbency, size, and radical product innovation. Journal of marketing, 64(3), 1-17.

Clark, W. C. 2001. A transition toward sustainability. Ecology Law Quarterly 27(4):1021-1076.

EEA. (2015a). SOER 2015 – The European environment – state and outlook 2015. A comprehensive assessment of the European environment's state, trends and prospects, in a global context. Copenhagen: European Environmental Agency.

EEA. (2015b). State of nature in EU. Results from reporting under the nature directives 2007–2012, EEA technical report no2/ 2015. Luxembourg: European Environment Agency.

Elzen, B., Geels, F. W., & Green, K. (Eds.). (2004). System innovation and the transition to sustainability: theory, evidence and policy. Edward Elgar Publishing.

EZ. (2014). Rijksnatuurvisie 2014, Natuurlijk verder. The Hague: Ministry of Economic Affairs.

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. Research policy, 33(6-7), 897-920.

Geels, F. W. (2005a). The dynamics of transitions in socio-technical systems: a multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930). Technology analysis & strategic management, 17(4), 445-476.

Geels, F. W. (2005b). Processes and patterns in transitions and system innovations: refining the co-evolutionary multi-level perspective. Technological forecasting and social change, 72(6), 681-696.

Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. Environmental innovation and societal transitions, 1(1), 24-40.

Geels, F., Kemp, R., Dudley, G., & Lyons, G. (2011). Automobility in transition?: A socio-technical analysis of sustainable transport. Routledge.

Grin, J., Rotmans, J., & Schot, J. (2010). Transitions to sustainable development: new directions in the study of long term transformative change. Routledge.

Hekkert, M. P., Suurs, R. A., Negro, S. O., Kuhlmann, S., & Smits, R. E. (2007). Functions of innovation systems: A new approach for analysing technological change. Technological forecasting and social change, 74(4), 413-432.

Kishna, M., Negro, S., Alkemade, F., & Hekkert, M. (2017). Innovation at the end of the life cycle: discontinuous innovation strategies by incumbents. Industry and Innovation, 24(3), 263-279.

Leach, M., I. Scoones, and A. Stirling. 2010. Dynamic sustainabilities: technology, environment and social justice. Earthscan, London, UK.

Levy, D., Reinecke, J., & Manning, S. (2016). The political dynamics of sustainable coffee: Contested value regimes and the transformation of sustainability. Journal of Management Studies, 53(3), 364-401.

McGinnis, M. D., & Ostrom, E. (2014). Social-ecological system framework: initial changes and continuing challenges. Ecology and Society, 19(2).

Moore, M. L., Tjornbo, O., Enfors, E., Knapp, C., Hodbod, J., Baggio, J. A., ... & Biggs, D. (2014). Studying the complexity of change: toward an analytical framework for understanding deliberate social-ecological transformations. Ecology and Society, 19(4).

Naber, R., Raven, R., Kouw, M., & Dassen, T. (2017). Scaling up sustainable energy innovations. Energy Policy, 110, 342-354.

Nagendra, H., & Ostrom, E. (2014). Applying the social-ecological system framework to the diagnosis of urban lake commons in Bangalore, India. Ecology and Society, 19(2).

Ostrom, E. (2007). A diagnostic approach for going beyond panaceas. Proceedings of the national Academy of sciences, 104(39), 15181-15187.

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. Science, 325(5939), 419-422.

PBL. (2014). The Netherlands in 21 infographics, facts and figures on the human environment. Bilthoven: Environmental Assessment Agency. Retrieved from www.pbl.nl/en/ publications/the-netherlands-in-21-infographics

Rip, A., & Kemp, R. (1998). Technological change. Human choice and climate change, 2(2), 327-399.

Runhaar, H. (2017). Governing the transformation towards 'nature-inclusive'agriculture: insights from the Netherlands. International Journal of Agricultural Sustainability, 15(4), 340-349.

Smink, M. M., Hekkert, M. P., & Negro, S. O. (2015). Keeping sustainable innovation on a leash? Exploring incumbents' institutional strategies. Business Strategy and the Environment, 24(2), 86-101.

Smit, A. A., Driessen, P. P., & Glasbergen, P. (2009). Conversion to organic dairy production in the Netherlands: Opportunities and constraints. Rural Sociology, 74(3), 383-411.

Van den Bergh, J. C., & Bruinsma, F. R. (Eds.). (2008). Managing the transition to renewable energy: theory and practice from local, regional and macro perspectives. Edward Elgar Publishing.

Van der Vliet, R. E., Valluerca, I. O., Van Dijk, J., & Wassen, M. J. (2015). EU protection is inadequate for a declining flyway population of Black-tailed Godwit Limosa limosa: mismatch between future core breeding areas and existing Special Protection Areas. Bird Conservation International, 25(1), 111-125.

Westley, F., P. Olsson, C. Folke, T. Homer-Dixon, H. Vredenburg, D. Loorbach, J. Thompson, M. Nilsson, E. Lambin, J. Sendzimir, B. Banerjee, V. Galaz, and S. van der Leeuw. 2011. Tipping towards sustainability: emerging pathways of transformation. AMBIO 40(7):762-780. http://dx.doi.org/10.1007/s13280-011-0186-9 Westley

Young, O. R., Berkhout, F., Gallopin, G. C., Janssen, M. A., Ostrom, E., & Van der Leeuw, S. (2006). The globalization of socio-ecological systems: an agenda for scientific research. Global Environmental Change, 16(3), 304-316.

ANCHORING OF INTEGRALLY SUSTAINABLE ANIMAL PRODUCTION SYSTEMS:

Consequences for robustness and sustainability performance

BOELIE ELZEN, BRAM BOS, BART BREMMER AND BARBARA VAN MIERLO

Abstract
This paper analyses the combination of a method to design new sustainable animal husbandry systems by the name of RIO with efforts to stimulate the uptake of these new designs in practice. Over the past 15 years, this approach has been applied in a variety of animal production sectors in the Netherlands, one of which will be analysed here, notably a husbandry system for broilers (chickens for meat). To analyse the uptake process we build on the concept of anchoring that describes how a novelty becomes newly connected, connected in a new way, or connected more firmly to a niche or a regime. In the literature, three forms of anchoring are distinguished, notably technological, network and institutional anchoring. In this paper we refine this concept by distinguishing between a 'deepening' and 'broadening' variant for each of these three. We use this conceptualisation to analyse the development of the case by a contrasting set of two outcomes from various anchoring episodes, *viz.* 'robustness' and 'sustainability performance'. Robustness is a measure to indicate to what extent the preceding anchoring processes have led to a 'stable' situation. The 'sustainability performance' addresses various aspects of the overall RIO objective to develop 'integrally sustainable' animal production systems

KEY-WORDS: ANCHORING, ROBUSTNESS, SUSTAINABLE AGRICULTURE, ANIMAL PRODUCTION, REFLEXIVE INTERACTIVE DESIGN

1. INTRODUCTION

In traditional innovation studies, the issue of upscaling is conceptualised as the 'diffusion of innovations' (Rogers 1962). More recent work on transitions has shown, however, that innovation is a much more complex process, especially when looking at 'radical' innovations or 'system innovations' (Geels 2002, 2004, Elzen and Wieczorek 2006). The widely used multi-level perspective (MLP; Geels 2002) sees innovation as the interplay between the three levels of niches, regimes and landscapes. A regime denotes an existing socio-technical system which may be under external pressure from a socio-technical landscape to change. At present, the agricultural regime is under large landscape pressure to become more sustainable. The reaction of regime to such pressures typically is to transform via a path of incremental innovation.

Next to that, various actors may be tinkering with radical alternatives in 'technological niches'. In a niche, these alternatives (novelties) are protected from market forces via a variety of protection mechanisms, and the niches thus provide a space for the actors involved to develop the novelty further and learn how to make it work in practice. A novelty not only concerns technical aspects, but also social aspects like how it is to be used, a network of actors to sustain it, etc.

One key issue in transition studies is how niches can link up to regimes and start a process that may lead to a transformation of the regime (Smith 2007). This linking is a first key step in a process of upscaling. In this paper we will address this linking issue by building on the concept of 'anchoring' (Elzen et al. 2012a). We will apply this

to a case study from a RIO project that some of the authors have been involved in over the past decade. The next chapter will describe the general RIO approach and the anchoring concept. Subsequently we describe the case study and end with a discussion and conclusions.

2. REFLEXIVE INTERACTIVE DESIGN AND ANCHORING

Around the year 2000, Wageningen UR Livestock Research (WLR) was assigned the task to tackle the sustainability challenges associated with large scale animal production in the Netherlands. This led to the development of the RIO approach, a Dutch acronym for "Reflexive Interactive Design." The authors of this paper have applied this approach in several projects targeting various animal sectors and developed it further, taking into account what was learned in previous applications

Details of the RIO approach have been described elsewhere (Bos et al., 2011; Bos and Groot Koerkamp, 2009; Bos et al., 2009). Here we only describe its main features. After a thorough system analysis, RIO continues with a design phase that builds on the approach of Structured Design (Cross, 2008; Siers, 2004; Van den Kroonenberg and Siers; 1998), in an interactive fashion. The design groups consist of various types of agricultural stakeholders (including farmers, farming equipment suppliers, policy representatives, NGOs) to ensure the incorporation of practical and tacit knowledge, and prevent a research bias with respect to the values underlying the design.

To study the uptake of the results from the RIO design sessions, we build on the concept of anchoring, which was developed in the context of system innovation programmes (Loeber 2003, Grin & Van Staveren 2007). In a study of the uptake of radical energy novelties in glasshouse horticulture, the concept was defined more specifically as follows:

> "Anchoring is the process in which a novelty becomes newly connected, connected in a new way, or connected more firmly to a niche or a regime. The further the process of anchoring progresses, meaning that more new connections supporting the novelty develop, the larger the chances are that anchoring will eventually develop into durable links." (Elzen et al., 2012a, p.3)

Building on a distinction between three constituent components of a regime, notably technical, network and institutional components (Geels, 2004), the authors distinguish three forms of anchoring. These are technological anchoring, network anchoring and institutional anchoring (Elzen et al., 2012a, p.4-6). Technological anchoring takes place when the technical characteristics of a novelty (e.g. new technical concepts) become defined by the actors involved and, hence, become more specific to them. Network anchoring means that the network of actors that support the novelty changes, e.g. by enrolling new producers, users or developers. Institutional anchoring relates to the institutional characteristics of the novelty, i.e. the new rules that govern its further development and uptake. Institutional anchoring implies that developments within a niche or regime become translated into adapted or new rules that govern, at least temporarily, the activities of both niche and regime actors.

Elzen et al. (2012a) have described anchoring in rather general terms, providing evidence that the distinction of three forms of anchoring can help to understand how novelties are picked up in niches and regimes and can start a transformation process. In this paper we seek to explore how this affects the sustainability performance of novelties, with the underlying purpose to better understand upscaling by conceptualising anchoring.

We will do this by analysing a case that aimed at developing 'integrally sustainable' husbandry system for broilers, using the RIO approach. In earlier work (e.g. Elzen and Bos 2016) we have observed that in the anchoring processes that followed, some elements of the sustainability ambition were not realised or skipped. In this paper, we will use the dynamic of anchoring to try and understand how the sustainability performance of the novelty is affected in this process. To do so, we will use a 'contrasting' second concept to sustainability, which is the 'robustness' of the novelty.

Robustness is a measure to indicate to what extent the preceding anchoring processes have led to a 'stable' situation. This means that the novelty is technologically functioning well, is embedded in a sufficiently strong network and is also institutionally supported (the three dimensions of a regime and of anchoring). If one or more of these dimensions are not sufficiently addressed, the novelty is less robust and may eventually not survive. Robustness is a matter of degree and can be seen as a measure for the chances for survival of the novelty in the near term.

Looking at the dynamic of anchoring of a novelty with the robustness-sustainability performance dichotomy, we observed various instances where attempts to increase robustness (required to further the 'survival' of the

novelty) created tensions with the sustainability objectives. In this paper we seek to understand better how that played out.

To be able to do so, we found it necessary to refine the anchoring conceptual framework. For each of the three dimensions of anchoring (technology, networks and institutions) we now distinguish two variants, notably deepening and broadening. Deepening concerns a further specification of or a growing interdependency on one of the three anchoring dimensions. Broadening concerns new connections with the (until then) external environment of the novelties on one of the three anchoring dimensions.

This results in the following six forms of anchoring:

- Technological anchoring:
  - Deepening: Specification/articulation of ideas and expectations of the radical novelty, materialisation into objects;
  - Broadening: linking to existing technologies and infrastructure, new ideas elsewhere (not necessarily via concrete actors, but probably interconnected);
- Network anchoring:
  - Deepening: growing interdependency between actors taking concrete actions for the design, promotion, development, use of the novelty ;
  - Broadening: new actors becoming involved, widening of the network of active actors;
- Institutional anchoring:
  - Deepening: 'internal' specification of (new) radical-novelty-related rules, e.g. by translating values into concrete standards;
  - Broadening: linking to existing external rules, values, symbols, etc.

In the next section we will apply this framework to a Dutch case study on the development of a new, integrally sustainable (in the initial objective) husbandry system for broilers in the Netherlands.

Concerning the methodology for data collection, one of the authors has been involved as a project leader in the case described. Most of the empirical material is based on his own presence in various meetings and interactions with relevant actors.

3. WINDSTREEK CASE

3.1 Introduction

The formal origin of the Windstreek henhouse can be traced back to a government funded RIO project that started in 2009: Broilers with Taste. Farmer Robert Nijkamp became involved in the second half of 2010, during the first round of interactive design sessions.

One of the authors of this paper (Bram Bos) was involved as project leader in 2010, and played an active role in the follow-up of the project, after its end in 2011 (Janssen et al., 2011). The follow-up was spurred by a special policy instrument (Small Business Innovation Research or SBIR) used to elicit societally desired innovations from private enterprise by means of a tender, in which competition is firstly based on quality and business prospects, and only secondarily on price. Eventually, a consortium of five private parties around the concept of Windstreek was the big winner of the SBIR-tender "Sustainable barns in the landscape" that ran from 2011-2015. Helped by the considerable amount of financial support from SBIR (about 500k€), the consortium was able to further develop and establish the first pilot barn of Windstreek, at Nijkamp's farm.

The consortium consisted of a poultry slaughterhouse (Interchicken), a climate technology firm (Sommen), a landscape architectural bureau (Vista), farmer Nijkamp himself and Wageningen UR Livestock Research (WLR). Later, Interchicken was substituted by the largest Dutch slaughterhouse Plukon after a takeover, while Vista was replaced by the bureau Circular Landscapes.

This led to the development of Windstreek, opened late 2015, a henhouse very unlike the traditional ones in the Netherlands. Its iconic, asymmetrical form (cf. figure 1) is noticed from almost a kilometre away. Its 11 meter

high transparent front on the north side can be opened across the full 95 meter of its length, both in the upper as well as the lower 2 meters. As a result, the animals live by the natural rhythm of day and night. The air inside is refreshed by natural ventilation. The very young chickens (that enter the barn as one-day old chickens or as eggs) are kept warm in a special isolated 'mini-barn' - the brooding hood - that captures their own warmth and can be heated additionally by PV powered infrared panels. The higher parts of Windstreek are used as living space, both on the ground, as well as on long stretching tables that can be reached via straw bales. Special mats under the brooding hoods are used to remove the litter (with manure) from the barn, to prevent the emission of ammonia and fine dust. Trees on the outside, facing the high open front, capture part of the remaining fine dust before it is emitted to the environment. As a result, the Windstreek housing system is claimed to be very animal friendly, to have a very low energy consumption that can be renewably supplied by solar panels, to have low emissions of pollutants, while the working environment is more healthy than in regular systems.

As the system differs in so many respects from traditional housing systems, and is under a much bigger influence from weather conditions, testing of these and other claims is still going on. The economic prospects of the system, and thus its ability to scale up to a larger number of barns without subsidies, still have to be established.

Figure 1 presents a timeline of the history of Windstreek since the start of Broilers with Taste in 2009. Below the timeline, the visual and technical evolution of three central concepts are depicted, notably the barn system as a whole, the concept of the brooding hood and the concept of regular litter removal, each of which will be discussed in further detail below.

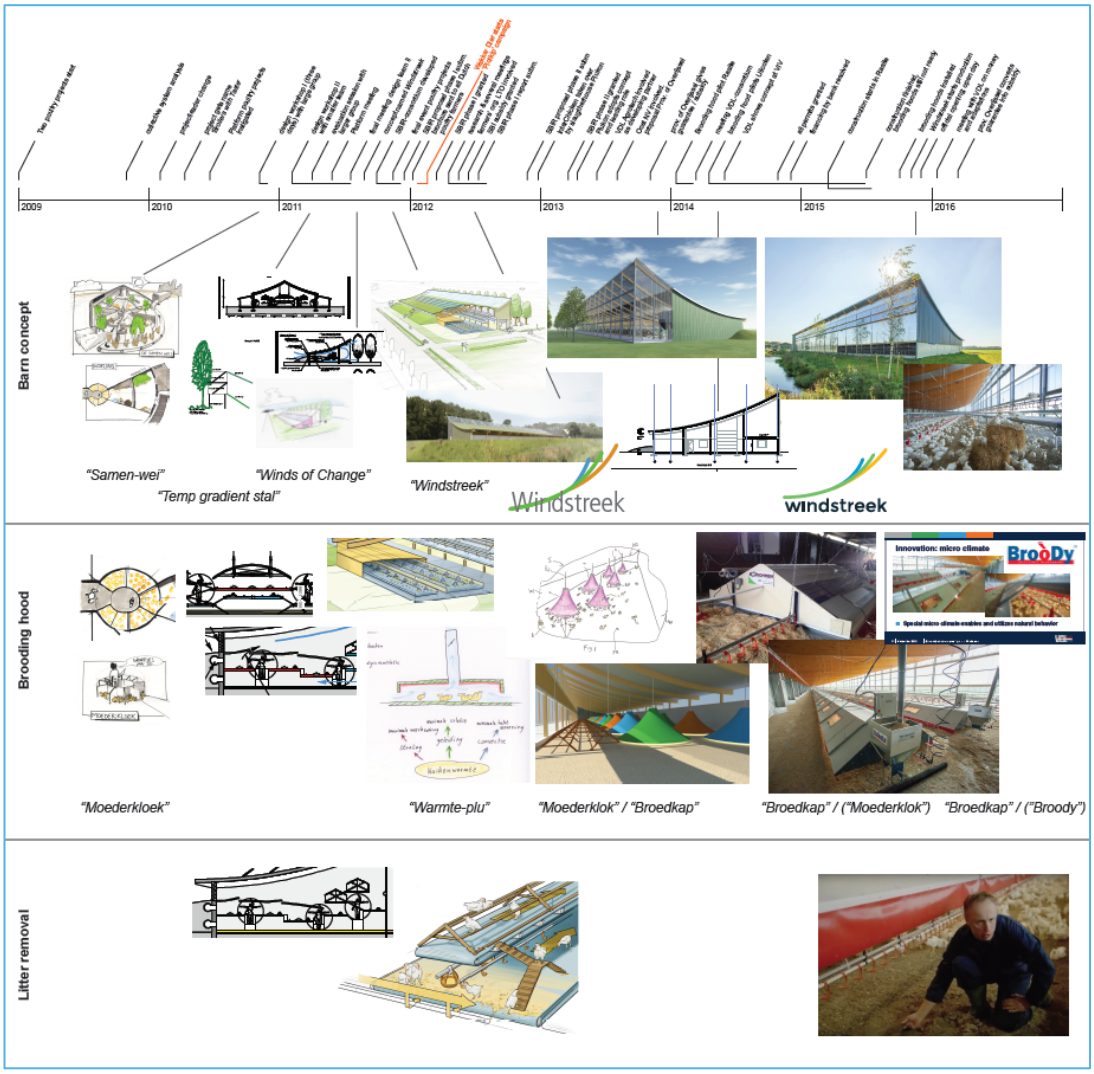


Fig.1: Timeline of Windstreek development for the overall concept and two 'partial innovations', brooding hood and litter removal.

3.2 Anchoring of the Windstreek concept as a whole

Most of the distinctive technical features of Windstreek were already present in the first interactive design session, including a special isolated area for the very young chicken, a temperature gradient, natural ventilation and an outward facing living area that becomes increasingly available for the chicken as they grow older (and larger). During the second, extended design round, these ideas got different shapes, but were maintained as core elements. Added were the use of the third dimension to enlarge the living area and the radical 'halving' of the architectural form (from the conventional point roof to a roof with a high and a low side) and curving the remaining slope. This curved slope was originally conceived as (technically) functional to natural ventilation, but appeared not to be critical to achieve this, as the stack effect of the difference between the low and high sides was much more important to drive ventilation. The curved slope was kept however, even though it increased building costs, to become part of the Windstreek 'signature', and it was registered by the consortium as a trademark together with the name itself. Thus, although the technical reasons for the curved slope weakened, it became firmly anchored in the network for aesthetical reasons. The curved slope was the distinctive feature that made immediately clear to an outsider that this broiler barn was very different from any other in the country. On one occasion, a representative of the slaughterhouse Plukon was asked about the whereabouts of Windstreek by a government official just by making a curved figure in the air with his hand, which signifies the importance of the outer form in strengthening its meaning among stakeholders involved.

For a different reason, the outer form is significant because the Dutch Animal Protection Society (APS) agreed to label chicken-meat from Windstreek with one star on their "Beter Leven Keurmerk" (BLK – "better life hallmark") certification scheme, although strictly Windstreek does not have the covered outside area required. The high roof, combined with the possibility to open it to allow for direct visual and climatic contact with outside, was enough to convince the APS to make an exception to the criteria. This is important for the commercial value, since meat with a BLK-star commands higher prices in the supermarket.

Landscape quality was an important provision under the SBIR-tender and a landscape architecture firm (Vista) developed the initial shape of a 'typical barn' into a concept that moulded with the landscape. They worked closely together with a governmental committee for building and landscape quality. Thus, the design evolved from a barn concept to a landscape concept, including the surrounding area and taking the characteristics of different landscapes into account. This helped the local government to bypass institutional barriers (building aesthetics regulations) that initially prohibited both height and form of Windstreek. These and other distinctive features helped to get Windstreek through the local and regional regulative systems.

The application of natural ventilation throughout the system became technologically anchored in the existing network via the involvement of a climate systems enterprise by the name of Sommen. Contrary to many similar firms, their specific business model turned out to fit working with natural ventilation, since Sommen did not primarily depend on the sales of mechanical ventilation systems, but on the sales of computer systems and software for climate regulation in livestock production. Part of the SBIR-grant was used by Sommen to completely redesign its climate software.

3.3 Anchoring of the Brooding hood

In the first two weeks of their life, broiler chickens cannot maintain their own body temperature. For this reason, traditional barns are heated these weeks to a temperature of about 32-38 degrees Celcius, which consumes much (fossil) energy. The mini-barn in the original Windstreek design of 2011 was intended to solve this, by reducing the volume to be heated. However, Dutch and EU-regulations prohibited limiting the space per chicken, even very small ones. Thus, the 2011 Windstreek-concept, that featured a smaller inner barn for young chickens, faced an important institutional hurdle that was unlikely to change.10 It was one of the reasons that the concept of a mini-barn morphed into the brooding hood.

[10] Parallel to the first phase of the SBIR-tender, project leader BB was involved in a similar case of a farmer who invented an inflatable wall to decrease the volume of his traditional barn in the first weeks of a round to save on energy. This farmer approached BB after the publication of the brochure of *Broilers with Taste* that was sent to all poultry meat farmers in the Netherlands. After some backing and forthing with, among others, the Dutch Animal Protection Society (Dierenbescherming), it became clear that there was no short term sight on institutional changes, that forbid this temporary decrease in living surface, despite the fact that there was evidently no animal welfare issue *per se*.

In the first phase of SBIR tender (spring 2012), the technical people from the Windstreek consortium developed an alternative to this mini-barn: they calculated that the warmth emitted by a large group of very young broiler chickens might be enough to keep an insulated enclosure warm, provided ventilation is reduced a minimum. The new concept was named: 'brooding hood'. In a subsequent visualization by Vista, the whole Windstreek barn was equipped with over sixty church bell shaped devices with different bright colours, each to be used by about 500 young chickens. Since these brooding hoods hover 10-20 cm above the floor, the young chickens can move freely throughout the whole barn, thus circumventing EU and Dutch regulations. But chickens are likely to stay underneath the warm hoods most of the time because it fits their thermal requirements and natural behaviour.

Shortly after the consortium won the second phase of the SBIR tender,[11] climate systems firm Sommen got in touch with VDL Agrotech, an industrial supplier of agricultural equipment, and part of one of the largest Dutch industrial conglomerates (VDL). Sommen saw a chance to enroll a partner that could develop and mass produce the brooding hood, a vital part of Windstreek, that would be needed in considerable numbers.

The new partner was reluctantly welcomed by the consortium. Initial contacts suggested a lukewarm and sceptical reception of the brooding hood concept by VDL. Especially the non-manufacturing partners in the consortium (Nijkamp, WLR, Vista) feared that a distinctive feature of Windstreek, with the most commercial potential, would be gradually appropriated by an outside partner and sold to anyone, as the brooding hood would also be applicable in standard broiler barns. Without exclusivity, the upscaling potential of the Windstreek concept as a whole might be in danger. Partners Plukon and Sommen, however, stressed the inevitability: the consortium would not be able to develop the brooding hood by itself, and more importantly, lacked the capabilities needed to produce them in large numbers at an affordable price.

Sommen and VDL started a series of small scale pilot experiments with the brooding hood. First in Nijkamp's open cow barn during winter, later in a covered alley way between two poultry barns of a farmer near Sommen headquarters in Ulicoten. These pilots involved a few hundred chickens and hand-made constructions of metal and plastic. Both mechanical and natural ventilation were tested. Heating was supplied by a warm water heating device.

After a few months of experimenting, VDL Agrotech decided to prominently present the brooding hood, as well as Windstreek, at the VIV-fair 2014 in Utrecht, an annual fair for the global equipment industry for intensive livestock production. This again sparked the doubts of the non-manufacturing partners on concept ownership.

At this point, Sommen and VDL were about to conclude that, for control reasons, the brooding hood should be mechanically ventilated. Farmer Nijkamp opposed this vehemently, since he wanted a robust system that would be as independent as possible from fallible technology. Additionally, he wanted to experiment with infrared heating, instead of warm water heating, since this could be powered by solar panels which would save the costs of a separate gas connection to the new barn.

Infrared heating and natural ventilation were implemented reluctantly by Sommen and VDL in the subsequent pilot experiments. Both features reduced the controllability of the brooding hood, and required new ways of thinking. As they proceeded, however, they became more and more convinced that these features were possible and an important characteristic of the brooding hood concept.

While the construction of the Windstreek barn commenced in March 2015, pilot experiments in Ulicoten were still under way. VDL had a contract with Nijkamp to deliver and install sixty brooding hoods in Windstreek. When the construction of Windstreek was almost finished, VDL told Nijkamp that, for construction reasons, the sixty brooding hoods would be fused into six large tunnel-like brooding hoods, an idea that Nijkamp had objected to in an earlier stage. However, since Nijkamp planned to start production only a few months later, he had no option but to agree. Production in Windstreek eventually started in November 2015.

In november 2016 VDL together with Sommen and WLR proudly presented Windstreek and the Brooding hood on the EuroTier in Hannover, a massive and renown international fair on livestock farming & technology. At the moment of writing (fall 2018) however, the brooding hood has not been further developed by VDL. A malfunctioning winch caused one of the six brooding hoods to be damaged beyond repair, but after a disagreement on the responsibility for this was not solved, the cooperation between VDL and Nijkamp dissolved. Nijkamp considers building his own replacement by his own design, more close to the original idea and much cheaper.

[11] The first phase is a feasibility study; the second phase a pilot, proof of concept or full scale implementation, aiming to show the commercial relevance.

3.4 Anchoring of the regular litter removal

The concept of regular litter removal (by means of belts) was a central idea from the start of the design process. This was intended to reduce the emissions of ammonia and especially fine dust from the barn by frequently removing the source of these emissions (the manure in the litter). Yet, the actual implementation in Windstreek has been half-hearted. An important reason is that it is primarily a solution for a problem that was not perceived to be urgent by anyone except the researchers of WLR. Since Windstreek is naturally ventilated with large volumes of air, fine dust is not seen as a problem inside the barn, nor in the rural surroundings of the village of Raalte. Additionally, some partners believe emissions will be low because of the slow air velocities associated with natural ventilation. On this basis, expensive dust reducing belts were replaced by cheap composting mats. Attempts to get a machine for removing and cleaning these mats failed initially, because of high costs and lack of motivation from third-party enterprises to develop this further.

However, since building the Windstreek-barn was permitted based on a so-called 'proefstal-status' (status as an experimental barn), Nijkamp had the obligation to perform measurements of the emissions of the barn within a three year period, according to the approved system description that included a regular litter removal system. Therefore, Nijkamp developed a simple removal system with a local blacksmith and applied this in his barn. At the moment of writing, the system is functioning in practice while emission measurements of ammonia and fine dust are continuing.

4 DISCUSSION

The overall objective of the RIO project was to design an 'integrally sustainable' husbandry system for broilers and to realise this in practice. This led to the development of the Windstreek chicken farm in which, indeed, most of the initial sustainability objectives were realised. It is in production and the chicken meat is sold in an existing niche market for 'animal friendly raised chickens'.

Because the Windstreek concept is now part of regular market transactions, it is rather stable and can be considered robust. But, thus far, it is a one-off concept, applied by only one chicken farmer. Hence, we may say that anchoring of the concept was successful in becoming part of a niche market but not in terms of anchoring successfully in the overall regime for chicken meat. Its potential for further growth at this point seems to be small.

Initially, the Windstreek (like any novelty) was very vulnerable and the actors involved were struggling to make it work in practice. In the eyes of the initiators, this implied that the barn concept should function well technically to achieve the desired integral sustainability, as well as that it should become an economically viable system for raising broilers. To achieve this, the actors involved had to undertake various attempts for further anchoring, triggered by either a specific objective that they wanted to realise or a problem that they had encountered. If these 'triggers' were not addressed adequately, i.e. if the attempts to realise anchoring failed, the novelty might be shelved or even totally abandoned.

Hence, various attempt at anchoring can be seen as an attempt to increase the robustness of the novelty and/or to realise a desired sustainability performance. Below, we use this 'driving force' to draw some conclusions on the dynamic of anchoring and the outcomes that result from this in terms of robustness and sustainability performance.

The concept of anchoring can be used at both the niche and regime level. Actually, it is intended as a 'bridging' concept to analyse how these two levels can be linked by analysing how a novelty transforms from an entity that needs niche protection to an entity that transforms a regime. We first discuss the niche level where we draw two sets of conclusions, one set related to the dynamic of anchoring and a second on the 'outcome' of anchoring in terms of the two concepts of 'robustness' and 'sustainability performance'. Subsequently, we also briefly discuss some lessons that can be drawn concerning linking with the regime level .

4.1 Anchoring at the niche level

Dynamic of anchoring

It is evident from the case study that anchoring follows very crooked paths with various forms of anchoring following one-another. Yet, some specific relations can be discerned in this wild dynamic.

Firstly, the cases show that ongoing network anchoring is a fundamental element for a novelty to survive. To move towards a position where the novelty becomes part of market transactions, various actors are needed. And every step may require new actors that are crucial to proceed. For the brooding hood we saw such network broadening in which especially the enrolment of a large regime actor (VDL-Agro) was critical to create a 'working' novelty, i.e. one actually being implemented in the final production unit. By contrast, such network broadening was much more problematic in the case of the litter removal which stalled development for a long time.

Bringing in a new actor usually leads to further technological or institutional anchoring, either broadening or deepening, depending on the skills and resources of the new actor. E.g. bringing in Sommen led to a new concept for regulating natural ventilation by software which is an example of technological deepening. Bringing in the animal protection society led to the awarding of the BLK-star for the meat, a form of institutional broadening. Once these new forms of anchoring were successful (in the sense that the actors involved saw them as useful or needed), this deepened the network anchoring as the actors had become more dependent upon one another.

In connection with institutional anchoring, an interesting distinction is being made by Smith & Raven (2012), notably between 'fit and conform' and 'stretch and transform'. In our cases we see instances of both. E.g. in the case of the brooding hood, the initial design (rather small, bell-shaped) was rather transformative but after bringing in VDL Agro this turned into a tunnel-like 'mass unit' following more the conventional regime logic. In the case of the APS awarded BLK star for the meat, the APS stretched its own rules because they saw Windstreek as a considerable leap forward in animal friendliness in the broad sense and wanted to give it support. It seems that which of the two patters (conform vs. transform) is followed seems to depends (at least to some extent) upon the conformative or transformative ambitions of the new actor that is brought in, possibly combined with the extent to which the existing network is dependent on the new actor to be able to move forward.

It seems that a new anchoring episode starts when the actors involved either need to take a new step because of a problem they encounter or because they seek to realise a specific ambition. Sometimes they can do that themselves but sometimes they have to bring in a new actor with specific skills or resources. In the latter case, the development may start to deviate from the initial ambitions. Hence, anchoring usually starts as a result of deliberate acting but may subsequently lead to unintended outcomes. This will subsequently affect the novelty's robustness and sustainability performance, as is discussed below.

Outcome of anchoring

As indicated in the introduction, we will seek to analyse the outcome of anchoring processes in terms of the concepts of 'robustness' and 'sustainability performance'.

Robustness

At first sight, it seems that a novelty becomes more robust as the result of technological deepening, making the definition of the technology more specific and committing the actors involved more to it, which thus leads to network deepening. However, this is not enough. Take the example of the bell shaped brooding hood. All actors involved at the time saw this as the way forward. But when VDL-agro subsequently came in to produce them, they decided for a redesign to a tunnel shape that was easier to produce. Thus, for the brooding bell network broadening did not take place and it was eventually abandoned and replaced by the tunnel shaped brooding hood that thus became robust. Hence, network anchoring also appears to be crucial to increase robustness.

This is also true for institutional anchoring. If the APS would not have awarded the BLK1* hallmark, Nijkamp's products would have had to compete with regular chicken meat that is sold at a low price. He would not have been able to recoup his investments which might have become the end of the Windstreek.

Thus, by a combination of technological, network and institutional anchoring the Windstreek concept, as well as the underlying novelties (brooding hood; litter removal) became robust within the existing network but not outside of that (i.e. applied in other contexts). But this happened for different reasons. Especially in the case of the brooding hood, it was expected (and even feared for a time) that it would be a technology that would be commercially applied outside of Windstreek. However, this did not happen, not because of lack of demand (several other farmers showed interest), but because of lack of commitment of VDL-Agro, the company that produced the brooding hood. Ultimately, they showed no interest in developing it into a marketable product (although they did produce a flyer on the product, and even trademarked a name for it ('Bróody').

Because of the difference between robustness within the existing network and the failure to be applied further (at least at present) we think that it is useful to make a distinction between robustness in a niche and robustness in a regime. It would require a wider range of case studies to analyse this further.

Sustainability performance
Sustainability was a strong driver for the initiating network (Nijkamp, WUR). In every attempt at anchoring during the process they tried to keep this ambition high. They were even able to create synergies between various sustainability aspects. E.g. the way natural ventilation was realised had positive implications for the sustainability performance on dimensions like 'energy consumption', 'safety against fire hazards' and 'animal welfare'. Because of this coincidence, this form of technological deepening also led to network deepening, making this part of the design very robust. Thus, increasing robustness coincided with good sustainability performance.

This was not always the case, however. Sustainability performance of litter removal was not yet realized when Windstreek initially went into production. Technological anchoring of the planned moving belt system failed because most actors in the network did not give it priority (a lack of network anchoring), and it was skipped as being too expensive. But the regulations for realizing the project forced the network to take some measures to reduce ammonia emissions from the chickens' manure. This enforced institutional broadening and led to the development of the compost mat system. How this affected the sustainability performance is as yet unclear as this is part of a still ongoing programme of emissions measurement.

There are also other examples that institutional anchoring can work as an important force for the increase of the sustainability performance (governmental regulations, BLK). However, it can also work as a conforming factor. E.g. Windstreek is producing for an existing market niche with higher meat prices for better animal welfare). The standard for this market segment, however, can also be satisfied by adapting existing barns, removing the market pull for Windstreek and its specific novelties.

Robustness vs sustainability
Sustainability was a strong driver for the initiating network (Nijkamp, WUR). They further enrolled actors that supported this and were thus able to keep the ambition high. In these episodes, the ambition to increase robustness was congruent with sustainability ambitions and further development went rather smoothly. But there were also instances where they conflicted which made further development less smoothly.
One example concerns the litter removal belts that were originally envisioned and subsequently deliberately skipped for costs reasons. The alternative compost mats (initiated by WLR, the primary driver of this novelty) were applied, but also the removal system for this concept was considered too costly. Only later, a cheaper removal system was developed by a local blacksmith, after Nijkamp realized the regulatory necessity of implementing this. In this case the sustainability ambition was (at least initially) partly sacrificed for realising robustness.
A contrasting example is when Sommen and VDL tried to apply 'proven technologies' into the brooding hood (mechanical ventilation; hot water as a heating source). In this case the initiating farmer Nijkamp countered this effectively, partly because of the sustainability ambitions (no fossil energy, less fallible technology), partly because of cost reasons as well.
It this seems that robustness and sustainability ambitions can go hand-in-hand but that it requires a deliberate strategy to realise this. There are various instances in our case where one ambition is favoured at the expense of the other and keeping them both high appeared to be a challenge at times.

4.2 Anchoring at the regime level

The description above addresses the niche level where various anchoring attempts led to a situation in which the novelty was robust and also realised most of its initial sustainability ambitions. At the regime level, however, it is not such a large success, at least at present.

Regime anchoring can be considered partly a success in the sense that the Windstreek concept has become part of an already existing chicken meat market niche. It that sense the novelty becomes embedded in the chicken meat regime.12 But this is a market niche in which there are also other, more animal friendly

[12] Using the term 'niche market' may be a bit confusing vis a vis the term (technological) niche as it is used above. In a technological niche, a novelty needs protection to be developed further. In a market niche, i.e. a subsection of a larger market', it has become part of regular economic transaction and no longer needs outside protection.

'conventional' husbandry concepts. In this market, Windstreek is not distinguishable from these other concepts and the emergence of this niche market, and (more importantly) the lifting of the baseline in supermarkets in the Netherlands with the so called "Kip-van-Morgen" ("Tomorrow's chickens") concepts, has taken away most of the societal pressure to change the general chicken husbandry system. Hence, the success of Windstreek in the market niche may have turned into a barrier for its transformative potential vis-à-vis the incumbent regime. Thus, it seems, it has become robust 'internally' (within the network of actors involved) but with limited 'external' potential (to be used further). Thus the second objective (of RIO) of broad application, thus far, has not been realised.

This happened despite attempts to do so. Bringing on VDL was a deliberate attempt to create links with the regime. Bringing on this major supplier of farming equipment would increase options to apply the brooding hood concept wider. But bringing in VDL also brought in VDL's view on animal production systems, i.e. it should be easy to produce and sellable to many farmers. This created tension with the developing Windstreek network, eventually leading to a 'compromise technology' for the niche and no anchoring in the regime at all. Yet, this hardly affected the sustainability performance of the developing Windstreek so there seems to be a potential that the brooding hood might help to promote sustainability in the broiler regime at large.

However it is not likely that this potential will be realised in the near term. Although there were initial ideas that the brooding hood might also have positive sustainability effects in conventional farms, so far there are no indications that it will be promoted further as the manufacturer is not interested in developing it further for mass production. Hence, wider anchoring of the concept in the regime so far failed.

Of course, this may still change in the future and promotors of the Windstreek concept are still trying to raise further interest. But again, the success of the niche market for 'animal friendly chicken meat' seems to create a barrier because the societal and political pressure for change, that existed a decade ago, has dropped considerably in recent years.

5 CONCLUSION

Sustainability was a strong driver for the initiating network (Nijkamp, WUR). They further enrolled actors that that also represented this sustainability ambition. To increase the robustness, however, and be able to develop the concept further, the existing network had to broaden to include new actors with diverging viewpoints and specific skills and resources, like Plukon and VDL. This often went hand in hand with compromising over sustainability performance.

Nonetheless, the Windstreek concept did succeed in keeping its intended 'integral sustainability' ambition high. But doing so, it did not succeed in affecting the regime at large and 'only' became part of a market niche within the regime. And even there, the concept is not applied further beyond this one single farm. So at this point it seems to have resulted in a chicken farm with a 'high sustainability performance' but with a 'low transformation potential' for the chicken meat regime.

This result is also related to the wider developments that took place within the broiler regime in the Netherlands between 2013 and 2015. Primarily because of the pressure of another animal protection NGO, Wakker Dier (Awake Animal), retail decided to shift the baseline to a higher level of animal welfare which led to a growing market share of about 10% for animal friendly produced meat. Various farmers succeeded in satisfying the production requirements without a complete overhaul of the housing system, as in the Windstreek case. As a result, societal and consumer demand in the Netherlands was satisfied to such an extent, that the sense of urgency for a system redesign waned. This transformative regime shift (30% of the total volume produced in the Netherlands) is the probably the main reason for the lack of upscaling of the Windstreek concept. Another possible reason is that the sustainability performance of Windstreek is not yet fully established as a programme of emissions measurement is still ongoing. This took more time than anticipated, partly because it took a long time to get the litter removal system in place.

Acknowledgements

Further confusion may be that also in a market situation there may be forms of protection (e.g. market subsidies, trade barriers, BLK-star hallmarks) but these have a more permanent nature whereas protection of a technological niche is intended to have a temporal, short-term nature.

This paper was financially supported by TKI Agri & Food via the project "Ontwerpen voor een Gezonde Pluimveehouderij / MIP" (AF-16204). The authors thank the partners in the Windstreek-consortium for providing valuable information on the Windstreek development.

REFERENCES

Bos, A. P. & Groot Koerkamp, P. W. G., 2009. Synthesizing needs in system innovation through methodical design. A methodical outline on the role of needs in Reflexive Interactive Design (RIO). In: Poppe, K. J., Termeer, C. & Slingerland, M. (eds.) Transitions towards sustainable agriculture, food chains and peri-urban areas.Wageningen: Wageningen Academic Publishers.

Bos, A. P., Groot Koerkamp, P. W. G., Gosselink, J. M. J. & Bokma, S. J., 2009. Reflexive Interactive Design and its application in a project on sustainable dairy husbandry systems. Outlook on Agriculture, 38, 137-145.

Bos, A. P., Spoelstra, S. F., Groot Koerkamp, P. W. G., De Greef, K. H. & Van Eijk, O. N. M., 2011. Reflexive design for sustainable animal husbandry: mediating between niche and regime. In: Spaargaren, G., Loeber, A. & Oosterveer, P. (eds.) A transition perspective on sustainable food and agriculture. London: Routledge.

Cross, N. 2008. Engineering Design Methods - Strategies for Product Design. Fourth Edition, Hoboken, NJ, Wiley.

Elzen, B. and Bos, A.P., 2016. The RIO approach: Design and anchoring of sustainable animal husbandry systems, Technological Forecasting and Social Change. http://dx.doi.org/10.1016/j.techfore.2016.05.023

Elzen, B., Leeuwis, C. and Van Mierlo, B. C., 2012a. Anchoring of innovations: Assessing Dutch efforts to harvest energy from glasshouses. Environmental Innovation and Societal Transitions, 5, 1-18.

Elzen, Boelie, Barbier, Marc, Cerf, Marianne and Grin, John, 2012b. Stimulating transitions towards sustainable farming systems. In Darnhofer, Ika, Gibbon, David and Dedieu, Benoit (eds.). Farming Systems Research into the 21st century: The new dynamic. Dordrecht: Springer.

Elzen, Boelie and Wieczorek, Anna, 2005. Transitions towards sustainability through system innovation. Technological Forecasting and Social Change, 72, 651-661.

Geels, F. W. 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Research Policy, 31, 1257-1274.

Geels, F. W. 2004. From sectoral systems of innovation to socio-technical systems; Insight about dynamics and change form sociology and institutional theory. Research Policy, 33, 897-920.

Grin, J., van Staveren, A., 2007. Werken aan Systeeminnovaties (Working on System Innovations). Van Gorcum, Assen.

Janssen, A. P. H. M., Nijkamp, R., Van Geloof, E., Van Ruth, J., Kemp, H. & Bos, A. P. 2011. Broilers with Taste - Sustainable chicken takes flight, Wageningen and Lelystad, Wageningen UR.

Loeber, A., 2003. Inbreken in het gangbare: Transitiemanagement in de praktijk – De NIDO benadering (Breaking in into the Usual: Transition Management in Practice – The NIDO Approach). NIDO, Leeuwarden.

Rogers, Everett M. (1962) Diffusion of Innovations, Glencoe: Free Press.

Siers, F. J., 2004. Methodisch ontwerpen volgens H.H. van den Kroonenberg (Structured Design according H.H. van den Kroonenberg). Amsterdam: Wolters-Noordhoff.

Smith, A., 2007. Translating Sustainabilities between Green Niches and Socio-Technical Regimes. Technology Analysis and Strategic Management, 19, 427-450.

Smith, A. & R. Raven (2012). What is protective space? Reconsidering niches in transitions to sustainability. Research Policy, 41, 1025-1036.

Van den Kroonenberg, H. H. & Siers, F. J. 1998. Methodisch Ontwerpen (Structured Design). Groningen: Noordhoff Uitgevers B.V.

AFFILIATIONS

Boelie ELZEN

Boelie Elzen (1953) was trained as an electrical engineer and holds a PhD in Science and Technology Studies. Currently, he works at Wageningen Plant research on a variety of EU H2020 projects for sustainable agriculture. Next to that he has his own company (called Alnus) for research and consultancy on sustainability transitions and as such he acts as a researcher and consultant to RIO projects described in this paper.

His general interest is to create bridges between research insights on the one hand, and sustainable development in practice on the other. His dual goal is to make the latter more effective while, based on these practical experiences, broadening and deepening scientific insights. He has published widely on his research, including a frequently cited volume on sustainability transitions for which he was the lead-editor.
Recent publication: Elzen, B., A. Augustyn, M. Barbier and B. van Mierlo (eds.), 2017. AgroEcological Transitions: Changes and Breakthroughs in the Making. DOI: http://dx.doi.org/10.18174/407609
Mail address: P.O. Box 430, 8200 AK, Lelystad, The Netherlands
Email: boelie.elzen@wur.nl

Bram BOS

A.P. (Bram) Bos (1968) holds an MSc in Biology (VU Amsterdam, 1993) and in Science & Technology Dynamics (Universiteit van Amsterdam 1993). He obtained his PhD in philosophy in 2004 at the Vrije Universiteit, Amsterdam with a thesis on the role of living organisms in technological systems. Since 2002 he was involved as a senior researcher in several interdisciplinary innovation projects for sustainable animal husbandry at the Animal Sciences Group, Wageningen UR. His research interests lie in the field of technology studies, philosophy of technology and policy studies on technological innovation processes.

Recent publication: Elzen, B. & Bos, A. P. 2016. The RIO approach: Design and anchoring of sustainable animal husbandry systems. Technological Forecasting and Social Change.
Email: bram.bos@wur.nl

Bart BREMMER

Bart Bremmer is an independent innovation sociologist. Het works on projects and policies that aim at stimulating sustainable agriculture. He is a consultant, with a keen interest for (system) innovation sciences. In his work he seeks to build bridges between science, policy and practice.
Recent publication: B. Bremmer & B. Bos (2017). Creating niches by applying Reflexive Interactive Design. In: B. Elzen, A. Augustyn, M. Barbier, B. van Mierlo (Eds.). AgroEcological Transitions: Changes and Breakthroughs in the Making. Wageningen UR: Wageningen.
Mail address: Kerkstraat 51, 6871 BH Renkum, Netherlands
Email: Bart.Bremmer@innovatiesocioloog.nl

Barbara VAN MIERLO

Barbara van Mierlo is associate professor, working as a sociologist at the Knowledge, Technology and Innovation Group of Wageningen University & Research. She studies processes of transformative, systemic change towards sustainability and their intersection with everyday social practices. Being actively engaged in these processes, special interests include the significance and features of interactive learning and discursive strategies, the value of change-oriented evaluation, emergence of reflexivity, responsible innovation, and transdisciplinary collaboration. She has developed the methodology of Reflexive Monitoring in Action (RMA), which has a wide international uptake in among others sustainable agriculture, natural resource management, renewable energy and health (http://www.wageningenur.nl/rma).
Recent publication: Van Mierlo, B., & Beers, P. J. (2018). Understanding and governing learning in sustainability transitions: A review. Environmental Innovation and Societal Transitions. In press
Email: Barbara.vanmierlo@wur.nl

INNOVATION PLATFORM AS MECHANISM FOR RESOURCE MOBILIZATION AND ENABLING KNOWLEDGE SPACES FOR SUSTAINABLE LAND USE

AUTHORS: CRISTIAN MATTI, FABRIZIO ROSSI AND VALERIO BRUSCHI

KEY-WORDS: INNOVATION PLATFORMS, KNOWLEDGE SPACES, SUSTAINABLE LAND USE, PARTICIPATORY PROCESS, RESOURCE MOBILIZATION, LOW-CARBON ECONOMY

INTRODUCTION

The interdependent challenges of climate change need innovation in systems of practice and provision, not single innovation in products and processes. In this context, regions and cities face the challenge of dealing with climate risks and impacts, while moving to more sustainable, zero-carbon and resilient pathways. This is a major opportunity for a new, sustainable market to combine existing knowledge and economies of scale that exist within territorial strategies to produce new systemic solutions. However, there are considerable differences in progress between the leading geographies (mostly in Northern/Western Europe) and the one's lagging behind.

Intra-EU disparity claims for the existence of platforms that follow a systemic approach instead of "picking the winner". The structures which allow for the coordination of a variety of actors by combining individual goals and capacities with shared purposes, norms and expectations, refers to innovation platforms. This paper addresses the role of innovation platforms as catalysers of existing (or new) innovation systems in the field of low carbon economy to explore market opportunities.

The codified results of the participatory process are analysed with methodological techniques for content analysis. Additionally, participatory process is described and analysed in terms of the place-based conversations where the emergence of knowledge spaces in the form of thematic local or multi-located clusters and their evolution over time by analysing patterns of knowledge combination and specialisation in relation to different governance configurations.

This study aims to contribute to a better understanding on innovation platforms as a mechanism to accelerate innovation in the urban environment that can contribute to enhance collaboration to achieve more equally distributed progress across all Europe. Additionally, this paper seeks to highlights the effect of inclusive approaches for enabling the transitions in sustainable land use area.

The paper is structured as follows: section two introduces the conceptual framework of the study by combining elements on innovation platforms and multi stakeholder conversations as mechanism for knowledge mobility. Section three introduces the methodological framework while section four presents the exploratory study and analyses the results of the implementation of two multi-stakeholder participatory workshops where emphasis is put in the dynamic of learning process. Finally, section five concludes by presenting key insights focusing on some preliminary insights coming from the ongoing research study.

INNOVATION PLATFORMS AS A SYSTEMIC MECHANISM TO FOSTER KNOWLEDGE SPACES

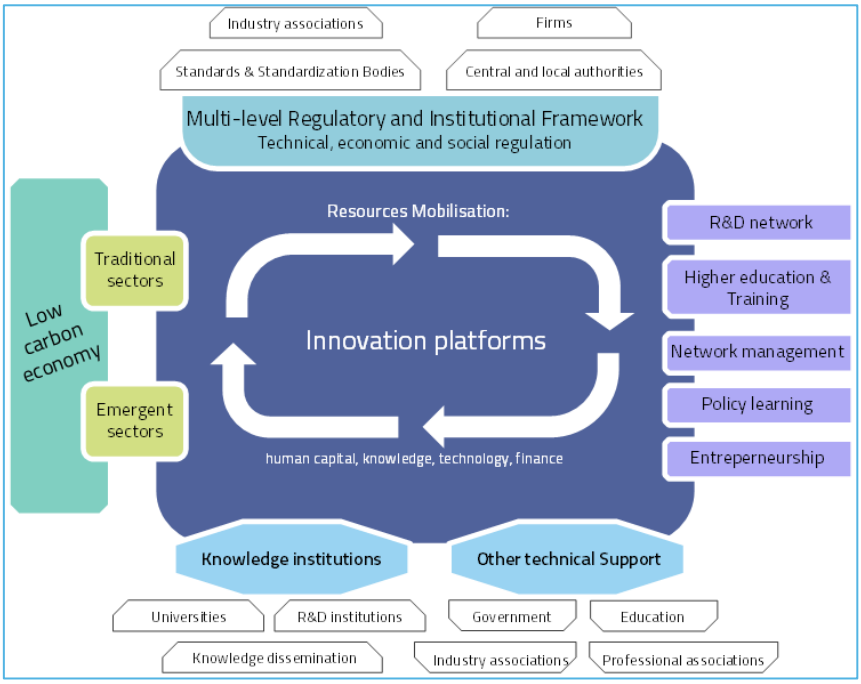
Innovation platforms can be described as systemic infrastructures and established governance mechanisms that facilitate the organisation of distributed (or localised) innovation processes. These platforms allow the

coordination of a variety of actors by combining individual goals and capacities with shared purposes, norms and expectations (D. Consoli & Patrucco, 2011; Gawer, 2010). These platforms can be also described as the space where different actors manage a variety of knowledge flows by creating linkages and combinations that would not be possible in uncoordinated arenas where knowledge is disperse and fragmented. At the same time, the interaction between actors facilitate the development of new knowledge not just form the result from place-based interaction but is often acquires strategic partnerships designed through experimental actions and management of complex knowledge embedded in emergent sectors as low-carbon economy (Vivas Lalinde, Matti, Panny, & Juan Agulló, 2018).

The management of complex knowledge require governance mechanism to achieve the effective engagement of different actors by stimulating new ideas through recombination of existing knowledge but also enable effective communication and knowledge transfer in a context of organizational flexibility and coordination (Davide Consoli & Patrucco, 2007; Grabher & Stark, 1997). The dynamic characteristics of complex systems involve the integration of different and complementary elements and components (Antonelli & Quéré, 2002), which in turn reflect different and complementary knowledge spaces. Innovation platforms enable the search for complementarities by highlining the advantages of co-existing multiple knowledge areas (Gawer, 2010) while facilitating the management of different mixes of the explicit and the tacit through transformational mechanism underpinned by different learning and replication processes.

Figure 1 below shows the model described by Vivas et. al (2018) for innovation platform economy. It defined the platform as part of the logic of public–private partnerships (PPP) responding to create new channels to mobilise and build on existing relational and knowledge resources (i.e. human capital, knowledge, technology) to enable innovations facing climate change challenges. This model describes the mechanism by which resource mobilization integrate different components of the innovation ecosystem such as coordinated activities such as research training, professional education, entrepreneurship (start-ups, spin-offs) and R&D support as well as the participating organisations within platforms (firms, higher education institutions, local and national authorities, industry associations, etc.)

Figure 1 Low-carbon Innovation platform model



Source: Vivas Lalinde et al. (2018)

The innovation platforms are presented as a mechanism to accelerate innovation though the creation of knowledge spaces to enhance interactions within a platform at both "multi- and cross-scales" (i.e. public-private, several industrial sectors, research/education/training), as well as "multi- and cross-level" (i.e. firm/cluster/network/industry, local/regional/national/European). The role of platforms is especially important to facilitate dynamics in places where interaction, communication and knowledge exchange between actors is weak

and, thereby, new practices and mechanism are needed precisely to strengthen and put together otherwise isolated change agents (Healey et al., 2003). With that respect, facilitating conversation as emerging practice for knowledge integration is a critical mechanism to enable the combination of local available assets while reconnecting regional ecosystems with broader innovation process in terms of the multi-level processes including the mix of actors, levels, policy domains and time (Matti et al., 2016).

1.1. Conversations as mechanism for knowledge mobility

In the previous section, innovation platforms were presented as a broad mechanism that enable multi-actor interactions in a knowledge space aimed to accelerate innovation processes. This paper explores mechanisms by which multiple stakeholders perform horizontal interactions by combining individual goals and capacities with shared visions, norms and expectations with the purpose of explore market opportunities in low carbon economy. It thus goes beyond a decalogue of systemic instruments by contributing to research gaps such as the learning process (Kuhlmann, 2004) in a specific place and time, considering geographical dynamics and, most importantly, learning mechanisms in a path-dependent innovation process (Uyarra, 2017).

The concept of conversations has been recently introduced to explore these mechanisms in a knowledge-based economy as it incorporates social interaction and a spatial dimension. Conversations are described as intentional and ongoing processes of knowledge creation (Rutten, 2017) They are spatially bound and shape by place-based needs, thus provide a clearer understanding of the role of regions and cities in the innovation process, as the concept of Smart Specialization also suggests. However, successful implementation of conversations require anchoring (Uyarra, Flanagan, Magro, & Zabala-Iturriagagoitia, 2017).

Knowledge mobility has become an important phenomenon when studying the innovation process. Despite the local environment or "local buzz" plays a key role in absorbing this mobile knowledge, (Crevoisier & Jeannerat (2009) uses the term anchoring to contribute more extensively to the challenges that are faced by regions in a knowledge-based society. Anchoring is described as "an interactive process where regional actors mobilize knowledge, markets, legitimacy, and financial investment" (Uyarra et al., 2017). This term differs from embeddedness because it incorporates a new context, but also differs from "mobility" as learning (beyond mere movement) is required (Binz, Truffer, & Coenen, 2016; Crevoisier & Jeannerat, 2009).

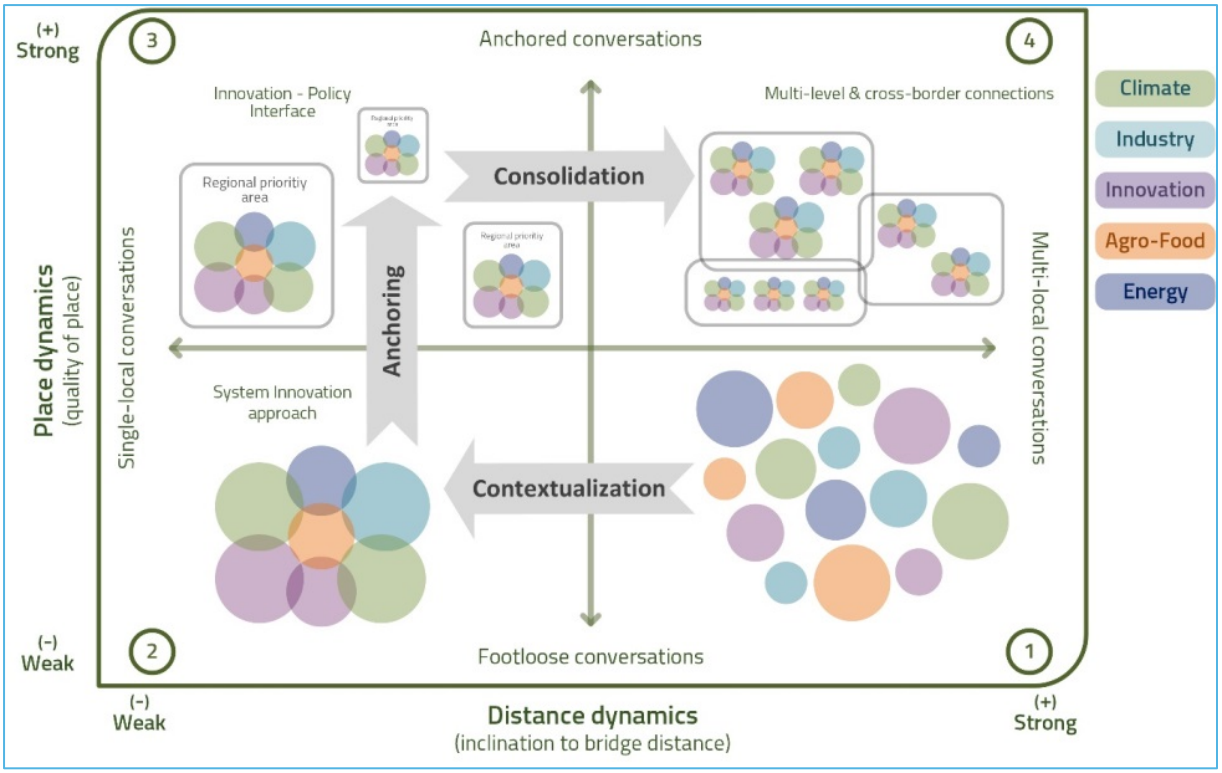
Uyarra et al. (2017) disentangles the geographical dynamics of conversations by identifying process where the place dynamics in terms of the quality of interactions and the purpose of those interaction in terms of creating linkage in terms of distance of interactions can be explain through with three processes:

- Contextualization. Knowledge departs from footloose multi-local conversations taking place in a specific context (decontextualization) to then be contextualized, integrated or absorbed (Crevoisier & Jeannerat, 2009). This re-contextualization requires diffusion in the new place, supporting actors and flexible institutional settings (Binz et al., 2016).
- Anchoring. Once the spatial aspect is introduced, the term "anchoring" looks at the interaction (or its absence) between contextualized knowledge and the new context itself. Despite not all forms of knowledge are equally mobile (Binz et al., 2016), there are different modalities of anchoring depending on the relations that take place. Learning is essential for successful anchoring (Uyarra et al., 2017) as Crevoisier & Jeannerat (2009; 1237) remark, when the anchoring is strong, the learning permits an enrichment of knowledge: either of the location or of the mobile element or of both. The concept of stickiness also takes special relevance as anchoring makes certain extra regional resources more locally or spatially sticky (Binz et al., 2016; Uyarra et al., 2017).
- Consolidation. To go from single to multi-local anchored conversations, it is necessary a process of consolidation, which means taking into consideration the priorities and interests of multiple locations, as well as the global character of knowledge. Conversations with users, specialist and the community in general, anchored around local problems and challenges, may favour the development of niche innovations by contributing to enhancing place-specific innovative advantages

Figure 2 shows an application of these concepts to the case of multi-stakeholder's conversations in the search of innovation opportunities in low-carbon economy. The narrative on knowledge mobility and creation of knowledge spaces can be followed by starting from quadrant 1 (bottom right) where several disperse (footloose) multi domain conversations (e.g. climate, energy, agro-food, innovation) are taking place around several topics

concerning low carbon-economy. The re-contextualization process is then facilitated by a system innovation approach for low carbon-economy that integrates actors, resources and activities under a common knowledge space searching for integrated and coordinated solutions at system level (Quadrant 2). The anchoring process seeks to enable flows between the contextualised knowledge and the context in terms of linkages with the innovation and multi-level policy framework that indicate the regional priorities. By doing so, complementarities about multiple simultaneous actions and instruments should facilitate a learning process to better exploit the synergies with regional strategy (Quadrant 3). Finally, the consolidation process involves a broader system perspective by considering interaction with multiple places and sectors engaged in similar challenges. In this step, a socio-technical multi-scalar and cross-border elements (Quadrant 4) provide additional knowledge flows to reconnect place-base innovation process with the systemic and illustrate long terms perspectives that require the changes needed for a transition to low carbon economy.

Figure 2 Dynamic of conversation in a multi-domain knowledge space for low-carbon economy



Source: own elaboration based in Crevoisier & Jeannerat (2009) and Uyarra et al. (2017)

The example of knowledge space for low-carbon economy illustrate the relevance of the sequence of contextualization, anchoring and consolidation in terms of the complexity of applying system innovation to climate change by connecting local ecosystems and experts with similar challenges to conversations elsewhere can be key for developing in regions with different level of maturity in their innovation ecosystem (Matti & Panny, 2017; Vivas Lalinde et al., 2018), especially in the context of emerging industries where dense local knowledge networks coexist with global buzz (Binz et al., 2016). Those connections facilitate the exploration and establishment of a new domain of opportunities indicated by the smart specialization approach where practical challenges arise to reconcile horizontal priorities (capacity building) with vertical priorities in primary domains.

In this paper, the role of innovation platforms is explored in terms of the creation of knowledge spaces where a variety of governance mechanism seeks to put in place more effective pathways for resource management aimed at fostering place-based low carbon economy. For doing so, we focus on the role of multi-stakeholder participatory process as a specific mechanism to facilitate conversation and knowledge mobility across the level and geographies. In the next section, the empirical study of the action undertaken by the area of Sustainable Land Use at EIT Climate-KIC is presented by highlighting key aspects of creation of knowledge spaces by including a EU regions and stakeholders.

THE METHODOLOGICAL FRAMEWORK

This empirical research is based on different sources, namely methodological and policy documents, reports, as well as a series of multi stakeholder participatory processes run in 2018 in Brussels as part of the EIT Climate-KIC Sustainable Land Use Thematic area. The exploratory study is aimed at identifying underlying factors of geographical structural differences and what are the patterns of relations between knowledge spaces and governance configurations. By doing so, we identify main areas of divergence between the perspective of practitioners and the perspective of policy makers. The study is presented in two steps:

- First, key elements of the challenge, background and the overall narrative on the multi stakeholder participatory processes as part of the innovation platform logic and the specific thematic aspect of the EIT Climate-KIC Sustainable Land Use Thematic area.
- Second, we present the preliminary analysis of the results of those processes regarding mapping knowledge spaces based in the application of methodological techniques for content analysis. In doing so, we identify some insights form the follow up conversation with stakeholder as part of a decision-making process for planning place-base and platform level innovation actions

Stakeholder participation as a mechanism for social learning and system change has been highlighted in the literature in terms of the potential to facilitate the management and understanding of complex system and enable learning process while additional element on systemic thinking has provided a new dimension to participation as a source of knowledge creation (Nevens, Frantzeskaki, Gorissen, & Loorbach, 2013). More specifically, the co-creation component is an essential since the complexity of certain phenomena, i.e. climate change, requires co-created knowledge that is usable, subjective, socially robust and solution-oriented (Salter, Robinson, & Wiek, 2010) which is embedded in the social-spatial dynamics of knowledge creation as "conversations" (Rutten, 2017).

The Participatory Socio-Technical Mapping Approach(Matti, Stamate, et al., 2018) is briefly presented below as tested approach applied to facilitate the interaction of a diverse group of stakeholders to achieve social learning and contribute to the quality of decisions from a challenge led approach

1.2. Participatory Socio-Technical Mapping Approach to facilitate, map and analyse conversations

Participatory action research can be applied as set of methods based in participatory techniques and science-based visual tools. The Participatory Socio-Technical Mapping Approach includes the application of semantic and visual maps for system analysis through a set of ready-to-use visual tools (Matti, Bauer, Granell Ruiz, & Fernandez, 2017; Matti, Juan Agulló, Hubmann, & Morigi, 2017; Matti, Stamate, et al., 2018). A challenge-led approach is applied in the design and implementation of the process by redefining the role of participants, experts and speakers as experts´ role is subtlety shifted to increase the horizontality of the team performance as well as ensuring the closeness to the stakeholder's challenges.

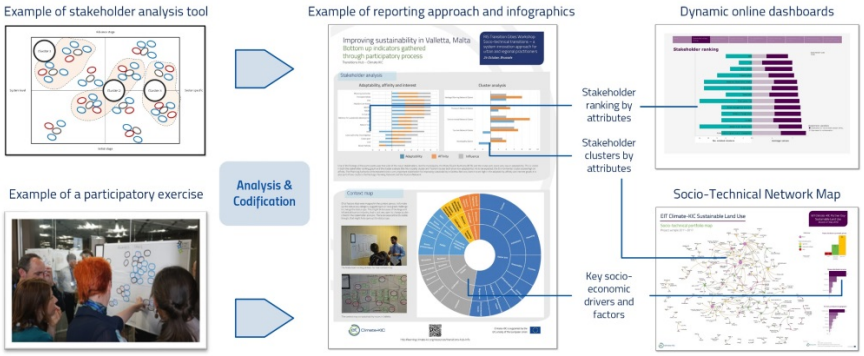
It addresses a collaborative construction of knowledge through the active participation of researchers and participants, thus promoting critical and self-awareness that leads to individual, collective and/or social change (McIntyre, 2007). As important as the results is the research process since it allows to build alliances between researchers and participants while developing skills, knowledge and capacities among all the contributors (Kindon, Pain, & Kesby, 2008; McIntyre, 2007)

As part of the entire process, content analysis can be applied to codify knowledge gathered through the tools. Content analysis is a flexible research method that can be both qualitative and quantitative. It uses rules of inference, or analytical constructs to move from text to response of a research question. An innovative mechanism for knowledge management is introduced in this process. It consists in gathering and codifying each piece of information into a data set with a panel data format. Each participant input is then considered a data input guided by a stakeholder mapping science-based analytical tool based in Social Network Analysis (De Vicente Lopez & Matti, 2016; Matti, Stamate, et al., 2018; Matti, Steward, & Huck, 2018). The following process of knowledge systematization of those inputs allow the design of simplified clusters that illustrate the pattern of relation between components of socio-technical systems.

Figure 3 bellows shows a simplified logic of the codification process and the output as a dashboard of bottom-up based indicators. From an adaptive management perspective, the participatory processed follows a "learning by managing" logic (Pahl-Wostl, 2009) where mechanisms such as webinars or executive meetings allow in further stages the exchange and communications of results as conversation between experts and stakeholder

facilitate a collective understanding of the socio-technical system from a territorial and place-based narratives (Matti, Bauer, Altena, & Tuinenburg, 2016; Matti, Bauer, et al., 2017)

Figure 3 Example of application of visual tools for co-creation of indicators and knowledge maps



Source: own elaboration based on Matti, Stamate, et al. (2018)

EMPIRICAL STUDY

In this section, the result of the participatory mapping exercise is presented by analysing two main dimensions of the process, the collective understanding of knowledge spaces in Sustainable Land Use and the potential of the participatory set up to facilitate conversation on the identification of actions and mechanism to accelerate innovation by mobilizing resource within an innovation platform logic. The exercise seeks to facilitate the analysis of evidence from patterns in the data while presenting evidence on the use of knowledge co-creation process for multi-stakeholder decision making process.

EIT Climate-KIC is considered in this paper an example of a thematic innovation platform that mobilise resources in low-carbon economy. Empirically, the paper explores in the context of Sustainable Land Use area (SLU), the role of innovation platform to provide diverse mechanism to create and maintain knowledge spaces aimed to facilitate the changes to systems level transformation. Three emergent questions are driving this exploratory study:

Q1: Why is innovation platform an adequate mechanism to create and maintain knowledge spaces in low carbon economy?

Q2: What is the potential of multi-stakeholder conversations aimed to support decision-making process for planning place-base and platform multi-level innovation actions?

Q3: What can participatory processes illustrate about collective understanding of socio-technical system and innovative mechanism for resource mobilisation?

These emergent questions are rooted the pillars of a research activity based in science-policy-practice interface as the central logic to explore the empirical evidence and participatory action research (Kindon et al., 2008; McIntyre, 2007) as the methodological references. Additionally, the results of the research are closely connected with process of knowledge co-creation and adaptation of science base tools which can fall under the category of translational research in terms of application behavioural in connection to practical problems (Mace & Critchfield, 2010). The study addressed this question by starting by the practical aspect (Q2 and Q3) to provide evidence to address more general aspects (Q1).

1.3. Multi-stakeholder participatory process

In this section, analytical evidence is presented on multi stakeholder participatory processes run in 2018 in Brussels as part of the EIT Climate-KIC[13] Sustainable Land Use Thematic area. The participatory process was

[13] The EIT Climate-KIC, one of the EIT Knowledge and Innovation Communities created in 2010, has been characterised since the beginning by its regional, place-based approach to innovation in its structure, in addition to its academic and corporate components. It is operation is organised in 4 Thematic areas: 1) Urban Transitions, 2) Sustainable Production Systems, 3) Sustainable Land Use and 4) Decision, Metrics and Finance.

designed to explore system perspective approaches of stakeholders with various backgrounds and, by doing so, illustrate the connections between different knowledge areas. For doing so, participatory approach counting a focus group workshop was combined with a series of executive meetings with stakeholders to facilitate the engagement in the design and the implementation of action plans in the different programmes.

The first example involves a participatory co-design process aimed to experiment innovative methodological guidelines to the set-up of the Forestry Flagship, a platform focusing in specific projects related to sustainable forest management. The second example involves a workshop designed to run a multi-stakeholder dialogue on the goals and strategy of Sustainable Land Use thematic area. The overall goals and context of these two examples are briefly described below.

1.3.1. The co-creation of a Forestry program

An "Scoping Workshop" to engage with multiple stakeholder in the preparation of the Flagship programme, a multi-year ensemble of activities that generates an ecosystem of actors able to tackle critical forestry climate issues in a systemic way. The plan was to gather feedback from partners involved in the forestry sector to work around priority challenges, resources, stakeholders and Flagship components. With an attendance of 90 participants from all Europe (see annex), the scoping meeting aimed to analyse the forestry landscape and derive priority areas. To do this, several external organisations (European directorates, PEFC, Wood Technology Platform, etc.) had been invited to provide their views and to discuss potential synergies with Climate-KIC as an Innovation Platform.

The format of the participatory involve a 2-day event designed to let participants work together in several working groups to identify 5 sets of elements in the forestry sector. The event focussed on 4 main working group exercises:

- Definition of Issues and Challenges: participants provide feedback and new inputs of a series of issues and challenges have been identified through workshops and meetings with experts prior to the workshop and refined during the workshop thanks to a collaborative exercise.
- Backcasting of Activities and Outputs: the backcasting exercise was conducted for the 6 first challenges.
- Stakeholder Mapping: The Stakeholders maps help identify who is part of the sector and who could be a potential partner for the Forestry Flagship
- Resources Mapping: This exercise has been moderated thanks to the use of a Socio-Technological roadmap (De Vicente Lopez & Matti, 2016) with the aim of taking advantage of a collaborative tool to help managers identify the social and technical changes as well as related resources (e.g. knowledge, infrastructure and funding categories) and activities for the long term working plan

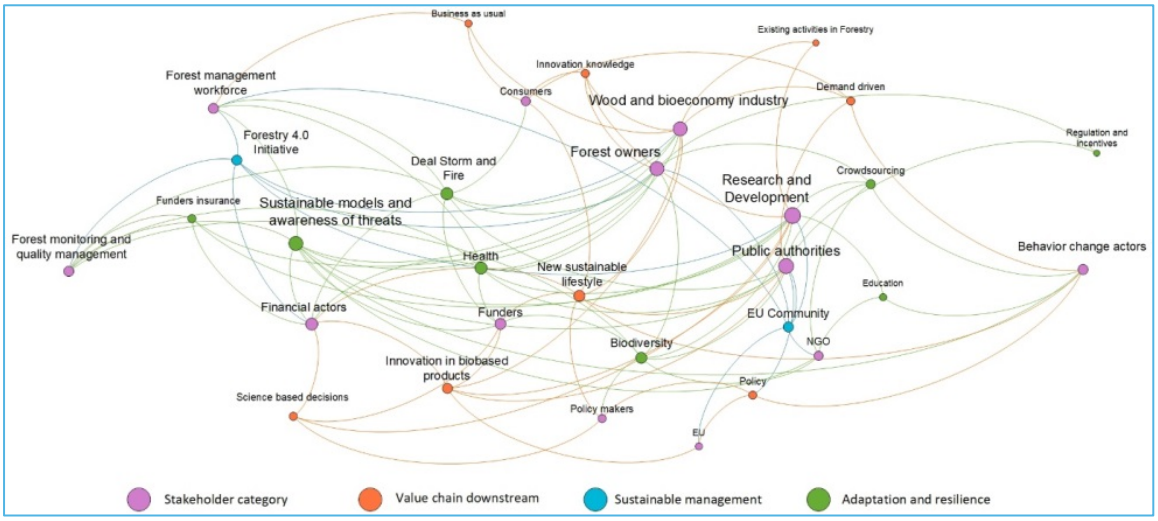
The workshop was followed by a broad communication and dissemination action and the design of a working group to support the next steps of the design and implementation of the forestry program.

Analysis of system mapping and knowledge mobilization

The participatory process has supported stakeholders to identify key partners and resources for the development of the Flagship programme while providing a space for refine priorities of Forestry Flagship. Figure 3 shows the resulted integrated stakeholder amp for the forestry sector where three main knowledge areas and their relations are identified. This pattern of relation has provided a better understanding of the overall context on forestry as well as concrete thematic challenges are mapped for each of the geographical areas (Zimmer, Rossi, & Bruschi, 2018)

See more here https://www.climate-kic.org/

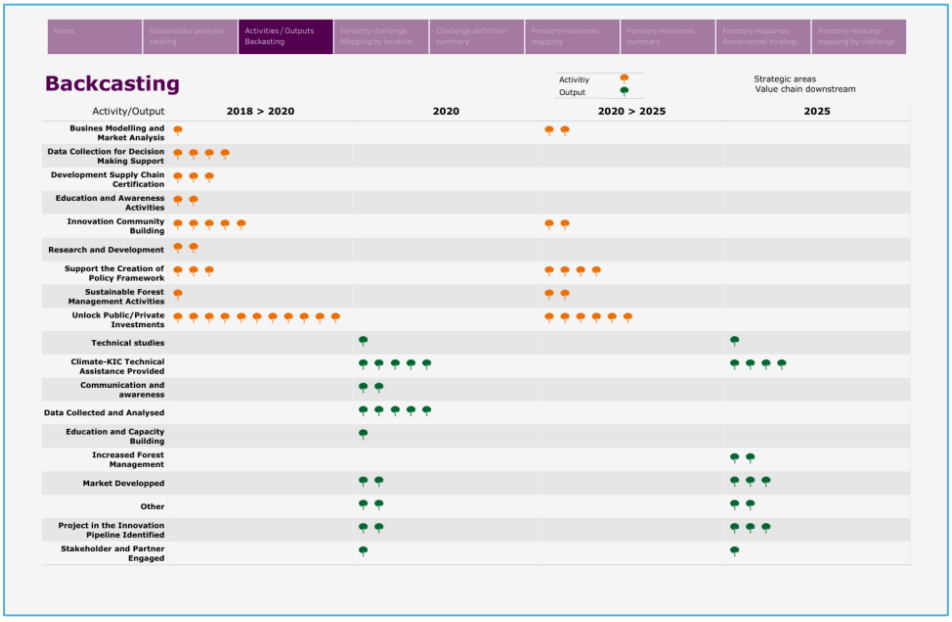
Figure 4 Integrated stakeholder map for Forestry sector



Source: own elaboration

The main objective was to use this methodical approach to gather feedback from partners to be reused in the next phases of the forestry programme preparation. In fact, in the months after this event, the organizing team worked to analyse, compare, categorize, rank and highlight relevant data that was shared with the participants. Participants were delighted to see the results of a precise methodology used during the working sessions. The conversations enabled in this process has allowed the contextualization of the forestry challenge in different aspects. On one hand, activities and outputs were clearly identified (see Figure 4) while discussion on refining the priorities in line with the challenges and current portfolio has taken place to develop synergies and preparing a triennial work plan for the forestry programme (Zimmer, Rossi, & Bruschi, 2018).

Figure 5 Dashboard of bottom-up indicators on activities and output mapping (Screen capture Tableau Dashboard)



Source: own elaboration

The interactions between partners has facilitated the identification of supporting actors as small number of partners indicate their willingness to contribute to the interim steering committee while the institutional setting of the programme was reinforced since participants get to know each other's organization as well as the governance & management of the programme. Anchoring elements in the form of learning were developed through reflection on the rationale beyond the forestry Flagship. More specifically, a collective understanding of system approach to be developed enable the whole community to discuss the important blocks of activities beyond thematic aspects such as tools/instruments that should be developed training activities, start-up support and early stage vs later stage activities. Data gathered has supported the definition of the multi annual forestry workplan for which a design support group was defined to guide the next steps of the programme development(Zimmer, Rossi, & Bruschi, 2018).

1.3.2. Community engagement for strategic planning on Sustainable Land Use

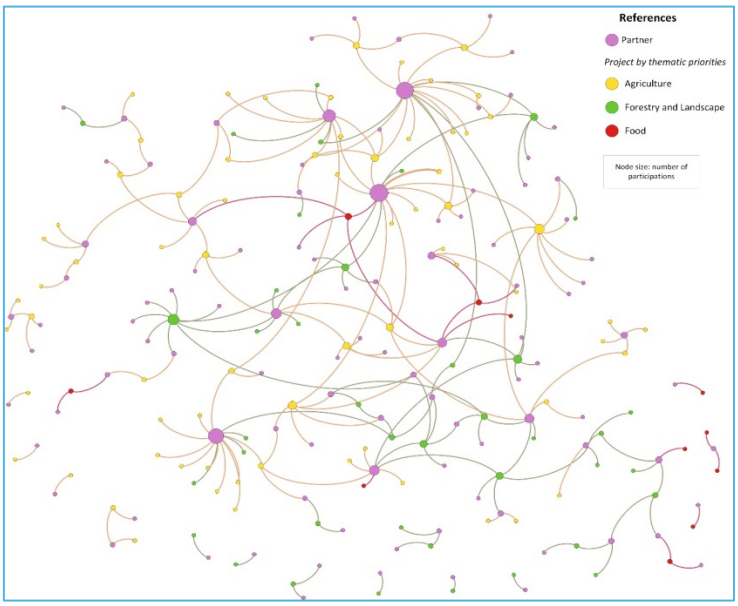
This community event was organized to facilitate interaction between partners involved in existing and management staff of Climate-KIC. The event 52 attendees (see annex) who were participating in lively discussions, inspirational thoughts and networking activities. Synergies between project teams have been created and there were a lot of concrete inputs for delivering long term climate impact on Sustainable Land Use projects. The overarching objective was to facilitate matchmaking between partners (and some start-ups), to progress toward a consistent portfolio of activities and to source and stimulate new projects.

The format of the community event follow the logic of Joint System Mapping based on the Ocean of opportunities tool (De Vicente Lopez & Matti, 2016) by which the participants were split in small groups for almost the whole day to work on the visualization of the systems behind three strategic areas representing the impact goal of Sustainable Land use: 1) Make agriculture climate-smart, 2) Transform climate-damaging food systems and 3) Nurture forests in integrated landscapes. Additionally, the exercise includes example of existing project with the aim of facilitating better understanding of the overall platform resources by enabling interaction between projects leaders and partners

Analysis of system mapping and knowledge mobilization

This community engagement event was aimed to facilitate interactions between the projects already running (with the representatives of the projects) and partners identified several to promote further synergies as part of the existing and further working plan. For doing so, the overall logic of the joint mapping exercise allows the participant to make reflection from different point of view. On one side, a snapshot of the trajectory of the SLU area was presented in terms of portfolio map (see Figure 6) while the joint mapping exercise allow the emergence of bottom up perspectives.

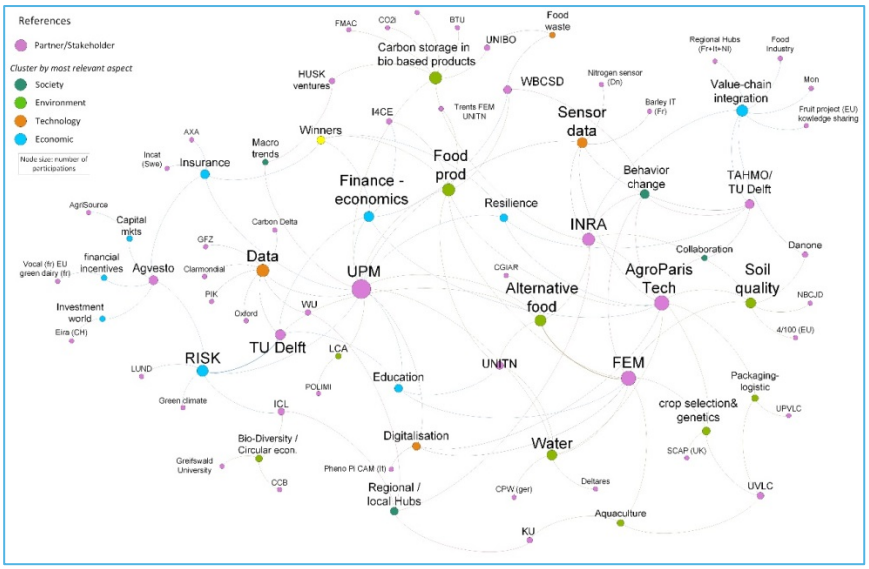
Figure 6 EIT Climate-KIC SLU Socio-technical portfolio map – project sample 2011-2017



Source: own elaboration

Figure 7 shows the integrated stakeholder map for agro-food sector where different aspect of the socio-technical system (society, environmental, technology and economy) is represented by a series of interconnected areas that need to be addressed in a comprehensive approach. These contrasted views facilitate conversations where the contextualization of the trajectories in terms of the emergence idea facilitate a process of knowledge co-creation where partners were able to position their roles and involvement on these maps while developing a common view of the different areas of work in SLU.

Figure 7 Integrated stakeholder map for Agro-Food sector



Source: own elaboration

1.3.3. Consolidation process under the logic on innovation platform for the KIC ecosystem

The Knowledge Innovation Communities (KICs) promote entrepreneurial, innovation and professional mobility activities among different places in Europe. Through their technical support to these activities and projects, knowledge on circular economy, smart specialization and other climate-related themes is contextualized. In other words, KICs anchor knowledge to local contexts, consolidates conversations by connecting them across territories, programs and themes and builds capacity by upgrading knowledge.

In European regions, multiple conversations are taking place at the same time: managers from different sectors that build capacity in their departments, public and private actors coworking in entrepreneurial activities, multi-actor collaborations join for policy deliberation etc. In fact, it is through those activities that 'conversations' between regional stakeholders and different actors involved in the programme take place based on several types of proximities (geographical, cultural, technological, cognitive, institutional, etc.) depending on the nature of mechanism and the involvement of a variety of actors and regions. Individuals operate in a certain moment and place; in a world where knowledge is global and a variety of stakeholders 'need' to connect, this reality translates into multi-local anchored conversations (Rutten, 2017).

These conversations become critical inputs for a process of collective understanding on how public-private interactions reveal potentials and opportunities (structural characteristics, capacities) and, therefore, the direction of structural change. The co-creation of a regional narrative helps regions know themselves better by reconciling horizontal priorities (capacity-building) with vertical priorities in terms of industrial focus while the creation of territorial spaces enables entrepreneurship through the exchange, combination and adaptation of different types of knowledge.

In the case or EIT Climate-KIC Sustainable Land Use area, some significant elements in terms of learning process and the setting of priorities in multiple locations. The participatory process explained above has provided a scenario for stakeholder interaction where KIC community have interacted with non-KIC European actors of the SLU are (the Forestry domain) and receive their feedback on overall challenges & priorities for contributions to climate change in Europe. Knowledge flows has gone beyond the community building since Non KIC actors were able to explore the possibility to develop synergies with Climate-KIC and make their suggestions on where these synergies could be developed and how this could be achieved

More specifically, the participatory process has facilitated conversation regarding the forestry challenges which significantly differ according to the geographical context. Local partners in Northern, Central and Southern Europe have different interests and priorities. Conversation has contributed to understand those difference and contribute to mitigate what could represent a limiting factor for an organization that supports transnational innovation projects. The approach applied to the elaboration of the work plan from a 100% bottom-up perspective has been applied by the first time in EIT Climate-KIC. Thus, lesson learnt on this regard are related to the specific risk of allowing partners designing the activities to capitalize on their current knowledge and strengths instead of trying to do something new and get out of their comfort zone – we have observed that very often innovation happens when organizations/institutions get out of their comfort zone.

CONCLUSION

This paper presents an exploratory exercise where the role of innovation platforms for enabling collective understanding of innovation system and process in terms of geographical issues and innovation process in terms of knowledge combination through a variety of actions.

The paper's contribution lies in the focus on bottom-up processes that look at the platform and community level, understanding the potential of multi-stakeholder conversations to define knowledge spaces as form multiple interrelated layers by including a macro transnational network space and the local & project level space based in a community of practice vision. The overall approach regarding creating linkages with practitioners and policy maker resonate in high level process related to implementation gaps multilevel policies schemes such as Cohesion Policy and local implementation processes

The study contributes to better understand conceptually and empirically the existence of intrinsic learning process that includes several loops, at action level, and methodological approach levels and at context level. At the same time, the logic of translational research as a form of science, policy interface has been validated and expanded to other areas as EU Policy and co-creation of territorial strategies. More specifically and regarding the thematic aspect of sustainable land use, main challenges emerge on the identification of opportunities for innovation projects in terms of exploring different composition of the project partnership

Remerciements

This paper is part of a broad study on transition to circular economy models based in science- practice interface between different units at EIT Climate KIC including Sustainable Land Use Theme and the Transitions Hub. A team of practitioners, managers and researches have directly and indirectly collaborated for this first paper but, we want to specially acknowledge the contribution of Irene Vivas Lalinde, Blanca Juan Agullo at different stage of this "work in progress" research collaboration.

ANNEX

Table 1 Format and level of participation of two participatory process on Sustainable Land Use

PARTICIPATORY PROCESS	LEVEL OF PARTICIPATION	FORMAT	TEAM AND ORGANISATION	INPUTS/ DATA GATHERED	DATE & PLACE
The co-creation of a Forestry program	56 attendees on day 1 and 41 attendees on day two	2 days, 28 working Group Sessions	3 teams implicated to organise the event and analyse the feedbacks	676 inputs processed	January 2018, Brussels
Community engagement for strategic planning on Sustainable Land Use	52 attendees	1 day, 6 working Group Sessions	2 teams implicated to organise the event and analyse the feedbacks	798 inputs processed and analysed, 3 systemic maps produced	May 2018, Brussels

Source: own elaboration based in(Zimmer, Rossi, Bruschi, et al., 2018, 2018)

REFERENCES

Binz, C., Truffer, B., & Coenen, L. (2016). Path creation as a process of resource alignment and anchoring: Industry formation for on-site water recycling in Beijing. *Economic Geography*, *92*(2), 172–200.

Crevoisier, O., & Jeannerat, H. (2009). Territorial knowledge dynamics: from the proximity paradigm to multi-location milieus. *European Planning Studies*, *17*(8), 1223–1241.

De Vicente Lopez, J., & Matti, C. (2016). *Visual toolbox for system innovation. A resource book for practitioner to map, analyse and facilitate sustainability transitions*. Brussels: Transitions Hub, EIT Climate-KIC.

Kindon, S., Pain, R., & Kesby, M. (2008). *Participatory action research.* Elsevier.

Mace, F. C., & Critchfield, T. S. (2010). Translational research in behaviour analysis: Historical traditions and imperative for the future. *Journal of the Experimental Analysis of Behaviour*, *93*(3), 293–312.

Matti, C., Bauer, A., Altena, T., & Tuinenburg, P. (2016). New practices for development of urban Cleantech strategies based in collectively constructed notion of system innovation. Presented at the 11th Regional Innovation Policies Conference, Cardiff, UK.

Matti, C., Bauer, A., Granell Ruiz, R., & Fernandez, D. (2017). Challenge-led participatory approach to foster territorial sustainability strategies. Presented at the Practicing the Commons. XVI Biennale IASC-Conference, Utrecht, Netherlands.

Matti, C., Juan Agulló, B., Hubmann, G., & Morigi, G. M. (2017). *Challenge-led participatory approach. Transitions Hub technical proposal for participatory capacity building and technical assistance* (EIT Climate-KIC internal report). Brussels.

Matti, C., & Panny, J. (2017). Policy mixes fostering regional capacity in low carbon economy. Insights from the implementation of the RIS model in peripheral European regions. Presented at the RSA Annual conference "The Great Regional Awakening: New Directions" (Dublin), Dublin.

Matti, C., Stamate, E., Juan Agulló, B., Martin Corvillo, J. M., Bauer, A., & Avella, G. (2018). *Participatory socio-technical mapping. Handbook for practitioners to design and implement a community-based process for system mapping and analysis.* Brussels: EIT Climate-KIC.

Matti, C., Steward, F., & Huck, A. (2018). Challenge-led and participatory learning processes to facilitate urban strategies for innovation on low carbon futures.

McIntyre, A. (2007). *Participatory action research* (Vol. 52). Sage Publications.

Nevens, F., Frantzeskaki, N., Gorissen, L., & Loorbach, D. (2013). Urban Transition Labs: co-creating transformative action for sustainable cities. *Journal of Cleaner Production*, *50*, 111–122.

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change*, *19*(3), 354–365. https://doi.org/10.1016/j.gloenvcha.2009.06.001

Rutten, R. (2017). Beyond proximities: The socio-spatial dynamics of knowledge creation. *Progress in Human Geography*, *41*(2), 159–177.

Salter, J., Robinson, J., & Wiek, A. (2010). Participatory methods of integrated assessment—a review. *Wiley Interdisciplinary Reviews: Climate Change*, *1*(5), 697–717.

Uyarra, E., Flanagan, K., Magro, E., & Zabala-Iturriagagoitia, J. M. (2017). Anchoring the innovation impacts of public procurement to place: The role of conversations. *Environment and Planning C: Politics and Space*, *35*(5), 828–848.

Vivas Lalinde, I., Matti, C., Panny, J., & Juan Agulló, B. (2018). Innovation platforms fostering low-carbon economy resource mobilization. A community of practice approach for knowledge triangle integration in EU peripheral regions. *World Journal of Science, Technology and Sustainable Development*, *(in press)*.

Zimmer, D., Rossi, F., & Bruschi, V. (2018). *Forestry Flagship Scoping Workshop Event Report* (EIT Climate-KIC internal report). Brussels.

Zimmer, D., Rossi, F., Bruschi, V., Pan, P., Gigante, F., & Laurent-Polz, C. (2018). *SLU Partner Day Event Report* (EIT Climate-KIC internal report). Brussels.

AFFILIATION

Cristian Matti

EIT Climate-KIC and Copernicus Institute for Sustainable Development – Utrecht University

Cristian Matti has PhD in the field of Science, Technology and Innovation Studies – Economic geography. He is an expert in sustainability transitions and environmental innovation. He is Transition Hub lead at EIT Climate-KIC and Researcher at the University of Utrecht. He has contributed to research projects on natural resource-based innovation, regional and industrial systems of innovation, and innovation policies for public and private organisations in Europe and South America. His primary interest is the linkages between science and practice in facing the challenge of transforming environmental governance and technological development processes.

Institutional contact: Climate-KIC Brussels Office, Rue Guimard 7, 5th floor

1040 Brussels, Belgium. e: cristian.matti@climate-kic.org

Fabrizio Rossi

EIT Climate-KIC, Sustainable Land Use Theme, Programme Lead

Institutional contact: Climate-KIC Brussels Office, Rue Guimard 7, 5th floor

1040 Brussels, Belgium. e: Fabrizio.Rossi@climate-kic.org

Valerio Bruschi

EIT Climate-KIC, Sustainable Land Use Theme, Project Officer

Institutional contact: Climate-KIC Brussels Office, Rue Guimard 7, 5th floor

1040 Brussels, Belgium. e: Valerio.Bruschi@climate-kic.org

PS4: FOSTERING SUSTAINABILITY TRANSITION AT THE EUROPEAN LEVEL

How can the deep decarbonization of the European agri-food sector be achieved? A study of institutional work in shaping transition pathways

Maria Tziva

What is the relevant approach for engaging territorial actors in a High Nature Value innovation project? Understanding the strategic context – findings from HNV-Link H2020 Thematic Network

Xavier Poux, Claire Bernard-Mongin, Diana Dumitras, Maria Isabel Ferraz de Oliveira, Fabrice Gouriveau, Dimitris Goussios, Irina Herzon, Mugurel Jitea, Yanka Kazakova, François Lerin, Magnus Llung, Angela Lomba, Vali Mihai, James Moran, Teresa Pinto-Correia and George Vlahos

Participatory design: Improving innovation support in Living Labs across Europe

Jorieke Potters, Chris Blackmore and Herman Schoorlemmer

THE PROTEIN TRANSITION:

A study of the development of plant-based meat substitute innovations in the Netherlands

AUTHORS: TZIVA M., NEGRO S.O., KALFAGIANNI A., HEKKERT M.P.

Abstract

In this paper we study processes that contribute in the emergence of the plant-based meat substitutes industry in the Netherlands. Technological Innovation Systems (TIS) literature has been useful in the analysis of innovation dynamics of emerging industries. Within TIS literature, the motors of sustainable innovation typology identifies patterns in the development of key processes that create feedback and contribute in the acceleration or decline of systems. However, TIS literature has not sufficiently explored innovations within the context of the food sector. We apply the motors of sustainable innovation typology to the case of plant-based meat substitute innovation in the Dutch food sector. We find that during the development of the TIS, important processes were the utilisation of advanced technologies from other sectors and social construction strategies by entrepreneurs that aimed to align products with changing societal cognitive and normative institutions. We contribute in TIS literature by providing policy relevant insights into the organization of innovation in supplier-dominated industries.

KEY-WORDS

TECHNOLOGICAL INNOVATION SYSTEM, SECTOR, SYSTEM FUNCTIONS, FOOD INNOVATION, MEAT SUBSTITUTE

1. INTRODUCTION

Meat and dairy agriculture contributes significantly to climate change. It is estimated that it accounts for about 14.5% of global Green House Gas (GHG) emissions (Gerber, 2013). A large share of these emissions are non-CO2 emissions of methane (CH4) for which commercially available mitigation options have a limited potential (Herrero et al., 2016). In the EU (2011) roadmap towards a low carbon economy, the commission has set a target of overall 80% emissions reduction below 1990 levels by 2050. Meeting this targets will require agriculture to reduce non-CO2 emissions drastically. Large mitigation potential still exists in reducing meat and dairy consumption (Hallström et al., 2015; Hedenus et al., 2014; Westhoek et al., 2014). The diffusion of a range of plant-based meat substitutes, could contribute to accelerated dietary shift and disruption in meat and dairy consumption trends (Apostolidis, & Mcleay, 2016; Smetana et al., 2015). Therefore, in this paper, we study the development of plant-based meat substitute innovations as a decarbonization pathway for the EU economy.

Theoretically we contribute to Technological Innovation Systems (TIS) literature. Innovation System (IS) studies have strongly influenced innovation research over the past decades by recognizing the systemic character of innovative activities (Edquist; 1997; Freeman, 1897; Lundvall, 1992). Within IS studies the TIS perspective conceptualizes the emergence of low-carbon industries as systems consisting of actors and institutions around technologies or materialities (Markard et al., 2015; Weber & Truffer, 2017). Because the TIS perspective is used to analyze system performance, it has been proven valuable in producing policy relevant understandings (Markard et al., 2015).

Scholars have suggested that by exploring dynamics within strictly delimited systems, often TIS studies pay little attention to the influence of different types of contextual structures, including the technological, sectorial, geographical and political context (Bergek, et al., 2015; Jacobsson & Bergek , 2011). Particularly the importance of the sectorial context has been highlighted in Sectoral Innovation System (SIS) literature (Breschi et al., 2000; Malebra, 2002). Recent TIS studies have drawn insights from SIS literature and have contributed in understanding the relationship between industry related factors and the diffusion of technologies in production as well as the valuation of products in markets (Binz & Truffer, 2017; Haley, 2018; Makkonen & Inkinen, 2018; Stephan et al., 2017). Nevertheless, it still is important to explore the influence of the sectorial context on the build-up process of TISs and its dynamics.

By studying the development of the TIS of plant-based meat substitutes, we explore the TIS build-up process within the context of the food industry. Suurs (2009), in the motors of sustainable innovation typology, identifies patterns of the development of processes or functions during the build-up of TISs within the energy sector. These patterns generate feedback and contribute in the acceleration or decline of systems (Suurs & Hekkert, 2009a). We apply the motors of sustainable innovation typology to the case of the plant-based meat substitutes TIS in the Netherlands.

In the case of meat substitutes, the majority of firms involved in the sector are producers of personal goods. Because of their relatively limited ability to develop their own products and processes they are often referred to as supplier-dominated industries (Castellacci, 2008). Sources of innovation in meat substitutes are advancements in variety of manufacturing processes that allow the production of distinct products in terms of form and texture.

The EU food industry is characterized by almost complete absence of protected niche markets by governmental support. Food production and processing is mainly the subject of EU food safety and international competition laws. National governments have been reluctant to adopt regulations that would facilitate demand for particular food products, such as stringent production standards or tax exemptions, due to barriers erected by the international regulatory institutions, uncertainties related to the impact of such tools and strong industry opposition (Bødker et al., 2015; Fellmann at al., 2017). The promotion of meat substitutes under the premise of health and/or sustainability has mainly been restricted to providing consumers with information and educational programmes. Market formation for the sector is mainly consumer driven and strongly influenced by changes in relevant cognitive and normative institutions.

Due to these characteristics we expect that different patterns of processes will be important in the acceleration or decline of the plant-based meat substitute TIS. Therefore we ask how did the TIS emerge and which patterns of processes could be identified and how did they influence the structure of the system?

In Netherlands the meat substitutes TIS already has a fairly mature structure. The Dutch sector is comprised by domestic producing and processing firms. The Netherlands constitutes one of the largest national markets for meat substitutes globally (Changing markets, 2018). In 2017, the total retail turnover of plant-based protein products, including meat substitutes was estimated at 368 million euro (Distrifood, 2017). Therefore, the case study allows the analysis of the development of the TIS over time on the supply as well as the demand side.

2. THEORETICAL BACKGROUND

The central idea of innovation system (IS) studies is that firms are part of a structure, an IS, which also determines the innovation process (Lundvall, 1992; Edquist; 1997). Within innovation system studies, the Technological Innovation Systems (TIS) perceptive, explores the growth of emerging low-carbon industries (Bergek et al. 2015; Markard & Truffer 2008). A TIS is comprised by structural components, actors, institutions and technologies or materialities (Bergek et al. 2008; Markard & Truffer 2008). TIS boundaries are set around an emerging technological knowledge field or a product/product group (Bergek et al., 2008). Complex interactions among the structural components underlie the development of a TIS (Markard & Truffer 2008).

The TIS framework further identifies interpretive categories of interactions, a set of seven key processes or functions that evolve during the development of a system (Bergek et al. 2008; Hekkert et al. 2007; Suurs & Hekkert, 2009a). These include entrepreneurial activities [F1], knowledge development [F2], knowledge diffusion [F3], guidance of the search [F4], market formation [F5], resource mobilization [F6] and legitimacy creation [F7] (Hekkert et al. 2007). In the ideal outcome, the development process of a TIS goes through a formative phase

before it switches to growth and eventually mature into a system with fairly stable structure (Bergek et al., 2008b; Jacobsson, et al., 2004).

The development of a TIS is not a linear process. Central to the development process of a TIS is the notion of cumulative causation. Cumulative causation refers to feedback created through the co-evolution of system functions (Suurs & Hekkert, 2009a). Positive feedback contributes to the acceleration of the build-up of a TIS (Suurs & Hekkert, 2009a). Negative feedback might result in struggles and decline of the build-up process of a TIS (Suurs et al., 2010). Understanding feedback mechanisms and how they influence the structure of TIS is important in understanding how and why TIS evolve.

Suurs (2009) proposes the typology "motors of sustainable innovation". The typology identifies four patterns of cumulative causation, motors, which are characterized by a sequence of events through which different functions emerge (Suurs et al., 2010). The science and technology push motor is mainly dominated by patterns of positive expectations for a technology and the setting up of government supported R&D programmes. The entrepreneurial motor, is triggered by new entrants and the initiation of projects. Depending on the outcome of the projects, there is feed back into the dynamics of the system which incentivizes or discourages the initiation of new projects. In the system building motor entrepreneurs increasingly organize themselves into networks and strategically participate in activities that aim to strengthen system functions. Finally, in the market motor, institutional structures that facilitate commercial demand for the emerging technology are introduced and this contributes to a boost in all system functions.

Suurs (2009) explains the emergence, retention and/or decline of motors according to the structural components present in TISs. Table 1 presents a summary of which structural components constitute drivers and barriers of the different motors of innovation.

Table 1. Enabling and disabling structural components in motors of sustainable innovation adapted from Suurs (2009)

Motors of sustainable innovations	**Enabling structural components**	**Disabling structural components**
Science and technology push motor	Emerging technology A small group of science and industry actors as enactors Growing sense of urgency among policy makers for societal problem/s	Limited support of enactors by selectors on the supply side Very limited willingness among enactors and selectors on the demand side Uncertainty regarding the technological potential in current market setting
Entrepreneurial motor	Relatively developed but still pre-commercial technology Firms and utilities as enactors, government and large firms as selectors, a few potential demand side enactors Promise of commercial environment for technology	Weak organization of networks of enactors Lack of support in demand-side by important selectors e.g. part of government, incumbents
System building motor	Near mature technology, typically beyond demonstration Firms in supply and demand side and usually (lower level) government as enactors Strong networks Variety of selectors ready to invest in marketing and infrastructure Promise of commercial environment for technology	Limited expectations for further development of technology Resistance by potential users Sectors potentially capture enactors in order to maintain the status-quo
Market motor	Reliable technology Solid basis for commercial market environment constructed by formal institutions e.g. national government regulation Enactor group of a variety of stakeholders , large group of selector e.g. incumbents, national government, first end-users Internal momentum can overcome resistance	Resistance from selectors that have previously been uninvolved Actors within the incumbent energy system may attempt to encapsulate the emerging technology in order to control its disruptive potential e.g. by erecting market barriers

As Malebra & Nelson (2011) emphasize the build-up of sectors over time is a result of sector-specific co-evolutionary processes. The motors of sustainable innovation typology offers an analytical framework to explore these processes and move beyond static analyses of factors that foster sectoral innovation.

The motors of innovation typology was developed through the aggregation of results from case studies in emerging technologies within the energy sector (Suurs, 2009). The SIS stream of literature emphasizes that the characteristics of specific industries also determine the organization of innovation (Breschi et al., 2000; Malebra,

2002). Industry related factors have a crucial impact on patterns of innovative activities (Breschi et al., 2000; Malebra, 2002) due to differences between industrial sectors in terms of their knowledge base, technological opportunities, cumulativeness and appropriability conditions, relevant to the diffusion of new technological paradigms (Breschi et al., 2000; Poel, 2003; Dosi et al., 2006). Sectors dominated by producers of personal goods follow not so dynamic trajectories in terms of technological development and mainly acquire advanced technologies produced in other sectors in order to re-create opportunities (Castellacci, 2008).

A few TIS studies have made a link between TIS and SIS literatures. Indeed, the importance of knowledge development and diffusion function have been found to vary among different sectors (Stephan et al., 2017) as well as of processes by which a new technologies becomes valuable in markets mostly described through the market formation and legitimacy creation functions (Makkonen & Inkinen, 2018; Binz & Truffer, 2017). The TIS literature can still be benefited by exploring the development of functions in the formation of industries, dominated by personal goods firms which have limited capabilities in developing their own technologies and are in the final steps of supply chains, closer to end users.

To sum up, the study of patterns of cumulative causation, can offer valuable insights into the dynamics of emerging low-carbon industries. Suurs (2009) made an important contribution by identifying patterns in the formation of different TIS within the energy sector. However, due to differences in the organization of innovation across different sectors, the IS literature could be benefited by studies outside of the energy sector.

3. METHOD

We followed an iterative approach. The first step of this study was mapping the structural components of the TIS by identifying relevant actors, institutions and technologies. Empirical data were collected from secondary sources, including professional journals, industry reports, policy papers, and scientific literature. Afterwards, we conducted a qualitative historic event analysis between 1990-2017, in order to reconstruct the narrative of the development of the sector. We developed a database containing relevant events. We coded the events according to the seven functions of TIS (Hekkert et al., 2007). This allowed the identification of the development of system function and therefore provided an indication of cumulative causation during the build-up of the system.

We complemented the results of the event analysis with 30 semi-structured in-depth interviews. We interviewed actors across the supply chain of meat substitutes as well as relevant stakeholders from the food industry. In the interviews, we explored the build-up of the system according to the different interviewees perspective. Interviewees provided us with some additional document material which was included in the event analysis. To address the validity of our study, we triangulated the results of the interviews with the narrative.

4. RESULTS

This section starts by providing a description of the analytical boundaries of this study. It continues by illustrating the narrative of the development of the TIS in the Netherlands.

4.1. Background

We delineate the innovation system by plant-based meat substitutes, products that take the place of meat in the human diet and have an appearance, texture and nutritional content similar to meat products. The supply chain of meat substitutes can be conceptualized in four broad steps. In the first step, a variety of protein crops are cultivated globally (e.g. soybeans, rapeseed/canola, wheat, rice, oats, peas, beans and lupines) (Day, 2013). In the second step, crops are procured and processed into protein ingredients, such as protein concentrates and isolates (Jones, 2016; Osen et al., 2014). In the third step, firms in the food sector purchase protein ingredients, formulate and process them into texturized intermediary products and/or finished meat substitutes. Finally, in the last step, products reach consumers through retail and food service.

The food sector and particularly producers and processors of meat substitutes depends on inputs which mainly stem from the agricultural commodities and biotechnology industries. These industries in turn depend on several processes, such as plant breeding, protein isolation and functionalization. For the purposes of this paper the focus is kept on the food sector. However, the analysis considers dependencies that stem from the complete supply chain of meat substitutes.

Methods for developing meat substitutes include a variety of manufacturing processes. The majority of plant-based meat substitutes are produced by cooking extrusion. Products developed with low-moisture extrusion have existed in Europe already in the 1960's (Aiking et al., 2006). The majority of these products are extruded defatted soy flour or flakes and soy concentrates, commonly referred to as Textured Vegetable Protein (TVP) (Asgar et al., 2010). Products developed with high-moisture extrusion have reached the market recently as a result of advancements in cooking extrusion processes (Cheftel et al., 1992; Knoch, A. 2016; Lin et al., 2000; Yao et al., 2006). They are characterized by defined fiber formations that closely resemble meat and have enhanced taste sensation (Lin et al., 2000; Yao et al., 2006). Therefore, they are perceived to better satisfy consumer expectations.

4.2. Narrative

4.2.1. A niche market (1990-1995)

During the early 1990's in Europe, there was no urgency in public discourses for a sustainable agri-food system. Meat substitutes served niche vegetarian and vegan markets, driven by ethical, cultural or religious factors. Traditional preparations of vegetarian products, such as tempeh, tofu and seitan were present, as well as a narrow assortment of meat substitutes mainly based on TVP, wheat and mycoprotein (Sadler, 2004). The market share of meat substitutes remained very small mainly because the products did not yet appeal to a wide range of consumers.

Within policy making, there was growing attention on long-term environmental robustness. The first Dutch National Environmental Policy Plan had already been adopted (Straaten, 1992). In 1993, within the context of the plan, the Sustainable Technology Development (STD) research programme introduced the idea that the promotion of technological innovation could contribute in meeting human needs more efficiently [F4] (Vergragt & Grootveld, 1994; Weaver et al., 2000). Future meat-like products that would have a factor 20 lower environmental impact than meat and would be attractive to consumers were identified as a potential solution within the theme of nutrition [F4].

Consequently, in 1994, the Novel Protein Foods (NPFs) of Sustainable Technological Development programme was initiated. The NPFs programme assessed non-animal protein sources and processing technologies for the development of the next generation of meat substitutes that could better satisfy consumer expectations [F2] (Quist, 2007). The results illustrated that the substitution of components of assembled or processed end-foods, such as minced meat, was feasible, but still knowledge development was needed to manage a satisfactory texture and taste and large scale production [F2].

The NPFs programme triggered the unit for (sustainable) products and consumption in the Ministry of the Environment (Quist, 2007). Stimulating the production and consumptions of NPFs was perceived as an opportunity to develop policies for sustainable products [F4].

4.2.2. Crises in meat supply chains (1996-1998)

Between 1996-2004 , crises related to livestock supply chains and increased public concerns over health and safety aspects of food drove developments in the system of meat substitutes. The outbreak of bovine spongiform encephalopathy (BSE) crisis, referred to as mad cow disease and the dioxin scare led to mass media reporting numerous messages which linked meat consumption to health risks (Morabia et al., 1999; Sans et al., 2008; Verbeke et al., 1999).

In the Netherlands, the topic of meat substitutes became present in public discourses. Print news articles reported significant increase in the retail sales of meat substitutes and reproduced positive expectations for further growth of the sector [F5][F4].

At the time, the two international firms Quorn and Tivall dominated the Dutch market of meat substitutes. Two Dutch SMEs, Vivera, and Schouten Europe, had been established [F1]. Raised expectations for market growth led to increase in the supply of products [F5]. However, so far, the product range of meat substitutes in the market remained fairly stable. The range of available protein ingredients that could be texturized was very limited. The most commonly applied manufacturing process was low-moisture extrusion. Therefore, the taste and texture of products could not match consumer expectations.

In 1997, as a result of efforts to harmonize food laws and pressure stemming from public concerns over uncontrolled imports of genetically modified soy, the European Commission adopted of the EU Novel Food Regulation (Vogel, D., 2003). The Novel Food Regulation provides the authorization procedure for the introduction of foods and ingredients which have not been consumed in Europe to a significant extend before 1997 (EC, 1997). It applies to a number of potential raw materials for the development of meat substitutes [F4]. Because the procedure requires large financial investment, it influenced the character of entrepreneurial experimentation in the following years. It was easier to start from already authorized ingredients and thus, whether ingredients fell under the Novel Food Regulation became a criterion for the initiation of projects.

4.2.3. An incumbents joins the enactors group (1999-2006)

Closer to the new millennium, climate, and particularly concerns over the energy system, became important in EU policies. Similarly, in the Netherlands, within the Ministry of the Environment the agenda shifted towards climate change and spacial planning and interest in sustainable products and consumption decreased (VROM, 2001; Quist, 2007).

In 1999, the Ministry of Agriculture had already funded the multidisciplinary research programme PROFETAS, as a continuation of the NPF programme [F6] (Aiking & Boer, 2006). PROFETAS consisted of 15 research projects, in different scientific disciplines, which explored the potential of products based on a single crop, pea (Pisum sativum L) (Aiking et al., 2006). The PROFETAS programme delivered scientific knowledge on technological feasibility, sustainability, consumption opportunities and barriers regarding products based on pea [F2] (Aiking & Boer, 2006). In terms of technological feasibility, the results of the programme were equivocal. They illustrated that a range of meat-like products could be developed. But, still research was needed, particularly in texturization processes, and it could not yet be assessed whether these products would better meet consumer preferences [F4] (Vereijken et al., 2006).

Five industrial firms were involved in the programme but no products were introduced in the market (Quist, 2007). Moreover, due to increased competition in the food industry and particularly a price war between Dutch retailers SMEs started to exit the market of meat substitutes (Quist, 2007).

Nevertheless, In 2005, the Dutch incumbent dairy cooperative Friesland Campina introduced the meat substitute brand Valess, based on dairy protein. Friesland Campina rolled-out a large-scale marketing campaign for the promotion of Valess, which costed three million euros [F6] (De Volkskrant, 2005). The promotion efforts of Friesland Campina led to an increase in sales of meat substitutes [F5]. Friesland Campina and Valess received the yearly award of the food innovation network Food Valley as the "healthy alternative to meat", implying that at the time the dominant market framing of plant-based products was substitution of meat consumption due to health concerns [F4].

«You have to understand that in 2000, 2002, 2003, there was no thoughts about sustainability and livestock… It was a different world, nobody was thinking about sustainability. We were thinking about healthy food. »

The introduction of Valess also triggered, for the first time, dissent over meat substitutes. A dispute started between Friesland Campina and a NGO representing animal welfare over the origin of the eggs used as raw materials [F7]. Moreover, the Dutch meat information office filed a lawsuit against the company [F7]. The promotional campaign of Valess directly compared the meat substitute with meat. The Nutrition Center issued a statement in which they explained that dairy substitutes do not have the same nutritional value as meat [F7]. The court ruled against Valess which had to modify information on their website.

4.2.4. The second generation of meat substitutes (2006-2009)

From 2007 onwards, the adverse environmental impact of livestock production became an important issue. The publication of "Livestock's Long Shadow" (Steinfeld et al., 2006) from the Food and Agriculture Organization of the United Nations (FAO), was a turning point regarding wider awareness for the link between livestock agriculture and climate change. Coupled with increasing awareness for animal welfare compromises in livestock agriculture, meat production and consumption became a more contested issue.

In the Netherlands, the negative attention on livestock production incentivized new actors to become involved in the system of meat substitutes. NGOs from environmental and animal welfare perspectives started promoting meat substitutes in their campaign [F7]. This led to new cognitive associations between meat

substitute products and environmental and animal welfare benefits. Meat substitute firms that had already been established, such as Valess, Vivera and Schouten Europe, experienced growth in sales and experimented with product development [F1][F5].

During this period, new intermediary products were introduced in the market. In 2006, Meatless, a new entrant originating from the meat processing sector, acquired a hydrocolloids process developed in the sugar industry and introduced textured products based on rice, wheat and lupine [F1]. In the same year, professionals in TOP BV, a service provider for the agri-food industry, started exploring the potential of applying high-moisture extrusion principles for the development of meat substitutes [F1]. Due to the high moisture content level, resulting products offered benefits in terms of texture and taste. The up-scaling test of the process was positive and in 2009 the firm Ojah was established [F1]. Ojah introduced "Beeter", a textured product that could be further processed into a variety of end products.

The introduction of Meatless and Ojah was a milestone in the diffusion of products, commonly referred to in the Netherlands, as the new generation of meat substitutes. In the following years, they allowed end-product firms to produce better performing products in terms of taste and texture and to use of a wider range of protein ingredients. Therefore, the range and quality of products in the market widened.

«And now we have all kind of different processes, hydrocolloids, wet extrusion which is totally different… we got all kinds of varieties.»

«It was a very new texture, very original still to this day. No other extruder comes near to what they are doing.»

Within the government, the increased attention on livestock agriculture contributed in the protein transition being brought in the political agenda. In 2009, the ministry of Agriculture, Nature and Food Quality introduced the memorandum Sustainable Food, which had a focus on protein innovation as means to a sustainable food system [F4] (LNV, 2009) . Consequently, the memorandum triggered the following patterns.

Knowledge development was supported by the program Innovations in Protein Chains with a budget of 6 million euros [F6] (LNV, 2009). The programme had a focus on isolation processes for the introduction of novel protein sources, mainly insects, algae and in-vitro, with applications in both feed and food [F2]. Interaction between stakeholders and knowledge diffusion was supported by the programme "Protein Dialogue" which provided space for discussing the possibilities for the acceleration of plant-based protein production and consumption [F3]. Entrepreneurial experimentation in the food sector was stimulated through the Small Business Innovation Research (SBIR) subsidy scheme with the call replacement of animal proteins, which allocated 1.7 million euros [F6] (Deuten et al., 2010).

At the time, new entrants faced significant barriers. Industrial scale food processing requires large-up front investments in equipment and machinery. Because the volumes in the sector were relatively low, production costs remained high. Consequently, the price of meat substitutes was high. Due to imbalances of power in the supply upstream in the supply chain, it was difficult to establish products in the market. Government funding and the enabling policy environment was, thus, pivotal in the development of firms [F1]. Among the firms that governmental support were Meatless and Ojah.

«We were struggling to move on, fairly high losses and an uncertain future. You need money for that, … but the government was also helping to keep us going. And that was especially in the year 2006 to 2009. That was very important»

Finally, increased urgency contributed to the buildup of science-based knowledge regarding the nutritional value and the environmental impact of meat substitutes. Various studies were triggered [F2] (Blonk 2008; CR, 2011; Pluimers & Blonk, 2011; RIVM, 2011; Westhoek et al., 2011;). Particularly, the publication "Guidelines for good nutrition, the ecological perspective", from the health council of the Netherlands (CR) (CR, 2011) led, for the first time, to the conclusion, that less animal-based and more plant-based diets would benefit both public health and the environment [F2]. It advised on increasing the consumption of plant-based products, including meat substitutes [F7].

«So this was very important milestone, so this is kind of consensus, scientific consensus, and it give us an opportunity to inform people with these guidelines and how health and sustainability goes together»

4.2.5. Entrepreneurs take the lead (2010-2014)

The agricultural sector was becoming more prominent in EU climate mitigation policies (EC, 2011). In the Netherlands, between 2007-2010, the minister of agriculture, Gerda Verburg, had a strong influence on the inclusion of the protein transition in the agenda. In 2010, there was a change in government. The protein transition lost ground in the political agenda and ultimately, efforts in the context of the sustainable food memorandum stagnated [F4]. Only the pattern of scientific knowledge development on protein isolation processes was continued through the Protein Innovation programme [F2] (NWO, n.d.).

However, in 2011, a study on barriers for the development and marketing of alternative protein food products in the Netherlands, based on stakeholders' perspectives, was carried out on behalf of the ministry of economics (LEI, 2012). The study concluded that stakeholders perceived that governmental support was not suitable for the needs of the sector. SMEs had a disadvantage, relatively to knowledge institutions and incumbent firm, in successfully applying for subsidies. The scale of subsidies was perceived as insufficient and their scope as not relevant to the needs of the sector. As a result, there was little applicability for the output of research projects.

Despite absence of policy support, moderation in meat consumption among non-vegetarian consumers, the rise of flexitarians, was becoming an important trend (Dagevos, 2014; De Bakker & Dagevos, 2010). Entrepreneurs picked-up this movement and several end-product brands started to emerge. In 2010, the Vegetarian Butcher was established. The Vegetarian Butcher was the launching customer of Ojah. It opened a meat substitutes concept store in The Hague. In the following years, the brand experienced significant growth. By 2014, Vegetarian Butcher products were present in retailers in the Netherlands [F5]. By 2015, they were present in 2500 sales points in more than 10 countries [F5].

A few successful projects downstream in the supply chain started to emerge. For instance, a biotechnology professional developed an indoor breeding system to cultivate algae [F1]. In 2009, he established a firm which introduced algae ingredients for food applications [F1]. Therefore, the variety of ingredients for the development of meat substitutes widened and relatively new concepts of products reached the market.

A common characteristic among meat substitute brands during this period is innovative marketing strategies which employed sustainability and animal welfare associations. Additionally, a few entrepreneurs actively participated in public discourses and advocacy relevant to health and sustainability aspects of the food system. This led to increasing media coverage for the sector and alignment of brands with changing societal cognitive institutions [F7].

As a response to the rising popularity of meat substitutes, contestation regarding the naming of meat substitutes and whether they could use animal terms surfaced in the form of political debates. In the following years, due to similar developments in other European countries, European livestock industry groups will began calling for legal restriction in the labelling of substitute products under the rational that consumers can be misled.

Moreover, during this period, entrepreneurs increasingly developed networks in order to address barriers typical in emerging industries. In 2012, the 13 key actors in the sector of meat substitutes came together in the first industry association, Het Planeet [F7]. In the following years, Het Planeet would provide a space for collaboration and organized lobbying for the industry's interests [F3][F7].

A pararellel development was research in Wageningen and Delft Universities which explored the possibilities of shear cell technology. Shear cell or coquette cell technology offers benefits in developing meat substitutes that replace complete muscular parts of animals, such as, chicken breast or beef meat (Krintiras et al., 2015, 2016). Such products did not exist in the market. The founders of the Vegetarian Butcher became interested in this research. They were instrumental in setting up a foundation and attracting financial resources, through novel routes such as crowd funding [F6]. In 2015, a prototype of the technology would be presented in 2015 [F1]. The Plant Meat Matters consortium, with the participation of agri-food incumbents such as Unilever, would be set up in order to further the development of the first vegetarian steak.

4.2.6. Protein innovation in global spotlight (2014 onwards)

Growth in markets of meat substitutes, key consumer trends and stagnating profits in meat sectors led to rising positive expectations for further growth in international markets (FAIRR, 2016; ING, 2017). As a response, global incumbent meat processors, consumer goods firms and food retailers started stepping into the industry. Examples include Tyson Foods investment in the plant-based meat substitute start-up, Impossible Foods, the

acquisition of the meat substitute firm Tivall by Nestle and the development of the meat substitute private label by Tesco.

Urgency for addressing the GHG emissions form livestock agriculture continued to strengthen. An important milestone was the explicit inclusion of agriculture in the Paris Agreement (UNFCCC, 2015). In the Netherlands, in 2014, the critical report Towards a Food Policy (WRR, 2014) from the Scientific Council of the Government Policy (WRR) heavily criticized the food related regulatory framework and triggered the introduction of the Food Agenda for Safe, Healthy and Sustainable Food (EZ, 2015). The Food Agenda brought back aims for protein innovation and the transition in protein consumption [F4]. Therefore, it was once again followed by the allocation of governmental recourses through a number of subsidies and the initiation of several programmes [F6].

Building on the science-based knowledge on health and environmental benefits of plant-based diets that had been developed in the previous years, the Dutch Nutrition Center revised its official dietary guidelines (CR, 2015). For the first time, the advisable consumption of meat decreased and the guidelines included meat substitutes [F7].

During the same time, following the establishment of the industry association Planet, entrepreneurs continued building the necessary structures for the development of the sector. Example of initiatives established by entrepreneurs include the introduction of trial facilities for joint development of end-products and platforms for knowledge sharing between industrial actors [F3]. This led to more collaboration, strengthened patterns of entrepreneurial experimentation and introduction of a variety of products in the market [F1][F3][F5].

The introduction of the food agenda gave entrepreneurs an opportunity to become formally associated with a broad range of stakeholders and further strengthen their legitimacy. Through Het Planeet, they successfully lobbied for the participation of governmental agencies and NGOs in initiatives of the sector [F6][F7]. For instance, in 2016, a multi-stakeholder platform which aims to change the protein consumption balance in the Netherlands to 50:50 protein (plant:animal) in 2025, the Green Protein Alliance (GPA) was established [F4] [F7] (GPA, 2017). The ministry of economic affairs, the Nutrition Center and the NGO Nature & environment became partners in the GPA.

«Working together with the government and government agencies or semi-governmental agencies such as the Dutch Center for Nutrition, gives them a lot of credibility, because the nutrition center would never work with just one company but they will work together with a number of companies that work together with the government»

Moreover, this time actors from across the supply chain of meat substitutes also participated in multi-stakeholder platforms of the sector. For instance, Unilever and the leading Dutch retailer Albert Heijn became members in the GPA [F7]. Therefore, the group of actors involved in the promotion of meat substitutes in the Netherlands widened and new actors, particularly those up-stream in the supply chain, brought a diverse set of capabilities in the system. Collaborative entrepreneurial projects across the supply chain, awareness campaigns and lobby efforts followed [F1][F3][F7].

«then the missing link is that we had all these meetings for the last 10 years and at none of them, have we even invited retailers, we've never invited food service companies, we've never invited, well we've invited a couple of producers but never the link between the supply chain and the market, right, which is the retailers.»

5. REFERENCES

Aiking H., de Boer J., Helms M., Niemeijer D., Zhu X, van Ierland E. C. & de Groot R. S. (2006). Environmental Sustainability In Aiking, H., & Boer, J. D. (2006). Sustainable protein production and consumption: Pigs or peas?. Dordrecht: Springer.'

Aiking, H., & Boer, J. D. (2006). Sustainable protein production and consumption: Pigs or peas? Dordrecht: Springer

Apostolidis, C., & Mcleay, F. (2016). Should we stop meating like this? Reducing meat consumption through substitution. Food Policy, 65, 74-89.

Asgar, M., Fazilah, A., Huda, N., Bhat, R., & Karim, A. (2010). Nonmeat Protein Alternatives as Meat Extenders and Meat Analogs. Comprehensive Reviews in Food Science and Food Safety, 9(5), 513-529.

Bergek, A., Hekkert, M., Jacobsson, S., Markard, J., Sandén, B., & Truffer, B. (2015). Technological innovation systems in contexts: Conceptualizing contextual structures and interaction dynamics. Environmental Innovation and Societal Transitions, 16, 51-64.

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. Research Policy, 37(3), 407-429.

Binz, C., & Truffer, B. (2017). Global Innovation Systems—A conceptual framework for innovation dynamics in transnational contexts. Research Policy, 46(7), 1284-1298.

Blonk, H. Anton K., Lusker B. & de Waart S. (2008). Environmental effects of protein rich food products in the Netherlands. Consequences of animal protein substitutes. Gouda: Blonk consultants.

Breschi S., Malebra F., Orsenigo L. (2000). Technological regimes and Schumpeterian patterns of innovation. The economic journal 110 (463), 388-410.

Changing markets (2018). Growing the good: the case of low-carbon transition in the food sector. Changing markets org.

Cheftel, J. C., Kitagawa, M., & Quéguiner, C. (1992). New protein texturization processes by extrusion cooking at high moisture levels. Food Reviews International, 8(2), 235-275.

CR (2011). Richtlijnen goede voeding ecologisch belicht. The Hague: Gezondheidsraad.

CR (2015). Richtlijnen goede voeding 2015. The Hague: Gezondheidsraad.

Dagevos, H. (2014). Flexibility in the Frequency of Meat Consumption - Empirical Evidence from The Netherlands. EuroChoices, 13(2), 40- 45.

Day, L. (2013). Proteins from land plants – Potential resources for human nutrition and food security. Trends in Food Science & Technology, 32(1), 25-42.

De Bakker, E. and Dagevos, H. (2010). Vleesminnaars, Vleesminderaars en Vleesmijders: Duurzame Eiwitconsumptie in een Carnivore Eetcultuur [Meat Lovers, Meat Reducers and Meat Avoiders: Sustainable Protein Consumption in a Carnivorous Food Culture]. LEI Wageningen UR: The Hague

Deuten, J., Boekholt, P., Mostert, B., Nagle, M., van der Veen G., Zuijdam, F. (2010). Eerste evaluatie Small Business Inovation Research (SBIR) programma's in Nederland. Amsterdam: Technopolis group.

Distrifood (2017). Consument eet vaker producten op basis van plantaardige eiwitten. Distrifood.

EC (2011). A roadmap for moving to a competitive low carbon economy in 2050. European Commission: Brussels.

Edquist, C., 1997. Systems of innovation approaches—their emergence and characteristics. In: Edquist, C. (Ed.), Systems of Innovation—Technologies, Institutions and Organizations. Pinter Publishers/Cassell Academic, London, p. 35.

EZ (2015). Voedselagenda voor veilig, gezond en duurzaam voedsel. The Hague: Ministerie van Economische Zaken.

FAIRR (2016). The future of food: the investment case for a protein shake up. Farm animal investment risk & return. London: Farm Animal Investment Risk & Return.

Freeman, C., 1987. Technology Policy and Economic Performance: Lessons from Japan. Frances Pinter, London.

Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A. & Tempio, G. (2013). Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO), Rome.

Gilani, G., & Lee, N. (2003). PROTEIN | Sources of Food-grade Protein. Encyclopedia of Food Sciences and Nutrition, 4873-4879.

GPA (2017). Green growth plan. The Green Protein Alliance.

Haley, B. (2018). Integrating structural tensions into technological innovation systems analysis: Application to the case of transmission interconnections and renewable electricity in Nova Scotia, Canada. Research Policy, 47(6), 1147-1160.

Hallström, E., Carlsson-Kanyama, A., & Börjesson, P. (2015). Environmental impact of dietary change: A systematic review. Journal of Cleaner Production, 91, 1-11.

Hedenus, F., Wirsenius, S., & Johansson, D. J. (2014). The importance of reduced meat and dairy consumption for meeting stringent climate change targets. Climatic Change, 124(1-2), 79-91.

Hekkert, M.P. et al., 2007. Functions of innovation systems: A new approach for analysing technological change. Technological Forecasting and Social Change, 74(4), pp.413–432.

Herrero, M., Henderson, B., Havlík, P., Thornton, P. K., Conant, R. T., Smith, P., . . . Stehfest, E. (2016). Greenhouse gas mitigation potentials in the livestock sector. Nature Climate Change, 6(5), 452-461

ING (2017). The protein shift: will Europeans change their diet?. Amsterdam: ING economic department.

Jacobsson, S., Sandén, B., & Bångens, L. (2004). Transforming the Energy System — the Evolution of the German Technological System for Solar Cells. Technology Analysis & Strategic Management, 16(1), 3-30.

Jeannerat, H., & Kebir, L. (2015). Knowledge, Resources and Markets: What Economic System of Valuation? Regional Studies, 50(2), 274-288.

Jones, O. G. (2016). Recent advances in the functionality of non-animal-sourced proteins contributing to their use in meat analogs. Current Opinion in Food Science, 7, 7-13.

Knoch, A. (2016). Production of Restructured Meatlike Products by High Moisture Extrusion Technology. Reference Module in Food Science.

Krintiras, G. A., Diaz, J. G., Goot, A. J., Stankiewicz, A. I., & Stefanidis, G. D. (2016). On the use of the Couette Cell technology for large scale production of textured soy-based meat replacers. Journal of Food Engineering, 169, 205-213.

Krintiras, G. A., Göbel, J., Goot, A. J., & Stefanidis, G. D. (2015). Production of structured soy-based meat analogues using simple shear and heat in a Couette Cell. Journal of Food Engineering, 160, 34-41.

Lin, S., Huff, H., & Hsieh, F. (2000). Texture and Chemical Characteristics of Soy Protein Meat Analog Extruded at High Moisture. Journal of Food Science, 65(2), 264-269.

LEI (2012). Development and marketing of new proteins: experienced obstacles and solutions. Wageningen UR.

LNV (2009). Duurzaam Voedsel. The Hague: Ministerie van Landbouw, Natuur en Voedselkwaliteit

Lundvall, B.-Å. (Ed.), 1992. National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning. Pinter Publishers, London.

Makkonen, T., & Inkinen, T. (2018). Sectoral and technological systems of environmental innovation: The case of marine scrubber systems. Journal of Cleaner Production, 200, 110-121.

Malerba, F. (2002). Sectoral systems of innovation and production. Research Policy, 31 (2), 247-264.

Malerba, F. (2005). Sectoral systems of innovation: A framework for linking innovation to the knowledge base, structure and dynamics of sectors. Economics of Innovation and New Technology, 14 (1–2), 63–82.

Malerba, F., & Nelson, R. (2011). Learning and catching up in different sectoral systems: Evidence from six industries. Industrial and Corporate Change, 20(6), 1645- 1675.

Markard, J. & Truffer, B., 2008. Technological innovation systems and the multi-level perspective: Towards an integrated framework. Research Policy, 37(4), pp.596–615.

Morabia, A., Bernstein, M., Héritier, S., & Beer-Borst, S. (1999). A Swisspopulation-based assessment of dietary habits before and after the March 1996 'mad cow disease' crisis. European Journal of Clinical Nutrition, 53(2), 158-163.

Osen, R., Toelstede, S., Wild, F., Eisner, P., & Schweiggert-Weisz, U. (2014). High moisture extrusion cooking of pea protein isolates: Raw material characteristics, extruder responses, and texture properties. Journal of Food Engineering, 127, 67-74.

Pluimers J., Blonk H. (2011) Methods for quantifying the environmental and health impacts of food consumption patterns. Gouda: Blonk consultants.

Poel, I. V. (2003). The transformation of technological regimes. Research Policy, 32(1), 49-6.

Quist, J. (2007). Backcasting for a sustainable future, the impact after 10 years (doctoral dissertation). Delft, Eburon.

Rachida Azough (Dec 31, 2005). Die Kwestie met "marteleitjes'. De Volkskrant

RIVM (2011). Replacement of meat and dairy by more sustainable protein sources in the Netherlands. Bilthoven: National Institute for Public Health and the Environment.

Sadler, M. J. (2004). Meat alternatives — market developments and health benefits. Trends in Food Science & Technology, 15(5), 250-260.

Sans, P., Fontguyon, G. D., & Giraud, G. (2008). Value-based labels for fresh beef: An overview of French consumer behaviour in a BSE crises context. International Journal of Consumer Studies, 32(5), 407-413

Smetana, S., Mathys, A., Knoch, A. et al. Int J Life Cycle Assess (2015). Meat Alternatives: Life cycle assessment of most known meat substitutes 20: 1254.

Stephan, A., Schmidt, T. S., Bening, C. R., & Hoffmann, V. H. (2017). The sectoral configuration of technological innovation systems: Patterns of knowledge development and diffusion in the lithium-ion battery technology in Japan. Research Policy, 46(4), 709-723.

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., de Haan C. (2006). Livestock's long shadow: Environmental issues and options. Rome: Food and Agriculture Organization of the United Nations.

Straaten, J. V. (1992). The Dutch national environmental policy plan: To choose or to lose. Environmental Politics, 1(1), 45-71.

Suurs, R. A. (2009). Motors of Sustainable Innovation: towards a theory on the dynamics of technological innovation systems (doctoral dissertation). Utrecht University, Utrecht, the Netherlands.

Suurs, R. A., & Hekkert, M. P. (2009a). Cumulative causation in the formation of a technological innovation system: The case ofbiofuels in the Netherlands. Technological Forecasting and Social Change, 76(8).

Suurs, R. A., & Hekkert, M. P. (2009b). Competition between first and second generation technologies: Lessons from the formation of a biofuels innovation system in the Netherlands. Energy, 34(5), 669- 679.

Suurs, R. A., Hekkert, M. P., Kieboom, S., & Smits, R. E. (2010). Understanding the formative stage of technological innovation system development: The case of natural gas as an automotive fuel. Energy Policy, 38(1), 419-431.

UNFCCC (2015). Adoption of the Paris Agreement. Report No. FCCC/CP/2015/L.9/Rev.1. United Nations Framework Convention on Climate Change.

Verbeke W., Viaene J., Guiot O. (1999). Health Communication and Consumer Behavior on Meat in Belgium: From BSE until Dioxin. Journal of Health Communication, 4(4), 345-357.

Vereijken, J. M., Heng L., O'Kane F. E., Yin X.,…, van Boekel, M., A., J, S. (2006). 'Technological feasibility' in Aiking, H., & Boer, J. D. (2006). Sustainable protein production and consumption: Pigs or peas? Dordrecht: Springer.

Vergragt, P.,J., Grootveld G. (1994). Sustainable technology development in the Netherlands: the first phase of the Dutch STD programme. Journal of cleaner production. 2(3–4), 133-137.

Vogel, D. (2003). The Hare and the Tortoise Revisited: The New Politics of Consumer and Environmental Regulation in Europe. British Journal of Political Science, 33(04), 557-580.

VROM (2001) Nationaal Milieubeleidsplan 4, Een wereld en een wil: werken aan duurzaamheid. The Hague: Ministry of Housing, Spatial Planning and the Environment.

Weaver P., Jansen L., Van Grootveld G., van Spiegel E., Vergragt P. (2000) Sustainable technology development, Greenleaf Publishers, Sheffield UK.

Westhoek H., Rood T., van de Berg M., Janse J., Nijdam D., Reudink, M., Stehfes, E. (2011). The Protein Puzzle. The Hague: PBL Netherlands EnvironmentalAssessment Agency

WRR (2014). Towards a food policy. The Hague: The Netherlands Scientific Council for Government Policy.

Yao, G., Liu, K., & Hsieh, F. (2006). A New Method for Characterizing Fiber Formation in Meat Analogs during High-moisture Extrusion. Journal of Food Science, 69(7), 303-307.

Weber, K. M., & Truffer, B. (2017). Moving innovation systems research to the next level: Towards an integrative agenda. Oxford Review of Economic Policy, 33(1), 101-121.

AFFILIATION

Maria TZIVA is a PhD candidate in innovation science at the Copernicus Institute of Sustainable Development, at Utrecht University, since January 2017. She is supervised by prof. dr. M. Hekkert, dr. S. Negro and dr. A. Kalfagianni. Her PhD is part of the REINVENT Horizon 2020 project which explores low-carbon transitions in key emission-intensive industrial sectors, including the agri-food sector (reinvent-project.eu). She studies dynamics of plant-based protein innovation as a deep decarbonization pathway for the EU agri-food sector.

Institutional contact: m.tziva@uu.nl

WHAT IS THE RELEVANT APPROACH FOR ENGAGING TERRITORIAL ACTORS IN A HIGH NATURE VALUE INNOVATION PROJECT?

A strategic perspective – findings from HNV-Link H2020 Thematic Network

Xavier Poux, Claire Bernard-Mongin, Diana Dumitras, Maria Isabel Ferraz de Oliveira, Fabrice Gouriveau, Dimitris Goussios, Irina Herzon, Mugurel Jitea, Yanka Kazakova, François Lerin, Magnus Ljung, Ângela Lomba, Vali Mihai, James Moran, Teresa Pinto-Correia, George Vlahos

Abstract

High Nature Value (HNV) farmland designates "*those areas in Europe where agriculture is a major land use and where that agriculture supports, or is associated with, either a high species and habitat diversity […]*" Their conservation needs adapted strategies at a territorial level. HNV-Link is a H2020 thematic network (2016-2019) aiming at demonstrating how so called "HNV brokers" can engage with other local actors for HNV conservation. On the basis of the initial phase of the thematic network, the paper shows that two approaches are envisaged for such engagement ('practical' vs. 'ideal') and discusses the strategic ins and outs of each approach.

KEY-WORDS: HNV FARMING, INNOVATION, BIODIVERSITY CONSERVATION, BROKERING, ENGAGEMENT

HIGH NATURE VALUE FARMING AND ITS CHALLENGES IN THE EUROPEAN CONTEXT

High nature value (HNV) farmland designates "those areas in Europe where agriculture is a major land use and where that agriculture supports, or is associated with, either a high species and habitat diversity or the presence of species of European conservation concern, or both" (Andersen, et al., 2003). They are an important component of European agriculture in terms of biodiversity, cultural landscape, territorial cohesion, quality products and employment.

HNV farmland are under severe threat. Land intensification and land abandonment, frequently taking place in the same area — while they are the two faces of the same techno-economic process — are the main cause of the degradation of HNV characteristics at the landscape level. This trend is taking place at the whole European level, with severe consequences on biodiversity. For example 70% of European grassland butterfly show a decline over the period 1990-2009 (European Environment Agency, 2011). Causes of such trends are well known, they stand in uneven competition between low-productive HNV farming systems and "mainstream" farming systems and subsequent consequences in food chain organisation based on mass production and thus neglecting supply from HNV area. In brief, they are economically, economically and socially marginalised in the wider economic European productive space (Jones & Poux, 2012).

Fighting back the negative threats requires local actions able to adapt the development of HNV farming systems on the basis of local assets. In brief, it needs local innovation for combining HNV farming systems viability with biodiversity conservation attributes. This innovation challenge indeed is the matter of HNV-Link H2020 thematic network, which forms the case presented and discussed in the present paper.

HNV-LINK: A THEMATIC NETWORK DEDICATED TO HNV CONSERVATION – THE INNOVATION BROKERING APPROACH

HNV-Link is a thematic network addressing the challenges of HNV conservation through the angle of local innovation. Its goal is to demonstrate through local examples how innovations can be mobilized for the conservation of HNV farming systems. Its aim is to disseminate across Europe by giving insights and concrete examples how to further develop other HNV conservation projects in the future.

HNV-Link positions itself in the wider approach envisioning innovation both as a "content" and as a "process". In that sense, it is worth noting that these two aspects are not clearly separated and, on the contrary, generally, bundled. The "process" component of innovation is fundamental to understanding when, how and with whom and in which context a single innovation can be developed, selected, adopted and disseminated. Innovation is (almost always) a process of "network building, social learning and negotiation" (Leeuwis, 2003). So, highlighting the "innovation process" was a way for HNV-Link to insist on the multi-actor and dynamic aspect of innovation, understood also as "*co-production process occurring in a specific territory, whereby actors interact, cooperate, coordinate their activity to generate new knowledge, technologies and practices for desired change*" (Esparcia, 2014).

HNV-Link consists in a network of ten learning areas (LA), which are a multi-actor clusters involving a range of stakeholders and are embedded in a specific HNV territory. Each LA has a coordinator whom role is manage each local HNV innovation project and communicate amongst a wider set of targets actors. The identification of each LA has been based upon a set of criteria that are explicitly targeting innovative territorial settings for HNV farming (institutional, agro-ecological, management farmland issue - N2000 conservation, agri-tourism landscape etc.). Innovations are therefore captured and analysed in their agro-ecological and institutional contexts.

While the concept of HNV farming insists on the link between the technical/economic functioning of the HNV farming systems and biodiversity attributes, maintaining their socio-economic viability may mobilise other perspectives placing HNV farming in its broader local and regional outlook.

It should be noted that all LA but one — the Burren, in Ireland which is now a 10 years success story in terms of innovative HNV management — were starting the innovation process specifically dealing with HNV conservation issues. This is not to say that LA coordinators were starting from scratch: all of them were already committed in some ways, showing a diversity of status in terms of place in the local actors' game (from the committed local advisor to the regional authority). But the approach of innovation dedicated to HNV conservation, implicitly or explicitly (we will come back on this aspect later on), was a new step, all the more when considering that this approach took place in a visible European network bringing method, legitimacy and financial means.

HNV-Link thematic network envisages further levels of exchanges and interconnected networks: (1) between the set of 10 LA themselves, (2) between the coordination team engaged in the development of the H2020 project (method and facilitation) and the 10 LA (3) between each LA and its regional/national institutions (4) between the consortium and wider national and European actors involved, sensu lato, in HNV policy development (European Innovation Partnership, DG Agri and Env, NGOs, some national authorities etc.).

This multi-level and multi-network approach logically puts each member of the consortium in a position of broker, and notably LA coordinators as it will be further developed in the next section. The project proposal thus set that: "*The HNV-Link thematic network proposes an innovation brokering process through which these 10 HNV Farming Learning Areas can be coordinated and stimulated through the means of five work packages. This ramp up process seeks to gradually empower each learning area into their own capacity to lead innovation exchanges […].*

At the level of HNV-Link Thematic Network, the innovation brokering process [is] organised into four stages, over a three-year period.

• 1st stage: Framing the network. An iterative and participative constitution of methodological guidelines bringing different actors within the LA, will consolidate the "multi-actor approach" […].

• 2ndstage: Shaping the network. Based on the framing agreement, the LA are going to produce their own assessment, baseline and strategic diagnosis and to capture and collect existing innovations. There, the LA representatives should be able to choose, within the Compendium of LAs innovation, which ones could be of real importance for their own needs.

• 3rd stage: Using and expanding the network. Constitution of a twofold dissemination action plan by each LA: (1) regional/national meetings and dissemination events, (2) peer learning with networking visits to evaluate how an innovation

made abroad can by transferred and adapted to the situation at home. Communication to the wider world the results obtained through this innovation brokering process, to align the conclusions to national policies.

• 4th stage: Wrapping up. This last phase of HNV-Link Network will proceed to the overall appraisal of its actions, […]. This phase will be closed by the third and last network meeting in Brussels, synthetising the final results […]." (CIHEAM-IAMM, 2015).

Our research question is how to better understand and assess the ins and outs of the engaging phase of brokering? — considering that the way engagement is designed will have medium term effects (see for example (Beers, Hermans, Veldkamp, & Hinssen, 2014).

When the present paper is written (October 2018), HNV-Link is still ongoing, processing its "using and expanding" phases. The analysis is conducted on the two first stages of the project (framing and shaping) and conceptually consists in a mix of in itinere and ex ante assessment, where the founding phases of the project are described and analysed with outlooks of their future potential impacts.

This paper is thus an interpretative discussion based on the observation of what took place during the preparatory phases of the project. We intend to better understand the way to engage in similar biodiversity conservation projects, granted that engagement has the same ex ante and interpretative dimension. The overall intention is to assist future HNV brokers in the assessment of their strategic context, consisting in the situation they intervene in and in their resources for such intervention.

AN ANALYTICAL FRAME FOR UNDERSTANDING THE ENGAGEMENT OF HNV BROKERS

HNV farming areas are currently under threat and are disappearing all across Europe. This process takes place in a wider context in which agricultural development is conceived and designed in such a way that it leads to land abandonment and/or to land intensification. This fundamental statement has further consequences is the analysis of our research question:

- conserving HNV farming systems indeed consists in changing a dynamic and a development system in place, towards more integration of biodiversity in the goals and actions taking place in HNV areas;
- this change takes place in a broadly adverse context and thus requires a strategic approach in order to reach a change that, otherwise, has no reason to occur in a given actors' configuration (Mermet, Billé, Leroy, Narcy, & Poux, 2005). One should note that this adversity can or cannot take place at the local level, but it will always take place at a wider level imposing its development agenda at the local level at the end, otherwise, there would not be any challenge in conserving HNV farming;
- this change can also be analysed through a translation process grid, as it consists in bringing in a local development agenda an issue that is not acknowledged as such in the current situation. Except for the Burren case, most learning areas were dealing with the two first steps of the translation process (Callon, 1986), namely setting the problem ("problematize") and interest other actors ("our HNV conservation issue might be interesting for you as well");
- this process puts the LA coordinators in a specific position of bringing innovation into a local context. As such they are brokers positioned at the interface between different worlds (research, policy, action and local development), seen "*as the human force behind knowledge transfer, finding, assessing and interpreting evidence, facilitating interaction and identifying emerging research question*" (Ward, House, & Hamer, 2011). More precisely, LA coordinators are bridging local and European worlds, consisting in the HNV conservation community agenda organized at the EU level for the latter. Their brokering role is to convey visions and issues in both top-down (from EU to local) and bottom-up (from local to EU, to enrich the understanding of local contexts) approaches.

In sum, HNV brokers are engaging in a translation process connecting different worlds, in which different actors have different goals and interests. In realigning actors, they should undertake a strategic approach in order to make that their goal (conserving HNV attributes) become the goal of a majority of actors. This framing revisits the "neutral" vision of brokering in which "*brokering (...) involves processes of translation, coordination, and alignment between perspectives. (...) It also requires the ability to link practices by facilitating transactions between them.*" In a biodiversity conservation perspective, it is not mainly a matter of coordination but of winning against adverse actors' alignment. HNV-Link Innovation brokers are not neutral: they are intentional. "*Therefore intermediation*

cannot be described as only transferring knowledge and objects in a given web of interest for technological innovation, or playing a strict functional role within the social web of innovation to fulfil knowledge gaps of system failures" (Steyaert, Barbier, Cerf, Levain, & Loconto, 2016).

In such a framing, the core assumption of this paper is that the first step of engagement with local actors is crucial, as it positions the HNV broker in the local game. Furthermore, it considers that each broker has an initial understanding of what is the best way to engage with actors that is frequently implicit and reflects his/her position in the wider actors' configuration. The discussion aims at describing different strategies taking place in a dual space structured by a practical vs. ideal approaches (Loeber & Vermeulen, 2012) and proposing a wider evaluation frame about the pros and cons of each approach in the case of HNV conservation.

On this basis, the analysis aims at providing a conceptual grid useful for future HNV brokers rather than an extensive and systematic review across the 10 learning areas.

THE FORMAL AND INFORMAL MATERIAL ANALYSED

During this first year, LA coordinators were committed to two main tasks:

- The first one was performing the "baseline assessment", consisting in a synthetic assessment of the agro-ecological, techno-economical, sociological and institutional analysis of their LA. This baseline assessment was designed in order to produce two alternative scenarios: a "business as usual" one, revealing what would take place without the introduction of HNV innovations and a "HNV vision" one, consisting in socio-ecological image based on desirable HNV landscapes in the future. This vision is meant to both justify the need for HNV innovation and to identify the means to achieve such a vision. (Poux, Bernard, & Lerin, The Ten Baseline Assessments , 2017) coordinated the collection of the 10 baseline assessments. It should be noted that the building of HNV visions ranged from an office work by the LA coordinator to participatory meetings, depending on the strategic context.
- The second task was identifying and assessing the set of innovations relevant for each HNV area. This task consisted in an extensive review of innovations classified into four main issues (social and institutional, regulation and policy, products and markets, farming techniques and management). This review has been done at the level of each LA, of each regional and national context and at the EU level, adopting a benchmarking approach. The material obtained was assessed and scored against the needs of each LA, on the basis of the baseline assessment. (Beaufoy & Partners, 2017) show the review and assessment of innovations obtained in HNV Link in a compendium.

This material was designed in such a way as to be used in the "using phase" of the project, precisely consisting in building a community of interest around HNV management in each learning area, through the demonstration of the relevance (the HNV vision) and practicability of innovation (the compendium). In other terms, it had a brokering intention.

While the 10 Baseline assessments and visions and the Compendium of innovation review (CIR) provide an explicit source of information for our analysis, other material is mobilized. Firstly, an interview with the 10 LA coordinators at the very beginning of the project (June 2016) addressing their perception of the challenges of HNV conservation in their area, the actors' game configuration (adverse vs. favorable) and their means in terms of usable resources or identified gaps. The interviews are recorded in the archives of HNV-Link as an internal document (LA coordinators, 2016).

A more informal source of information consists in collective discussions that took place during the two consortium meetings (in Montpellier in 2016 and in Evora in 2017) and during the course of the project.

TWO VISIONS OF INNOVATION BROKERING IN HNV LINK

As evoked above, (Loeber & Vermeulen, 2012) distinguish two approaches in the facilitation of sustainable agricultural projects:

- « Developing ideas » approach, that we label « ideal », which engagement with actors stand on "*develop an understanding of and responsiveness to participants' needs as a basis for pushing ideas and visions beyond their immediate reach*"

- « Designing implementable structures », that we label « practical », which is tagged as "*strives for an understanding of and responsiveness to the participants' needs and motives to gain their mandate for steering the process towards a shared vision and an implementable design*".

Such duality indeed echoes the two tasks performed during the first year of HNV-Link project. The Baseline assessment of vision of the first work-package referred to the "ideal" approach while the review and assessment of innovations of the second work-package focused on issues dealing with the implementation of solutions.

In principle, there is no opposition between the two approaches, and they can be considered as complementary. Indeed, the most advanced LA – the Burren, in Ireland — succeeded in combining a demanding long-term vision for the area with practical solutions for farmers.

But this complementarity cannot be taken for granted as each approach insists on different dimensions and entry points for innovation and project design, not to mention more fundamental strategic understanding of what supports each approach in the case of HNV-Link. The two definitions of HNV innovation in the framing documents for the baseline assessment and vision on the one hand and of innovations review on the other hand reveal such a difference, not to mention that there was a need for two different definitions:

- The methodological document for the baseline assessment (Poux & Moran, 2017) states that "*HNV-Link is about this specific kind of innovations: those that are able to conserve landscape features of natural value. We call them "HNV innovations" in order to distinguish them from other "regular innovations" that only are about economy or efficient resource management, regardless of biodiversity conservation.* [HNV innovation] *specifically address HNV conservation*". The overall approach of the baseline assessment insists on the need to display an explicit vision of the landscape and HNV attributes: "*it is the basis for the "enrolment" of stakeholders in an HNV innovation project*".
- While the definition of HNV innovation in the Compendium (Beaufoy & Partners, 2017) shares the conservation objective ("*HNV innovation" is defined in the project as a change in the social, institutional, regulatory, market or farming approach that makes it better able to conserve HNV farming and its characteristics*") it also states that "*An HNV innovation does not necessarily have an explicit nature conservation objective, but it does have the effect of maintaining high nature values, even if as a side-effect of another objective (e.g. socio-economic viability of HNV farms).*"

The above comparison shows that the definitions conceptually refer to the above two different approaches.

- Insisting on the need to explicit HNV landscape features as the basis of the vision puts the exercise in an "ideal" perspective: the enrolment of actors will be based on the common understanding of what is at stake in the long term biodiversity management of the area. Solutions will come further and should derive from such a common basis. This approach puts the environmental monitoring at the core of HNV innovation projects, and insists on the "social process" component of innovation. In this perspective, the HNV broker' role is to bring an explicit HNV conservation goal in the actors' game — otherwise, there is no reason that this goal should be attained as said above — and to facilitate its understanding and sharing across a growing community of actors.
- On the contrary, putting the socio-economic viability of HNV farms at the core of the objective of innovation while considering nature conservation as a side-effect targets much more precise objectives and thus, gives hand to more practical innovations. Indeed, the compendium consists in a list of innovations and thus insists on the "content" component of innovation, which is much more able to engage with actors in the shorter term (as opposed as "*ideas and visions going beyond [their] immediate reach*").

This discussion does not only take place on the theoretical stand, as it had consequences in the completion of the supporting material (baseline assessment + HNV vision, on one hand, and review of innovations on the other hands) and in the management of the local process, in the way of engaging local actors during the framing phase. Indeed, we assume that the type of approach perceived as relevant by HNV broker for engaging with local actors, has had impact on the design of the work to be performed as priority.

Without detailing a systematic comparative approach of what had been achieved in each learning areas in terms of outputs — the idea is not to score the deliverables — three types of HNV visions can be characterized in formal terms: some are rather general and do not really equip the local debate in an "ideal" perspective (they are not useful for engagement); some are detailed and explicit in terms of landscape and ecological vision, on the

basis of experts' office work (they might be used for engagement); some combine such landscape and ecological vision with participatory process (they have been used for engagement).

Such differences reflect different level of inputs in terms of data collection, processing and facilitation efforts. The delivery of such visions appeared to be rather difficult to perform for some LA, for a set of reasons: lack of data, lack of time, lack of knowledge and/or human means and lack of clarity of what should the baseline assessment and the vision should consist in, and for what purpose. For some LA coordinators, the "brokering" interest of the vision might be relevant in principle, but too theoretical in practice. Indeed, a collective discussion taking place at the end of the shaping phase of HNV Link revealed contrasted assessment of the interest in such an exercise: for some LA, it clearly had been a crucial step for engaging local actors in a strategic process, while for other it was rather useless and formal at the end. In comparison, the completion of innovation review was also demanding in terms of human effort, but did not bring the same level of conceptual discussions at the end: the practical approach underlying the innovations review appeared to be much more useful, even if the assessment of the relevance of the list of innovations appeared to be challenging, as discussed below.

ANALYSING THE ISSUES OF THE TWO TYPES OF ENGAGEMENT

Both ideal and practical engagement have their respective pros and cons for innovation brokers. The advantages of practical engagement stand in its very labelling: it is practical and thus able to respond to immediate needs expressed by local actors. For example, in various LA, the need to urgently address sanitary issues for breeders appeared as an obvious entry point for engaging. In this case, the role of HNV broker has been to investigate how national/regional sanitary policies could be adapted to the needs of extensive farmers. Generally speaking, the "viability of HNV farms" underlying the innovation review takes place in this practical approach, with list of innovations making sense for farmers, local communities and regional authorities. Table I provides a list of examples from the innovation compendium.

Thematic field of innovation	Examples of innovation
Social and institutional	Improved representation and empowerment of HNV farmers, e.g. through specific associations, Operational Groups, local projects and processes
	Institutional dialogue with HNV farmers on policy issues such as animal health, Natura 2000 plans
	Outreach, advisory services, local projects targeted at supporting HNV farmers
	…
Regulatory and Policy	Adapt CAP Pillar 1 rules to the characteristics of extensive grazing land
	Use CAP Pillar 2 options to support extensive grazing for delivery of other policy aims (biodiversity, fire prevention)
	Develop locally led HNV projects, with payment to farmers for biodiversity results
	…
Products and Markets	Branding/marketing/certifying products from extensive grazing systems (differentiation from intensive livestock)
	Joint farmers' marketing and/or processing (e.g. farmers running small-scale local abattoirs)
	On-farm processing and direct sales from the farm
	…
Technical and Management	Improved efficiency and reducing costs through better infrastructure, technical developments and organization
	Better management on extensive and common pastures for animal health control
	Management plans for pastures, especially integrated planning for production and environmental services, including common pastures
	…

Table 2: Examples of innovations from the Compendium (Beaufoy & Partners, 2017)

In comparison, the ideal approach looks more difficult to implement for reasons, some of them having been evoked above. It is by nature much more complex and requires more means in order to be credible. In addition,

in HNV conservation approach, it stands on putting forward biodiversity objectives which legitimacy may appear as poor in some socio-political context, against other rural development agenda. This statement was clear in the answers to the following question "Generally speaking, would you say that biodiversity conservation is a priority for most stakeholders in the LA?" from the questionnaire sent to the 10 LA coordinators at the start of HNV Link (June 2016): 9 answers set that this was not a priority, when the dominant vision was not against biodiversity conservation (LA coordinators, 2016). Thus, proposing a credible and sound HNV vision needs data, expertise, skill in rendering the vision understandable for a variety of actors (e.g. through maps, landscape design, etc.), since a too general vision will not be convincing. More fundamentally, the baseline assessment appeared as rather difficult to implement in practice with unclear status on how it should be used and discussed in the local context. In short, its usefulness appeared poor to some LA coordinators while it was conceived as a formal and/or too ambitious exercise with little expected added-value on the local actors' game.

In return, the advantages of the practical approach may have its drawback in the longer term. None of the innovations in the list (table 1) is on its own able to address biodiversity conservation in a HNV area. The compendium indeed states that "They are not separate, unrelated "boxes", in fact the themes are often mutually supporting, and many examples of HNV innovation include aspects under multiple themes." (Ibid). In fact, they are not only often but always mutually supporting, as changing the course of existing agricultural development always entails sociological changes coupled with economic and/or technical positive change at the end (otherwise, there is no biodiversity conservation). Assessing whether the "need" for one innovation is favorable for HNV conservation thus is a demanding exercise and there is a need to analyse both the context and the wider set of innovations in which it takes place. Thus, at the end, the same kind of holistic expertise as the one for building the vision in the "ideal" approach, is needed for innovation process.

There is no opposition between the two approaches, and indeed they are complementary in principle. In HNV-Link shaping phase, the scoring exercise aimed at in the innovation review conceptually mobilises the vision. But in practice, due to limited resources, it proved difficult to completely relate the BA and vision (the "ideal" frame) with the assessment of innovations (the "practical" solutions) in many cases, as visible in the evaluations of innovations conducted in the LAs. Then, the risk of the practical approach is to engage with actors on the basis of actions responding to expressed needs, but with partial ex-ante assessment with regards of HNV conservation.

The case of branding local cheese produced by HNV farmers, at higher selling prices, illustrates this aspect. It might appear as an appealing innovation per se as it may combine biodiversity conservation and farm viability. But its environmental impact is unclear and depends on other factors. If such an innovation takes place in areas with a potential for intensification and with little socio-institutional setting able to monitor the market development on the basis of environmental and social criteria, there is a high risk that this brand will lead to land intensification and farm concentration. It may correspond to an improved viability of (former) HNV farms in (former) HNV area. Such trends took place in further areas producing cheese under protected denomination of origin, with adverse impact on biodiversity (e.g. (Quetier, Marty, & Lepart, 2005).

This short example illustrates that from a brokering perspective, taking into consideration biodiversity conservation makes the practical approach less simpler and obvious to adopt. If it does not make the ideal one easier to implement, it makes more justifiable to envisage it as a relevant starting point for engagement.

TAKING INTO ACCOUNT THE CONTEXT FOR A SUCCESSFUL ENGAGEMENT

The emblematic example of HNV brand shows that both agroecological issues (the potential for intensification) and socio-institutional issues (the ability of local actors to monitor the brand in order to conserve biodiversity attribute, as it took place in some cases) are to be considered altogether. The HNV broker must then have a holistic understanding of the area he/she is operating in, in order to better understand the potential consequence of his entry point for engagement with other actors on biodiversity management.

As a matter of fact, we can refine a bit our analysis. The above HNV cheese brand case brings to the conclusion that a "constrained" agroecological context — i.e. with very limited room of manoeuvre for intensification — might indeed put forward the interest of a practical engagement. When this constraint is clear enough and does not need huge investigations, typically when the soil and/or relief and/or climatic conditions are so harsh and widespread that farming systems cannot intensify in some places, the risk exemplified in the HNV cheese brand looks small. Even more if the socio-economic situation of farms is fragile. In such local contexts,

engaging on a social process proposing and ideal vision might indeed look odd when the socio-economic emergency looks obvious and when the disappearing of farming systems is to lead to land abandonment. In such cases, a practical approach focusing on overcoming blockages will be a consistent way of engagement. The example of the Burren support this analysis: indeed, the karstic rangelands of the Burren are impossible to intensify and the issue was to bring any form of pastoralism back on the land that were under process of abandonment. The issue was to find practical solutions for the watering, fencing, foraging of animals so that they could extensively make use of the area (Dunford, 2016).

However, this case of "no intensification potential" is not the rule, even in HNV areas where the iconic image is that there is no such potential and that abandonment is the main process at play. Indeed, it has been finding of HNV-Link to better understand the relationship between (i) the dynamic at place in terms of development of farming systems (under the main indicator of overall land-use: does agriculture keep its place in land use or is it losing importance?) and (ii) the dynamic in terms of HNV conservation. The comparison of LA revealed that the situations were diverse and that a many LA had to deal with intensification risks.

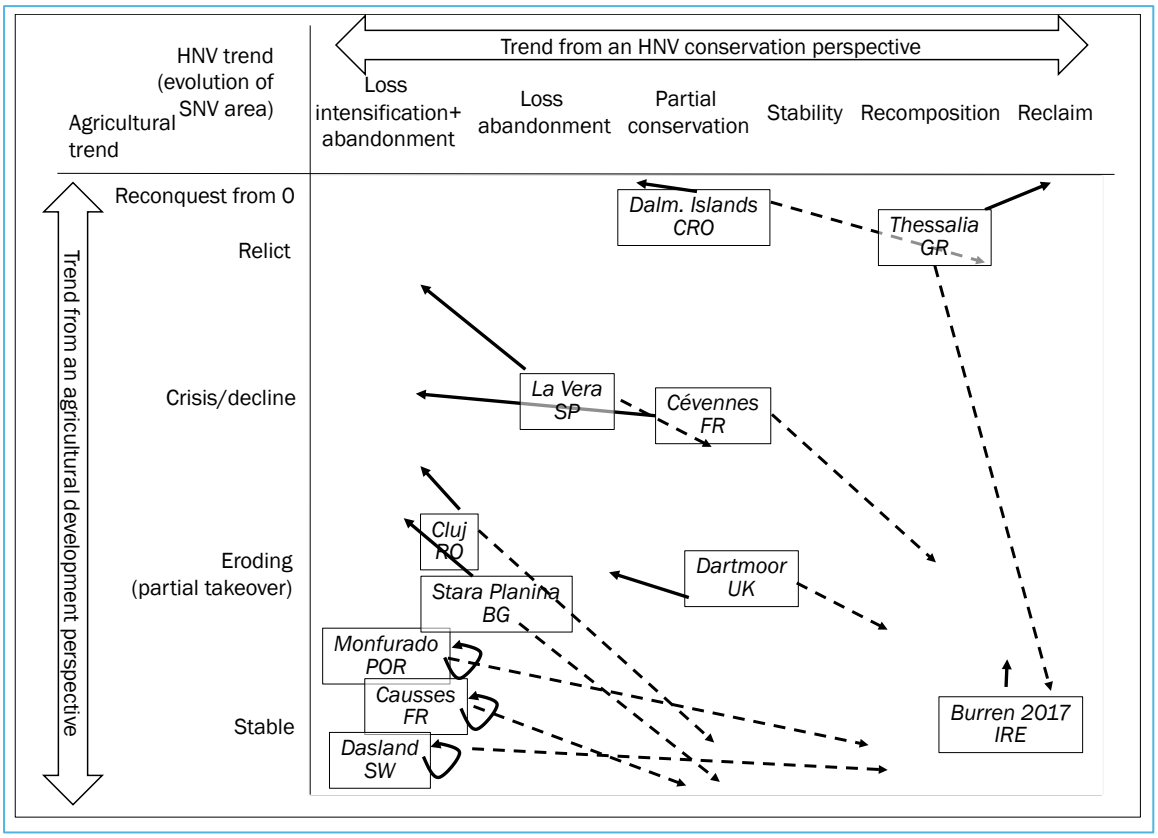


Figure 8: crossed analysis of the dynamics of farming systems and HNV landscapes in the 10 LA of HNV-Link (Poux, Bernard, & Lerin, 2017)

Complete arrows show the expected dynamic under a Business as usual scenario, dotted arrow the dynamic aimed at for the HNV vision scenario.

The interpretation of such a figure brings to the conclusion that agricultural development in HNV areas is not necessarily corresponding with conservation of HNV farming; it is the case only when the agricultural crisis is causing land abandonment. In other cases, more accurate analysis should be envisaged when engaging for both biodiversity conservation and agricultural development.

This latter consideration leads to another component of the strategic context of an HNV broker: the actors' game he/she intervenes and the way he/she should approach it for engagement. As a matter of fact, three categories of actors should be considered: (i) the farmers themselves, because they are managing the land at the end, (ii) the actors explicitly defending biodiversity conservation, from different perspectives and (iii) the rest of actors interacting with the two first categories, on different registers (mayors, food-chain agents, tourists, state

agent,…) (Mermet L. , 1992). Frequently, broker engagement will focus on engagement with farmers, thus leading to a problematisation in terms of "selling" the HNV agenda by actors of type (ii) to farmers, so that they integrate environmental practices in their farming system. Such approach is consistent with the practical engagement tagged above.

But HNV conservation is not primarily a farmers' issue in itself. It takes place in a wider agenda dealing with biodiversity and landscape management whose beneficiaries are outside the farmers' community, falling in types (ii) and (iii) in the actors' typology. Many learning areas have, for example, a touristic issue in which landscapes are a potentially shared interest between HNV conservationists and other actors. A wide range of LA have N2000 sites and national parks. The justification of HNV conservation must involve a wider set of actors than just farmers; the interest for these latter being more indirect.

This statement leads to the need to understand the social and economic context in which the HNV agenda takes place at the local level and the actors' configuration in this context. If, for engagement, the issue is to find allies potentially interested by the issue of HNV conservation (e.g. by making them aware that land abandonment will lead to increased forest fires, that HNV farming can have touristic returns and/or contribute to local culture, etc.), it has to also deal with adverse interests (e.g. because HNV conservation may decrease physical output from a food-chain perspective and/or re-allocate scarce CAP payments, etc.). Thus, the role of an HNV broker is to set a strategy for progressively overcoming oppositions by convincing and empowering a wider range of actors. Our point is to put the engagement's issue in a "process" perspective evoked at the beginning of this text and defend the idea that this process should start with an holistic vision, a credible narrative for engaging with a variety of actors. Here again, the case of the Burren illustrates this idea as the success of the project does not only rely on its practical component, but on a conservation vision explicated and shared with the whole local community. Pride of conserving landscapes and biodiversity is made visible through documented assessments and social events (e.g. the Burren Winterage), during which the results of farmers' engagement is shown to a wider local, national and international community. It is a success because it had resulted in concrete actions at the end, but it is a success story because it adopted an "ideal" approach at first instance.

CONCLUSION: STRATEGY ALSO IS A MATTER OF MEANS

Our overall intention is to rehabilitate a certain "ideal" approach when engaging for HNV conservation. Except in some very specific cases in which the issue indeed is to find individual innovations, the "practical" approach cannot be taken for the most relevant one in the medium and long term, even if proposing a set of innovations might appear appealing in a context where biodiversity conservation is rarely a priority against mainstream agricultural agenda.

We here reiterate that there no conceptual contradiction between the two approaches, on the contrary. But we experienced a real tension in HNV-Link consortium when it came to concretely prepare engagement with local actors to start with. The main means a HNV broker has is information, knowledge, skill in human relationship and time. Even if the HNV broker is not necessarily an individual person and may consist in a small close team more able to mobilise a wider range of means, this does not change the issue in the best resource allocation. And under this angle of resource scarcity, the "practical approach" has strong arguments. As the practicality of the proposed solutions will come sooner or later, it makes sense to start with such solutions, aiming at a progressive process. In return, with limited resources, a consistent "ideal" process as sketched above — meaning a comprehensive agro-ecological assessment, a mapping and understanding of actors' interests, the design of an engaging while sound HNV vision — might understandably look out of reach.

Under this angle, HNV brokers are caught in a contradiction between what is needed but not feasible (the "ideal") and what is feasible but highly risky (the "practical"). The issue of means is thus central in the understanding of this contradiction. It might seem obvious, but again it is frequently underestimated from several angles. Agri-environmental projects seem doomed to limited financial allocation and, thus, human means for accompanying the local dynamics. The success of the Burren is also explained by a preparatory phase that engaged 2 million euros through a Life project on 5 years, steered by a close working group with clear conservation goals, and animated by a local champion engaging with farmers and local community.

As long as accompanying human resources will be considered as a minor issue in practice — for example against payments that should go to farmers first in agri-environment design — the above tension will be ineluctable. But one can go beyond this deadlock in envisaging the research of means (financial, methodological, political, communicational,…) as the first step of the strategic process. Some brokers consider the capacity

building and empowerment as an issue for the local communities. But they can consider that they are the first concerned and act consistently in building a brokering team with resources before engaging in the wider world.

Such vision goes against a commonly shared one in which the issue for an HNV (or any conservationist) broker is to come at the collective table with a set of generous goals and solutions, regardless of the actual means he/she have to fight with. This diffusionist approach of innovation has little documented success in terms of environmental management. We guess that the above analysis helps understanding why. We hope that it will also help future HNV brokers to properly prepare their intervention in putting forward a strategic grid.

HNV-Link has received funding from the European Union Horizon 2020 research and innovations program under Grant Agreement No. 696391

REFERENCES

Andersen, E., Baldock, D., Bennett, H., Beaufoy, G., Bignal, E., Brouwer, F., . . . Zervas, G. (2003). Developing a high nature value indicator. . Copenhagen : Report for the European Environment Agency.

Beaufoy, G. (., & Partners, H.-L. (2017). THE HNV-LINK COMPENDIUM. Comparative collection of High Nature Value innovations, experiences, needs and lessons, from 10 European "Learning Areas". (HNV-Link H2020 Project). HNV-Link WP2, deliverable 2.6.1. EFNCP & CIHEAM-IAMM.

Beers, P., Hermans, F., Veldkamp, T., & Hinssen, J. (2014, June). Social learning inside and outside transition projects: Playing free jazz for a heavy metal audience. NJAS Wageningen Journal of Life Sciences. Special issue on Social learning towards sustainability: problematic, perspectives and promise. , 69(6), 5–13.

Callon, M. (1986). Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay. In J. Law, Power, action and belief: a new sociology of knowledge? (pp. 196-223). London: Routledge.

CIHEAM-IAMM. (2015, 03 03). High Nature Value Farming: Learning, Innovation and Knowledge.

Dunford, B. (2016). The Burren Life Programme: An Overview. National Economics and Social Council, Dublin.

Esparcia, J. (2014). Innovation and networks in rural areas. An analysis from European innovative projects. Journal of Rural Studies, 34, 1-14.

European Environment Agency. (2011). The European Grassland Butterfly Indicator: 1990–2011. EEA. Luxembourg: European Union.

Jones, G., & Poux, X. (2012). Socio-economic perspective on HNV farming. In R. Opperman, G. Beaufoy, & G. Jones, HNV farming in Europe (pp. 451-458). Ubstadt-Weiher, Basel: verlag regionalkultur.

LA coordinators. (2016, June). HNV-Link - WP1 Assessment of the baseline situation, initial questionnaire — internal document. (X. Poux, Interviewer)

Leeuwis, C. (2003). Communication for Rural Innovation. Rethinking Agricultural Extension, Third Edition. BlackWell Science, ICTA.

Loeber, A., & Vermeulen, T. (2012). The art of 'doing' sustainable agricultural innovation : approaches and attitudes to facilitating transitional projects . In I. [online] (Ed.), System Innovations, Knowledge Regimes, and Design Practices towards Transitions for Sustainable Agriculture (posted online November 20, URL: http://www4.inra.fr/sad_eng/Publications2/Free-e-books/System-Innovations-for-Sustainable-Agriculture ed., pp. 102-117). Barbier M. and Elzen B.

Mermet, L. (1992). Stratégies pour la gestion de l'environnement : la nature comme jeu de société ? Paris: L'Harmattan.

Mermet, L., Billé, R., Leroy, M., Narcy, J., & Poux, X. (2005). L'analyse stratégique de la gestion environnementale : un cadre théorique pour penser l'efficacité en matière d'environnement. Natures Sciences Sociétés, 13, 127-137.

Mermet, L., Homewood, K., Dobson, A., & Billé, R. (2013). Five paradigms of collective action underlying the human dimension of conservation. In D. MacDonald, & K. (. Willis, Key Topics in Conservation Biology (Vol. 2, pp. 42-58). Oxford: Willey-Blackwell.

Poux, X., & Moran, J. (2017). Assessment of the baseline situation - Guideline for LA coordinators - An HNV-Link H2020 Report, Deliverable 1.2 for WP1. CIHEAM-IAMM.

Poux, X., Bernard, C., & Lerin, F. (. (2017). THE HNV LINK ATLAS Crossed perspectives on 10 learning areas - Understanding the field of play for High Nature Value innovation projects. EU H2020. CIHEAM-IAMM.

Poux, X., Bernard, C., & Lerin, F. (2017). The Ten Baseline Assessments . HNV-Link H2020 report.

Quetier, F., Marty, P., & Lepart, J. (2005). Farmers' management strategies and land use in an agropastoral landscape: Roquefort cheese production rules as a driver of change. Agricultural Systems, 84(2), 171-193.

Steyaert, P., Barbier, M., Cerf, M., Levain, A., & Loconto, A. (2016). Role of Intermeidation in the Management of Complex Socio-technical Transitions. SISA International Workshop. Wageningen University Research.

Ward, V., House, A., & Hamer, S. (2011). Knowledge Brokering: The missing link in the evidence to action chain? Evidence Policy, 5(3), 267-279.

AFFILIATION

Xavier POUX,

PhD in rural economy, has been working at AScA for more than 25 years. He has developed expertise in the field of agriculture and environment policies, embracing technical, economic and socio-political aspects. Through studies, workshops and participation to agri-environmental networks, Xavier has been active in the agri-environmental debate in Europe and France.

Xavier is currently a fellow researcher at IDDRI (Paris), with which he has initiated and developed the Ten Years For Agroecology (TYFA) research program. https://www.iddri.org/fr/projet/tyfa

Contact: xavier.poux@asca-net.com

IMPROVING ADVISORY SERVICES FOR SUSTAINABLE AGRICULTURE

Some reflections on the early stages of the AgriLink project's Living Labs

JORIEKE POTTERS, CHRIS BLACKMORE AND HERMAN SCHOORLEMMER

"Two there are, who are never satisfied; the lover of the world and the lover of knowledge." Jalaluddin Rumi

Abstract
The H2020-project Agrilink aims to strengthen the contribution of advisory services to innovation in order to help realize more sustainable agriculture. AgriLink investigates the changing role of advisors and seeks to design improved tools and innovation support services for farmers. Within the project, the method of 'Living Labs' is used to explore how new tools can be made to work in practice, especially to stimulate the type of radical changes that are needed for a sustainability transition. Living Labs have been initiated in six different countries (Italy, Latvia, Netherlands/Belgium, Norway, Romania, Spain) to facilitate a multi-actor participatory design process. The Living Labs and the resulting improved innovation support are expected to contribute to the shift in knowledge regimes and design practices that are needed to realize more sustainable agriculture (Barbier and Elzen, 2012).

The European Network on Living Labs (ENoLL) defines Living Labs as user-centred, open innovation ecosystems based on a systematic user co-creation approach integrating research and innovation processes in real life communities and settings. In an attempt to bring some structure to the wide variety of Living Labs that have been created in the past decade, Enoll has defined the following five characteristics of Living Labs: real life setting, co-creation, end user involvement, multi tool, multi stakeholder participation (EnoLL website, 2018). In an Agrilink Living Lab, researchers, farmers and advisors and other actors work together to develop and test new tools and services for better connecting research and practice. Thus Living Labs may help to address the apparent mismatch (as identified in the Sisa call 2018) between insights developed in research and the more detailed practical issues that are at stake in the real life setting.

In operationalizing the Living Lab concept Agrilink has built on the principles of Design thinking, Systems thinking and Reflexive monitoring. Principles of efficiency, efficacy and effectiveness (often used in soft systems methodology) and the five characteristics of a living lab as defined by ENoLL are translated into a reflexive monitoring approach for the Living lab process. Contextualising these principles to six different real life settings provides a rich empirical basis for understanding how this type of participatory design takes shape and functions under different local contexts (eg Klerkxs et al (2017).

The authors are some of the researchers involved in the AgriLink Living Labs and the inquiry process is at a relatively early stage. This paper will address the following issues:

- How to operationalize the Living Lab approach using the principles of design thinking, systems thinking and reflexive monitoring in the early stages of the Living Labs?

- What do we learn about the participation of different stakeholders in the design process during the early stages of the Living Labs?

- What are initial insights in on key issues that influence the development and functioning of the Living Lab?

The creation of the Living Labs started mid-2017 and the process will continue until 2021. From the exploratory phase it seems that the following two characteristics are key to determine an appropriate arrangement of a Living Lab: 1) the mix of public and private good issues involved and 2) the advisory challenge at stake. For example in some labs such as the one in Romania the sustainability challenge is quite straight forward: to improve access of a specified group of producers to available agricultural knowledge and market information. The advisory challenge is to best serve the farmers private interest to improve their farm livelihoods. Advisors are likely to be change agents in this situation. Other labs, for example the joint Dutch Belgian lab, focus on situations where ecological sustainability is a much larger public and political issue. This leads to a more complex dynamic in the lab and raises different issues than in the Romanian example. Our first experiences suggest that it makes sense to distinguish between Living Labs concept that focus on public good issues and those that focus on private good issues. These distinction seems to have consequences for the stakeholder field, the advisory challenge and the reasons to search for participation and thus the functioning of the Living Lab for participatory design of advisory services.

KEY-WORDS : SUSTAINABLE AGRICULTURE, LIVING LAB, ADVISORY SERVICE, PARTICIPATORY DESIGN, DESIGN THINKING, REFLEXIVE MONITORING

INTRODUCTION

The development of the agricultural sector across Europe is supported by various agricultural knowledge innovation systems (AKIS) that supply information and develop knowledge to support innovation. Of relevance to science, farmers and other stakeholders, one component of such knowledge and information systems is the advisory subsystem. Its goals is to support farmers in the overall farm management which covers several specific topics like soil management, pest management but also financial management (Jansen and Klerkx, 2010). Most governments in Europe at varying times during the 20th century had a leading role in the formal development of advisory systems and the main focus was to ensure sufficient food production to feed the population (PROAKIS, 2014).

During the late 20th and early 21st centuries both the organisation of the advisory services and the challenges to the agricultural systems have changed considerably. Awareness, concern and attention to sustainability challenges grew and governments have gradually withdrawn from actively supporting advisory services. It is interesting to observe how these two developments have taken place simultaneously, without directly being related in a causal or intentional manner. Privatisation and commercialisation in agricultural advisory systems have been fed by liberal market thinking and have become ongoing processes for over 30 years now in some parts of Europe. The EU SCAR group (2015) has made an analysis of this process. The expected benefits of privatisation are greater efficiency of service provision in terms of costs and resource allocation, increased provider accountability, a demand-driven elaboration of contents, and an emphasis on benefits and results. Competition is assumed to ensure constant improvement in the quality and diversification of goods (Klerkx *et al*., 2006). However, in practice there have also been some potentially more negative implications of privatising or commercialising advisory services described by the EU SCAR-group (EU-SCAR, 2015, p.104) as:

1. "the tendency toward a reduction of linkages both among organizations and among farmers in the exchange of agricultural and other relevant information;
2. the tendency to enhance advice for large-scale farms and to emphasize less on small-scale or less commercial farming;
3. the advancement of knowledge as a saleable commodity which makes it prone to interest biases of the advisor (Rivera and Cary, 1997) and
4. the diminishing emphasis on public-good information regarding for example environmental issues, mostly dealt with in a rather short-term perspective (Labarthe, 2009; Klerkx *et al*., 2006)."

With hindsight it is rather ironical that these developments took place at the same time. The sustainability challenges need profound changes in the knowledge systems and require exactly those knowledge processes and content that have been weakened by privitisation. As Koutsouris (2008, p205) highlights the changes that are needed, 'the shift from conventional farming to more sustainable forms of agriculture concern a systemic change and thus involves .... a profound change in assumptions and strategies underlying subsequent actions'. Jansen and Klerkx (p.150) cite Leeuwis and Van den Ban (2004) and Nettle and Paine, (2009) in describing what changes this implies for the role of the advisor: "Instead of being mere technical experts prescribing solutions, advisors must take on the role of coach, sparring partner and facilitator from a reflexive and adaptive position." This situation calls for innovative advisory services to better face the knowledge needs of the farmers and other stakeholders to deal with the sustainability challenges in their specific contexts. The AKISs and the advisory systems and the agricultural and sustainability challenges are very diverse from one context to another. This diversity requires a participatory design of such innovative advisory services in order to take multiple perspectives into account.

Inquiry processes known as Living labs, that have largely emerged in the early 2000s, seem to have potential to provide an appropriate space for such participatory design process. Living labs are broadly defined as user-centred, open innovation ecosystems based on a systematic user co-creation approach integrating research and innovation processes in real life communities and settings (EnoLL website, 2018). EnoLL identifies five characteristics of Living Labs: real life setting, co-creation, end user involvement, multi tool and multi stakeholder participation. Their rationale for using Living Labs in the context of agricultural advisory services is discussed in the next section.

In this paper we will explore how participatory design for improving advisory services can work in practice. To this end we introduce the case of the Horizon 2020 project 'AgriLink' and more specifically an inquiry process that has been designed and initiated through Living Labs in Italy, Latvia, Netherlands/Belgium, Norway, Romania, Spain.

In operationalizing the Living Lab concept Agrilink has built on the principles of Design thinking, Systems thinking and Reflexive monitoring. Principles of efficiency, efficacy and effectiveness (often used in soft systems methodology) and the five characteristics of a living lab as defined by ENoLL are translated into a reflexive monitoring approach for the Living lab process. Contextualising these principles to six different real life settings provides a rich empirical basis for understanding how this type of participatory design takes shape and functions under different local contexts (eg Klerkxs et al (2017). Further details of these principles, characteristics and settings are elaborated in later sections.

Overall, this paper aims to contribute on the one hand to the insights on improving the capacity of advisory services to face the challenges of sustainable agriculture and on the other hand to understanding the value of using participatory design in a living lab setting as an effective tool in such processes. Since the inquiry process is at a relatively early stage, this paper will focus only on issues that we feel able to comment on at this stage, namely:

- How to operationalize the Living Lab approach using the principles of design thinking, systems thinking and reflexive monitoring in the early stages of the Living Labs?
- What do we learn about the participation of different stakeholders in the design process during the early stages of the Living Labs?
- What are initial insights in on key issues that influence the development and functioning of the Living Lab?

The authors of this paper are all involved in the Living Labs work package of AgriLink along with many others. One of the roles of the lead author is as the monitor of the Dutch/Belgian Living Lab.

The rationale for the AgriLink Living Labs and their approach

The H2020-project Agrilink aims to strengthen the contribution of advisory services to innovation in order to help realize more sustainable agriculture. AgriLink investigates the changing role of advisors and seeks to design improved tools and innovation support services for farmers. The project has seven interconnected work packages as shown in Figure 1, The Living Labs comprises work package 3.

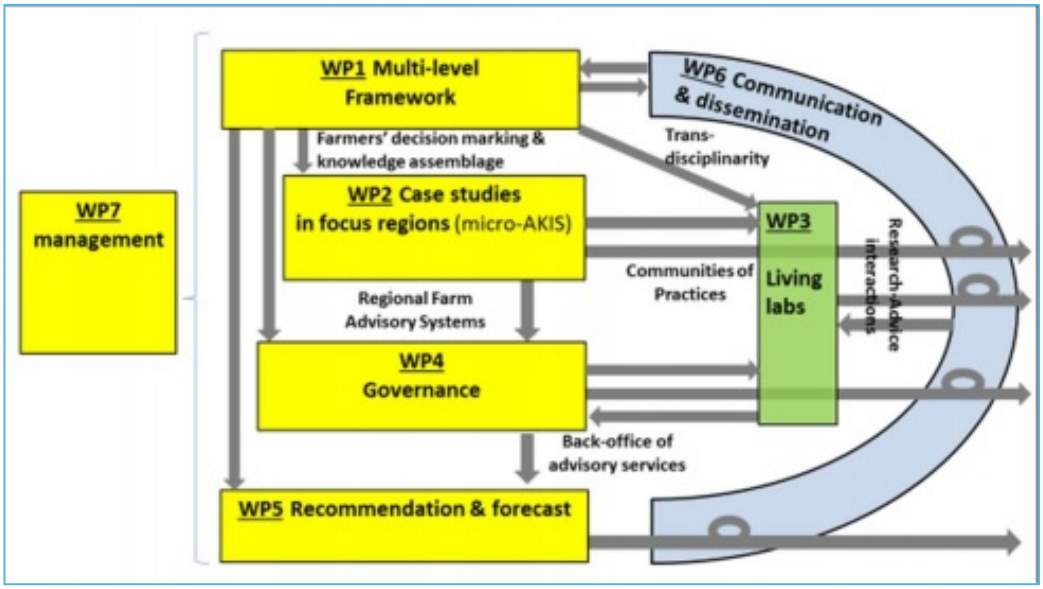


Figure 1 AgriLink work packages structure.
Source: AgriLink conceptual framework p.14

Within the project, the method of 'Living Labs' is used to explore how new tools can be made to work in practice, especially to stimulate the type of radical changes that are needed for a sustainability transition. The aim of the AgriLink Living Labs is to develop and test improved innovation support services with potential to stimulate transitions towards more sustainable agricultures. The assumption is that doing this in a Living Lab setting leads to better results. A Living Lab setting as characterised by ENoLL means involving stakeholders and end users in a co-creation process in a real life setting. A further assumption is that multiple tools and methods can enhance the process and support Living Labs. At the end the Living Labs and the resulting improved innovation support are expected to contribute to the 'shift in knowledge regimes and design practices' that Barbier and Elzen (2012) argue is needed to realize more sustainable agriculture. Agrilink Living Labs have been initiated in six different countries (Italy, Latvia, Netherlands/Belgium, Norway, Romania, Spain) to facilitate a multi-actor participatory design process.

As mentioned earlier design thinking, systems thinking and reflexive monitoring are key aspects of AgriLink's Living Lab approach. *Design thinking* is a method for practical, creative resolution of complex and ill-defined problems (Bootcamp,2010). The recommended stages in design thinking are *empathise, define, ideate, prototype, test and implement*. These stages are used in an organic, non-linear way to organize the support to the living lab teams. The stages are used as building blocks of an iterative process, going back and forth through them. *Systems thinking* is an approach to thinking about and acting in the world that recognises interconnections and contexts by creating systemic (holistic) representations of what 'we' perceive about situations. It is very suited to participatory, action-oriented research and is complementary to more systematic, reductionist methods embodied in the scientific approach. It complements design thinking in the way that it approaches the understanding of messy or complex situations for some purpose, usually to effect some changes. Systems thinking in practice deals with: understanding inter-relationships, engaging with multiple perspectives and reflecting on boundary judgements (Lane, 2017). *Reflexive monitoring* involves active reflection on the part of researchers and practitioners, to critically look at their own practices, their views and their ways of doing things. Reflexive monitoring offers tools to stimulate reflexivity in co-creation processes whilst also collecting relevant data on the processes that can later be used to compare and contrast the Living Labs.

Design thinking, systems thinking and reflexive monitoring have been identified by the AgriLink Living Labs work package team as aspects of particular relevance to AgriLink's aims and context. The processes involved in all three enable multiple perspectives of stakeholders to be appreciated while recognising that researchers have their own perspectives and make their own assumption which need to be made explicit in order for co-creation of knowledge to occur. The three conceptual pilars have all emerged from a wide diversity of practitioner and academic traditions that offer a range of tools to help facilitate such group processes and improvements in complex and messy situations.

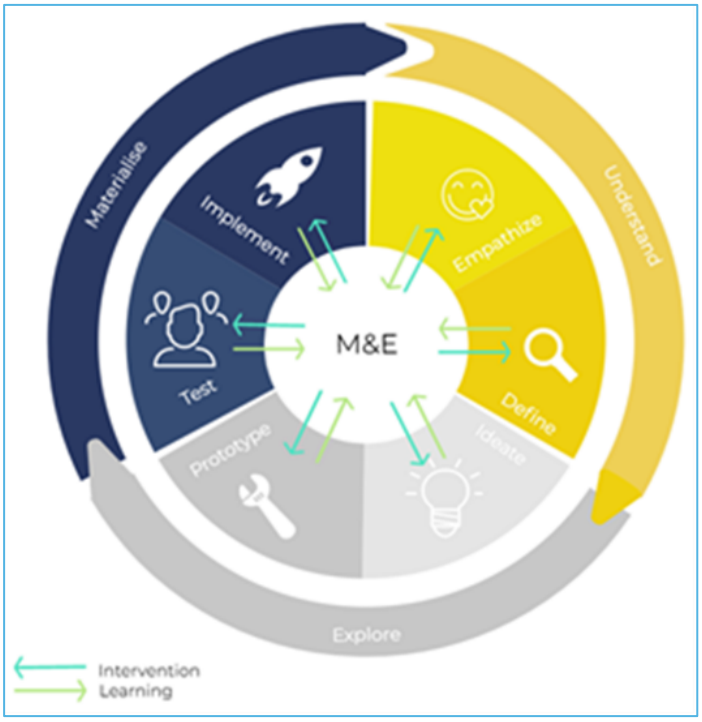


Figure 2 Contextualised and iterative design thinking with monitoring and evaluation. Source: Adapted by Hanne Leirs, based on Bootcamp, 2010 and AgriLink discussions.

The three aspects of AgriLink's Living Labs approach have been brought together in both design and practice of activities at the level of these individual Living Labs and at the level of the work package where the Living Lab teams work together. Figure 2 shows how reflexive monitoring (M) and evaluating (E) is intended to help link the stages of design thinking and how these stages are contextualised and part of an iterative process.

DEVELOPING THE LIVING LABS: SOME INITIAL FINDINGS

The creation of the Living Labs started in mid-2017 and the process will continue until 2021. Two criteria were important in selecting the topic and setting of the living labs. The first was relevance to sustainable agriculture, the selection of a topic with a clear sustainability challenge in which the potential role of advice was expected to be significant. The second was more pragmatic: ease of implementation. The topic and setting of the different Living Labs was selected in such a way that good relations pre-existed with the relevant stakeholders and the living lab was in some cases embedded in a wider project or program.
Table 2. provides an overview of the six Living Labs, the main topic and the sustainability and advisory issues at stake. Important to note that these selection criteria were the implicit starting point but have been further developed and made explicit iteratively through the Living Lab process.

The table shows a great variety of producers is involved in the Living Labs ranging from small scale horticultural producers in Latvia and Romania to commercial vegetable, dairy and arable farmers in Spain, Norway and the Netherlands and a variety of community level stakeholders in local communities in Italy. In the objectives of the labs two groups can be distinguished. On the one hand the labs that aim to stimulate the development of a specific part of the value chain for a certain product and stakeholder group. On the other hand the labs that aim to stimulate the application of specific sustainable practices like crop rotation, IPM and sustainable soil management. For the further understanding of the dynamics in the labs it is important to note that the first group focus on sustainability challenges where predominantly a private good issue is at stake, the living labs in the latter group focus on public good issues.

Country	Topic	Sustainability challenge	Advisory challenge	Advisory service in development
Italy	Local food production on common land and development of local value chain	Improve **income** situation, communal strength and **environmental** sustainability	Facilitate community development and provide knowledge on a broad range of topics to a diverse stakeholder group.	To be determined: an advisory service able to support multi-actor groups in the sustainable management of common land
Latvia	Processing and marketing of horticultural products	Improve the **profitability** of horticultural production and the **living standard** of small producers	Make relevant knowledge available to small scale producers	Online information platform for processing and marketing
Netherlands - Belgium	Sustainable soil management in maize cultivation	Improve maize **production** and reduce **environmental** impact of maize cultivation. Leaching, pesticide pollution of surface waters.	Stimulate and enable farmers to apply more sustainable soil management in maize cultivation	Three different tools: • Decision support tree on catch crops • Nitrate tour to increase awareness • Kitchen table talk between farmer, contractor and advisor
Norway	Crop rotation on farm and between farms	Strengthen use of local **natural resources** and improve **income** for farmers	Stimulate and enable farmers to apply crop rotation on farm and between farms.	To be determined: an innovation support services and tools that facilitate crop rotation
Romania	Professionalization of food producers cooperative	To improve **income security** of food producers	Improving the access to reliable, timely information for one cooperative	Design training and informational materials to suit their needs OR identify relevant experts with key knowledge
Spain	Integrated pest management	Reduce **pesticide use** to increase food safety and reduce air pollution, contamination of agricultural land and loss of biodiversity.	Improving the knowledge and skills of farmers and advisors to apply IPM. Development of new roles of advisors, as supporters of digital services and ICT specializations.	• Warning Digital System and collaborative monitoring of pests (AgroIntegra) • IPM Thematic group of farmers for innovation and demonstrations.

Table 1. Overview of the six Agrilink Living Labs

The overview of the advisory challenges and 'advisory-services-in-development' highlights some differences and trends. Some labs aim to improve the availability of relevant knowledge to the stakeholder groups, this type of advisory service tends to be about traditional knowledge transfer with the advisor in the role of expert. This strategy is being developed in Latvia, and Romania. These labs operate in situations where the advisory system for the topic is weakly developed and the end user has a relatively low level of professional formation. Other labs aim to support a certain sustainable practice by stimulating and enabling stakeholders to apply it, on their farm or in their community. This tends to be the case in the Netherlands/Belgium, Norway, Spain. This latter approach implies a more facilitative role of advisory services and strategy. In these situations the advisory systems and associated professions tend to be rather well developed. The Italian living lab is still in the exploratory phase so it is too early to make statements about its strategy.

The Living Labs are being developed through close cooperation between a small international work package team and the six living lab teams. The work package team is responsible for coordinating and supporting the creation of and learning in the Living Lab teams, and to provide guidance and support to the learning in and between the Living Labs. Each national living lab team includes a facilitator and a monitor. The two work closely together and share the responsibility for creating the living lab, but have a different focus in their activities. The facilitator is more focused on running the lab and the monitor on data collection and reflecting on the process.

During the first year the focus was on the formation of the Living Lab teams, the selection of topic and setting, assessing the context of the living lab and entering the dialogue with the stakeholders in order to define the focus of the Living Lab. Table 2 details the early activities of Agrilink Living Labs that have provided opportunities for developing knowledge and understanding. These were also occasions for the data collection on which this paper is based.

Activities	Content	Date
Workshop during kick off	Mapping the setting of the six LL.	June 2017
Start-up skype with each of the LL teams	Initial ideas for the LL	September 2017
Follow up skype	Outline of the living lab stakeholder dialogue	October 2017
Articulation of core challenges for providers of new Innovation Support Services	Perspectives of the different stakeholders	December 2017
2-day workshop	Training, context appreciation, exchanges and LL design	February 2018
Workshop during annual meeting Aberdeen	Exchange experiences and define monitoring questions	June 2018
M&E plans of the living labs	Questions and method of data collection	July 2018
Reflection memo's of quarterly progress	Progress, lessons learned and challenges	September 2018
Update conversation with each of the LL teams	Progress lessons learned and challenges	September 2018
Workshop Leuven with all the LL teams	Training and first analysis of experiences	September 2018

Table 2. Early activities of AgriLink's Living Labs used to develop knowledge, understanding and data.

Participatory design of the Living Labs took place at two main levels – across the Living Labs at the level of the work package and within each Living Lab. The principles of co-creation and multi-stakeholder participation were enacted in a range of different ways. Across the Living Labs, the workshops were designed in ways that facilitated participation of all attendees using a range of tools such as diagramming and small group work with feedback to the whole group to help understand multiple perspectives. The design of workshops tailor-made to the processes in the Living Labs was largely the responsibility of the central work package team, but attendees from the Living Labs were asked for their interests, ideas and feedback throughout the process. Within each Living Labs, facilitators and monitors with others in their teams took responsibility for the design process. Although all involved a range of different stakeholders, the ways in which this was done varied, with the ideas of co-creation and participation being introduced at different stages, some from the outset and some after some of the initial scoping and design work had been done. In part this reflected other starting conditions and trajectories of each Living Lab. Some built on previous projects, others started new processes in a range of different systems of interest. This participatory design process is still ongoing and it is too early to give full details so they will be discussed in a later paper.

DISCUSSION

In this paper we set out to consider

- How to **operationalize** the Living Lab **approach** using the **principles** of design thinking, systems thinking and reflexive monitoring in the early stages of the Living Labs?
- What do we learn about the **participation of different stakeholders** in the design process during the early stages of the Living Labs?
- What are initial insights in the **key issues** that influence the development and functioning of the Living Lab?

In the following paragraph we discuss each question in turn.

Operationalising the Living Lab approach and the principles

The building blocks of design thinking, systems thinking and reflexive monitoring for the Agrilink Living labs as explained in the rationale have so far provided inspiration to the Living Lab teams in developing a participatory design process of advisory services. Furthermore they are used to provide support to the living Lab teams, to create a common language and enable a mutual learning process. Reflexive monitoring and systems thinking have been used respectively to maintain a holistic view on the situation and to create a culture of learning and reflexivity. A range of tools and techniques have been used for these purposes, such as systems diagramming, a conceptual framework for reflexive monitoring and various templates that make explicit relevant measures, questions and processes. A monitoring and evaluation plan has been developed and agreed for the work package as a whole with accompanying monitoring and evaluation plans for each Living Lab. The very process of formulating the monitoring and evaluation plan was an opportunity for making the own assumptions, monitoring questions and learning objectives more explicit, share and discuss them within the Living Lab team and between the Living Labs. The steps of design thinking are being used in an organic way to organize the support to the living

lab teams. Although we are using them in a non-prescriptive way, they have so far proved quite useful in sharing methods and lessons learned in the process.

All living labs have started the ***empathise*** phase with an analysis of the context in which the Living Lab is taking place and a stakeholder analysis. They have entered into a dialogue with the main stakeholders about their perceptions of the situation, their interests, the challenges, the role of advice and possible solutions. A checklist and some guidance was provided for 'semi-structured' interviews. During the ***define*** phase the Living Lab teams defined the outline of their lab, specifying, amongst others the focus of the lab, the sustainability and advisory challenge and the need for additional knowledge and skills. During the ***ideate*** phase the aim was to set the boundaries of the innovative advisory service and to come up with different possibilities of advisory services that could help to make progress on the sustainability challenge. Besides workshops and informal conversations the information collected during the initial stakeholder interviews was an important source here too. Currently, the living labs are moving towards the last three steps of design thinking: prototype, test and implement. Most Living Labs have roughly demarcated the advisory service they are going to develop (the last column in table 2) and some have started making a first prototype indicating the content and form.

During the first year of running the labs, the ENoLL characteristics of a living lab were introduced and discussed. The following interpretation of these characteristics has been used as starting point:

- Real life setting: The advisory service is developed and tested in the setting it is going to be applied in thus making it applicable in practice.
- Active end user involvement: The end users of the advisory service are actively involved in the Living Lab process in a meaningful way, thus ensuring the quality and the implementation of the advisory service.
- Co creation: The advisory service is created building on the skills, experience and knowledge of all relevant stakeholders, to who share ownership of the process and the result.
- Multi tool: In the design process different tools are applied as relevant to facilitate the creation process and involve the stakeholders.
- Stakeholder participation: A variety of relevant stakeholders participate in the development and testing in accordance to their interest and capacities.

Again the intention was not to use these characteristics prescriptively but for guidance, building on their use by others in the ENoLL network. The definition of these characteristics as outlined above were the result of a mutual learning process between the Living Labs. The challenge how to apply these characteristics has been left to the judgement of the Living Lab teams, giving them space and room to find their own way and adapt them to their context. However, guidance has been given both in training sessions and in the work package monitoring and evaluation (M&E) plan. In their own M&E plans each lab started to indicate how they are using these different aspects.

At the September 2018 workshop (see Table 2) the importance of the ENoLL characteristics in the different phases of the design thinking process was assessed, shared and discussed between the Living Lab teams. This resulted in the following impressions. In the ***empathise*** phase of the design process especially the 'real life setting' and the 'user involvement' was given importance. The main task at this stage was to understand the problem perception of the users and the context. The LL teams have also found the participation of the broader stakeholder group important, but less so than the involvement of the end user, in most cases the farmer. During the ***define*** phase of the process the end user involvement is still very important but the real life setting was seen as less important. Several, but not all, labs are involving the end user as co-creator in defining the scope of the living lab. This is justified by refering to the notion that that the definition of the scope of the Living Lab should be in accordance with the views of the end user. Others perceive the definition of the scope of the Living Lab more as a back office task based on the insights gathered during the emphatise phase, and decided not to bother the stakeholders with this. During the ***Ideate*** phase the end user and real life situation are still important but the most importance is given to the wider stakeholder group. The ideate phase is organised as a co-creation process in half of the Living Labs, the other half use the ideas from the empathise phase as a basis to make a list of possible advisory services and discuss this with the stakeholdersThough various tools have been used in the earlier phases, only at this stage the Living Lab teams give explicit importance to the use of multi tools to stimulate creativity and facilitate the input of ideas from the broad stakeholder group. Following this logic one could perhaps expect that in the **prototype** phase the end user involvement, co creation and stakeholder participation becomes more important and in the **testing** the real life setting and the end user are the most important aspects to facilitate. However also in these phases the different Living Labs will give different meaning and implementation to the characteristics thus providing a rich basis for learning.

It is too early to draw conclusions on the consequences of these differences in the way these characteristics and principle are used. It seems however that the initial vagueness of the Living Lab concept and the choice to abstain from prescriptive instructions and use the characteristics as inspiration created a rich space to learn about the methodological choices to be made and the relevance and form given to these characteristics.

Observations on stakeholder participation

Some initial observations on participation in the design process in the Living Labs can be shared. The Living Lab thinking distinguishes between end users and stakeholders and co-creation. Of course these are overlapping categories, since the end user holds a stake and co-creation is a way of participating. Nevertheless, in our experience so far it does appear to make sense to put an extra focus on the end user and co-creation to avoid the creation of a general multi-stakeholder process in which the end user is merely absent or only consulted. The ENoLL characteristics in the context of reflexive monitoring are being used in the Living Labs as a reminder to ask from time to time whether the right stakeholders are involved in the appropriate way.

Another observation that seems relevant to mention, is a difference between the types of stakeholders who are participating in the different phases. Whereas in the early phases participation of a wide range of stakeholders that influence the sustainability challenge was sought. In the define and ideate phase specific stakeholders are invited for their knowledge or skills contributions. These same stakeholders are likely to be involved in the prototyping. Whereas in the early testing it would be important to focus on the end user and invite the original wider range of stakeholders to provide feedback. In summary, the initial experiences in the Living Labs indicate that sometimes the separate characteristics are overlapping, and distinction is merely a reminder not to forget important focus points and on other occasions it seems relevant to make more distinction within the characteristic of stakeholder participation. With the progress of the participatory design processes we will continue to observe how these characteristics are most useful in developing improved advisory services.

One key issue that has arisen regards what stakeholders are invited to participate and in what way. Were stakeholders mainly consulted, invited to discuss a proposal or to co-create? What boundaries were set before the stakeholders were invited? For example in some of the Living Labs the topic was established before the process started. Besides the preference, assumptions and values of the Living Lab team the possibilities to invite participation also depends on the active interest on the topic and the level of formation of the stakeholders. For example in the Dutch-Belgian lab it is quite a challenge to actively involve farmers in thinking about improved advisory services. Firstly because the farmers' sense of urgency around sustainable soil management in maize is not so high and secondly because their expectation of the contribution of advisory services was moderate. The Living Lab team dealt with this situation by listening carefully to the concerns of the farmers and out of that understanding identified different smaller topics that had the interest of some farmers and identified some other stakeholders that shared that interest. This way three smaller living lab were created around smaller topics.

Another issue that we will take forward is the capacity, ability and permission to participate in a meaningful way in the design process. The Living Lab concept as with other participatory design methods seems to be based on the premise that the design objective is clear and shared and all stakeholders are equally able to take part. In the reality of designing advisory services for sustainable agriculture this is often not the case. In many contexts, the distribution of power, capacity and resources is generally imbalanced (Hiemstra et al, 2013). Also in the Living Labs the meaningful participation of end users and other stakeholders is a key issue. For example in the case of Romania the Living Lab team experienced that the end users were uncertain about articulating their needs since they were not aware of the possibilities. What the Living Lab team did was to try to first fully understand the perspective and values of the end user and then to involve other stakeholders in the ideate and prototype phase to formulate the information supply. Another important option could be to invest time and attention to assist the end user to articulate their needs. In this case it requires some creativity to find meaningful ways to involve the end user in the development of the prototype.

The questions raised in the above section illustrate the different aspect of participation that will be explored in the further development of the Living Labs in order to understand how meaningful participation in the design of advisory services can take shape in different contexts and for challenges.

Key issues for the development of the Living Labs

In this section we zoom out and attempt to link the initial experiences in the Living Labs to the original sustainability challenges in agriculture and the advisory system as they were introduced in the first section of the paper. As stated earlier it is too early to provide answers or definite conclusions, however it makes sense to identify some key issues and raise follow up questions at this stage. The question we would like to contemplate in this final section of the discussion is what issues seem to be relevant in describing the differences between the Living Labs and share the initial observations on the consequences for the Living Lab process.

The difference between public good and private good issues that was mentioned earlier seems to be an important criteria here because it seems to relate to other aspects of the advisory challenge and the Living Lab process. We cannot be too precautious in mentioning that these are initial ideas and observations. We would like to bring them into discussion for the sake of learning and further assessing the Living Lab experiences. Below an attempt to specify some differences between the labs that focus on public and the ones that focus on private good issues. On the one hand the Latvian and Romanian Living Lab are dealing with private good issue. The aim is to increase income by processing and marketing of their produce. These challenges are rather straightforward, the producers lack the connection to the market to create added value. Though the various stakeholders involved in the market chain may differ in their interest, there is not so much conflict to be expected between interest. The challenge directly serves the interest of the farmer as the end user and the client of the advisor. As we saw earlier the advisory challenge is to improve the producers access to information and skills to be able to connect to the market and create extra value. The advisor is one of the change agents and can remain in the traditional role of expert.

On the other hand the Norwegian, Dutch-Belgian and Spanish Living Labs are dealing with public good issues. The aim is to reduce the environmental impact of agricultural production. These are quit complex challenges where different solutions exist and need to be developed and different stakeholders involved have different interest that do not naturally point in the same direction and may even conflict. For example in the case of the Dutch Belgian Living Lab the water board has a strong need for more clean agricultural production to meet the EU regulations for water quality. Many farmers do not seem to have strong perception of the need to change maize cultivation practice and some advisors feel tension between the long term needs and the short term interest in maintaining a good relation with the farmer or selling agricultural inputs. Attention is needed to create a common ground, a sense of urgency or negotiate an agreed objective of the Living Lab. This situation requires a strong facilitative role of the advisor, however the motivation or interest to take that role is not always clear. In these cases of public good issues it remains a question whether an advisor acts as change agents or more as defender of the status quo.

These differences seem to influence the development and functioning of the Living Lab. For the private good issue the motivation for searching participation seem to be born from the desire to better serve the needs of the end user and the desire for high quality input in the process. All the features above contribute to a quit straight forward setting for organizing a Living Lab for participatory design of advisory services. In the case of public goods issue participation of different stakeholders is more serving the need to negotiate the interests of the different stakeholders, get buy in from them and create a shared perspective. In this setting involving the end users and different stakeholders in the Living Lab proves to be quite a challenge since interest diverge and the benefits for the end user are not always clear. Table 3. Provides an overview of the initial ideas how the nature of the issue involved in the lab influences the Living Lab process.

Focus of the Living Lab =>	Private good issue	Public good issue
Complexity of the challenge	Relatively low	High
Level of congruence in interest between stakeholders especially the end user and advisor	High since the issue is directly serving the advisor client ie the end user	Lower since the issue serves not only the end user but also the public good.
Nature of the knowledge process	Transfer of knowledge is often sufficient	Awareness raising and Co-creating knowledge and balancing interests is often needed.
Role of the advisor	Expert or trainer	Sparring partner, facilitator
Reason for participation	Participation serves the quality of the developed technology	Participation of different stakeholders is needed to negotiate the interests of the different stakeholders
Ease of organising a Living Lab	Relatively easy since the stakeholders have a common interest and challenge	Relatively difficult to get the stakeholders together since interest diverge and the benefits for the end user are not always clear.

Table 3. Initial ideas how the nature of the issue influences the Living Lab.

In the follow up in the Living Labs it seems relevant to further explore how these and other differences and issues influence the of the Living Labs and the participatory design process.

Finally it is important to keep a broad scope. Next to the participatory design of improved advisory services it is important to look into alternative causes of suboptimal functioning of the advisory systems. As was indicated in the introduction it is often the commercialization of the advisory services and the drawback of the government from extension that contributes to the reduction of knowledge exchange and hampers the spreading of sustainability information and weakens the access to knowledge by small scale farmers. Next to a focus on the design of innovative advisory services it is important that public institutions take their responsibility in supporting the full agrarian population and the public good. Maybe involving these public institutions in the Living Lab process could be a way to start to make this point.

CONCLUSIONS

This paper describes and reflects on the initial stages of design and implementation of the AgriLink project's Living Labs. It is too early for in-depth analysis of outcomes but is intended to illustrate the thinking that is underpinning our process and some of the challenges that are emerging. For instance we cannot yet comment on the efficiency, effectiveness and efficacy of AgriLink's living lab approach but we do expect to able to do so in time.

So far, our experience shows that setting up a living lab is quite an intensive and costly process to undertake but seems likely to have a range of benefits to different stakeholders. The extent to which we will be able to compare and contrast these Living Labs, which are in diverse contexts with different emphases, also remains to be seen. Our first experiences suggest that the Living Labs concept seems to be more appropriate and relevant to apply in complex sustainability challenges, then in straight forward development support. However, the process of working across as well as within the Living Labs is already providing valuable opportunities for learning. The approach of using the ideas of design thinking in the context of systems thinking and reflexive monitoring is also providing a supportive structure and framing for the Living Lab inquiries for those involved.

The ENoLL characteristics have provided a useful starting point though we expect there to be some variations across the Living Labs regarding which are found most useful and appropriate. We anticipate that further or revised characteristics of these Living Labs are likely to emerge. Key issues that have arisen so far include how which stakeholders get involved in what, how to value and build on the Living Labs similarities and differences and how a focus on public or private goods influences the Living Lab process. We already have many questions that we are investigating, for example When is the innovation of advisory services the appropriate intervention and when is a living lab a good setting to do so? What kind of participation is required in what situation? But also when do other interventions more effective in improving the advisory system. As the project progresses we hope to be able to address these and many other questions in order to help improve a range of AKIS situations in our Living Lab countries.

We thank all the Agrilink colleagues especially Hanne Leirs of Innovatiesteunpunt and the six Living Lab teams for their dedication to running the Living Lab and sharing experiences in the Living Labs.

REFERENCES

AgriLink conceptual framework. https://www6.inra.fr/agrilink/Media/Fichier/AgriLink.Conceptual-framework-full-version-report4

Barbier M. and Elzen B. (eds), 2012. *System Innovations, Knowledge Regimes, and Design Practices towards Transitions for Sustainable Agriculture*. Inra [online]

Bootcamp Bootleg D.School. 2010. Available at http://dschool-old.stanford.edu/wpcontent/

uploads/2013/10/METHODCARDS-v3-slim.pdf Hassno Platner & Institute of Design at Stanford University.

Brouwer, J.H., W. Hiemstra, S.M. van Vugt and H. Walters. 2013. "Analysing stakeholder power dynamics in multi-stakeholder processes : insights of practice from Africa and Asia." *Knowledge Management for Development Journal* 9 (2013)3. - ISSN 1871-6342 - p. 11 - 31.

ENoLL webiste, 2018. 25 october 2018, https://enoll.org/about-us/

EU SCAR, 2015. Agricultural Knowledge and Innovation Systems Towards the Future – a Foresight Paper, Brussels.

Klerkx, L., K. de Grip, and C. Leeuwis. 2006. "Hands Off But Strings Attached: The Contradictions of Policy Induced Demand-Driven Agricultural Extension." *Agriculture and Human Values* 23 (2): 189-204.

Klerkx, L., and J. Jansen. 2010. "Building Knowledge Systems for Sustainable Agriculture: Supporting Private advisors to Adequately Address Sustainable Farm Management in Regular Service Contacts." *International Journal of Agricultural Sustainability* 8 (3): 148-163.

Klerkxs, L. P. Seuneke, P. de Wolf, and W.A. Rossing. 2017. "Replication and Transition of co-innovationL The Influence of Institutional Context in Large International Participatory Research Projects." *Land Use Policy* 61: 276-292.

Koutsouris, A., 2008. " Innovating towards sustainable agriculture: a Greek case study", *The Journal of Agricultural Education and Extension* 14, 203-215.

Labarthe, P. 2009. " Extension services and multifunctional agriculture. Lessons learnt from the French and Dutch contexts and approaches. *Journal of Environmental Management* 90 (supp 2) 193-202.

Lane, A. 2017. AgriLink Theory Primer 26. Systems and Complexity. https://www6.inra.fr/agrilink/Media/Fichier/AgriLink-conceptual-framework.-Theory-Primers.26

Leeuwis, C., and A. van der Ban., 2004. Communication for Rural Innocvation: Rethinking Agricultural Extension, Blackwell Science, Oxford.

Nettle, R. and M. Paine. 2009. " Water security and farming systems: implications for advisory practices and policy-makig", *The Journal of Agricultural Education and Extension* 15, 147-160.

PROAKIS, 2014. Country reports – Inventory of the AKIS and advisory services in the EU 27 http://www.proakis.eu/publicationsandevents/pubs.

Rivera, W.M., and J. Cary. 1997. "Privitaising agricultural extensions. In Agricultural extension: A reference manual. Rome: Food and Agricultural Organization.

AFFILIATION

Jorieke POTTERS,

is researcher on Innovation and knowledge. She specializes in facilitation and monitoring of innovation processes towards sustainable agriculture. She is currently involved as monitor, researcher and trainer in several innovation projects.

Institutional contact: Wageningen University & Research, field crops jorieke.potters@wur.nl Recent publication:

https://www.sciencedirect.com/science/article/pii/S1573521418300332#!

Chris BLACKMORE,

In both teaching and research I focus on learning systems, environmental decision making, environmental ethics and responsibility, sustainable development, managing systemic change and communities of practice Institutional contact: Open University chris.blackmore@open.ac.uk

Herman SCHOORLEMMER,

Is a senior researcher and research manager. Over 20 years of experience in national and international projects about entrepreneurship, farm economics, co-innovation and knowledge and innovation systems.

Institutional contact: Wageningen University & Research, field crops Herman.schoorlemmer@wur.nl

PS5: MULTI-STAKEHOLDER APPROACHES AND INNOVATION SUPPORT FOR SUSTAINABLE AGRICULTURE

Navigating through the Spiral of Innovations: Lessons from bottom-up innovative initiatives in rural Greece

Alex Koutsouris and Eleni Zarokosta

Innovation support services: an evidence-based exploration of their strategic roles in the Italian AKIS

Patrizia Proietti and Simona Cristiano

Knowledge production in agricultural demonstrations: matching the perspectives of stakeholders

Anda Adamsone-Fiskovica and Mikelis Grivins

SUPPORTING BOTTOM-UP INNOVATIVE INITIATIVES THROUGHOUT THE SPIRAL OF INNOVATIONS: LESSONS FROM RURAL GREECE

ALEX KOUTSOURIS & ELENI ZAROKOSTA

Abstract. This paper, following the Agricultural Innovation Systems (AIS) problematique/rationale, aims at presenting and discussing interactive innovation cases in-the-making, located in Karditsa Prefecture, Central Greece, with emphasis on the support needed by local groups in the process of putting together and implementing innovative ideas and the 'intermediation' role(s) of actors aiming at providing farmers with the necessary support. It is worth noting that the cases examined initiated their endeavours amidst the lack of (organised) extension mechanism and the country's economic crisis. Additionally, besides the technical-knowledge component of the innovations pursued they have a strong social-organisational component as they attempt to introduce new collaborative schemes (New Generation Cooperatives) in Greece. The analysis of the innovative cases is based on the experience gained through the AgriSpin H2020 project (www.agrispin.eu) and the project's cross-visit to Greece; The Spiral of Innovations is the main tool for the analysis of the collective, bottom-up innovations in-the-making examined, allowing for the identification of innovation phases as well asof the involvement of a wide variety of actors (including farmers, researchers/academia, innovation support services, etc.) and the type of support provided by each actor in each phase. The decisive support of the local Development Agency and its Collaborative Incubator playing the role of 'intermediary - innovation broker' is shown.

KEY-WORDS: BOTTOM-UP INNOVATIONS; INTERMEDIARIES; SPIRAL OF INNOVATIONS; INCUBATOR; GREECE

INTRODUCTION

Since the beginning of the 2010s, strong concerns about the bottlenecks pertaining the generation, dissemination and use of innovation in agriculture have been loudly voiced (see, EU SCAR 2012, 2014; World Bank 2012). In particular, such criticisms point to the weak link between research and practice and their cross-fertilization.

Therefore, through the latest reforms of the European Common Agricultural Policy (CAP 2014-2020), two instruments were designed and gradually implemented aiming at tackling such a complex issue: the European Innovation Partnership 'agricultural productivity and sustainability' (EIP AGRI) and, the multi-actor approach that has become a key component of Horizon 2020 projects. In parallel, the Strategic Working Group 'Agricultural Knowledge and Innovation Systems' (SWG AKIS) - a substructure to the Standing Committee on Agricultural Research, has been established.

Within such a context, the European Union Horizon 2020 project 'AgriSpin'[14] , breaking from the diffusion of innovations tradition (Rogers 1983), aimed at exploring ways of creating space in which interactions may lead to innovation as a co-creative process. Therefore, the in-depth exploration of a series of innovations at farm level, with special focus on what support service providers actually do to stimulate such innovations, was undertaken (Wielinga et al. 2017).

Following, innovation support in Greece, as explored within the AgriSpin project is discussed. It is imperative to note at this point the weak and fragmented nature of the Greek Agricultural Knowledge and Innovation

[14] Space for Innovations in Agriculture (http://agrispin.eu/); March 2015 to August 2017.

System, mainly owing to the demise of the country's public extension service in the early 1990's (see: Alexopoulos et al. 2009; Koutsouris 2014a, 2014b; Österle et al. 2016).

THEORETICAL BACKGROUND

Many scholars have been occupied with the identification of innovation generations, i.e. with the description of the phases of the process from idea to commercialized product. The most well-known among them is Rothwell's (1994) who distinguishes five generations:

- first generation – technology-push models (1950s – first half of 1960s);
- second generation – market-pull models (second half of 1960s – early 1970s);
- third generation – coupling model (early 1970s – early 1980s);
- fourth generation – integrated innovation process models (early 1980s – early 1980s);
- fifth generation models – integrated, interconnected, parallel and flexible innovation process models (since early 1990s).

Rothwell's analysis is considered almost universal given although, based on Chesbrough (2003), a sixth model, that of open innovation may be added to the list.

In line with such an argumentation, nowadays, in agriculture and rural development, the linear paradigm of innovation dissemination (Rogers 1983) is gradually abandoned (at least in theory) on behalf of Agricultural Innovation Systems (AIS) thinking embracing all the actors, and their interactions, involved in innovation generation, adoption, diffusion and use. Furthermore, AIS thinking claims that the process of innovation is messy and complex with new ideas being developed and implemented by actors who engage in networks and make adjustments in order to achieve desired outcomes (see: EU-SCAR 2012; Faure et al. 2011; Klerkx and Leeuwis 2008; Klerkx et al. 2010, 2012; World Bank 2012; Koutsouris 2018).

Therefore, AIS thinking focuses on processes relevant to innovation networks as formed by heterogeneous actors with particular attention being given to their co-ordination. Thus, growing attention is given to various types of 'intermediaries' aiming at overcoming network and institutional failures owing to cognitive, information, managerial or system gaps (Klerkx and Leeuwis 2009; Klerkx et al. 2012). Such 'intermediaries' are involved, taking an independent systemic role, in process facilitation rather than in the production or dissemination of innovation (Van Lente et al. 2003; Haga 2005).

In our times, along with the emergence of pluralistic extension/advisory services (Birner et al. 2009) and AIS thinking, new innovation support service (ISS) approaches also emerge (Cristóvão et al. 2012). Based on the understanding of the crucial role of networks for the generation of innovations such approaches aim at engaging of a wide range of stakeholders in networks and their facilitation to (co-)generate innovations (Klerkx et al. 2010, 2012; Cristóvão et al. 2012; Moschitz et al. 2015). A major role of these 'new-wave' services is that of the co-learning facilitator (usually found in literature under the umbrella-term 'intermediaries' or more specifically as 'facilitators' or 'brokers'[15]) assisting network partners to solve problems and develop innovations.

And while facilitation is rather familiar to support (extension) services in agriculture and rural development (Cristóvão et al. 2012; Koutsouris 2018), brokerage is new, particularly innovation brokerage. Brokers, in general, work to bridge the gaps between groups of people or organizations; especially an 'innovation broker' is defined as « an organization acting as a member of a network … that is focused neither on the organization nor the implementation of innovations, but on enabling other organizations to innovate » (Winch and Courtney 2007: 751) or « a type of boundary organization that specializes in brokering or facilitating innovation processes involving several other parties, but does not itself engage in the innovation process » (Devaux et al. 2010: 10).

[15] The plurality of definitions used, in a rather loose way, shows that field is still theoretically fragmented and not well grounded (Cristovao et al. 2012)

Therefore, nowadays, 'new-wave' ISS[16] emerge to make innovation happen by fostering interactions and the co-construction of knowledge. The literature on support services in agriculture (and innovation) shows that classifications of ISS are possible based upon either the content of the services provided or their functions. As far as content is concerned, seven classes of support services may be identified: technical; legal; financial/insurance; marketing; environmental; organizational; and social (Faure et al. 2012; Mathe et al. 2016).

With regard to ISS functions, Kilelu et al. (2013) identify six functions of ISS: 1) demand articulation (vision building, diagnosis, foresight), 2) institutional support (institutional change and boundary spanning), 3) knowledge brokering (connecting to knowledge and technology) 4) network brokering (match-making of partners), 5) capacity building (training, coaching, organizational development) and 6) innovation process management (aligning agendas and learning). From another perspective, Heemskerk et al. (2011) identify and discuss a slightly different set of functions: facilitation (stimulating and assisting the process between stakeholders with the objective of improving the quality of interaction), strategic networking (facilitation of network design and support), mediation (conflicts management between stakeholders), technical backstopping (providing advice on economic, social or technical issues), advocacy (informing policy makers and key actors for supporting policy change), capacity building (equipping stakeholders to play their roles) and documenting learning (stimulating reflection on the innovation process.

With reference to AgriSpin, based on the project's initial categorization of ISS functions (Mathe et al. 2016), Faure et al. (2017, 2018) propose the categorization of ISS functions as follows (Table 1).

ISS functions	**Brief definition of function**
Awareness and exchange of knowledge (access to knowledge)	All activities contributing to knowledge awareness, dissemination of scientific knowledge, or technical information for farmers. For instance, providing knowledge based on information dissemination forums (website, leaflets), meetings or demonstrations and exchange visits.
Advisory, consultancy and backstopping	Advisory, consultancy and backstopping depict targeted supportive activities aimed at solving complex problems regarding for instance, a new farming system or new value chain design. The provision of advice (technical, legal, economic, environmental, social etc.) during the innovation process based on demands of actors and the co-construction of solutions, all fall in this category.
Demand articulation	This specially involves services targeted to help actors to express clear demands to other actors (research, service providers, etc.). This is targeted support to the innovator towards enhancing his /her ability to express the needs to other relevant actors.
Networks, facilitation and brokerage	Provision of services to help organize or strengthen networks; improve the relationships between actors and to align services in order to be able to complement each other (the right service at the right time and place). It also includes all activities aimed at strengthening collaborative and collective action.
Capacity building	Provision of services aimed at increasing innovation actors' capacities at the individual, collective and/or organizational level. The services may comprise the provision of classical training and of experiential learning processes.
Enhancing / supporting access to resources	Provision of services for innovators aimed at enhancing the acquisition of needed resources to support the process. This could be facilitating access to inputs (seeds, fertilizers etc.), facilities and equipment (technological platforms, labs etc.) and funding (credit, subsidies, grants, etc.).
Institutional support for niche innovation and scaling mechanisms stimulation	Provision of institutional support for niche innovation (incubators, experimental infrastructures, etc.) and for out scaling and up scaling of the innovation process. This refers to support for the design and enforcement of norms, rules, funding mechanisms, taxes, subsidies, etc. that facilitate the innovation process or the diffusion of innovation.

Table 1: Innovation support service (ISS) functions

[16] ISS are found under different labels in the literature such as advisory services, extension organization, bridging organizations, intermediary organizations, etc. They may belong to the public, the private or the third sector as well as to Farmer Based Organizations (Knierim et al. 2017).

Nevertheless, as shown by the authors, the frontiers between the abovementioned functions are not always clear cut. Additionally, support needs may vary depending on the stages of the innovation (Geels 2002; Leeuwis and van den Ban 2004; Faure et al. 2014, 2017). Thus, according to Kilelu et al. (2013), the articulation of services and their alignment with farmers' demands remain challenging.

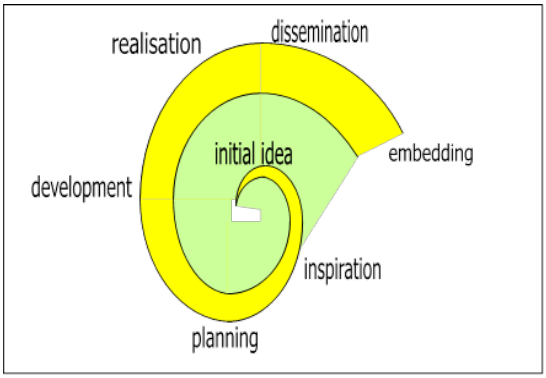
Based on AgriSpin data, Faure et al. (2017, 2018), in their effort to explore the differentiation of ISS have proposed a typology of innovation cases based on two criteria: the level of technological change (hardware) and the level of coordination among stakeholders (orgware). They thus constructed four types of innovations: high level of technological change and low level of coordination (A); low level of technological change and high level of coordination (B); high level of technological change and high level of coordination C); and, low level of technological change and low level of coordination (D). Accordingly, the ISS needed for each of these types of innovations are foreseen as follows: for A, ISS may be focused on technology transfer, advisory, consultancy and capacity building; for B, ISS may emphasize demand articulation, networking, capacity building; for C, a large range of ISS is needed; and for D, ISS will largely relate to traditional individual advisory services and consultancy at farm level (or other firm) level.

Through the examination of 43 innovative (AgriSpin) case studies the same authors conclude that: a) although all ISS seem to appear across the different phases of the innovation process[17], in the first phases (initial idea, inspiration and planning) ISS focus on exchanges, new knowledge and funding while in the final phases (dissemination and embedding) on knowledge transfer and advisory services; b) more, than in any other phase, services are provided in the development phase, reflecting the intense activities and increased needs for support during this phase; c) the 'networking, facilitation and brokerage' ISS, given the focus and interest of AgriSpin in 'multi-actor approaches', predominate and are allocated fairly evenly over each phase of the Spiral of Innovations; d) the 'awareness and exchange of knowledge' ISS are frequent in almost all phases, reflecting actors' general needs to access, produce or exchange knowledge whatever the phase; e) the 'enhancing/ supporting access to resources' (especially financial) ISS are key from the actors' perspective at the planning and development phase; and f) the 'institutional support for niche innovation and scaling mechanisms stimulation' ISS are key at the development phase.

METHODOLOGY

In AgriSpin a total of 13 Cross Visits were carried out. A cross-visit typically lasted 3 – 5 days and involved a mixed team of between 7 and 10 project partner members drawn from both science and practice. The aim of each Cross Visit was to study ISS in 3 to 5 concrete innovation cases.

The study of each case involved in-depth discussions with farmers and other key actors, in an effort to understand the processes that have taken place (see: Wielinga 2016; Wielinga et al. 2017). The information collected was systematically ordered on the Innovation Spiral (Wielinga et al. 2008). The Spiral comprises seven phases (Fig. 1) and allows for feedback mechanisms in case the process in any one stage gets stuck. Thus the Spiral made possible the analysis of the innovation processes in a flexible, non-linear fashion.



- *Initial idea phase: At this phase, actors get a new idea because of a problem or an opportunity.*
- *Inspiration phase: At this phase, others become inspired and form an informal network around the initiative.*
- *Planning phase: At this phase, initiators formulate plan for action, they negotiate space for experiments.*
- *Development phase: This is the phase of experimentation to develop new practices and to collect evidences.*
- *Realization phase: The innovation here goes into implementation at full scale.*
- *Dissemination phase. This is the phase where effective new practices are being picked up by others.*
- *Embedding phase. As the last phase in the process, the new practice becomes widely accepted. What matter is new rules, laws, subsidies, taxes, etc. to mainstream the innovation.*

Figure 1: The Spiral of Innovations (Ndah et al. 2018)

Following, the resulting 'pearls', 'puzzles' and 'proposals' of the cases were extracted and discussed with local stakeholders and the hosting team. Finally, hosts elaborated their own cases into 'Learning Histories'

[17] For the phases of innovation, see below: the Spiral of Innovations (Methodology section).

(see: Kleiner and Roth, 1997), i.e. each case's narrative, including all facts that mattered according to the actors involved and their observers, which the AgriSpin scientific partners analyzed further (Wielinga et al. 2017). In the next section (brief versions of) the learning histories of the Greek cases are presented and discussed.

The Greek cross visit took place in the Prefecture of Karditsa, Thessaly, in April 2016 and examined four innovation cases. Interviews were mainly carried out with two representatives of each initiative as well as the Development Agency of Karditsa (AN.KA.) staff involved in each initiative. The cases examined were as follows:

1. Efkarpon-Hellenic Super foods is a new generation cooperative (NGC) involved in the cultivation, processing and marketing of four innovative (for Greece) agricultural products (gojiberry, black chockberry, blueberry and sea buckthorn) following organic farming standards.
2. ASYST-The Agricultural Stevia Cooperative is a new generation cooperative (NGC) engaged in the cultivation, processing and trade of stevia products (Stevia sp.).
3. Psychanthos is a new generation cooperative (NGC) cultivating (following integrated farming standards), processing and trading products, byproducts and derivatives of commercial and traditional pulse varieties.
4. ESEK-The Energy Cooperative of Karditsa is an energy cooperative utilising locally produced biomass - as a by-product of agriculture and forestry.

RESULTS

Following, the histories of the 3 case studies (i.e. the ones closely relating to farming) explored during the AgriSpin cross visit in Greece (Karditsa) are briefly presented. It is important to take notice of the fact that all the initiatives emerged under adverse financial circumstances due to the economic crisis in Greece.

Efkarpon NGC

Efkarpon was an idea conceived by two friends, a young agronomist and a young farmer, according to which an innovative initiative in agriculture should focus on special produces that, after processing, can be turned into functional foods. Starting their initial planning in 2009 the two friends soon realized that for the success an idea/ investment they should operate on the basis of entrepreneurship and some collective scheme. They therefore focused on a group of fruits of similar characteristics able to support the same marketing strategy as well as to go on with a new type of cooperative engaged in production, processing and marketing and based on entrepreneurship (New Generation Cooperative – NGC), thus to avoid all problems related with the old type of cooperatives which have largely failed in Greece (Iliopoulos, 2005)

In 2011 the two friends contacted the Development Agency of Karditsa (AN.KA. S.A.) to help them in attracting farmers to their idea. Following, a series of seminars was organized by AN.KA. and next year (2012) the cooperative "Efkarpon-Hellenic Super foods" was established, capitalizing the dynamic of super-foods and becoming the first agricultural NGC, at least in the Thessaly Region. Efkarpon was the first new generation agricultural cooperative hosted by AN.KA. in the frame of its Collaboration Incubator (see below). Furthermore, Efkarpon members participated in a series of training workshops (so-called 'winter school' launched by ANKA in 2015), dedicated to collaboration, cooperative values and decision-making processes.

Moreover, the Coop put together a business plan concerning their processing unit which they submitted to AN.KA. (playing the role of the LEADER Local Action Group). The proposal was successful and Efkarpon got funding equal to one-third of the actual costs of its processing unit; the rest was covered by self-financing. Furthermore, the Cooperative Bank of Karditsa (generated through an initiative of AN.KA. to support local entrepreneurship, thus nowadays including the Collaboration Incubator initiative) played a significant role through the provision of financing guarantees. The unit was completed in 2015, thus in 2016 the coop was ready to launch new products in the market.

In spring 2016, the Cooperative comprised 115 members. All of them are growers but come from different professional backgrounds (free lancers, entrepreneurs, public servants, professional farmers, etc.). Some of them are well-educated professionals, such as agronomists and economists and the cooperative makes use of their knowledge and experience in cultivation (especially for gojiberry, due to the dearth of information regarding its cultivation, particularly in Greece) and management and marketing issues, respectively.

ASYST NGC

ASYST is established by professional farmers some of whom had been looking for alternatives to the traditional cultivations (tobacco, cotton, sugar beet) in order to replace them with innovative and more profitable ones. Among them, the Head of the local community of Fanari (nowadays president of ASYST) heard about stevia and asked around (in his close social environment) about it. Himself and three other key-persons (the Director of AN.KA.; the mayor of area municipality; and an agronomist, former manager of the Karditsa Tobacco Research Centre, who had carried out experiments and collaborated with stevia growers in a neighboring Prefecture in 2006) asked an informal group comprising people originating from the area but living elsewhere (mainly in Athens), active in organizing similar events – i.e. calling experts to provide information on topics of interest to local farmers, to organize a seminar on stevia. The event took place in November 2012. During the seminar, the invited (by AN.KA.) speakers from the University of Thessaly and the Technological Education Institute (TEI) of Thessaly confirmed the positive dynamics of stevia and its products (steviol glucosides). Ten farmers, encouraged by the four initiators of the meeting, immediately responded positively and arranged for a new meeting, in which concrete actions were planned. Then they started by informing their colleagues (personal contacts) and within a short time (December 2012) ASYST was founded by 21 farmers. ASYST was hosted by (the Collaboration Incubator of) AN.KA.; later on, ASYST members also participated in the 'winter school' organized by AN.KA. Following, stevia has been cultivated in pilot farms by 17 members (with technical support provided by the Tobacco Research Centre expert); these farmers shared the knowledge they acquired through these experimental cultivations with the rest of the coop's membership.

Right from the beginning ASYST farmers have aimed beyond primary production, i.e. at the establishment of a processing unit. Their endeavour was self–financed by 50% while the other 50% was financed through the Business Plan submitted in the local CLLD/LEADER programme (2014). Further financial guarantees were provided by the Cooperative Bank of Karditsa. The construction of the processing unit started in March 2015; it was completed in December 2015 and was expected to start producing the first high quality steviol glycosides by the end of summer 2016.

At technical level, the experimental method of the TEI of Thessaly for the production of high purity steviol glycosides without using organic solvents was offered free of charge to ASYST; TEI also supervised the adaptation of the machinery to the scale of the ASYST's processing unit. However, in the transition from the experimental to the industrial scale, besides technical problems tackled by TEI and farmers, 'bureaucratic' obstacles - derived from the absence of appropriate legislative and regulatory framework at both European and national level - had to be overcome as well, mainly through AN.KA.'s lobbying.

Psychanthos NGC

The idea of Psychanthos was put forward in March 2013, when AN.KA., after informal discussions with farmers who had followed a seminar organized by NAGREF (National Agricultural Research Foundation), espousing that both the European and the Greek markets of pulses are deficient while, on the other hand, in Greece consumers' demand for packed pulses of high quality and Greek origin is growing, took the initiative to organize a meeting for those interested in pulses cultivation. Some farmers responded and discussions, including NAGREF's recommendation that farmers' successful entrance in the markets requires entrepreneurial orientation and collective action, were repeated in September 2013 to finally end up with the establishment of the Cooperative in November 2014. The members of Psychanthos are professional farmers who chose to form a NGC focusing on the entirety of the value chain with special emphasis on the active participation of its membership in decision-making; the latter implies that the coop's members bind themselves in processes leading to consensus. The Development Agency further supported the NGC by hosting them (Collaboration Incubator). In addition, Psychanthos members participated in the 'winter school' (training workshops) run by AN.KA.

The coop harvested its first production in the summer 2015. At that point (summer 2015) they also intended to buy a warehouse but the implementation of their plan was delayed due to the imposition of capital controls in the country. In spring 2016, the coop standardized and stored its products in a rented unit, while it was on a search for a second warehouse. Meanwhile, they intended to put together an investment proposal in the new local CLLD/LEADER Programme (RDP 2014-2020).

Psychanthos is engaged in Integrated Crop Management; their main challenge in terms of production relates to the adaptation of the varieties to the microclimatic conditions of their fields. They have thus developed pilot

cultivations and have permanent collaboration with an agronomist, while NARGEF and the Plant Protection Department of the Technological Educational Institute (TEI) of Thessaly provide them with advice as well.

DISCUSSION

According to Faure et al.'s (2017) classification of innovations, the Greek cases, in general, fall under the type "high level of technological change and high level of coordination" - with the possible exception of Psychanthos (concerning a retro-innovation, i.e. the re-introduction of pulses in the cropping system, albeit now following integrated management). In this respect, the expectation that such innovations will 'attract' all the ISS functions is confirmed (see Table 2).

In the cases examined here, support services were provided by the Development Agency of Karditsa (AN.KA.)[18]. The Agency has, to various degrees, helped the aforementioned innovative initiatives to establish themselves as NGCs and proceed with their plans[19]. The overall services provided to the NGCs by AN.KA. are shown in Table 2.

innovation phases	ASYST	EFKARPON	PSYCHANTHOS
Initial idea	[farmers' initiative]	[two friends' initiative]	[farmers' initiative]
Inspiration	networking facilitation (incubator service h)	networking facilitation (info events to attract farmers; incubator service c)	networking facilitation (info events to attract farmers; incubator service c)
Planning	incubator service f		incubator service f
Development - Realisation	incubator services (a, b, d, e)	incubator services (a, b, d, e)	incubator services (a, b, d, e)
	capacity building (incubator service g)	capacity building (incubator services g)	capacity building (incubator service g)
	access to resources (incubator service i)	access to resources (incubator service i)	
	advocacy		

Table 2: Innovation Support Services provided by AN.KA.

Memo: a) hosting initiatives in the Agency's premises; b) assistance with cooperatives' establishment (legal schemes, procedures, etc.); c) awareness building among potential partners; d) technical support (secretariat services, internet page, information dissemination, etc.); e) coordination of the coop members' meetings; f) ideation/motivation with regard to business plans and their implementation; g) coop members' training (winter school); h) linking with centers of innovation; i) information on funding opportunities and relevant procedures.

The Agency (AN.KA.) supported innovative initiatives through its Collaborative Incubator. Through its incubator, the Agency undertook roles which correspond to those of ISS or intermediaries (innovation facilitators/brokers) (re: Faure et al. 2017) as follows: a) they largely facilitated the recruitment of the NGCs membership (re: network facilitation); b) they facilitated the linkages of NGCs with universities and research centers (re: network facilitation and access to knowledge); c) they hosted and provided support to the NGCs in their first steps (re: awareness; backstopping); d) they lobbied on behalf the NGCs in the MRDF and state bureaucracy (re: institutional support); e) they organized the training of the NGCs membership (re: capacity building) and f) they provided NGCs with information concerning access to resources (and thereafter, following the legal procedures provided the foreseen financial support, in accordance to its role as a LAG). Therefore, the

[18] For AN.KA., see: Koutsouris (1999 and 2000).

[19] At the same time - that is, in April 2016 - more initiatives were emerging in the area, again with varying degrees of support by the Agency; see Kogia (2017)

Agency amidst an organizational void (i.e. demise of extension and cooperatives in Greece resulting in a weak and fragmented AKIS) undertook the role of an ISS in order to support local initiatives with a view to building an 'innovation ecosystem' aiming at sustainable local development. Given that 'first ideas' mainly came from farmers, the Agency's role proved crucial, especially in the 'inspiration' to 'planning' to 'development' phases of the Innovation Spiral, a fact also pointing to the required diversification of services/functions in creating space for/ supporting innovation.

CONCLUSION

Nowadays, networking, knowledge co-creation and collaboration between different partners in AIS are becoming a focal point of the EU policy as means to stimulate innovation (EU-SCAR, 2012; 2014). In this respect, in order to avoid or overcome gaps, intermediaries work to facilitate the composition and functioning of networks; intermediaries are actors (organizations or individuals) who aim at the proper organization of the partnerships/networks as well as of the learning environments and the learning processes which will lead to innovation.

In Greece, despite the overall weak and fragmented AKIS, there are examples of actors, such as AN.KA. in the cases examined here, undertaking the role of intermediary (innovation facilitator/broker), even though this is done upon their own initiative and without (official) support or recognition. Nevertheless, such a role is (slowly) recognized; for example, there is a move to create a network of Development Agencies-as-brokers which will utilize the experience of the Collaborative Incubator of AN.KA. Such a move will certainly benefit the successful implementation of EIP-AGRI Measure (i.e. the establishment and functioning of Operational Groups) in Greece. However, as suggested by Österle et al. (2016), in Greece, it is all important to urgently address the need for a clear, integrated and stable policy mix to address the lack of ISS and bridge the gap through the setting up of networks to support learning and networking among diverse providers taking an AIS approach. Finally, the Spiral of Innovations proves to be a useful tool in exploring bottom-up innovation and the provision of relevant ISS.

REFERENCES

Alexopoulos, G., Koutsouris, A. and Tzouramani, E. 2009. The financing of extension services: A survey among rural youth in Greece. The Journal of Agricultural Education and Extension 15: 175-188.

Birner, R., Davis, K., Pender, J., Nkonya, E., Anandajayasekeram, P., Ekboir, J., Mbabu, A., Spielman, D.J. Horna, D., Benin, S. and Cohen, M. 2009. From Best Practice to Best Fit: A Framework for Designing and Analyzing Pluralistic Agricultural Advisory Services Worldwide. The Journal of Agricultural Education and Extension 15: 341-355.

Chesbrough, H.W. 2003. Open innovation: the New Imperative for Creating and Profiting from Technology. Boston: Harvard Business School Press.

Cristóvão, A., Koutsouris, A. and Kügler, M. 2012. Extension Systems and Change Facilitation for Agricultural and Rural Development. In: Darnhofer, I., Gibbon, D. and Dedieu, B., Editors, 2012. Farming Systems Research into the 21st Century: The New Dynamic. Springer Science, Dordrecht.

Devaux, A., Andrade-Piedra, J., Horton, D., Ordinola, M., Thiele, G., Thomann, A. and Velasco, C. 2010. Brokering Innovation for Sustainable Development: The Papa Andina Case (ILAC Working Paper 12). Institutional Learning and Change (ILAC) Initiative, Rome.

EU SCAR 2012. Agricultural Knowledge and Innovation Systems in Transition – a reflection paper. European Commission, Brussels.

EU SCAR 2014. Agricultural knowledge and innovation systems towards 2020 – an orientation paper on linking innovation and research. European Commission, Brussels.

Faure, G., Rebuffel, R. and Violas, D. 2011. Systemic Evaluation of Advisory Services to Family Farms in West Africa. The Journal of Agricultural Education and Extension 17: 325-339.

Faure F., Desjeux, Y. and Gasselin, P. 2012. New Challenges in Agricultural Advisory Services from a Research Perspective: A Literature Review, Synthesis and Research Agenda. The Journal of Agricultural Education and Extension 18: 461-492.

Faure G., Gasselin, P., Triomphe, B., Temple, L. and Hocdé, H. 2014. Innovating with rural stakeholders in the developing world: action research in partnership. CTA, Wageningen.

Faure, G., Knierim, A. Koutsouris, A., Ndah, T., Audouin, S., Zarokosta, E., Wielinga, E., Triomphe, B., Mathé, S., Temple, L. and Heanue, K. 2017. How to strengthen innovation support services in European rural areas: lessons learnt from AgriSpin.

In: Transformative learning: New directions in agricultural extension and education (23rd ESEE), http://www.esee2017.gr/uploads/attachments/82/Faure_et_al..pdf

Faure, G., Knierim, A., Koutsouris, A., Ndah, T., Audouin, S., Zarokosta, E., Wielinga, E., Triomphe, B., Mathé, S., Temple, L., and Heanue, K. 2018. How support services can strengthen innovation in agriculture: between network facilitation and coordination. In: Les Nouveaux Modes D'Organization Des Processus D'Innovation (Congress Reseau De Recherche Sur L' Innovation), IUT de Nimes – Universite de Montpellier, Nimes, June 4-5 2018

Geels F. 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Research policy 31: 1257-1274.

Haga, T. 2005. Action research and innovation in networks, dilemmas and challenges: two cases. Artificial Intelligence & Society 19: 362–383.

Heemskerk W., Klerkx, L. and Sitima, J. 2011. Brokering innovation. In: Nederlof, S., Wongtschowksi, M. and van der Lee, F., Editors, 2011. Putting heads together: Agricultural innovation platforms in practice, KIT Publishers, Amsterdam.

Iliopoulos, C. 2005. New generation cooperatives: The potential of an innovative institutional arrangement for Mediterranean food supply chains. New Medit 4: 14–20.

Kilelu C., Klerkx, L. and Leeuwis, C. 2013. How dynamics of learning are linked to innovation support services: insights from a smallholder commercialization project in Kenya. The Journal of Agricultural Education and Extension 20: 213-232.

Kleiner, A. and Roth, G. 1997. Learning History. How to make your experience your company's best teacher. Harvard Business Review (September-October): 172-177.

Klerkx, L. and Leeuwis, C. 2008. Balancing multiple interests: Embedding innovation intermediation in the agricultural knowledge infrastructure. Technovation 28: 364-378.

Klerkx, L. and Leeuwis, C. 2009. Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. Technological Forecasting and Social Change 76: 849-860.

Klerkx, L., Aarts, N. and Leeuwis, C. 2010. Adaptive management in agricultural innovation systems: The interactions between innovation networks and their environment. Agricultural Systems 103: 390-400.

Klerkx, L., Van Mierlo, B. and Leeuwis, C. 2012. Evolution of system approaches to agricultural innovations: concepts, analysis and interventions. In: Darnhofer, I., Gibbon, D. and Dedieu, B., Editors, 2012. Farming Systems Research into the 21st Century: The New Dynamic. Springer Science, Dordrecht.

Knierim A., Labarthe, P., Laurent, C., Prager, K., Kania, J., Madureira, L. and Ndah, T. 2017. Pluralism of agricultural advisory service providers – facts and insights. Journal of Rural Studies 55: 45-58.

Kogia, P. 2017. Networking and innovation processes: The case of Karditsa. MSc thesis, Dept. Agricultural Economics and Rural Development, Agricultural University of Athens.

Koutsouris, A. 1999. Networking for a Sustainable Future: The case of Development Agencies. In: Doppler, W. and Koutsouris, A., Editors, 1999. Rural and Farming Systems Analyses: Environmental Perspectives (Proceedings of the 3rd European Symposium on Rural and Farming Systems Research). Margraf Verlag, Weikersheim.

Koutsouris, A. 2000. Conventions as a means for the pursuit of knowledge. In: Cerf, M., Gibbon, D., Humbert, B., Ison, R., Jiggins, J., Paine, M., Proost, J. and Roling. N., Editors, 2000. Cow up a Tree: Learning and Knowing Processes for Change in Agriculture in Industrialised Countries. INRA Editions, Paris.

Koutsouris, A. 2014a. 'Failing' to implement FAS under diverse extension contexts: a comparative account of Greece and Cyprus. In: Farming systems facing global challenges: Capacities and strategies (11th European Farming Systems Symposium), http://ifsa.boku.ac.at/cms/fileadmin/Proceeding2014/WS_1_8_Koutsouris.pdf

Koutsouris, A. 2014b. AKIS and advisory services in Greece. Report for the AKIS inventory (WP3) of the PRO AKIS project, www.proakis.eu/publicationsandevents/pubs

Koutsouris, A. 2018. The role of Extension in Agricultural Technology Transfer: A critical review. In: Kalaitzandonakes, N., Carayannis, E., Grigoroudis, E. and Rozakis, S., Editors, 2018. From Agriscience to Agribusiness - Theories, Policies and Practices in Technology Transfer and Commercialization, Springer International, Cham (Switzerland).

Leeuwis, C. and Van den Ban, A. 2004. Communication for innovation: rethinking agricultural extension (3rd edition). Blackwell Publishing, Oxford.

Mathe, S., Faure, G., Knierim, A., Koutsouris, A., Ndah, T., Temple, L., Triomphe, B., Wielinga, E. and Zarokosta, E. 2016. Typology of innovation support services. Deliverable 1.4 of the AgriSpin project, http://agrispin.eu/wordpress/wp-content/uploads/2016/10/Report_Typology.pdf

Moschitz, H., Brunori, G., Roep, D. and Tisenkofs, T. (guest eds.) 2015. Learning and innovation networks for sustainable agriculture: Processes of co-evolution, joint reflection and facilitation. Journal of Agricultural Education & Extension, 21: 1-89.

Österle, N., Koutsouris, A., Livieratos, Y. and Kabourakis, E. 2016. Extension for organic agriculture: A comparative study between Baden-Württemberg, Germany and Crete, Greece, Journal of Agricultural Education and Extension 22: 345-362.

Rogers, E.M. 1983. Diffusion of Innovations. Free Press, N.Y.

Rothwell, R. 1994. Towards the Fifth-Generation Innovation Process. International Marketing Review 11: 7–31.

Van Lente, H., Hekkert, M., Smits, R. and Van Waveren, B. 2003. Roles of systemic intermediaries in transition processes. International Journal of Innovation Management 7: 1-33.

Wielinga, H.E., Zaalmink, B.W., Bergevoet, R.H.M., Geerling-Eiff, F.A., Holster, H., Hoogerwerf, L. and Vrolijk, M. 2008. Networks with free actors: encouraging sustainable innovations in animal husbandry by using the FAN approach. Wageningen University and Research, Wageningen.

Wielinga E. 2016. The cross visit method. Deliverable 2.4 of the AgriSpin project, http://agrispin.eu/wordpress/wp-content/uploads/2016/11/Cross-Visits_Improved-Methodology-1.pdf

Wielinga E., Koutsouris, A., Knierim, A. and Guichaoua, A. 2017. Generating space for innovations in agriculture: the AgriSpin project. Studies in Agricultural Economics 119: 26-33.

Winch, G. and Courtney, R. 2007. The organisation of innovation brokers: An international review. Technology Analysis and Strategic Management 19: 747-763.

World Bank 2012. Agricultural Innovation Systems: An investment source book. World Bank, Washington DC.

Remerciements

The AGRISPIN project has received funding from the European Union's HORIZON 2020 research and innovation programme under grant agreement No 652642. The opinions expressed in this paper are not necessarily those of the EU.

AFFILIATION

Alex KOUTSOURIS,

Dept of Agricultural Economics & Rural Development, Agricultural University of Athens (AUA)

Prof. Alex Koutsouris is the Head of the Unit of Agricultural Extension, Rural Systems & Rural Sociology, AUA. Specialist in agricultural extension (interactive innovation (and) communication) and agricultural education/training. Currently, Co-Editor, The Journal of Agricultural Education & Extension, invited expert in SWG SCAR AKIS4 and member of the PRIMA SAC. Participant in research and collaboration projects including the H2020 projects: FAIRSHARE; INNOSETA; AGRI-LINK; AGRIDEMO-F2F; AGRISPIN.

Koutsouris, A. (2018) The role of Extension in Agricultural Technology Transfer: A critical review. In: *From Agriscience to Agribusiness - Theories, Policies and Practices in Technology Transfer and Commercialization*. Eds.: N. Kalaitzandonakes, E. Carayannis, E. Grigoroudis, and S. Rozakis. Springer, 337-359.

Institutional contact: 75 Iera Odos, 11855 Athens, Greece; koutsouris@aua.gr.

Eleni ZAROKOSTA,

Dept of Agricultural Economics & Rural Development, Agricultural University of Athens

Ms Eleni Zarkosta (BSc in Animal Production and MSc in Integrated Rural Development, AUA) is PhD candidate in the Dept of Agricultural Economics & Rural Development, Agricultural University of Athens.

Zarokosta, E. and Koutsouris, A. (2018) The landscape of creation and facilitation of dairy sheep-farmers' discussion groups in stables in Karditsa, Greece. *International Journal of Agricultural Extension,* Special Issue: European Seminar on Extension (and) Education (ESEE): 99-110 http://escijournals.net/index.php/IJAE/article/view/2407

Institutional contact: 75 Iera Odos, 11855 Athens, Greece; eleniz72@yahoo.gr

INNOVATION SUPPORT SERVICES: AN EVIDENCE-BASED EXPLORATION OF THEIR STRATEGIC ROLES IN THE ITALIAN AKIS

SIMONA CRISTIANO AND PATRIZIA PROIETTI

Abstract
The turn of the European innovation policies towards interactive and multi-actor approaches has contributed to the development of new actors who are specifically committed in supporting innovation processes, particularly through the operational groups (OGs) funded under the RDPs.
This study explores the state of the art of the innovation support services (ISS) within co-operation projects for innovation, in Italy, through investigating: (1) the variety of actors who are providing innovation support services, both at local and system levels, (2) the functions that they are performing, (3) the 'effects' of changes in relation to the strategies and activities carried out by the different providers, the propensity of farmers for innovation, and (4) the development towards a more sustainable agriculture.
The study shows the existence of a variety of actors and organisations, that traditionally didn't play a role of advisory and mediation, which are developing new skills and competences to support multi-actor innovation processes.
These findings lay the foundations for reconsidering the role of the innovation support services within the AIS towards a more inclusive approach that recognizes different typologies of services providers and involves them since the definition of the strategic framework of the CAP.

KEY-WORDS: INNOVATION SUPPORT SERVICES, MULTI-ACTOR INNOVATION PROCESSES, AKIS, OPERATIONAL GROUPS

INTRODUCTION

Over the last years, the transition towards a more sustainable agro-food systems and the emphasis on systemic, multi-actor and transdisciplinary approaches to innovation has led to an increasing interest about actors able to facilitate and support innovation processes. They are known as innovation brokers (Howell, 2006; Klerkx and Leeuwis, 2009; Perèz et al., 2010; Herman et al.,2012; EU SCAR, 2012), free actors (Wielinga et al., 2008; Wielinga and Vrolijk, 2009), hybrid actors (Elzen et al., 2012), facilitators (Cristóvão et al., 2012; Koutsouris, 2014), boundary spanners (Tisenkopfs et al., 2015), innovation support services (ISS) (Mathé et al. 2016; Faure et al., 2017), etc.. The different labels point out to the diversity of strategies and functions played in carrying out their activities.

The diversity of service providers, goals, strategies of services provision and functions played, have been explored by the literature under different perspectives, which extend the scope of investigation from traditional agricultural extension and advisory services to services aimed at facilitating innovation processes and/or fostering system innovations (Elzen et al. 2004; Geels, 2005; Barbier and Elzen, 2012).

Studies take into account objectives and organisational models, nature of service delivered to farmers, clients (Birner et al., 2009; ADE, 2009; Labarthe et al., 2013; Faure et al., 2016; Knierim et al., 2017; Kivimaa et al., 2018), types of services providers, strategies to provide services and contents (Röling and Jong, 1998; Ozelame et al., 2002; Albert, 2000 ; Leeuwis and van den Ban, 2004 ; Borrás and Edquist, 2013), functions (Leeuwis, 2004; Smits and Kuhlmann, 2004; Howell, 2006; Klerkx and Leeuwis, 2009; Heemskerk

et al., 2011; Kilelu et al., 2013; Labarthe et al., 2013; Allebone-Webb et al., 2016; Mathé et al., 2016; Steyaert et al., 2017).

Mathé et al. (2016) carried out an extensive analysis of the existing literature, summing up the diversity of service providers in supporting innovation under the concept of Innovation Support Services (ISSN) that refers both to actors who provide services and services activities. All the previous thinking has been conceptualised under 7 support service functions that occur at various decision-making scales, e.g. from farm to territorial or value chain, and at different stages of the innovation process. These typologies were further adapted by Ndah et al., 2018: (1) knowledge awareness and exchange, (2) advisory, consultancy and backstopping aimed at solving complex problems, to be provided during the innovation process and based on demands of actors and the co-construction of solutions, (3) demand articulation, to allow actors to have access to new ideas, identify their needs, define their objectives and express clear demands to other actors, (4) networking facilitation and brokerage, to help organize or strengthen networks, improve the relationships between key actors and to align services in order to be able to complement each other, (5) capacity building, aimed at increasing innovation actors' capacities in order to play their roles in the innovation process, (6) enhancing/supporting access to resources by facilitating access to inputs, facilities and funding, (7) institutional support for niche innovation and scaling mechanisms stimulation (design and enforcement of norms, rules, funding mechanisms, taxes, and subsidies, etc., that facilitate the innovation process or the diffusion of innovation).

The concept of ISS broadens the focus from on farm-production level providers and services, towards innovation system ones, in line with an Agricultural Innovation System (AIS) approach (Klerkx et al., 2012). The last focuses on a wide range of actors and networks contributing to innovation processes beyond the traditional knowledge providers (research, extension and education). Roles and functions of actors are analysed as part of wider networks which are involved in social learning processes within given cognitive (paradigms, cognitive rules and regimes) (Hermans et al., 2013; Klerkx et al., 2010) and policy frames (Labarthe et al., 2018).

Among these actors, Kivimaa et al. (2018) have focused on intermediaries which are aimed at speeding up change towards more sustainable socio-tecnical systems. They are defined as '*actors and platforms that positively influence sustainability transition processes by linking actors and activities, and their related skills and resources, or by connecting transition visions and demands of networks of actors with existing regimes in order to create momentum for socio-technical system change, to create new collaborations within and across niche technologies, ideas and markets, and to disrupt dominant unsustainable socio-technical configurations*'.

Transition intermediaries (Steyaert et al., 2017) can be specifically created to boost transitions (Hodson and Marvin, 2009, 2010) or assume intermediary roles and activities during their existence, or emerge, as new actors, in the process of transition (e.g. in response to institutional change, to market restructuring and new modes of regulation, to fill institutional gaps, etc.) (Moss, 2009; Moore et al., 2012). In some cases, they can be also unaware of their intermediation (Moss, 2009). They are engaged in both supporting niche innovations from the ground (e.g., performing intermediation functions between innovative local projects and a more aggregate level, or between actors within local projects) and breaking into the prevailing socio-technical regime (e.g., performing intermediation functions between consumers and producers, or between multiple network partners within an overall system comprising both niche and regime actors (Van Lente et al., 2003; Hodson and Marvin, 2009). Kivima et al. (2018) conceptualised five typology of transition intermediaries: (1) systemic intermediaries operating on all levels (niche, regime, landscape), promoting an explicit transition agenda and taking the lead in aiming for change on the whole system level (Van Lente et al., 2003); (2) regime-based transition intermediaries that have a specific mandate to promote transition and, thus, interacts with a range of niches and with the whole system (Hodson et al., 2013); (3) niche intermediaries, that typically work to experiment and advance activities of a particular niche (through scale up niche), trying to influence the prevailing socio-technical system for that niche's benefit (Geels and Deuten, 2006); (4) process intermediaries, that facilitates a change process or a niche project (Elzen et al., 2012); (5) user intermediary translating new niche technologies to users and user preferences to developers and regime actors (Hyysalo et al., 2013, 2018).

This conceptual framework highlights, in an AIS perspective, a double switch involving both the actors performing ISSs and the functions that they perform (from knowledge transfer to intermediation). As well, the focus of ISSs are no longer the farmers, but a multitude of actors.

In Italy, the implementation of Measure 124 of Rural Development Programmes (RDPs) 2007-2013 – co-operation for innovation – and even more, the operational groups (OGs) funded under the RDPs 2014-2020, led different actors (farmers, producer's organizations, research and innovation centres, extension and advisory services and LAGs) to perform spontaneously a number of functions aimed at supporting innovation processes, through facilitating the networking and interaction among different actors and stimulating bottom-up approaches around innovative projects (Cristiano and Proietti, 2014).

This study explores the state of the art of the innovation support services (ISS) within co-operation projects for innovation, in Italy, through investigating:

- the variety of actors who are providing innovation support services, both at local and system levels,
- the functions that they are performing.

While analysing these features, we tried to go more in deep to observe what are or what can be the 'effects' of changes in relation to the strategies and activities carried out by the different providers, the propensity for innovation of the Italian farming community and the development towards a more sustainable agriculture.

METHODS AND DATA

The methodology applied for this study was based on desk research and field work.

Desk research relied on recent literature, as well as on co-operation projects databases (our databases include information on co-operation projects supported by the European Agricultural Fund for Rural Development – EAFRD), which provided qualitative and quantitative information on types of actors and functions of services providers in Italy (Caggiano, 2014; Caggiano and Labarthe, 2014; Cristiano and Proietti, 2014).

Field work was grounded on two surveys, interviews to ISSs and one focus group with policy makers who are responsible for the implementation of measure 124 of RDPs 2007-2013 and sub-measures 16.1 and 16.2 of the RDPs 2014-2020, both supporting multi-actor partnerships applying for co-operation projects of innovation.

For the purpose of this study, the qualitative methods applied at field work were chosen according to the different sources, as showed in the methodological scheme of figure 1.

This methodological scheme allowed investigating and analysing: i) the actual variety of actors who are providing innovation support services; ii) the types of functions performed and how these are positioned with respect to the wider classifications carried out by the literature; iii) the changes perceived by the various ISSs providers on their own work; iv) the extent to which these changes in ISSs stimulated the development towards more sustainable agriculture.

Survey among ISSs providers

This survey was aimed at investigating the current variety of actors who perform the different types of innovation support services, and related functions, within cooperation projects for innovation (letters (i) and (ii) of the methodological scheme), with particular focus on 'scaling up niches' and supporting their development and diffusion by sharing co-produced knowledge and helping the formation of new projects.

The survey was sent following a purposeful sampling approach, according to the availability of contacts, and it was addressed to possible providers who effectively provide services to farms on a regular basis. They were selected among the ones who: (1) had provided services under the Farm Advisory System (FAS) at RDPs level, (2) participated to the co-operation projects of measure 124 (RDPs 2007-2013), (3) act as FADN surveyors. The survey was designed predominantly on closed questions, as the advisors were asked to indicate which of the different types of functions they effectively provide to farmers and if these functions are played in the context of cooperation for innovation (OGs, measure 124, others) or research (H2020) projects. The questionnaire on line included a number of 6 questions and it was accessible by the advisors

for three days in October 2019. Total respondent to the survey amounted to 334. Out of them, 262 declared to be advisors and 218 stated to provide advisory services to farms on a regular basis.

The functions have been defined with reference to the type of services characterized by Ndah et al. (2018) and adapted based on the results of the analysis on brokering functions performed in Italy within the implementation of measure 124 of RDPs 2007-2013, carried out by Cristiano and Proietti (2014). The systematization of this types of functions is represented in table 2.

Survey among the partners of the OGs

The survey among the OGs' members was predominately oriented by a multiple perspective approach aimed at investigating who is performing innovation support function (table 1) within the co-innovation process, by capturing the different viewpoints and perceptions of OG partners concerning ISSs roles and functions.

The survey was carried out among all the current Italian partnerships of co-operation projects for innovation funded under RDPs 2014-2020.

Total respondent to the survey amounted to 95, belonging to 45 different OGs.

Research questions	The state of art of the ISSs in Italy			
	Variety of actors who are providing innovation support services		Changes and dynamics in place within ISSs	
	Functions performed by ISSs within co-operation projects for innovation			
Dimensions of investigations and Analysis' Criteria	Types of actors playing ISSs	Types of actors playing ISSs Types of functions applied for ISSs provision Relational assets of ISSs	Types of changes observed/perceived How has this affected the work of various ISS providers? Has this made it easier or more difficult and for whom? Has this stimulated the innovative activities of the Italian farming community? Has this stimulated (or not) the development towards more sustainable agriculture?	
Key sources	Literature Database of co-operation projects and partnerships for innovation	OGs members ISSs providers	RDPs Managing Authorities ISSs Other key sources	RDPs Managing Authorities
Methods	Desk research	Survey	Interviews	Focus group

Table 1. Scheme of research methodology

Table 2. Systematization of types of functions

Types of Functions		
Types of Functions conceptualised by Cristiano and Proietti, 2014	**Types of Functions used for the surveys**	**Types of Functions conceptualised by Ndah et al., 2018**
	1. Support aimed at solving complex problems at the farm level	Advisory, consultancy and backstopping aimed at solving complex problems, to be provided during the innovation process and based on demands of actors and the co-construction of solutions
	2. Provision of services to support the access to resource	Enhancing/supporting access to resources by facilitating access to inputs, facilities and funding
Discovering innovative ideas, identifying and articulating farmers' needs;	3. Identification and articulation of farmers' needs and innovative solutions	Demand articulation, to allow actors to have access to new ideas, identify their needs, define their objectives and express clear demands to other actors
Connecting partners, identifying suitable partners from different knowledge fields;	4. Identification of potential partners from different fields of knowledge and their aggregation	Networking facilitation and brokerage, to help organize or strengthen networks, improve the relationships between key actors and to align services in order to be able to complement each other
Supporting partners to refine the idea, articulating their demands and expectations; Identifying funding; Preparing the project proposal	5. Support to partners in the development and implementation of the project: articulation of their requests and expectations, relations with the administration, possible negotiations along the supply chain (for example, to improve access to markets), etc.	
Coordinating/ facilitating, leading the dialogue and the learning process;	6. Coordination / facilitation, guidance of the dialogue and learning process within the operational group during the co-innovation processes	
Running innovation, playing a role in initiating, developing and testing an innovation;	7. Provision of technical advice/assistance (agronomic, legal, economic, environmental, etc.) during the process co-construction of innovative solutions at farm level	Knowledge awareness and exchange
Communicating results, carrying out effective dissemination activities addressed to transfer knowledge on the innovations.	8. Communication of the results of the project, through dissemination activities aimed at transferring knowledge about innovations outside the partnership	Networking facilitation and brokerage, to help organize or strengthen networks / support for niche innovation and scaling mechanisms stimulation
	8a. Dissemination with the purpose of scaling-out the innovations	
	8b. Dissemination with the purpose of scaling-up the innovations across the supply chains	

Survey among the partners of the OGs

The survey among the OGs' members was predominately oriented by a multiple perspective approach aimed at investigating who is performing innovation support function (table 1) within the co-innovation process, by capturing the different viewpoints and perceptions of OG partners concerning ISSs roles and functions.

The survey was carried out among all the current Italian partnerships of co-operation projects for innovation funded under RDPs 2014-2020.

Total respondent to the survey amounted to 95, belonging to 45 different OGs.

Interviews to key AIS actors and focus group with the managing authorities of RDPs cooperation measures

Qualitative, semi-structured interviews were conducted, in-person or by telephone, among 10 key experts who are involved in cooperation for innovation (OGs, measure 124, others) and other multi-actor projects (e.g. Horizon 2020).

The interviews were aimed at going more in deep in analysing the roles and functions performed by ISSs and capturing the expert opinions about changes and dynamics in place in ISS provision across Italy.

Besides, a focus group involved 5 policy makers who are responsible for the implementation of RDPs' measures 124 and 16 which are aimed to the cooperation for innovation. It was guided around four semi-structured questions and aimed at harvesting the views, reactions and understandings on changes and dynamics in place within ISSs provision across Italy.

The list of the types of key experts interviewed is provided in table 3.

Table 3: List of key experts

Types of key expert	Type of method
5 RDPs Managing Authorities (measures 124 of RDPs 2007-2013 and 16 of RDPs 2014-2020)	Focus group
1 advisor	Interview
2 representatives of Farmers' Unions	Interview
3 Innovation brokers	Interview
1 representative of Cooperatives Federation	Interview
1 representative of Producers Association	Interview
1 farmer involved in OG and Producers Association	Interview

RESULTS

Actors providing Innovation Support Services

The analysis of data collected through the different sources of investigation shows the existence of a variety of actors and organisations, that traditionally didn't play a role of advisory and mediation, which are developing new skills and competences to support multi-actor innovation processes (this is particularly evident from the analysis of the databases collecting information about co-operation projects).

The number of public providers performing innovation support services in the context of cooperation projects is quite limited. In general, they are restricted to the former Regional Agencies for Development and Innovation which, in some cases, have been mandated to support the innovation processes funded through measure 16 of the RDPs. Among the public actors we should include Research Institutions supervised by the Ministries (e.g. CREA, CNR) and the Universities. Actually, these organisms provide services that are complementary to an applied research, but they are not officially responsible for supporting innovation processes. Despite this, the Universities and Research Centres, especially private ones, still remain in a leading position in supporting co-innovation processes (Cristiano and Proietti, 2014), often through spin-offs that have been specifically created (an overview of the role of the different providers in supporting co-operation projects is illustrated in table 4, showing data from the survey among OGs).

Also, some LAGs (public-private partnerships) show a certain attention towards actors needs in term of support to co-innovation processes and, to a certain extent, perform a key role in providing some services in rural areas.

Really, roles and functions of public and public-private organisms are strongly dependent on programmes delivery. Currently, only few Regions formally confer specific functions to Regional Agencies or LAGs within

the co-innovation projects, despite their natural role of animator and their mandate in promoting development.

New innovation support services providers are mainly private, farmer-based organisations, also from the tertiary sector.

Farmers-based actors include producers associations, cooperatives and consortia, farmers networks, the Farmers' Unions. Their role in supporting innovation has been consolidated in recent years, in some cases due to a support strategy developed by their associations, such as Confcooperative and Legacoop.

The expansion of farmer-based ISS is particularly evident and effective in some areas of innovation, such as those concerning sustainable and organic farming practices, that were previously lacking services. The need to fill these gaps has favoured, over the time, the creation of farmers' networks and associations able to support farms and foster knowledge exchange. These bodies represent, today, an added value in supporting the development of co-innovation paths.

Compared to the past programming period, both the Farmers' Unions and private advisors have enhanced their role in supporting co-operation projects, as shown by the results of the surveys and confirmed trough the interviews.

The interviews, together with the survey among the OGs, let emerge, also an involvement of actors (producers and sellers) from the input sector (feed industry, seed industry, mechanization, etc.).

Beside the actors who have always been part of the agricultural and rural sector, there is a growth of organisms from the tertiary sector. Generally, they are organisms that provide advice downstream of the production chain (agri-food sector) or actors from other sectors that usually carry out intermediation activities, project design and management, administrative services, etc. These subjects are taking ground thanks to their highly expertise, which traditional providers difficultly can have, and which is necessary to manage complex projects. It has been reported that, in many cases, the farms in particular look for this expertise due to several gaps in current services provision. Also, some organisms that usually provide support services for the management of administrative procedures, are taking ground thanks to the procedural complexity for applying to public funds, on the one hand, and the re-organisation of Farmers Unions towards innovation support activities, on the other hand.

Functions performed by ISSs within co-operation projects for innovation

The analysis of data concerning the types of functions performed by the different actors let emerge different perceptions about the role of the advisors within co-operation projects for innovation.

The survey among the advisors lets emerge that the more traditional functions (technical advice/assistance, dissemination, support aimed at solving complex problems and the provision of services to support the production process) are performed to a greater extent than the ones related to innovation brokerage (demand articulation, aggregation of partners and networking) and to the communication of the projects results (table 5). On the contrary, the investigation among the OGs partners highlights a major role in supporting the partnership in the development and implementation of the project.

The functions performed by the Farmers' Unions within the co-operation projects for innovation mostly concern dissemination activities, support to the partners in project development and implementation, tailor-made services to solve complex problems, support to access to resources.

Cooperatives and consortia are more involved, respect to the previous programming period, in providing technical advice during the process of co-construction of solutions within the farms as well as in articulating farmers needs and identifying innovative solutions (table 4).

In any case, the breakdown of the data by the types of functions played by the different actors, let emerge that private advisors, farmers' unions and farmer-based organizations perform all the functions of the ISSs, as well as Universities and Private Research Centres (table 4).

Table 4. Actors and functions performed in co-innovation projects: results of the survey among OGs partners. Percentage numbers

Function / Type of Organization	1. Support aimed at solving complex problems at the farm level	2. Provision of services to support the access to resource	3. Identification and articulation of farmers' needs and innovative solutions	4. Identification of potential partners from different fields of knowledge and their aggregation	5. Support to partners in the development and implementation of the project	6. Coordination / facilitation, guidance of the dialogue and learning process within the operational group during the co-innovation processes	7. Provision of technical advice/assistance during the process co-construction of innovative solutions at farm level	8. Communication of th results of the project, thorugh dissemination activities aimed at transferring knowledge about innovations outs the partnership
Advisor (e.g. agronomist, forest agronomist, veterinary, oenologist, agrotechnician, ...)/Advisory association	14	10	16	15	21	16	19	
Consorzia	7	10	7	8	7	9	5	
Cooperative/Association/ Organization of producers	5	12	12	3	7	12	19	
Farmer	11	16	16	13	10	7	5	
Farmers Union	16	14	12	10	12	9	7	
Innovation broker - Strategic advisory organization				3		2	2	
Input sector producer/seller (feed industry, seed industry, mechanization, etc.)	2	7		3			7	
LAG	2		2			2	2	
Local/Regional Administration		5	2			2		
Other private organisation (e.g. Foundation, Specialised company, etc.)			5	5	5	4		
Other public organisation (e.g. Consorzio di bonifica)					2	2		
Innovation Center	2	2		5	2	2		
Private Research Center	14	10	5	20	24	16	14	
Public Research Center	9	2	9	3	2	5	9	
Regional Agency for Agricultural Development		2	2				2	
University	18	10	12	15	7	9	9	
	100	100	100	103	99	97	100	

Table 5. Functions played by advisors in cooperation for innovation projects

Types of functions	**Number of advisors (% of the total respondents)**
8a. Dissemination with the purpose of scaling-out the innovations	12%
8b. Dissemination with the purpose of scaling-up the innovations across the supply chains	14%
1. Support aimed at solving complex problems at the farm level	13%
2. Provision of services to support the access to resource	13%
3. Identification and articulation of farmers' needs and innovative solutions	10%
4. Identification of potential partners from different fields of knowledge and their aggregation	4%
5. Support to partners in the development and implementation of the project: articulation of their requests and expectations, relations with the administration, possible negotiations along the supply chain (for example, to improve access to markets), etc.	6%
6. Coordination / facilitation, guidance of the dialogue and learning process within the operational group during the co-innovation processes	3%
7. Provision of technical advice/assistance (agronomic, legal, economic, environmental, etc.) during the process co-construction of innovative solutions at farm level	19%
8. Communication of the results of the project, thorugh dissemination activities aimed at transferring knowledge about innovations outside the partnership	3%

Although the number of public providers that support co-operation projects is quite limited, there is an evidence that, across the two programming periods (RDPs 2007-2013 and 2014-2020), the number and the role of the public extension providers has been reinforced (this data was confirmed during the focus group). This included the attribution of a major number of functions concerning the information at territorial level to potential beneficiaries of the Measure 16 of RDPs, the farmers' needs' assessment and the identification of innovative ideas (F3), the aggregation of partners (F4) and the communication of projects' results (F8).

It is interesting to observe that both the surveys point out that the actor engaged in identifying and bringing together partners from different fields of knowledge (F4), as well as in articulating farmers' needs (F3), is already part of a relational network developed within previous participations in multi-actor projects and, particularly, in cooperation projects for innovation funded under the Measure 124 of RDPs 2007-2013.

This result highlights the added value of co-operation projects in creating and/or strengthening relationships between the different actors and first between farmers and researchers. Moreover, these projects have undoubtedly contributed to the growth of a new and widespread awareness among the rural actors, and in particular the farmers, about the importance of innovation to foster the development of agricultural and forestry systems.

One of the main limitations (emerging from the interviews and the focus group) of Italian ISSs is represented by the poor interest and/or propensity to perform functions that go beyond the implementation of the project, thus to ensure the scale up of innovation and the 'capitalization' of knowledge and learning for implementing new projects and setting-up an enabling environment for innovation. The survey among the advisors show that only the 12% and the 14% of the respondents perform activities aimed at disseminating knowledge with the purpose of scaling-up and scaling out the innovation.

Despite this, the analysis of data concerning the relations with other actors let emerge an unexpected ability of private advisors to relate to other providers and, above all, to other private advisors (19%) and Farmers' Unions (18%). Their relational systems are set upon a large variety of actors (table 7).

Changes and dynamics in place within ISSs

The data show a dynamic and evolutionary framework which is strongly influenced by public policies on research and innovation and their delivery mechanisms, as well as by the farms' demand for services that, to some extent, appears more mature and aware or at least shifted, compared to the past, towards farm tailor-made services and intermediation activities aimed at solving complex problems through the co-construction of solutions.

The emergence of a new model of services provision, as well as of different service providers, has been facilitated by a gap in traditional advisory services that followed a progressive cut in public funds and the failure of the Farm Advisory System (Cristiano and Proietti, 2015). This breakdown has been mainly due to the consistent contraction of services provision by the Farmers' Unions (and their shift towards a major role in farm's application procedures) which, till the end of the '90s, had provide extension services on behalf the public system (Cristiano and Proietti, 2015).

Table 6. Functions played by different typologies of private advisors in co-operation projects for innovation

Typs of Functions /Types of Actors	Private Advisor (e.g. agronomist, forest agronomist, ...)/Advisory association	Regional agency for farm development	Local Administration	Regional administration	Cooperative/Association/ Organization of producers	Farmer	Farmers' Union	University
1. Support aimed at solving complex problems at the farm level (e.g. the transition from conventional to conservative farming)	64%	2%	0%	1%	3%	0%	29%	1%
2. Provision of services to support the production process, related to the supply of products	63%	2%	0%	3%	2%	0%	29%	1%
3. Identification and articulation of farmers' needs and innovative solutions	64%	0%	0%	1%	4%	0%	29%	1%
4. Identification of potential partners from different fields of knowledge and their aggregation	68%	0%	0%	0%	4%	0%	24%	4%
5. Support to partners in the development and implementation of the project: articulation of their requests and expectations, relations with the administration, possible negotiations along the supply chain (for example, to improve access to markets), etc.	58%	2%	0%	2%	2%	0%	33%	2%
6. Coordination / facilitation, guidance of the dialogue and learning process within the operational group during the co-innovation processes	57%	9%	0%	0%	4%	4%	26%	0%
7. Provision of technical advice/assistance (agronomic, legal, economic, environmental, etc.) during the process co-construction of innovative solutions at farm level	65%	2%	1%	2%	3%	0%	29%	0%
8. Communication of the results of the project, thorugh dissemination activities aimed at transferring knowledge about innovations outside the partnership	60%	0%	0%	5%	5%	0%	25%	5%
8.a. Dissemination with the purpose of scaling-out the innovations	67%	1%	0%	2%	5%	0%	22%	2%
8.b. Dissemination with the purpose of scaling-up the innovations across the supply chains	67%	1%	0%	1%	4%	0%	24%	2%

Table 7. Advisors' relational system

Types of advisory services providers in relation with	Farmer	Input sector producer/buyer (feed/seed industry, mechanization, etc.)	Private Advisor (e.g. agronomist, forest agronomist, ...)/Advisory association	Farmers' Unions	University	Public Research Center	Private Research Center	Innovation hub/Technological park	Consortia of farms	Cooperative/Association/ Organization of producers	LAGs	Local Administration	Regional agency for farm development	Regional administration	**Totals**
Private Advisor (e.g. agronomist, forest agronomist, veterinary)/Advisory	36	39	88	84	33	18	8	3	9	43	11	29	22	42	**465**
Advisor (Farmers Union)	57	11	20	39	2	3	2	0	1	19	5	21	3	24	**207**
Regional Administration	3	3	2	6	4	2	0	1	1	0	3	4	3	7	**39**
Cooperative/Association/ Organization of producers	6	3	1	2	1	1	0	1	0	2	0	0	0	0	**17**
Farmer	5	1	1	1	0	1	0	0	0	2	0	0	0	1	**11**
University	2	0	2	2	2	0	0	0	0	1	0	0	1	0	**10**
Regional Agency for Agricultural Development	2	1	1	2	0	0	0	0	0	1	0	0	2	1	**10**
Local Administration	2	1	1	0	1	0	0	0	0	0	0	1	0	2	**8**
LAG	2	0	0	1	0	0	0	0	0	0	2	1	0	1	**7**
Input sector producer/buyer (feed industry, seed industry, mechanization, etc.)	1	1	1	1	0	0	0	0	0	1	0	0	0	0	**5**
Public Research Center	0	0	0	0	1	1	0	0	0	0	0	0	0	0	**2**
Totals	116	60	117	138	44	26	10	5	11	69	21	56	31	77	**781**

Compared to the previous programming period, the farmer's unions are demonstrating a major interest in supporting co-innovation processes and they are attempting to reinforce their role and functions in co-operation projects. Among them, different support strategies have been implemented to boost and facilitate farms' innovation. In one case, external organism specialized in brokerage have been committed to identify farmers' needs and design the projects and, at the same time, new approaches and methods have been put in place, such as study visits among OGs to exchange experiences and demonstration farms. Another Farmers Union have supported on its own to all the phases of a co-innovation project, also by training the personnel on innovation brokering. In another case, a Farmers Unions have given up, due to lack of human resources and skills, and is limiting its service provision to more traditional ones.

The Farmers Unions are the actors that, probably, are undergoing the most significant transformations, having to take back skills and abilities that have been lost (both in expertise and in number of employees) due to their progressive involvement in bureaucratic tasks. In this respect, one Farmers Union feels the need to reorganize its services through a network of specialised providers able to support co-innovation processes.

Another important change involves the private advisors, who have broadened their support provision and participation in co-innovation projects. They hardly played a role in the implementation of Measure 124 of RDPs 2007-2013 because of a lack of expertise and, above all, of self-acknowledgement on their role in fostering innovation at farm level. This determined a turnover with Universities and Research Centres, which by-passed advisors and technicians in approaching and assisting the farmers. Currently, advisors seem to have got back their role in innovation processes, although the reorganization of expertise affects only a part of them, who are more willing to get involved in co-innovation processes through learning new skills and working methods. On the other hand, many advisors are still anchored to 'conventional' advisory approaches.

About the structural organisation of advisors, the delivery mechanisms of measure 16, that currently do not provide for the possibility of remunerating the professional services of advisors, is pushing towards associationism (this problem could be overcome by the introduction of standard costs).

Farmer-based organisations (producers associations, cooperatives and consortia, producers' networks, etc.) consolidate and extend their role in co-innovation processes, particularly in spreading innovation between the farmers and across the local supply chains (Cristiano and Proietti, 2014). Their growth in providing ISS is supported by their Federations, which are reorganising to provide direct and/or indirect support (through backstopping services) to their members within co-innovation projects.

Among this type of actors, it has been observed a first attempt to broaden the functions performed and the final users of service provision. In fact, a network of organic producers is performing intermediate functions between actors within co-innovation projects both on a geographical and multilevel scale, trying to foster the scale-up and the scale-out of innovations and advance the activities of a niche.

Another change is affecting Universities and Research Centres, which are moving toward new approaches: they are more willing to pay attention to farmers needs and to identify, together with them, the most suitable solutions rather than to propose standardised solutions according to a top-down attitude. This is partly to a due growing awareness and capacity of farmers in expressing their needs. On the other side, Universities and Research Centres are more acknowledged that the involvement of farmers since the early stages of the project is a guarantee of greater participation and a greater probability of success. Moreover, the experience of Measure 124, allowed the capitalisation of connections and relationships between the different actors, as well as the increase of confidence between them: this is now representing

an asset, both for University/Research Centres and farmers, in supporting the organisation and strengthening of co-innovation networks.

The effects of changes mainly affect organisational strategies, performed functions (which are shifting towards brokerage) and approaches. Effects on the governance and system of ISSs are hardly significant, mainly due to the difficulty (also of a cultural nature) of policy makers to map a variety of actors and interact with them.

The direction and extent of changes is mainly determined by policies and markets. Both are pushing towards inclusive and sustainable farming systems based on economic, social and ecological goals.

Therefore, it is possible to state that there's a slight shift towards sustainable agriculture, but it is difficult to express, without an ad hoc survey, a clear judgement about its key features and determining factors.

DISCUSSION AND CONCLUSION

The results of this study confirm that the introduction of interactive and multi-actor approaches for research and innovation in Rural Development Policy is leading to a certain pluralism of ISSs. Also, it is observed that ISSs are provided by a variety of actors that, spontaneously, perform a number of functions aimed at supporting innovation processes. A relevant finding of this study is also that, differently from the first experiences engaged in RDPs 2007-2013, private advisors are enhancing their participation in such innovation process.

The study provides new and updated knowledge on ISSs in Italy, leading to clear advancements into the literature, with relevant implications in terms of both policy and research.

From the research point of view, the current Italian scenario of ISSs is characterized by changes and trends in place which, as above described, are direct consequences of the renewed European Research and Innovation policy and of the introduction of the interactive model of innovation.

Until now, no literature has considered the specific matter of mapping and analysing the types of actors and functions which are in place to boost, intermediate and implement the systemic, multi-actor and transdisciplinary approach to innovation.

However, a limitation of this study is that it doesn't describe the overall state of art of the ISSs in Italy, along with other possible dynamics (political, cultural, economic, etc.) which could have influenced the observed changes and trends.

Indeed, this study is a first attempt to provide a snapshot of the changes and trends in place involving organisational structures and functions of ISSs in the light of the experiences gained in the context of the specific co-operative innovation projects co-funded by RDPs. In this respect, one of the merits of this study is that it has been carried out almost 10 years later the introduction of co-operation projects for innovation (measure 124 in RDPs 2007-2013), thus allowing to let emerge the long-term effects of those experience. These mainly concern the reinforcement of the advisory services providers, who definitely have increased their relational capital and trustiness within the niches of local innovation systems. They also are increasing their own awareness about the variety of functions to be applied for in innovation processes.

Further research should enlarge the fields of investigations in order to include the interplays of actual ISSs providers within the AIS and go more in deep into the analysis of their organizational models, strategies and methods and of their contribution to the transition towards the sustainability of farming systems.

Certainly, the Italian Agricultural System is not yet fully aware of the needs and approaches to be applied to speed up change towards more sustainable socio-technical systems, except for very few cases. As well, the focus of Italian ISSs seems to be far to be shift from farmers to a variety of actors.

Moreover, there's a need to broaden the exploration concerning the variety of delivery models applied for systemic innovations to get examples and insights for policy makers which could help a more aware setting of enabling environments for innovation in agriculture.

The main implications of this study for policy makers concern the major knowledge provided on where, along the research and innovation processes, the different actors are positioning themselves, through

playing specific roles and functions in the implementation of the EIP-Agri and how they are committing their expertise to interactive projects. This is worth especially in mapping the potential end-users, the enablers and the hinders to consider/involve them in policy making.

Also, major knowledge on the potential of some ISSs in connecting research and innovation projects, through participating to H2020 and OGs is crucial in setting the scene for synergies among policy instruments. All this worth in the definition of strategies and policy instruments to foster innovation and, most of all, in clearly identifying the counterparts in policy making processes.

Indeed, the results of this study lay the foundations for reinforcing the role of the innovation support services within the Agricultural innovation System towards a more inclusive approach that recognizes different typologies of services providers and involves them since the definition of the research and innovation policies and instruments, such as the foreseen strategic plan of the AKIS which will be possibly set under the framework of the CAP 2021-2027.

REFERENCES

ADE, 2009. Evaluation of the Implementation of the Farm Advisory System. Final Report e Descriptive Part. Louvain-La-Neuve, Belgium.

Albert, H., (2000) Agricultural service systems: A framework for orientation, Services for rural development GTZ. Eschborn, Eschborn, 26.

Allebone-Webb, S., Douthwaite, B., Hoffecker, E., Mathé, S and Triomphe, B. (2016) What is capacity to innovate and how can it be assessed? A review of the literature. IFSA Conference. New Port, GB, 25.

Barbier M. and Elzen B. (eds), 2012. System Innovations, Knowledge Regimes, and Design

Birner, R., Davis, K., Pender, J., Nkonya, E., Anandajayasekeram, P., Ekboir, J., Mbabu, A., Spielman, D., Horna, D., Benin, S., Cohen, M., 2009. From best practice to best fit. A framework for analysing pluralistic agricultural advisory services worldwide. J. Agric Educ. Ext. 15 (4), 341e355.

BORRÁS, S. and C. EDQUIST, 2013, "The choice of innovation policy instruments". Technological Forecasting and Social Change 80(8), 1513-1522.

Caggiano M. (2014) AKIS and advisory services in Italy. Report for the AKIS inventory (WP3) of the PRO AKIS project. http://www.proakis.eu/

Caggiano M. and Labarthe P. (2014). From the "best fit" to the "big fuss": the lost opportunities of the Italian advisory services. 11th European IFSA Proceedings.

Cristiano, S., Proietti, P. (2014). Acting as Agricultural Innovation brokerage in Italy: experiences from the Rural Development Programmes 2007-2013, 11th European IFSA Proceedings, p. 803-812

Cristóvão, A., Koutsouris, A, Kügler, M. (2012). Extension systems and change facilitation for agricultural and rural development. In Darnhofer, I, Gibbon, D., Dedieu, B., Farming Systems Research into the 21st Century: The New Dynamic, Springer Editors

Elzen, B., Geels, F.W. and Green, K. (Eds.), (2004). System Innovation and the Transition

Elzen, B., van Mierlo, B., Leeuwis, C., 2012. Anchoring of innovations: assessing Dutch efforts to harvest energy from glasshouses. Environ. Innov. Soc. Trans. 5, 1–18.

EU SCAR. (2012). Agricultural knowledge and innovation systems in transition – A reflection paper. Brussels: Commissione Europea.

Faure G., Knierim A., Koutsouris A., Ndah T., Audouin S., Zarokostac E., Wielinga E., Triomphe B., Mathé S., Temple L., Heanue K. (2017). How to Strengthen Innovation Support Services in European Rural Areas: Lessons Learnt from AgriSpin. 23rd ESEE Proceedings, 4th – 7th July 2017, Chania (Greece)

Faure, G., **Davis, K.**, **Ragasa, C.**, **Franzel, S.**, **Babu, S. C.**, 2016. Framework to assess performance and impacts of pluralistic agricultural extension systems. The best-fit framework revisited Washington DC : IFPRI-CIRAD

Geels, F., Deuten, J., 2006. Local and global dynamics in technological development: a socio-cognitive perspective on knowledge flows and lessons from reinforced concrete. Sci. Public Policy 33, 265–275.

Geels, F.W., (2005). Technological Transitions and System Innovations: A co-evolutionary

Heemskerk, W., L. Klerkx and J. Sitima, 2011. "Brokering innovation". Putting heads together: Agricultural innovation platforms in practice. S. Nederlof, M. Wongtschowksi and F. van der Lee. Amsterdam, KIT Publishers, 43-54.

Hermans F., Stuiver M., Beers P.J., Kok K., 2013. The distribution of roles and functions for upscaling and outscaling innovations in agricultural innovation systems. Agricultural Systems 115: 117–128

Hermans, F., Klerkx, L., & Roep, D. (2012). Structural conditions for dynamic innovation networks: a review of eight. Online proceedings IFSA 2012: Producing and reproducing farming systems, The 10th European IFSA Symposium, Aarhus, Denmark, 1-4 July 2012. - Aarhus, Denmark: IFSA, 2012, 1 - 11.

Hodson, M., Marvin, S., 2009. Cities mediating technological transitions: understanding visions, intermediation and consequences. Technol. Anal. Strat. Manag. 21 (4), 515–534.

Hodson, M., Marvin, S., 2010. Can cities shape socio-technical transitions and how would we know if they were? Res. Policy 39, 477–485.

Hodson, M., Marvin, S., Bulkeley, H., 2013. The intermediary organisation of low carbon cities: a comparative analysis of transitions in Greater London and Greater Manchester. Urban Stud. 50 (7), 1403–1422. 35, 715–728.

Howells, J. (2006). Intermediation and the role of intermediaries in innovation. Research Policy 35: 715-728

Hyysalo, S., Juntunen, J., Freeman, S., 2013. Internet forums and the rise of the inventive energy user. Sci. Technol. Stud. 26 (1), 25–51.

Kilelu, C.W., Klerkx, L., and Leeuwis, C. (2013) How dynamics of learning are linked to innovation support services: insights from a smallholder commercialization project in Kenya. The Journal of Agricultural Education and Extension 20 (2):213-232.

Kivimaa, P., 2018. Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda. Research Policy, https://doi.org/10.1016/j.respol.2018.10.006

Klerkx L., Aarts N., Leeuwis C., 2010. Adaptive management in agricultural innovation systems: the interactions between innovation networks and their environment. Agricultural Systems 103: 390–400.

Klerkx, L., Hall, A., Leeuwis, C. (2009). Strengthening agricultural innovation capacity: are innovation brokers the answer? International Journal of Agricultural Resources, Governance and Ecology 8: 409-438

Klerkx, L., Leeuwis, C. (2009). Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. Technological Forecasting & Social Change 76 (2009) 849–860

Klerkx, L., Van Mierlo, B., & Leeuwis, C. (2012). Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions. In I. Darnhofer, D. Gibbon, & B. Dedieu. Farming systems Research into the 21st Century: The new dynamic. Dordrect: Spring Science.

Knierim, A., Labarthe, P., Laurent C., Prager, K., Kania, J., Madureira, L., Ndah, H.T. (2017) Pluralism of agricultural advisory service providers – Facts and insights from Europe. Journal of Rural Studies 55 :45-58. doi: https://doi.org/10.1016/j.jrurstud.2017.07.018.

Koutsouris, A. (2014) Exploring the emerging intermediation roles (facilitation and brokerage) in agricultural extension education, International Journal of Agricultural Extension, Special Issue: International Conference – Emerging Horizons of Agricultural Extension for Sustainable Rural Development, February: 21-37.

Labarthe, P., Caggiano, M., Laurent, C., Faure, G., and Cerf, M., 2013. Concepts and Theories to Describe the Functioning and Dynamics of Agricultural Advisory Services. Deliverable WP.2e1 of the PRO AKIS project.

Labarthe, P., Lee-Ann Sutherland, L., Elzen, B., Adamsone-Fiskovica, A., 2018. Advisory role in farmers' micro systems of agricultural knowledge and innovation (microAKIS). Paper presented at the 13th European IFSA Symposium, 1-5 July 2018, Chania (Greece)

Leeuwis, C. (2004) Communication for Rural Innovation: Rethinking Agricultural Extension. Oxford: Blacwell Sciences.

Leeuwis, C., and Van den Ban, A. (2004) Communication for innovation: rethinking agricultural extension, Third edition. Oxford, Blackwell Publishing.

Mathé S., Faure G., Knierim A., Koutsouris A., Ndah HT., Temple L., Triomphe B., Wielinga E., Zarokosta E. (2016). Typology of innovation support services, WP1 AgriSpin, deliverable 1.4. CIRAD, Montpellier, France.

Moore, M.-L., Westley, F., Broadhead, T., 2012. Social finance intermediaries and social innovation. J. Soc. Entrepreneurship 3 (2), 185–205.

Moss, T., 2009. Intermediaries and the governance of sociotechnical networks in transition. Environ. Plann. A 41, 1480–1495.

Ndah, H.T., Knierim, A., Koutsouris, A., Faure. G., 2018. Diversity of innovation support services and influence on innovation processes in Europe – Lessons from the AgriSpin project. Paper presented at the 13th European IFSA Symposium, 1-5 July 2018, Chania (Greece)

Oakley, P. (1991) Projects with people: The practice of participation in rural development, International Labour Organization.

Ozelame, O., Dessimon M.J., and De Hegedus, P. (2002) O enfoque sistêmico na extensão: desde sistemas "hard" a sistemas "soft"". Agrociencia 6(2), 53-60.

Perez, S.A., Klerkx L., Leeuwis, C. (2010). Innovation brokers and their roles in value chain-network innovation: preliminary findings and a research agenda. ISDA 2010, Montpellier, France

Röling, N., and Jong, F.D. (1998) Learning: shifting paradigms in education and extension studies". The Journal of Agricultural Education and Extension 5(3), 143-161.

Smits, R., Kuhlmann, S., (2004). The rise of systemic instruments in innovation policy. International Journal of Foresight and Innovation Policy 1: 4-30

Steyaert, P., Barbier, M., Cerf, M., Levain, A., Loconto, A., 2017. Role of intermediation in the management of complex socio-technical transitions. In Elzen, B., A. Augustyn, M. Barbier and B. van Mierlo, 2017. AgroEcological Transitions: Changes and Breakthroughs in the Making. DOI: http://dx.doi.org/10.18174/407609

Tisenkopfs, T., Kunda, I., šūmane, S., Brunori, G., Klerkx, L., Moschitz, H., 2015. Learning and innovation in agriculture and rural development: the use of the concepts of boundary work and boundary objects. J. Agric. Educ. Extension 21, 13–33.

Van Lente, H., Hekkert, M., Smits, R., van Waveren, B., 2003. Roles of systemic intermediaries in transition processes. Int. J. Innov. Manag. 7, 247–279.

Wielinga, H.E., Vrolijk, M. (2009). Language and Tools for Networkers. The Journal of Agricultural Education and Extension (15)2 pp 205-217. (article, based on presentation in 8th IFSA symposium, Clermont Férrant.)

Wielinga, H.E., Zaalmink, B.W., Bergevoet, R.H.M., Geerling-Eiff, F.A., Holster, H, Hoogerwerf, L., Vrolijk, M. (2008). Networks with free actors: encouraging sustainable innovations in animal husbandry by using the FAN approach. Wageningen University and Research.

AFFILIATION

Simona CRISTIANO

CREA – Council for Agricultural Research and Economics, Policies and Bioeconomy,

Simona Cristiano is a Researcher and Evaluation expert at CREA-PB, with more than 15 years of experience in the field of programming, monitoring and evaluating European and National Policies. Her main domain of expertise is rural development policy with a focus on agricultural knowledge and innovation systems, farm advisory services, agricultural supply chains, quality of life and local development strategies. She is the project manager of two projects of the National Rural Development Network that support the monitoring and evaluation of the rural development programmes and the implementation of the EIP-Agri. Via Po, 14 - 00198 Roma, tel. +39 06 47856263,

e-mail: simona.cristiano@crea.gov.it

Patrizia PROIETTI

CREA – Council for Agricultural Research and Economics, Policies and Bioeconomy,

Patrizia Proietti is a researcher at CREA-PB, as well as a member of the Italian Rural Network. She has significant experience in rural development, innovation dynamics, agricultural knowledge and innovation system and policies evaluation. Since the achievement of her Ph.D. in Agricultural Economics and Policy (2000), she has been mainly involved in policy design and analysis, research projects and evaluation of rural policies at European, national and regional level. She has a long-standing experience as professional trainer and has great know-how on social and individual learning and participative methodologies. Her professional background includes 9 years of experience as researcher and lecturer at the University of Pisa (2000-2009). Via Bardazzi, 15 – 50127 Firenze
e-mail: patrizia.proietti@crea.gov.it

Publications:

Cristiano S. and Proietti P., 2018. Do EIP Interactive Innovation Approaches interact each other? International Journal of Agricultural Extension. In press

Cristiano S., Proietti P., 2017. Evaluating the effects of interactive innovation interventions at farm level: the use of the FADN. The Journal of Agricultural Education and Extension. In press

KNOWLEDGE PRODUCTION AND COMMUNICATION IN AGRICULTURAL DEMONSTRATIONS

Matching the perspectives of stakeholders

AUTHORS: ANDA ADAMSONE-FISKOVICA, MIKELIS GRIVINS

« The new mode of knowledge production involves different mechanisms of generating knowledge and communicating them, more actors who come from different disciplines and backgrounds, but above all different sites in which knowledge is being produced. » (Gibbons et al. 2007: 17)

Abstract:

Building on premises of science and technology studies and insights from agricultural extension literature, the paper uses a case study of a publicly-funded project of agricultural demonstrations in Latvia to analyse the processes of agenda-setting, knowledge co-production and communication in an arrangement that brings together farmers, advisors and scientists. The paper looks into the relationships between the different stakeholders and their views on the process of identifying the trial topics, implementing the trial on the farm, and carrying out the public demonstration. It argues that there are tensions between the perspectives and commitment of the involved stakeholder groups along all the three stages of the trial and demonstration process, leading to trade-offs between the initial conceptions and the implemented practices.

KEY-WORDS: AGRICULTURAL DEMONSTRATIONS, KNOWLEDGE CO-PRODUCTION, STAKEHOLDER ENGAGEMENT

I. INTRODUCTION

Agricultural demonstrations represent a mode of instruction that provide farmers with observable use of farming methods and technologies that can be subsequently applied in their own practices to bring about positive changes on the farm (Adamsone-Fiskovica et al. 2017: 160). Having been around as a changing form of learning and knowledge sharing already for several centuries, demonstrations are presently regaining momentum in Europe as a means for promoting practice- and/or research-based farming solutions. As part of designated policy measures that are increasingly designed also in response to the European Union (EU) policy trends, demonstrations are pursued *inter alia* with an aim to facilitate the uptake of economically and/or environmentally sustainable production methods or even whole production systems.

There are different types of demonstrations depending on the profile of the organiser (private or public body), demonstration site (research or commercial farm) and funding source, which all can have different implications for the profile of the demonstration in terms of objectives, involved actors, target groups, format and content. Publicly-funded demonstrations, as most educational instruments, tend to reinforce preferable knowledge and thus support specific development directions. However, being held on operational farms, demonstrations, if compared to other knowledge transfer forms, involve much more pronounced reliance on farmers' perception of what it is they should learn. Because of this, formally organised demonstrations have to deal with the complex relations between top-down and bottom-up trends in both defining the topic and managing the demonstration process.

This paper, building on a case study conducted in Latvia in the framework of the EU project PLAID, explores the relations between the different stakeholders – farmers, advisors, and scientists – while organising and

implementing demonstrations. The paper addresses three research questions: (1) What is the relationship between expert-driven and user-driven processes in setting the agenda for publicly-funded demonstrations, (2) How the production of and claims for evidence-based (scientific) knowledge are negotiated during the on-farm trial process, and (3) What implications multi-actor processes in demonstrations have for farmers' learning. The paper argues that there are multiple tensions between the perspectives held by the different stakeholders with regards to (a) appropriate topics for a demonstration, (b) practical implementation of the trial on the host farm, and (c) usability of a public demonstration event as a format for peer-to-peer learning.

The selected case represents a publicly-funded demonstration project in animal husbandry carried out in Latvia between 2012-2018. The Herbivorous project (hereafter – project) consisted of set of field trials and consecutive public on-farm demonstrations. Field trials have been held on commercial farms specialising in animal production (dairy and beef cattle, sheep, goats) where individual trials were carried out under the guidance of an advisor and a researcher over the course of 2-3 years, with each farm usually hosting two public Farm day events.

The methods for data gathering for the case study included desk research, in-depth interviews with managers, scientists, advisors and host farmers involved in the implementation of demonstration activities within this project, as well as participant observations and exit surveys of attendants carried out during several demonstration events.

The paper builds on the theoretical framework developed in the interdisciplinary field of science and technology studies bringing to the fore the concepts of the co-production of knowledge, scientific knowledge claims, and expert/lay knowledge divide and looking at the implications for stakeholder engagement and overall governance of agricultural knowledge production. Through a multi-actor perspective and using insights from studies on agricultural extension, the paper looks at the role of advisors, scientists and farmers and their differing knowledge basis, cultures and values in interpreting the desired and actual form and content of demonstrations.

II. THEORETICAL FRAMEWORK

Issues underlying the processes of knowledge production, application and dissemination have attracted academic interest in many disciplines. Sociology of knowledge, sociology of science, and more recently the wider interdisciplinary field of science and technology studies have contributed notably to our awareness and comprehension of the complex processes and relations underpinning any act of knowledge production and communication, but also those involving expert and scientific knowledge. Research advanced in the field of sociology of scientific knowledge (Barnes et al. 1996; Woolgar 1988; Pinch 1990) has challenged the privileged status of science over other sources of knowledge, thus calling for more egalitarian relations between "lay" and "expert" knowledge. The advocates of the paradigm of co-produced knowledge as represented, for instance, by Mode 2 (Gibbons et al. 2007), appeal to production of knowledge that is more problem-oriented, interdisciplinary, non-hierarchical, reflexive, and engaging a more diverse range of actors. The new paradigm places an emphasis on the extension role or the so-called 'third mission' of universities and research organisations in addressing and meeting public needs (Adamsone-Fiskovica et al. 2009; Bauer and Jensen 2011; Brundenius et al. 2017) and thereby bridging the gap between science and practice. The debate also addresses the need for an upstream engagement of citizens in research agenda-setting as well as the very implementation of research (Stilgoe and Wilsdon 2009), including the promotion of citizen science (Irwin 1995).

There has been also a growing body of studies specifically on the production of agricultural knowledge, focusing on multi-actor learning networks involving different stakeholders and bringing together and capitalising on the diverse types of knowledge possessed by those (Moschitz et al. 2015; Oreszczyn et al. 2010; Knickel et al. 2009; Tisenkopfs et al. 2015). The role of advisory services is increasingly emphasised in this context pointing to the challenges faced by those in embracing the paradigm shift from knowledge and technology transfer to intermediation and interactive engagement with farmers in innovation processes. This also implies wider recognition of the location-specific, indigenous and informal knowledge possessed by individual farmers (Wynne 1996; Šūmane et al. 2018). While there haven't been too many academic studies focusing on demonstrations, the agricultural extension literature generally acknowledges the importance of generating and providing need- and demand-based knowledge for farmers (Haug 1999) and promoting these practices for facilitating not only knowledge exchange between advisors and practitioners but also peer-to-peer learning (Leeuwis 2004).

Much of the debate around agricultural demonstrations is focused on the role of this mode of instruction in the diffusion of innovations, based on the premise that knowledge is the key to change. Demonstration as a form of knowledge transfer is aimed at enforcing this link by trying to present knowledge through practice and example. Yet, for the demonstration to be effective in achieving this, it needs to secure engagement of a diverse group of stakeholders – farmers as hosts and visitors, as well as scientists, advisors and other relevant groups. Each of these actors does receive a share of power to influence the course of a demonstration. The agreement on what ideas the demonstration will represent needs to be reached and re-negotiated at all organisational stages. Thus, the process of demonstration is a constant co-production of knowledge with all parties contributing their expertise in generating appropriate solutions. Yet, this seldom is a smooth and easy process.

III. CASE STUDY

Herbivorous project

Formal demonstrations in Latvia are predominantly organised by public research and advisory organisations. Research organisations usually hold demonstrations on their own plots as part of research farms. But this does not rule out their proactive engagement with commercial farms by building networks of demo farms along their specialisation. Demonstrations on commercial farms are usually carried out by advisory organisations and non-governmental organisations. One of the key organisers of such demonstrations is the Latvian Rural Advisory and Training Centre (LRATC), which has 26 regional offices all over the country.

Establishment of the network of demonstration farms formed by LRATC within the framework of the Herbivorous project (2012-2018), analysed in this paper, has been funded by the Ministry of Agriculture of the Republic of Latvia through the activity "Implementation of sustainable pilot projects of agricultural production" managed by the National Rural network. It has been elaborated and managed by the LRACT Competence Centre in Animal Husbandry (hereafter – Centre) responsible for the development and implementation of demonstration programmes on dairy cattle, beef cattle, sheep-breeding, and goat-breeding, and contributes to elaboration of collaboration strategies with scientists, advisors and farmers in the field of animal husbandry. The project represents the first common larger-scale framework for on-farm demonstrations in this field in Latvia. Unlike crop farming, there are no national research institutes in animal husbandry, therefore, the project has placed an emphasis on research-based demonstrations.

The main aim of these demonstrations has been to facilitate sustainable development of animal husbandry and competence-based implementation of field trials and demonstrations in the sector. It was to be achieved by providing systematically organised and thematically comprehensive object-lessons presented to the wider farming community at Farm days on individual farms in boosting the efficiency of production in the field of livestock-breeding. The underlying goal has been « to promote best practice knowledge transfer and introduction on livestock farms, ensuring the exchange of experience between farmers, advisors and scientists, and to promote cost-effective methods of farming » (Diebele 2016: 4).

In total 25 field trials have been held on 29 commercial farms specialising in animal production from all regions of Latvia, where individual thematic trials were carried out over the course of 2-3 years each. Each of the involved farms were used for addressing a different problem. The host farms and their field trial results were being presented to interested farmers on special Farm days held on the individual farms that usually were organised twice on each farm (one per year) with a slightly changing focus of the event. The programme of these Farm days (~4-5 hours) included a theoretical and a practical part where a seminar format is followed by a visit to the host farm.

Methodology

For the case study both qualitative and quantitative research methods were used. Between February and September 2018, 12 semi-structured in-depth interviews with individuals involved in the implementation of the project were conducted, including four advisors, six host farmers, and two scientists. All interviews, except for one, were conducted face-to-face and lasted between 45 minutes and one hour and 45 minutes. Most of the interviews were audio-recorded with interviewee's consent. In seven out of the 12 interviews two researchers were present.

Researchers also carried out unstructured participant observations at four Farm days organised in May-September 2018. These where used for observing the actual demonstration process and the interactions of the involved actors during the public events. The insights allowed to generate additional questions for in-depth interviews still to be conducted and provided basis for interpreting the information and opinions already harvested. In each observation two or three researchers were involved with one making more extensive notes during the process, while other(s) sharing their reflections after the event. Attendance at the Farm days also allowed for some brief informal exchanges with participants of various profiles thus providing some further qualitative information.

Additionally, to evaluate the demonstrations and get a better idea of the profile of visitors, researchers conducted an exit survey of participants at the four Farm day events, using a self-administered questionnaire with both closed and open questions. The survey was conducted in four waves (each representing a separate event) resulting in 131 filled out questionnaires. The response rate ranged from 40 to 56% - a rather good result given the fact that many visitors attended the event together with other household members and often filled out the questionnaire jointly.

Last, but not least, to get a better grasp of the case study in general and obtain additional information, researchers participated in several project-related events (e.g. annual summary workshops) and studied other outputs generated by or produced on the project.

The obtained data were analysed according to their type. For interviews, qualitative data analysis methods were applied, including elements of discourse analysis. The interview transcripts were reviewed to identify and code statements and reflections explicitly or implicitly addressing the research questions posed for the study, also noting down quotes featuring those. The survey data were analysed both quantitatively (for the closed questions) and qualitatively (for the open questions), initially separately for each event and later at an aggregate level for all four events. In the paper the different data are used to varying degrees, depending on the relevance and applicability of data generated by different methods for the three aspects selected for the analysis.

Looking behind the scenes

Selection of topics and host farms: aligning expert assessments and user needs in research agenda-setting

According to the official discourse, the project has been responding to farmers' needs for better and cheaper maintenance of cattle by promoting cost-effective methods of farming with a view to improving the quality and volume of production, thus boosting the competitiveness of farms.

The identification of problems to be tackled by the field trials and demonstrations was to be carried out by a special advisory board of the Centre (12 members) in cooperation with researchers, advisors and other professionals. Smaller thematic groups were formed within the board to work on specific themes and attract relevant advisors. As argued by the project managers, the choice of the trial areas was based on expert opinion on the pressing issues and priorities for the sector stemming from an economic analysis of the sector, forecasts of the future development of the various segments of this sector, and existing legal requirements.

When looking for possible topics for demonstrations, advisors were also trying to apply a bottom-up approach in identifying farmers' needs by inquiring individual farmers about the things they would see as useful to be addressed in a trial. Nevertheless, advisors have remained somewhat sceptical of the overall responsiveness of farmers and their ability to define relevant issues. According to their accounts, there are farmers that « want everything, but don't know what exactly ». It was also noted that the views by individual farmers can be very fragmented and lack a more overarching sectoral, long-term (macro) perspective.

In practice the choice of the topic for each trial has been made by following different routes, depending on the individual circumstances. The preferred way was to look for farms that could uptake the task to work with the identified issues after the themes were identified. This turned out to be a challenging task because advisors needed to find a suitable farm willing to get involved in a demonstration. The farm needed to be appropriate for studying the issue experts had identified and at least in some way successful. The selected host farms usually featured performance in terms of output and productivity that is above the average in the country. Also, farmers needed to be convinced that they should participate in the project and this meant that often only the farms holding pre-existing contacts with advisers responded. The pre-defined need for the economic and production data for the trials to be successful frequently served as the reason for selecting farms that were using the services

of the LRATC accountancy. Consequently, project coordinators were forced to align their expectations with what was available.

Another route to selecting a topic was to identify a farm and only then tailor a trial topic depending on what was deemed suitable under the specific conditions of the farm, while also trying to take account of its relevance for the wider farming community. While the latter scenario seemed to work quite well resulting in rather high satisfaction level by the hosts, under the former scenario there was a varying degree of the relevance of the topic for the selected farm, which had implications for the perceived value of the trial and dedication of the farmer to this effort.

The discussion and assessment of the way trial topics and demonstration farms were selected reveals a certain misalignment between the officially declared route and the one implemented in practice as well as between what has been deemed appropriate and feasible by the coordinators, on the one hand, and farmers, on the other.

A large part of the debate on the proper selection of topics and host farms has to do with the appropriate size of the farm and the relevance of the selected trial topics for farms of different sizes. The peculiarity of the dairy sector in Latvia, which is the largest one in animal husbandry in the country, is the high number of small farms (CSB 2017). However, most of the selected host farms were medium or large ones. While it has been argued that most of the trial topics are relevant for all farm sizes, there were indications that demonstrations specifically aimed at small farms are needed to enhance their transferability potential. As revealed by host farmers, demonstration visitors from small and less progressive farms are inclined to take the position that regular farms like theirs (« ordinary humans ») by default are not capable or in a position of doing the things done of the demo farms and of achieving such results (« I would also do that provided I had the means they have »).

There has been already some earlier concern over the extent demonstrations carried out in the project manage to reach small and medium farmers as well as the less active ones (Diebele 2016). Experts have drawn attention to the need of taking better care of the representation of the interests of different farmers (small, medium, big) in the advisory board (ibid.). The scale and the level of advancement of the host farm can act as a notable factor in the learning outcomes by different profiles of attending farmers. Yet, as argued by the interviewed advisors and scientists, there are restrictions posed on the selection of host farms due to the trial requirements for ensuring the possibility of establishing a control group in the herd.

Interviews with host farmers revealed that, given the way trial topics had been defined, these were often perceived as imposed top-down, sometimes even based on false premises. As in many instances these topics were not stemming from the actual problems faced by commercial farms, implementation of the trial had reduced the subjective motivation of the host farmer to actively engage in the implementation process. It was emphasised that a more efficient use of the public funds could be made (« not just for people to come, meet, and have free lunch »), not least by learning more of the grass-root needs of farmers by advisors through their daily communication and on-farm observations, and by identifying the recurrent ones that could be then addressed by the demonstration. The latter point, however, largely resonates with readiness of farmers to speak of their problems and share their concerns. As recurrently emphasised by interviewees of all profiles, the ability of acknowledging and recognising the presence of problems on one's farm is not a common feature in the farming community in Latvia. And this has also implications for the pool of farms that are available for carrying out a demonstration.

It has also been noted that identification of a practical problem on the farm and finding its cause(s) is a difficult task since it may involve complex factors and may not result in a solution within the given timeframe of the project, the terms defined by the funder, and the type of specific expertise held by advisors. The possibilities for manoeuvre by the organisers have, for instance, been limited by the need to adhere to the principle of an equal regional distribution of trials stipulated by the funding terms, thereby not allowing them to take up some of the bottom-up themes suggested by host farmers for upcoming trials on the same farm.

In sum, the whole process of agenda-setting for the given demonstration project represents a certain struggle in aligning the expert-driven and user-driven identification of farmers' needs and finding a room for manoeuvre within the limits imposed by legal, financial and human resources at hand.

Trial phase: reconciling scientific principles with on-farm conditions in the production of knowledge

According to the designed procedure, each trial theme was allocated one advisor and one scientific expert who both were contracted to work on the given demonstration with engagement of the selected host farm. While the advisor was more involved in direct contact with and visits to the host farm, the scientific expert

primarily provided input with insights on the trial topic and trends from scientific literature, development of the methodology of the trial, as well as with articulation of research questions and calculations based on the data provided by the farm. It was expected that farmer would follow the instructions provided for the trial and gather data. However, in practice, a range of points of deviation from the formal procedures and the initial plan became apparent.

The interviews revealed a certain ambiguity with regards to the status of the whole endeavour in terms of its scientific profile. While the trial did involve scientists and the prescribed trial procedures were developed in line with principles of scientific research, it was not unanimously claimed that the trial results are scientifically sound. As argued by one of the scientists, « these are not perfectly scientific projects » as they are conducted on commercial farms under actual production conditions; according to other accounts neither could these be treated as experiments. This fact has largely to do with the debate about the conceptual and practical distinction between a trial, an experiment and a demonstration, especially with regards to the possibility of making any scientific claims. The very use of the two terms (trial vs. demonstration) was acknowledged to be tailored to the needs of adhering to the scope and focus of one or another funding scheme.

Most of the interviewed farmers were not expecting the workload the participation in the trial generated for them. It was generally acknowledged by host farmers that involvement in the project was rather time- and work-consuming and a source of high stress for them. At times the farmer felt left alone with the daily implementation of the procedures, thus requiring the motivation and skills to self-organise under conditions of a limited daily presence of and guidance by the advisory staff. This might account for the fact that some host farmers were not as dedicated to the project as it might have seemed during negotiations.

Sometimes it had not been made clear early on enough what kind of data and in what form should the host farmer register. The lack of clear and strict guidelines and missing data were deemed to lead to potentially speculative calculations and data errors. Some host farmers voiced scepticism about the very set-up and implementation of trials both on their own farm and other host farms thereby undermining the validity of the results. Upon one of the public events there were also people from the audience voicing objections to trial results. On the other hand, the advisors reported of instances where due to the lack of commitment and diligence of the host farmer there were difficulties in visiting the farm and carrying out the actions by the advisory team as stipulated by the originally developed methodology of the trial. As also personally recognised by one host farmer, « we did the weighting not to derange the whole endeavour, but I wouldn't say that we were very precise in doing that ».

Selected farmers reported on their willingness and personal effort in improving or even expanding the prescribed procedures of the trial, but at times there was limited support to this kind of initiatives (« don't worry that much, just promote your own business »). On the one hand, this can be seen as a human gesture for not overloading the host farmers with extra work by minimising the effort required from them while maximising the personal benefit of the farmer from his/her engagement in the project. On the other hand, taking such a stance by the coordinators disincentives those farmers who have the will and capacity of going beyond the formal requirements to ensure efficient implementation of the trial and increase the validity of the results. At the same time advisors praised the diligence and devotion of those farmers who were investing additional work and energy beyond what they were officially required to do.

The interviewees also reflected on the involvement of scientists in the project, which can be a challenge both for the farmers and advisors and for the scientists themselves. The common problem was the degree to which a member of a university staff can be engaged in this kind of an endeavour given their primary job obligations and lack of institutional support for extension activities. Some participants thought that more active engagement of the attracted scientists in the field trial and communication with the host farmers could be anticipated to facilitate direct contact and knowledge exchange. Some of the interviewed host farmers were not even aware of the attracted scientists until their appearance with a presentation on the Farm day event or until reading the overview material published on the trial results. The expertise of the local scientists and advisors was also at times questioned, pointing to the lack of language skills allowing them to draw on the extensive foreign experiences and provide new knowledge. While it has been argued that the project has provided valuable experience for the academic staff, the enacted mode of cooperation tended to reproduce the segregation between science and practice.

While the core topic per field trial had been to a large extent defined in advance and fixed in the project's documentation, the real-life situation either on the individual farm or region during the trial period frequently introduced adjustments to the initial concept. Thereby additional issues that become topical for the farm during the trial phase either due to observations made by the advisor (e.g. mastitis outbreak in the herd, mortality of

calves) or due to some external conditions (e.g. heat stress of animals, animal wellbeing after attack by wild animals) were brought up and addressed also as part of the trial, thus enriching the scope of initially defined topics. At the same time the various unanticipated *force majeure* factors also had implications for the possibilities of carrying out the original trial and obtaining data for drawing meaningful conclusions.

Overall, the involved stakeholders tended to hold different interpretations of the role of each of them plays in the trial process and the levels of commitment expected by the other parties. This led to mutual expectations that frequently were not met. The mix of the different interfering factors as well as the differing degrees of personal commitment by individual advisors, host farmers and scientists inevitably also had effect on the type and quality of knowledge produced in each trial.

Public demonstration: merging expert-led and peer-to-peer communication of knowledge

The Farm day as the event for public demonstration of the trial results usually started with an in-doors seminar with an introduction to the project, information on the host farm, presentation of trial results, additional information and recommendations on the trial topic by other invited speakers, followed by a visit to the host farm.

The set-up and implementation of the public demonstration as part of the work involving all the parties also highlighted certain tensions among those. While for the project managers the event was mainly a means for presenting the results of the trial and thereby delivering the officially required set of activities that could be reported on, including the presentation of hard data stemming from economic analysis, the host farmers were more devoted to trying to think of things that might be interesting and relevant for the visitors beyond the topic addressed by the trial. As a result, the Farm day programme was usually enriched with some side-topics that were either in some way related to the core topic of the trial or to specific practices of the farm unrelated to it.

All these topics reinforced the fact that individual on-farm practices are closely intertwined with many other aspects of farming and can hardly be treated as isolated, stand-alone items. The added activities on the farm in a way seemed to compensate for the non-demonstrability of many of the issues tackled by the trials and presented in the form of various calculations, thus aiming to supplement those with practical observable things on the farm that have a very direct and tangible meaning for the visiting farmers.

There were some objections voiced by the host framers with regards to the allocation of roles between the different parties at the Farm day. At the same time the differing degrees of communication skills of host farmers and readiness to share their experiences and knowledge with others also lead to a differentiated division of labour per event. There was some critique addressed to the organisers for attracting lecturers on the Farm day that didn't have much to do neither with the trial topic, nor the host farm, thus to some extent undermining the reputation of the hosts.

The quantitative survey revealed that while both parts of the event were seen to be well organised and relevant, the part with an on-site visit of the farm were more highly valued by the visitors, which is most likely due to the practice-oriented nature of the latter. The suggestions made by the visitors regarding possible improvements primarily dealt with the organisation of a more extensive farm walk, less intense use of figures in the presentations, provision of handouts, along with some ideas on potential extra topics that could have been addressed as part of the given demonstration or in future trials.

Several survey participants noted that the Farm day allowed them to learn many new things, especially the experience-based ones, but also to refresh some previously known but slightly forgotten things, as well as to gain more general knowledge of the sub-sector. Nevertheless, it was acknowledged that demonstration events are attended not only for formal learning, but also for taking the opportunity to socialise and network with peers, acquaintances and colleagues and meet new people. The Farm days were characterised as a valuable opportunity for a free get-together. As observed during the Farm days, farmers take the opportunity to informally share their experiences.

Taking notice of the different benefits for visitors, it is, however, important to see those in the context of the primary objective of the demonstration event and the underlying investments, by assessing whether these effects can be achieved only by rather costly trial-based demonstrations or other forms of less financially-intensive social events.

IV. CONCLUSIONS

The three reviewed dimensions along the process of planning and implementing demonstrations in the framework of the case study allow to highlight the differing views held by the involved parties on the selection of trial topics, enactment of trial procedures and communication of trial results, but also more generally about the aims and outcomes of publicly-funded demonstrations carried out on and for commercial farms.

It has been established that the process of selecting the demonstration topics is influenced by several factors, including terms defined by the funding instrument, expert opinion on the pressing issues and priorities for the sector, and practical issues deemed important by individual farmers. While there are efforts in ensuring a process of joint decision-making to balance the interests of funders, advisors, scientists and farmers, the outcome can nevertheless present explicit or latent dissent among one or several stakeholder groups and lead to trade-offs between expert- and user-driven processes of setting the research agenda for agricultural trials.

The case study revealed that the process of implementing the trial, which forms the core of the overall demonstration concept in the project, represents a trade-off between the anticipated scientific rigidity with regards to the required structural characteristics of the farm, the necessary trial conditions, the production and registration of data, on the one hand, and the actual commitment of all parties in ensuring efficient implementation of the trial, the capacity of the host farm in terms of the available infrastructure, the readiness and ability of the farmer to diligently follow the prescribed trial procedure and self-organise, and the unanticipated effects of *force majeure* factors present on commercial farms, on the other. The combination of these factors also has notable implications for the knowledge produced during the trial, incl. the ability of making scientifically sound claims, the generalisability of the results, as well as the differences in the subjective relevance for advisors/scientists and farmers of the knowledge produced. This also poses questions on the proper balance between private and public benefits resulting from such publicly-funded incentives.

Last, but not least, the case study allowed to observe that the public demonstration event serves as a platform for both delivering the officially required set of activities and selected side-activities feasible on the given farm that add a practical and directly observable dimension to the demonstration process, not necessarily related to the specific topic of the trial, to compensate for the lack of sensory experiences in the process of learning. The demonstration event *per se* serves a double mission of facilitating formal expert-led public communication of the trial results, on the one hand, and of enabling social networking and informal peer-to-peer learning on a diverse set of farming-related practical issues, on the other. The challenge thus is to make a functional link between credible research-based knowledge and existing and potential on-farm practices allowing to tap the whole potential for bridging the gap between science and practice.

In sum, the involvement of farmers, advisors and scientists in jointly setting up and implementing such a multi-actor demonstration activity is a challenging endeavour of co-producing knowledge that, ideally, allows building on the differing interests and types of knowledge represented by the various actors and integrating those in a mutually beneficial format. This, however, requires addressing a range of trade-offs along the whole process from inception to communication and application of results.

Acknowledgements

This research has been carried out in the framework of the PLAID project ("Peer-to-peer learning: Accessing innovation through demonstration", 2017-2019) funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 727388. The authors would like to thank all the interviewees as well as the participants of the Farm day surveys for their time and valuable input. Special thanks go to our BSC colleague Emils Kilis for his assistance with conducting the exit surveys.

REFERENCES

Adamsone-Fiskovica, A., Kristapsons, J., Lulle, A., Tjunina, E., Ulnicane-Ozolina, I. (2009) Moving beyond teaching and research: economic and social tasks of universities in Latvia. *Science and Public Policy* 36(2): 133-137.

Adamsone-Fiskovica, A., Tisenkopfs, T., Grivins, M. (2017) Formats, outcomes and impacts of knowledge exchange in demonstration activities. In: *Proceedings of the XXVII European Society for Rural Sociology congress "Uneven processes of Rural Change: On Diversity, Knowledge and Justice",* pp. 160-161. Institute of Sociology, Jagiellonian University.

Barnes, B., Bloor, D., Henry, J. (1996) *Scientific Knowledge: A Sociological Analysis.* Chicago: University of Chicago Press.

Bauer, M., Jensen, P. (2011) The mobilisation of scientists for public engagement. *Public Understanding of Science* 20(1): 3-11.

Brundenius, C., Görannson, B., de Mello, J.M.C. (eds) (2017) *Universities, Inclusive development and Social Innovation: An International Perspective*. Springer.

CSB (2017). *AGRICULTURE IN LATVIA Collection of Statistics.* Central Statistical Bureau of Latvia. Available at http://www.csb.gov.lv/sites/default/files/nr_24_latvijas_lauksaimnieciba_2017_17_00_lv_en_0.pdf

Diebele, A. (2016) *Latvia Cross visit report* (AgriSpin project). Latvian Rural Advisory and Training Centre. http://agrispin.eu/wp-content/uploads/2016/11/CV-Report-Lavia.pdf

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M. (2007) *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London: SAGE Publications.

Haug, R. (1999) Some leading issues in international extension: A literature review. *Journal of Agricultural Education and Extension* 5(4): 263-274.

Irwin, A. (1995) *Citizen science: A study of people, expertise and sustainable development*. London: Routledge.

Knickel, K., Brunori, G., Rand, S., Proost, J. (2009) Towards a better conceptual framework for innovation processes in agriculture and rural development: From linear models to systemic approaches. *Journal of Agricultural Education and Extension* 15 (2): 131-146.

Leeuwis, C. (2004) *Communication for Rural Innovation: Rethinking Agricultural Extension*. 3rd edition. Blackwell Publishing.

Moschitz, H., Roep, D., Brunori, G., Tisenkopfs, T. (2015) Learning and innovation networks for sustainable agriculture: Processes of co-evolution, joint reflection and facilitation. *The Journal of Agricultural Education and Extension* 21(1): 1-11.

Oreszczyn, S., Lane, A., Carr, S. (2010) The role of networks of practice and web of influencers on farmers' engagement with and learning about agricultural innovations. *Journal of Rural Studies* 26: 404-417.

Pinch, T. (1990) *The Sociology of the Scientific Community. In: Companion to the History of Modern Science*. Olby, R. C., Cantor, G. N., Christie, J. R. T., Hedge, M.J. S. (eds). Routledge. 87-99.

Stilgoe, J., Wilsdon, J. (2009) The new politics of public engagement with science. In: *Investigating Science Communication in the Information Age: Implications for public engagement and popular media*. Holliman, R., Whitelegg, E., Scalon, E., Smidt, S. and Thomas, J. (eds). Oxford University Press. 18-34.

Šūmane, S., Kunda, I., Knickel, K., Strauss, A., Tisenkopfs, T., Des los Rios, I., Rivera, M., Chebach, T., Ashkenazy, A. (2018) Local and farmers' knowledge matters! How integrating informal and formal knowledge enhances sustainable and resilient agriculture. *Journal of Rural Studies* 59: 232-241.

Tisenkopfs, T., Kunda, I., Šūmane, S., Brunori, G., Klerkx, L., Moschitz, H. (2015) Learning and innovation in agriculture and rural development: The use of the concepts of boundary work and boundary objects. *The Journal of Agricultural Education and Extension* 21 (1), pp. 13-33.

Woolgar, S. (ed) (1988) *Knowledge and Reflexivity: New Frontiers in the Sociology of Knowledge*. SAGE Publications.

Wynne, B. (1996) May the sheep safely graze? A reflexive view of the expert-lay knowledge divide. In: *Risk, environment and modernity: towards a new ecology*. Lash, S., Szerszynski, B., and Wynne, B. (eds). SAGE Publications. 44-83.

AFFILIATION

Anda ADAMSONE-FISKOVICA,

Researcher at the Baltic Studies Centre (Latvia). Holds a master's degree in Society, Science and Technology in Europe from Linkoping University and a doctoral degree in sociology from the University of Latvia. Has

undertaken research on innovation policy, science communication, public understanding of science and citizen engagement. Some of the latest publications include a chapter "Investigating social inclusiveness of universities in Latvia: policy discourse and university practices" in *Universities, Inclusive Development and Social Innovation: An International Perspective* (2017), and a chapter "Consuming, experiencing and governing: setting the scene for public encounters with biomedicine" in the *Handbook of Popular Culture and Biomedicine: Knowledge in the Life Sciences as Cultural Artefact* (2019). A more recent academic interest is related to agricultural knowledge and innovation systems and farmers' learning, explored in several EU-funded projects (INNOFRUIT, SALSA, AGRLINK, PLAID).

E-mail: anda@lza.lv

Mikelis GRIVINS,

Researcher at the Baltic Studies Centre (Latvia). Holds a doctoral degree in sociology from the University of Latvia. Has undertaken research on agro-food systems, food supply chains, rural development, wild products and forestry. Some of the latest publications include a chapter "*Manoeuvring between regulations to achieve locally accepted results: analysis of school meals in Latvia and Finland*" in Food Security (forthcoming), "*Benefitting from the global, protecting the local: The nested markets of wild product trade*" in Journal of Rural studies (2018) and "*Bricolage for Self-Sufficiency: An Analysis of Alternative Food Networks*" in Sociologia Ruralis (2017).

E-mail: mikelis.grivins@gmail.com

PS6: MULTI-STAKEHOLDER APPROACHES AND INNOVATION SUPPORT FOR SUSTAINABLE AGRICULTURE

Shedding light on and sharing farmers' innovative practices: lessons from R&D initiatives in support of innovation

Chloé Salembier, Jean-Marc Meynard, Blanche Segrestin and Benoît Weil

How co-design processes can contribute to and renew the scientific knowledge production?

Quentin Toffolini, Lorène Prost, Marie-Hélène Jeuffroy and Jean-Marc Meynard

Exploring the future contribution of multidisciplinary research to the development of coupled innovations between agriculture and food processing, towards sustainable food systems

Juliette Brun, Marie-Hélène Jeuffroy, Jean-Marc Meynard, Caroline Pénicaud and Marianne Cerf

TITLE: BRINGING TO LIGHT AND SHARING FARMERS' INNOVATIVE PRACTICES: LESSONS FROM R&D INITIATIVES IN SUPPORT OF INNOVATION

AUTHORS: CHLOÉ SALEMBIER, BLANCHE SEGRESTIN, BENOÎT WEIL, JEAN-MARC MEYNARD

ABSTRACT

KEY-WORDS AGRONOMIC EPISTEMIC PROCESSES, CREATIVE ANOMALIES, DESIGN CAPABILITIES, INNOVATIVE FARM PRACTICES, INNOVATION PROCESSES.

INTRODUCTION

A major issue in the collective drive towards sustainable agriculture is how to share ideas, knowledge and knowhow from a variety of origins to support collective learnings and the design of innovative farming systems (Barbier & Elzen, 2012; Darnhofer et al., 2012). In recent years an increasing number of agricultural R&D initiatives have focused on identifying and sharing farmers' 'innovative' practices so as to stimulate innovation (Goulet, 2017).

Examples can be found (i) in local, national and international initiatives led by farmers themselves (e.g. www.Agricool.net) or led by R&D actors (e.g. FarmHack.org), (ii) in various strategic guidance documents and calls for R&D projects (e.g. Agricultural European Innovation Partnership, EIP-AGRI), and (iii) in science, where researchers are increasingly interested in farmers' innovations (e.g. Smith et al., 2014). These initiatives are based on the assumption that innovation processes can be stimulated by bringing to light and sharing knowledge on farmers' unique, situated, 'innovative' practices. However, the processes by which such knowledge is brought to light and shared, and the epistemic choices underlying these processes, have rarely been studied (Girard & Magda, 2018). Who judges these practices innovative, and what does 'innovative' mean? How are the farmers found? What agronomic content is produced, and how? Which such contents are shared? And what contribution do these processes make to farming system design? In this paper we explore these questions.

The process we are examining contrasts with the predominant and better-known rationales of prescriptions in agronomy, which are 'nomological', i.e. grounded in general laws (Cohen, 2017). Prescriptions in agronomy today is dominated by the quest for generic technical solutions that can be quickly disseminated and enable farmers to manage one or several production factors in the field (plant nutrition, pest management etc.). Scientifically validated agronomic models are used to describe the bio-physico-chemical processes to be managed and explain the interactions between these processes and one or more farming techniques (e.g. sowing, tillage). The purpose of these models is to predict probable changes in field conditions according to variants in the techniques used (Milleville, 1987). These variants are sometimes chosen using decision models based on standard descriptions of production systems (e.g. Alvarez et al., 2018). It is assumed that both agrosystem functioning and farmers' decisions can be modelled, and that these models can be used to predict what practices farmers will adopt. This reasoning is based on a desire to stabilise predictive prescriptions: any deviation from the prescription is considered an anomaly, a signal that the models are incomplete and must be enriched to incorporate these deviations and to improve the prescriptions (Jansen, 2009).

But what happens when the anomalies themselves become the basis for developing prescriptive content? What agronomic reasoning is used, and what prescriptions emerge? The purpose of our study was to better understand the agronomic reasoning by which prescriptive contents for farming system design are produced by studying anomalous farmer practices that are considered innovative.

Our purpose is more specifically geared to today's situation, when agroecology is presented as a desirable collective project for agriculture. The properties of agroecological systems and their practical management raise new questions for agronomy, which the dominant prescriptive approach is hard put to address. Firstly, as the design and management of these systems is based on stimulating natural balances, designers must take into account the interdependences and coevolutions between different components of the agroecosystem (Bredart, Stassart, 2017); but these are specific to each farming situation and many are little known (Bawden, 1991; Pretty, 1995). This lack of knowledge reduces our ability to predict the effects of techniques and requires us to imagine singular, adaptable systems, suited to each productive situation, and whose management takes into account the uncertainties and hazards that farmers face (e.g. markets, weather). How to design such systems, and what their underlying agronomic reasoning is, are live issues in agronomy today.

The above-mentioned initiatives are a part of this collective process. They are responses to the key question of how to support the design of singular systems by learning about other singular systems. There have been few scientific agronomy studies of this issue. A few scientists have identified, analysed and assessed practices they considered innovative, unusual or atypical so as to draw lessons towards sustainable farming practices (e.g. Feike et al., 2010; Michel-Dounias et al., 2012) and a few have proposed methodologies for rationalising these approaches (e.g. Elzen et al., 2017). These authors all use different methodologies and few of them step back to consider the repercussions of the epistemic choices they make or propose.

Our study started from this observation. We compared 12 initiatives coordinated by R&D actors, to study (i) their agronomic reasoning, i.e. the epistemic processes by which agronomic contents concerning farmers' innovative practices are produced, shared, formalised and transformed, and (ii) the resulting prescriptions for farming system design. We explore the following questions: What specific resources in aid of farming system design are produced from farmers' innovative practices? Through what agronomic reasoning do these resources emerge?

CONCEPTUAL FRAMEWORK

What is meant by "farmers' innovative practices" in this paper?

The word 'practice' is common in the agronomy literature but can refer to many kinds of object. In this paper we adopt the definition of "farmers' practices" given by Teissier (1979) and Landais et al. (1988): "ways of doing things for production purposes (…) farmers' practical ways of doing things". This definition has two advantages for our study in the current situation. (i) It highlights the fact that a farmer's practice is a situated event which unfolds in action, over time, in a specific context (Blanc Pamard et al., 2013); such practices are not reducible to fixed knowledge that can be made explicit. (ii) It highlights the difference between the farmers' action and that of the prescribers who generate prescriptive agronomic content (Gras et al., 1989). In a way, what we have been studying is how 'practices' that are considered innovative (i.e. were not previously known to those referring to them) are turned into 'prescriptive content'. As explained by Le Masson et al. (2006): the notion of innovation has no meaning in itself and, faced with an 'innovative' proposal, two observers will have different judgements. In this paper we examine the innovative nature of practices from the standpoint of those who define them.

Characterising prescriptive agronomic content and reasoning

To study prescriptive agronomic reasoning, i.e. reasoning intended to effect change in farming practices, one must consider (i) the epistemic processes by which agronomic contents (knowledge, innovation concepts, research questions) are produced, made explicit, formalised and transformed, and (ii) the resources produced by this 'agronomic reasoning', i.e. the part of the agronomic content produced that is actually shared (or 'circulating', Moity-Maïzi, 2011).

(i) We will use concepts from agronomy to describe the epistemic processes associated with the study of practices (e.g. assessment of technical systems – Bockstaller et al., 2008; analysis of the rationales that lead farmers to act the way they do – Osty, 1978; Milleville, 1987; Sebillotte, 1974), and we try to identify the specific features of these processes in the cases we examine. We pay special attention to the use made of the 'systemic reasoning' that is frequently highlighted in connection with agroecology (Meynard, 2017; Bawden, 1991; Darnhofer et al., 2012).

(ii) Different types of prescriptive resources have been described in the agronomy literature (ex. Mc Cown, 2001, Prost et al., 2016; Salembier et al., 2018): decision support tools, action rules, etc. By studying their agronomic contents, we aim to pinpoint the specific features of the resources produced in the cases examined.

What is meant by 'farming system design'?

We want to discuss what these initiatives contribute to the design of agroecological systems. We define 'design' as an activity by which a designer defines a new object that he wishes to see emerge, i.e. what the object is, its composition and constitution, who would use it, for what, when and in what conditions, etc. We see the design process as strongly dynamic (Hatchuel, Weil, 2003): the new object is defined over time, through iterations between specifying its properties and acquiring knowledge in and by situated action (Cook and Brown 1999). Designing assumes an intent to effect change, i.e. the formulation of a 'desirable unknown' (Hatchuel et al., 2011). We consider that the process is only partially predictable because it is subject to chance events in the situations (sometimes routine, sometimes surprising) where it takes place (Schön, 1983). Lastly, different 'resources' can be mobilised to support this activity and authors have shown that, depending on their properties (agronomic content, forms, etc.), these resources may convey widely differing design capabilities (e.g. Toffolini et al., 2016; Benade et al., 2016; Le Masson et al., 2013). In this paper we discuss the design capabilities conveyed by the resources produced by the initiatives examined.

METHOD

Using case studies

As the aim of this work is to better understand the epistemic processes by which innovative practices are harnessed for design purposes, we have taken a comprehensive research approach (Dumez, 2010) based on several case studies (Yin, 2003). As we wanted to explore the links between agronomic reasoning and a variety of prescriptive contents, cases (Table 1) were chosen by the following criteria. Initiatives had to be (1) intended to contribute to agroecological systems design; (2) based, at least partly, on producing and sharing knowledge of farmer practices that were considered innovative, (3) had produced resources that had already been shared/disseminated and (4) had emerged in a variety of institutional contexts. This last criterion was intended to widen the range of processes explored in our study. Other points of divergence emerged during our analysis: the when and where of the initiative, and the organisation of tasks involved in valorising the innovative practices. Where necessary, we will call the R&D actors preforming these tasks 'investigators'.

Data collecting

For this work we took an abductive approach (e.g. Duboi et Gadd, 2002), and data collecting and analysis were concomitant, within an iterative process.

Between January 2017 and February 2018, 23 semi-directive interviews were conducted with the promoters of all the initiatives studied. The interviews were structured so that the interviewee would made explicit the processes by which the work of valorising the innovative practices emerged, was performed and changed over time. Each interview was recorded and transcribed in full. In addition to the interviews, ten events (feedback meetings, farm open days, symposia) were observed. For each case we systematically collected documents presenting the initiative and its aims and development (PowerPoint presentations, project documents, websites, reports etc.) and the written or visual aids by which the innovative farmer practices were shared (technical data sheets, articles, videos etc.). In February 2018, the first analyses were presented to the initiative promoters and discussed over the course of a day. These discussions were taken into account in the second stage of the analysis.

Data analysis

A coding system based on the transcribed interviews, observations and written documents was developed and a series of iterations between single case and cross case analyses (Eisenhart, 1989) was performed. The analysis was from the investigator's standpoint, in order to reveal the link between their epistemic choices and the design resources produced. The coding brought out five categories of variables. One concerned the value fields the promoters specified as the reason for their work and the guidelines for their explorations. Another concerned the patterns of interaction, during the process, between the investigators and the farmers involved. A third category was that of reasoning operations performed during the process; these were analysed in relation to the agronomic contents (the fourth variable category) that were described, produced or transformed (Figure 1). The fifth category was the resources produced by the reasoning for the purposes of innovative farming system design.

	Case	Resources produced examined	Institution	When	Where	Brief description
1	ECOPHYTO	Scientific and technical articles	INRA	2014-2017	France	Studying the feasibility to reduce pesticide use in France through the statistical analysis of farming systems in 1000 farms engaged to innovate toward this objective
2	4SYSLEG project	Master's thesis	INRA	2015	One region	Tacking innovative practices on farm to learn on intercrop management in market gardening production, to design pesticide free cropping systems
3	Légitimes project	Technical article; Master's thesis	INRA	2015	3 regions	Tacking of farming innovative practices on farm to learn on intercrop management combining legumes and cereals and foster their development in French territories
4	AgriBio 1 project	Technical article	Agro-Transfert Ressources et Territoires	2014-2017	One region	Searching for farmers practicing intercrops with legumes, to manage weeds and nitrogen nutrition, and foster the development of organic agriculture
5	Berry network	Technical article	Terres Inovia	Ongoing	One region	Supporting the step by step design of innovative rapeseed crop management systems
6	Auto'N	Technical article	Chamber of Agriculture	2015-2020	One region	Supporting the step by step design of chemical nitrogen free cropping systems
7	Innov' Action	Technical article; physical discussion space	Chamber of Agriculture	Ongoing	One region	Organizing open-farm days to share innovative practices among local farmers
8	OSAE	Written testimonies; videos; virtual discussion space	Solagro (consultants)	Ongoing	France	Sharing testimonies of farmers on their agroecological practices on an internet platform
9	AgriBio 2 project	Technical articles	Agro-Transfert Ressources et Territoires	2014-2017	One region	Supporting the step by step design of organic farming systems in a region
10	Agri' novateurs network	Technical article; physical discussion space	Chamber of Agriculture	Ongoing	One department	Sharing testimonies of farmers among and beyond a local group
11	Atelier Paysan	Technical article; virtual discussion space	Farmer workshop	Ongoing	France	Sharing testimonies of farmers that designed auto-constructed machineries in support of organic farming
12	Vitinnobio project	Technical article	Institut Français de la Vigne et du Vin	2013 - 2017	3 regions	Sharing testimonies of farmers engaged in organic vine production

Table 1: The initiatives selected as case studies

RESULTS

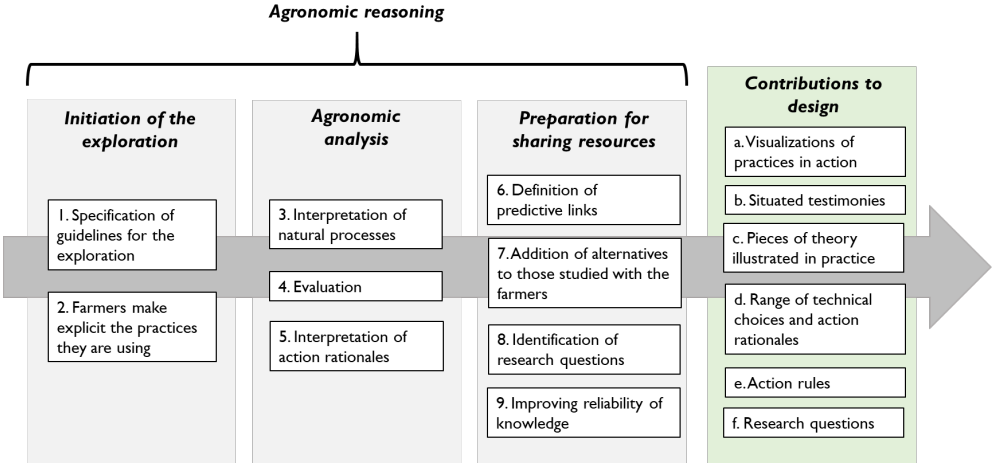


Figure 1: Different dimensions of the processes studied

To present our results, we describe first of all the farming system design resources produced as output from the initiatives (six resources, numbered a to f in Figure 1), then the agronomic reasoning operations performed in the process of producing the outputs (9 operations, numbered 1 to 9 in Figure 1).

Contributions of the initiatives studied to the design of agroecological systems: a wide-ranging panorama of resources

The cross-case analysis revealed a wide range of resources produced in aid of farming system design. Cross-analysis of the resources led us to divide them into six types differing in terms of (i) the form in which the agronomic content is shared (e.g. written material, field visit), (ii) the subject concerned by the resource, (iii) the agronomic content, (iv) the nature of the systemic links present in the agronomic content (v) the flexibility of the resource (e.g. can users adapt the content to their needs?) and (vi) the role of the innovative farmer practices in these resources.

Type of output	Form of the resource	Subject	Cases	Agronomic content					Nature of systemic links
				Situation links	Techniques	Agronomic situation	Knowledge of natural processes	Results	
a) Videos of practices in action	Videos	A technique	8, 11	Contextualised	A technique 'in action'	The environment and its changes before, during and after the action	Agronomic processes in play in relation to field conditions and actions	Field conditions showing effectiveness of the action	Visualisation of action under way enables 'action-situation-process-performance' links to be perceived
b) Collections of testimonies	Written material	An area of innovation	7, 8, 10, 11, 12	Contextualised	The technique(s) applied by a farmer, his action indicators	General context and aspects of the situation mentioned by the farmer to explain his/her technical choices and to interpret processes	Agronomic processes involved, referred to by the farmer	Level of farmers' satisfaction by their own criteria	Links, via written output, between different agronomic contents revealing the overall coherence of what the farmer has done in his situation
	Interaction spaces	A technique	7, 8, 10		Agronomic content depends on the discussions that take place at the event				Links constructed collectively during oral interaction
c) Technical choices and action rationales	Written material	A technique	2, 3, 4	Contextualised	A set of technical options taken by different farmers	Aspects of the situation mentioned by the farmers to explain their technical choices	Agronomic mechanisms referred to by the farmers; generic agronomic mechanisms	Level of farmers' satisfaction by their own criteria	Links between technical options and the reasons why farmers chose them, and between technical options, field conditions and agronomic mechanisms
d) Pieces of theory	Written material	A component of the agroecosystem to be managed sustainably	6, 9	Decontextualised	Generic techniques; generic action indicators	Conditions affecting the agrosystem component to be managed and implementation or efficacy of certain techniques	Knowledge of the biology/ physicochemistry of the component, generic agronomic mechanisms	/	Links are suggested in the documents or illustrated by testimonies
e) Decision rules	Written material	A technique / performance	1, 5	Decontextualised	Generic techniques	Types of agronomic situation	/	Economic and agroenvironmental performance criteria	Links between types of agronomic situation and technical options for achieving performance goals

Table 2: Types of resource produced, by distinguishing properties.

We will refer to Table 2 as we describe what the resources in each type have in common, in relation with the six distinguishing properties described previously.

a) Visualisations of practices in action. These are videos showing practices 'in action' and in situ. Each shows a farmer's actions in relation to initial conditions and how they change (soil, climate, pests, state of equipment during use, etc.). In some videos the farmer comments on what he is doing and describes the feedback he gets from the situation, which enables him to continue his action or assess its effects. The video of the action being performed shows the systemic links governing the coherence between action, situation, natural processes and the performance objectives.

b) Collections of testimonies. Each of these is a collection of accounts of a wide range of farmer practices concerning the same innovation area, such as organic vinegrowing. Each farmer's narrative, whether in written form or oral (e.g. at a farm open day), describes the coherent overall approach that led him to think up a new technical system and put it into practice in the particular way he did. The farmer's account shows the systemic links between the techniques he has used, his past decisions, the specifics of his agronomic situation (human resources, equipment, arable area, livestock units, soil and climate conditions etc.), his performance criteria and level of satisfaction, and under what conditions he takes action (the indicators he uses). In four cases, farmers' contextualised accounts were supplemented in written form or orally (farm advisor) by other agronomic contents, to prompt interpretation of the natural processes affected by the practices, or the farmer's assessment on other criteria; sometimes they suggest conditions for adapting their techniques to other situations, or ways of thinking up alternatives. In two cases the written output was just one stage in building on farmers' experience: each testimony is updated annually to see how the practice develops. Discussion spaces are flexible, in that they only partly determine the agronomic content that will be shared.

c) Sets of technical choices and action rationales. These resources are in the form of fixed written outputs about farmer practices. The main difference between these and the previous type is that these outputs focus on a specific technique (intercropping) and concern a panorama of practices by farmers referring to that technique. Contrasting with testimonies, they do not concern the ensemble of each farmer's practices but compare 'pieces' of these ensemble in different farmer's situation. We find two kinds of agronomic content in the writings. The first concerns the various techniques involved in intercropping (e.g. sowing, choice of associated species, their spatial arrangement), the technical choices made when implementing them (e.g. sowing date, spacing pattern) and the reasons why the farmers chose those options. The second kind concerns action rationales: keys for triggering an agronomic mechanism (e.g. for installing a physical barrier to prevent pest dispersal), i.e. links between a mechanism, field conditions and techniques.

d) Decontextualised pieces of theory. This type differs from the previous three in that the written outputs focus primarily on decontextualised pieces of agronomic theory. They also focus on a particular subject, a component of the agroecosystem that needs to be managed sustainably (e.g. perennial weeds in organic farming). The 'pieces of theory' shared may be: items of knowledge from biology, physics or chemistry intended to explain something about the component to be managed (e.g. its composition or functioning), agronomic mechanisms for managing the component in the field (e.g. species competition, weed removal), generic techniques (e.g. hoeing, introducing alfalfa) and the conditions for their use (e.g. perennial weeds are most vulnerable and easily destroyed when they are at the 'compensation stage'). The links between these contents may be suggested in the text (e.g. "Strategy type is to be chosen according to the weed species concerned, because its efficacy depends on the weed's biological characteristics" (case 9)) or through examples of farmers' technical systems. In these writings, what has been learnt from farmers' practices is added as an 'original idea' that has been applied in a situation (e.g. a farmer tills frozen ground to manage weeds) or, through testimonies to illustrate the generic theory in practice.

e) Action rules. These resources take the form of written outputs in which farmers' practices are not described. The outputs focus on a particular technique (e.g. oilseed rape intercropped with a highly frost-sensitive legume) or a performance target (reduction in pesticide use). The agronomic content is decontextualised; it consists of links between types of agronomic situation and 'suitable' technical options for achieving given performances (e.g. "Sowing should be done early (…) especially on clayey soil and in cooler regions, taking soil and weather conditions into account (ideally, when rain is expected shortly). If possible, prefer dates early in the recommended time bracket for cold, clayey soils and late in the time bracket for soils where nitrogen is more readily available." (Case 5)).

f) Research questions. Sometimes the resource produced consists of research questions. Some such questions concern the scope of validity of a theoretical concept in agronomy (e.g. what would be the 'preceding crop effect' in a field where different species or varieties have been intercropped? (case 3)).

Others concern incompleteness or inconsistency in scientifically validated knowledge (e.g. how does spraying a decoction of valerian help to heal frost-damaged vine leaves? (case 12)).

Agronomic reasoning operations that structure resource production

In this section we aim to better understand where these resources emerge from. We specify relationships that have emerged from the cross-case analysis between 'types of resource produced' (section 5.2) and the 'reasoning operations' set out in Table 3.

	n°	Reasoning operations	Details of epistemic processes	n°	Methods used in different cases	Cases
Orientation and initiation of the exploration	1	Orientation of the exploration	Specifying what counts as 'innovative farmer practices': (i) they concern widely different aspects of technical systems, (ii) they are 'hitherto unknown' to those studying them, (iii) they embody value fields it is hoped to develop in agriculture	1.1	Identifying farmer practices that address value fields not much explored in agricultural R&D so far	7, 8, 10, 11, 12
				1.2	Identifying farmer practices that address technical concepts whose practical applications are not well known	2, 3, 4
				1.3	Helping farmers design technical systems so as to learn how they manage sustainably a biological or physicochemical component of the agroecosystem	5, 6, 9
				1.4	Identifying practices used by farmers who are committed to achieving good economic-environmental performances	1
	2	Farmers make explicit their practices	By various means, getting farmers to explicit their practices	2.1	Semi-directive interviews or group discussions, farmer's a posteriori account of his practice in his situation	7, 8, 10, 11, 12
				2.2	Semi-directive interviews, explanation of the reasons that led different farmers to apply the same technique in different ways	2, 3, 4
				2.3	Discussion by various channels, during the action, about the practices being used by several farmers to manage a biological or physicochemical component of the agroecosystem	5, 6, 9
				2.4	Directive survey, to enter into a database variables that the investigators have identified in advance	1
Agronomic analysis	3	Interpretation of the natural processes involved	Choosing a level of interpretation and systemic analysis: identifying and ranking the agroecosystem components involved in natural processes, to define the causal links between components and between them and the agronomic situation	3.1	Analysis, during or after the action, of the natural processes involved	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
				3.2	Identification of agronomic mechanisms that can activate certain natural processes	
	4	Evaluation	Using indicators to assess possible performance or achievements in terms of chosen assessment criteria	4.1	Evaluation on farmer's criteria	2, 3, 4, 5, 6, 7, 10, 11
				4.2	Evaluation on investigator's criteria	1
				4.3	Combination of farmer's and investigator's criteria	8, 9, 12
	5	Interpretation of action rationales	Choosing a level of interpretation, constructing causal links by which to understand why a farmer has acted as he has and/or in some cases understand how those actions enabled him to achieve his performance goals. This analysis involves mobilising knowledge from agronomy-related disciplines (e.g. chemistry, biology, economics)	5.1	Qualitative systemic analysis of a practice, after it has taken place, to explain the rationale of the farmer's action in his situation	7, 8, 10, 11, 12, 2, 3, 4, 5, 6, 9
				5.2	Cross-case qualitative analysis of the action rationales of several farmers who have implemented the same technique, in order to classify the different 'technical options' implemented along with the reasons farmers gave for having chosen them	2, 3, 4, 5, 6, 9
				5.3	Cross-case qualitative analysis of the agronomic reasoning of farmers using the same technique: relating technical options to agroecosystem characteristics and agronomic mechanisms. The aim of this operation is to bring out decontextualised action rationales	2, 3, 4, 5, 6, 9
				5.4	Quantitative analysis, using statistical tests, to identify correlations between techniques, variables of the agronomic situation and performance levels	1
Preparation for dissemination	6	Prediction of effects of actions	Defining predictive links between a type of situation, a technique and expected performance levels, from repeated observations of the same phenomenon			1, 5
	7	Addition of alternatives to those studied on farms	Seeking and specifying alternatives (other technical options for achieving an agronomic mechanism; new performance criteria, conditions for action etc.)	7.1	From the literature, the investigators' knowledge, step by step design	5, 6, 7, 9, 10, 12
				7.2	By the state of the art on a particular subject	6, 9
	8	Identification research questions	Identifying incompleteness or inconsistency in agronomic theory	/	Using pieces of scientifically validated theory to interpret processes, assessment results or action rationales	1, 2, 3, 5, 6, 9, 10, 12
	9	Checking the reliability of the knowledge	Comparing knowledge from several sources, for greater certainty about the agronomic content shared	9.1	Farmers involved review the analysis	7, 8, 10, 11
				9.2	Comparing what farmers say with pieces of scientifically validated theory	2, 3, 4, 5, 6, 8, 9, 10, 12
				9.3	Comparing farmers' convergent explanations	2, 3, 4
				9.4	Validating performances with assessment tools	1
				9.5	By field observation	4, 5, 6,

Tableau 3: Description of the nine reasoning operations identified in the case analysis, the epistemic processes involved in each and the various ways they are performed.

1. Orientations of the exploration	2. Explanation of practices	Agronomic analyses			Preparation for dissemination				
		3	4	5	6	7	8	9	10. Choice of contents and formats
(1.1)	**(2.1)**	(3.1)	(4.1 or 3)	**(5.1)**	/	**(7.1)**	/	**(9.1)**	a, b) Testimonies / visualisation of practices in action
(1.2)	**(2.2)**	(3.1) + (3.2)	(4.1)	**(5.2) + (5.3)**	/	**(7.1)**	/	**(9.2) some times (9.3)**	c) Sets of technical options and action rationales
(1.3)	**(2.3)**	(3.1) + (3.2)	(4.1)	**(5.1)**	/	**(7.1) and (7.2)**	/		d) Pieces of theory
(1.3) or (1.4)	(2.3) or (2.4)	Nothing or (3.1)	**(4.2)**	**(5.5)**	**6**	various	/	**(9.4)**	e) Action rules
Various	Various	Various	**(4.2)**	**(5.5)**	/	/	**8**	/	f) Research questions

Table 4: Each line specifies the links identified between reasoning operations (codes from Table 3) and resources (codes from Table 2). A slash (/) means that the operation was not observed to generate this resource, and 'various' means the operations differed between cases. In bold type: the most differentiating operations for that row

Table 4 sets out the links we have identified between reasoning operations (Table 3) and resource properties (Table 2). It shows that, in several cases, the same reasoning chains help to generate resources of the same type, but it also shows that a single reasoning operation can help to generate several different resources.

a) Visualisations of practices in action and (b) testimonies were produced when investigators wished to promote farmers' unique innovative practices, using various media. They were all the fruit of initiatives (cases 7, 8, 10, 11 and 12) where investigators had identified practices addressing value fields that have been little explored in agricultural R&D (e.g. developing agroecology in a region) (1.1). In these cases, identification of the innovative practices was an open process in that the value fields did not, a priori, point to types of practice to be identified, and that the identifiers were a wide range of actors, each viewing the value field in question from their own standpoint. The agronomic contents putted into circulation/shared were as varied as the practices identified. They were based on coupling a farmer's account of his practices (2.1) with a qualitative analysis of this account, in order to explain the farmer's action rationale in his particular situation (6.1). In cases 8, 10 and 11, changes in the farmer's practices were followed up year by year. In some testimonies, the authors produced a quantified evaluation (4.3) of the practice and they identified knowledge that suggests alternative techniques or other natural processes or conditions for action (7.1). The reliability of the knowledge was checked, in most cases, by the farmer reviewing the investigator's transcription and analysis of his practices (9.1).

c) The sets of technical options and action rationales all concerned the technical concept of intercropping and were designed to share keys for implementing it. In all three initiatives, intercropping had been identified as a technical concept worth promoting as it is known to foster certain natural processes (e.g. by choosing species that occupy complementary nutrient niches) and improve sustainability (e.g. by reducing the use of chemical fertiliser). But the investigators lacked the knowledge to put the concept into practice (What species to choose? What spatial arrangement to choose and why? How to manage a mixed crop stand? etc.), which led them to seek out the few farmers already practicing intercopping on their farms (1.2). These farmers were interviewed about all the technical choices they had made and why they had chosen those options (2.2). Since all the interviews concerned the same technical concept, the investigators were able to make within-case and cross-case analyses of the farmers' action rationales (5.1). One type of cross-case analysis (5.2) consisted of extracting and comparing elements of the farmers' action rationales, revealing the links between the 'technical options' the farmers chose and the 'reasons' for their choices. This analysis produced the 'sets of technical choices'. The reliability of the content of these resources depended on farmers' statements and, in case 4, cross-checked by field observations. The other type of cross-case analysis (5.3) consisted of connecting components of farmers' action rationales with known natural regulation mechanisms in agronomy (e.g. dilution effect, stake effect, push-pull effect). By iteration between agronomic knowledge and the situations observed, this operation reveals plausible links between technical options, agroecosystem features and agronomic mechanisms. The cross-case analysis leads to generic action rationales. In these cases, the reliability of the knowledge is checked by comparing farmers' statements with pieces of scientifically validated theory (9.2).

d) Decontextualised pieces of theory were disseminated because they had been useful when the investigators were assisting farmers in their step-by-step design of technical systems (2.3). These cases differed from those above in that no 'innovative' practice existed at the outset: the investigators were assisting their design in situ. These initiatives followed regional diagnostic studies (cases 5 and 9) which had found that, although there were known techniques for managing an agroecosystem component (e.g. nitrogen) sustainably, there had been little progress in on-farm practice. The investigators reckoned that by assisting on-farm design they could learn how these known techniques could come alive in practice. In both cases the exploration focused on management of one agroecosystem component (e.g. weeds in organic farming) (1.3). The farmers involved were keen to commit to the approach. What was innovative was the reasoning that led them to think up an innovative technical system and put it into practice. Also, the decontextualised pieces of theory coupled the state-of-the-art elements applied to the exploration subject (7.2) with what they had learnt during in situ design in different situations (5.1, 5.3, 7.1).

e) Action rules emerge from agronomic reasoning aimed at producing predictive agronomic content (6). In case 5, these predictions coupled what investigators had learnt while assisting step-by-step design of innovative technical systems (3.1, 6.1) with other observations they had made in controlled experiments or with famers not in the Berry network. In case 1, the rules emerged from statistically identified regularities between 'techniques', variables in the agronomic situation and levels of performance. In this case the content was obtained through directive surveys which fed a database the investigators had defined in advance (2.4). It was the investigator who determined the systemic links on a statistical basis (5.4; 9.4) after assessing the performance of the technical systems using computer models (4.2).

f) Research questions. To identify these, prior analytical work was required (operations 3, 4 and 5). The questions emerged from comparing farmers' practices with scientifically validated theoretical knowledge.

DISCUSSION AND CONCLUSION

Resources to support agroecological system design: new 'objects to be designed'?

This study adds to our knowledge of what resources can emerge from studies of farmers' innovative practices. Below we discuss the properties likely to give these resources a 'generative capability' (Hatchuel et al., 2011) – a potential for stimulating farming system design (as defined in the conceptual background).

Our results show that the 'agronomic contents' disseminated by the investigators were very varied. In two cases the content was similar to the 'decision rules' which, as Le Masson and Weil (2013) explain, are poorly adaptable and are designed mainly for taking quick decisions with predictable outcomes (Sebillotte, 1978). The other agronomic contents studied are more like 'heuristic markers for action', intended to stimulate reflection and creative thought (Avenier & Schmitt, 2007).

Several resources propose 'alternatives' (several possible techniques, action conditions, performance criteria etc.), presented as system building 'bricks' to be selected from, with no prior definition of what to do. The link between techniques, agronomic situations, performances and processes are 'non-deterministic' (Le Masson et al., 2013) in that they are simply suggestions. This process is similar to what Benade et al. (2016) describe concerning 'use generative products', in that what can be done with the object is only partly suggested to the user, leaving them free to 'self-design the use'.

One challenge for agroecology is to help farmers appropriate and adapt to their own farms content that is either generic or has been produced in connection with another situation. Agricultural advisors can assist this process on farm open days, as Girard & Magda (2018) have shown. In other cases, the written output suggests ways to adapt to local conditions, either by specifying the 'conditions' for an action's implementation and efficacy, or by suggesting 'indicators' for triggering or monitoring the action (Toffolini et al., 2016; Lyon, 1996). With the 'decontextualised pieces of theory', testimonies 'illustrate' how some generic knowledge items can be contextualised.

For agronomic prescription, testimonies can be a way to address the difficulties of describing the many interdependencies that must be addressed in the agroecological context. They are, as Goulet (2017) explains, very useful for revealing the systemic complexity of change in this context.

There was also agronomic content to aid 'understanding', such as content about natural processes that provide keys for proving causality (Laurent et al., 2009) either before, during or after the action. The 'agronomic mechanisms', by contrast, are like 'concepts' (Hatchuel & Weil, 2003) that highlight design spaces in which different linkages between techniques/actions, situations, natural processes and performances can be conceived.

Flexibility seems to us a particularly original and promising property for designing resources that are adaptable and suitable for the diversity of situations and designers in agriculture (e.g. Prost et al., 2016).

The diversity of the 'resources' we have described suggests that it is important to regard them as objects to be designed, which we propose to call 'vectors of generative capability'. The properties we described offer an initial handle for thinking up such resources, and could usefully be supplemented by studying other emerging resources (e.g. Prost et al., 2018; Reau et al., 2017). As Chantre & Cardona (2014) have shown, it is important to design a diversity of resources to cope with variability (Darnhofer et al., 2010). There must be diversity in the forms, contents of resources, but also in the types of knowledge they produce or convey. Whereas most of the resources we studied are based on explicit knowledge, the videos and face-to-face discussions suggest channels for sharing tacit, sensory knowledge. Another challenge will be to design resources specifically to stimulate 'action' itself (what Cook and Brown (1999) call 'knowing as action'), whose creative power has been little studied as such in agronomy.

For a blossoming of innovative practices in agronomy

This research has brought to light the original epistemic processes by which knowledge of innovative practices is shared and disseminated, and the results show that there is no 'right way to do it'. All the investigators had conceived or adapted their 'agronomic practices' in light of the 'innovative farmer practices' they discovered.

A key result of the work is the matrix showing a diversity of agronomic reasoning operations, each of which contributes to the construction of a widely varied set of epistemic processes. This matrix complements earlier works on farmers' practices (e.g. Landais et al., 1988; Milleville, 1988; Gras et al., 1989; Sebillotte, 1974), bringing to light operations that are rarely spelled out explicitly, or are specific to the study of 'innovative' practices.

We identify four original reasoning operations intended to 'prepare for the dissemination stage' of agronomic content. One concerns how knowledge is checked for reliability, a topic of lively debate in agronomy today (Doré et al., 2011); we pinpoint different ways this is done in the context of design support. We also show that definitions of what makes a practice 'innovative' vary widely from case to case (as Le Masson et al. (2006) also observed). Organizing the collective definition of 'innovative' would be major asset for developing 'shared and distributed' design processes (Salembier et al., 2018).

Our results also show that ‘studying innovative practices’ enriches agronomic reasoning in several ways. (i) It helps us find our way in innovation fields that are underexplored by R&D; identifying innovative practices is thus similar to identifying 'need-solution pairs' (Von Hippel & Krogh, 2016). (ii) It helps agronomic reasoning to explore hitherto unseen systems (Agogué et al., 2013) and enriches our representations of farming systems, in the same way as Le Masson & Magnusson (2013) and Von Hippel (2005) for industry. (iii) It also offers approaches for explicitly sharing design work with farmers.

The different ways of addressing farmers' practices highlight tensions over how to consider knowledge in agronomy: it is sometimes seen as a 'stock' that can be examined at time t, then transmitted and applied as it stands, and sometimes as a process, an integral part of the action (Briggs, 2013), so that in different situations it is appropriated and transformed. This distinction considerably alters the relationship with the farmer interviewed and with the mutual benefits of the endeavours (Pretty, 1995), and we feel that being aware of these distinctions could considerably enrich the range of resources we design.

We have also identified different ways of operationalising 'systemic thinking', an approach that is widely employed in the context of agroecology (Meynard et al., 2012) but whose operationalisation in agronomy is often implicit. Our findings show that one case study is similar to what has been called a 'hard system' (Darnhofer et al., 2012), while in the rest, the system studied emerges from interactions between investigator and respondent, and from the former's analytical choices (Ison, 2012). The results show several ways of operationalising this type of approach, and show that epistemic choices are partly linked to the resources the investigators want to produce. In some cases, we also show the crucial role of 'agronomic mechanisms', rarely elucidated, which agronomists use in their analyses to bring knowledge from agronomy-related disciplines to bear on farmers' time- and place-specific actions.

This study has highlighted some features of emerging agronomic practices, initiatives that are a marginal part of agricultural R&D so far. These agronomic practices change the relationship with what is 'anomalous' in farmers' practices, and we have identified some first avenues towards Fallen's suggestion (Fallen, 2009) that, rather than seeing anomalies as deviations revealing incompleteness in agronomic models (Jansen, 2009), we should explore them as what she calls 'creative anomalies'.

This work has been done in collaboration with Jean-Yves Porhiel, Marie-Hélène Jeuffroy, Marie-Sophie Petit, Claire Cros, Raymond Reau, Nicolas Sinoir, Aïcha Ronceux, Marine Gimaret, Elise Favrelière, Audrey Petit, Leaticia le Breton, Stéphane Cadoux, Sébastien André, Martin Lechenet, Camille Noilhan, we all thank them gratefully for their contributions to this work and for sharing with us their 'innovative agronomic practices'. We also thank Harriet Coleman for the English translation of this paper.

REFERENCES

Agogué, M., Kazakçi, A., Hatchuel, A., Le Masson, P., Weil, B., Poirel, N., Cassotti, M., 2013. The Impact of Type of Examples on Originality : Explaining Fixation and Stimulation Effects. J. Creat. Behav. 48, 1–12. doi:10.1002/jocb.37

Alvarez, S., Timler, C.J., Michalscheck, M., Paas, W., Descheemaeker, K., Tittonell, P., Andersson, J.., Groot, J., 2018. Capturing farm diversity with hypothesis- based typologies : An innovative methodological framework for farming system typology development. PLoS One 1–24. doi:10.1371/journal.pone.0194757

Avenier, M., Schmitt, C., 2007. Élaborer des savoirs actionnables et les communiquer à des managers. Rev. française Gest. 5, 25–42. doi:10.3166/rfg.174.25-42

Barbier, M., Elzen, B., 2012. System innovations, knowledge regimes and design practices towards transitions for sustainable agriculture. INRA, Paris.

Bawden, R.J., 1991. Systems Thinking and Practice in Agriculture '. J. Dairy Sci. 2362–2373.

Benade, M., Brun, J., Le Masson, P., Weil, B., 2016. How smart products with built in flexibility empower users to self - design the use : A theoretical framework for use generation, in: 14th Open and User Innovation Conference, Boston, United-States. Boston.

Blanc-Pamard, C., Deffontaines, P., Friedberg, C., 2013. Techniques et pratiques : à la jonction du naturel et du social, in: Sciences de La Nature, Sciences de La Société. pp. 1–19.

Christian, B., Laurence, G., David, M., Anne, A., Philippe, G., Sylvain, P., 2008. Review article Agri-environmental indicators to assess cropping and farming systems. A review. Agron. Sustain. Dev. 28, 139–149.

Bredart, D., Stassart, P.M., 2017. When farmers learn through dialog with their practices : A proposal for a theory of action for agricultural trajectories. J. Rural Stud. 53, 1–13. doi:10.1016/j.jrurstud.2017.04.009 Briggs, J., 2013. Indigenous knowledge: A false dawn for development theory and practice? Prog. Dev. Stud. 3, 231–243. doi:10.1177/1464993413486549

Briggs, J., 2013. Indigenous knowledge: A false dawn for development theory and practice? Prog. Dev. Stud. 3, 231–243. doi:10.1177/1464993413486549

Chantre, E., Cardona, A., 2014. Trajectories of French Field Crop Farmers Moving Toward Sustainable Farming Practices: Change, Learning, and Links with the Advisory Services. Agroecol. Sustain. Food Syst. 38, 573–602. doi:10.1080/21683565.2013.876483

Cohen, A.G., 2017. Des lois agronomiques à l'enquête agroécologique. Esquisse d'une épistémologie de la variation dans les agroécosystèmes agroécologique. tracés.

Cook, S.D.N., Borwn, J.S., 2005. Bridging Epistemologies : The Generative Dance between Organizational Knowledge and. Organ. Sci. 10, 381–400.

Coquil, X., Dedieu, B., Béguin, P., 2018. Professional transitions towards sustainable farming systems : The development of farmers ' professional worlds. work 325–337. doi:10.3233/WOR-172565

Darnhofer, I., Bellon, S., Dedieu, B., Milestad, R., 2010. Adaptiveness to enhance the sustainability of farming systems. A review. Agron. Sustain. Dev. 30, 545–555. doi:https://doi.org/10.1051/agro/2009053

Darnhofer, I., Gibbon, D., Dedieu, B., 2012. Farming Systems Research into the 21st Century: The New Dynamic. Springer Netherlands, New York. doi:10.1007/978-94-007-4503-2

Doré, T., Makowski, D., Malézieux, E., Munier-Jolain, N., Tchamitchian, M., Tittonell, P., 2011. Facing up to the paradigm of ecological intensification in agronomy: Revisiting methods, concepts and knowledge. Eur. J. Agron. 34, 197–210. doi:10.1016/j.eja.2011.02.006

Dubois, A., Gadde, L., 2002. Systematic combining : an abductive approach to case research 55, 553–560.

Dumez, H., 2013. Qu'est-ce que la recherche qualitative ? Problèmes épistémologiques, méthodologiques et de théorisation. Ann. des Mines - Gérer Compr. 112, 29. doi:10.3917/geco.112.0029

Eisenherdt, K.M., 1989. Building Theories From Case Study Research. Acad. Manag. Rev. 14, 532–550.

Elzen, B., Janssen, A., Bos, B., 2017. Portfolio of promises: Designing and testing a new tool to stimulate transition towards sustainable agriculture, in: AgroEcological Transitions Changes and Breakthroughs in the Making. doi:10.18174/407609

Fallen, C., 2012. L'anomalie créatrice. Editions Kimé, Paris.

Feike, T., Chen, Q., Graeff-Hönninger, S., Pfenning, J., Claupein, W., 2010. Farmer-developped vegetables itercropping systems in southern Hebai, China. Renew. Agric. Food Syst. 25, 272–280.

Girard, N., 2015. Knowledge at the boundary between science and society: a review of the use of farmers' knowledge in agricultural development. J. Knowl. Manag. 19, 949–967. doi:10.1108/JKM-02-2015-0049

Girard, N., Magda, D., 2018. Les jeux entre singularité et généricité des savoirs agro-écologiques dans un réseau d'éleveurs. Rev. d'anthropologie des connaissances 12, 199–228. doi:10.3917/rac.039.0199

Goulet, F., 2017. Explorer et partager . Les expériences de réduction des pesticides dans une revue professionnelle agricole. Econ. Rural. 103–120.

Gras, R., Benoit, M., Deffontaines, J.P., Duru, M., Lafarge, M., Langlet, A., Osty, P.L., 1989. Le fait technique en agronomie. L'Harmattan, Paris.

Hatchuel, A., Le Masson, P., Weil, B., Reich, Y., 2011. A systematic approach of design theories using generativeness and robustness. Int. Conf. Eng. Des. 87–97.

Hatchuel, A., Weil, B., 2003. A new approach of innovative design: an introduction to C-K theory, in: Folkeson, A., Gralen, K., Norell, M., Sellgren, U. (Eds.), International Conference on Engineering Design. Stockholm, pp. 109–110.

Ison, R.L. (2012). Systems practice: Making the systems in Farming Systems Research effective.In: I. Darnhofer, D. Gibbon, and B. Dedieu (Eds.). Farming systems research into the 21stcentury: The new dynamic. Dordrecht: Springer, pp. 137–153.

Jansen, K., 2009. Implicit Sociology, Interdisciplinarity and Systems Theories in Agricultural Science 49. doi:10.1111/j.1467-9523.2009.00486.x

Landais, E., Deffontaines, J., Benoît, M., 1988. Les pratiques des agriculteurs. Point de vue sur un courant nouveau de la recherche agronomique. Etud. Rurales 109, 125–158. doi:10.3406/rural.1988.3226

Laurent, C., Baudry, J., Berriet-Solliec, M., Kirsch, M., Perraud, D., Tinel, B., Trouvé, A., Allsopp, N., Bonnafous, P., Burel, F., Carneiro, M.J., Giraud, C., Labarthe, P., Matose, F., Ricroch, A., 2009. Pourquoi s'intéresser à la notion d' « evidence-based policy » ? Rev. Tiers Monde 200, 853. doi:10.3917/rtm.200.0853 Le Masson, P., Weil, B., Hatchuel, A., 2006. Les processus d'innovation. Conception innovante et croissance des entreprises. Lavoisier, Paris.

Le Masson, P., Hatchuel, A., Weil, B., Mina, D., 2013. Teaching at Bauhaus: improving design capacities of creative people? From modular to generic creativity in design-driven innovation, in: 10th European Academy of Design Conference: Crafting the Future. p. 23 p.

Le Masson, P., Magnusson, P., 2003. User involvement: From ideas collection towards a new technique for innovative service design. 2nd World Conf. Mass Cust. Pers. 23.

Le Masson, P., Weil, B., 2013. Design theories as languages for the unknown : insights from the German roots of systematic design (1840-1960). Res. Eng. Des. 24, 105–126. doi:https://doi.org/10.1007/s00163-012-0140-2

Lyon, F. 1996. How farmers research and learn: The case of arable farmers of East Anglia, UK. Agriculture and Human Values 13(4):39–47.

Mccown, R.L., 2001. Learning to bridge the gap between science-based decision support and the practice of farming : Evolution in paradigms of model-based research and intervention from design to dialogue. Aust. J. Agric. Res. 52, 549–571. doi:https://doi.org/10.1071/AR00119

Meynard, J., Dedieu, B., Bos, A., 2012. Re-design and co-design of farming systems. An overview of methods and practices, in: Darnhofer, I., Gibon, D., Dedieu, B. (Eds.), Farming Systems Research into the 21st Century: The New Dynamic. Springer, Paris, pp. 407–432.

Meynard, J.-M., 2017. L'agroécologie, un nouveau rapport aux savoirs et à l'innovation. Oilseeds fats Crop. Lipids 24. doi:10.1051/ocl/2017021

Michel-Dounias, P.J.I., Ngnogue, T., Male, E., 2012. Afforestation of savannah with cocoa agroforestry systems : a small-farmer innovation in central Cameroon. Agroforestery Syst. 493–504. doi:10.1007/s10457-012-9513-9

Milleville, P., 1987. Recherches sur les pratiques des agriculteurs. Les Cah. la Rech. développement.

Moity-Maïzi, P. (2011). Interroger la localisation et la circulation des savoirs en Afrique. Revue d'anthropologie des connaissances, 53(3), 473‑491. http://doi.org/10.3917/rac.014.0473

Osty, P., 1978. L'exploitation agricole vue comme un système. Diffusion de l'innovation et contribution au développement. Bull. Tech. d'Information 326, 43–49.

Pretty, J.N., 1995. Participatory learning for sustainable agriculture. World Dev. 23, 1247–1263. doi:https://doi.org/10.1016/0305-750X(95)00046-F

Prost, L., Berthet, E.T.A., Cerf, M., Jeuffroy, M.-H., Labatut, J., Meynard, J.-M., 2016. Innovative design for agriculture in the move towards sustainability: scientific challenges. Res. Eng. Des. doi:10.1007/s00163-016-0233-4

Prost, L., Reau, R., Paravano, L., Cerf, M., Jeu, M., 2018. Designing agricultural systems from invention to implementation : the contribution of agronomy . Lessons from a case study 164, 122–132. doi:10.1016/j.agsy.2018.04.009

Reau, R., Cros, C., Leprun, B., Merot, E., Omon, B., Paravano, L., 2016. La construction des schémas décisionnels et leur mobilisation dans le changement des systèmes de culture. Agron. Environ. sociétés 6, 83–92.

Salembier, C., Segrestin, B., Berthet, E., Weil, B., Meynard, J.M., 2018. Genealogy of design reasoning in agronomy: Lessons for supporting the design of agricultural systems. Agric. Syst. 164, 277–290. doi:10.1016/j.agsy.2018.05.005

Schön, D. 1983. The reflective practitioner: how professionals think in action. Basic Books, New York

Sebillotte, M., 1974. Agronomie et agriculture. Essai d'analyse des tâches de l'agronome. Cah. l'ORSTOM, Série Biol. 3–25.

Smith, A., Fressoli, M., Thomas, H., 2014. Grassroots innovation movements : challenges and contributions. J. clean Prod. 63, 114–124. doi:10.1016/j.jclepro.2012.12.025

Teissier, J.M., 1979. Relations entre techniques et pratiques. Bull. INRAP 38.

Toffolini, Q., Jeuffroy, M.H., Prost, L., 2016. Indicators used by farmers to design agricultural systems: a survey. Agron. Sustain. Dev. 36, 1–14. doi:10.1007/s13593-015-0340-z

Toffolini, Q., Jeuffroy, M.H., Mischler, P., Pernel, J., Prost, L., 2017. Farmers' use of fundamental knowledge to re-design their cropping systems: situated contextualisation processes. NJAS - Wageningen J. Life Sci. 80, 37–47. doi:10.1016/j.njas.2016.11.004

Von Hippel, E., 2005. Democratizing innovation. MIT Press, Cambridge.

Von Hippel, E. Von, Krogh, G. Von, 2015. Identifying Viable " Need – Solution Pairs ": Problem Solving Without Problem Formulation.

AFFILIATION

Chloé SALEMBIER

Affiliation: PhD student at INRA, in agronomy-management sciences.

Article: Salembier, C., Segrestin, B., Berthet, E., Weil, B., Meynard, J.M., 2018. Genealogy of design reasoning in agronomy: Lessons for supporting the design of agricultural systems. Agric. Syst. 164, 277–290. doi:10.1016/j.agsy.2018.05.005

Institutional contact: UMR SADAPT, INRA, AgroParisTech, Université Paris-Saclay, 75005, Paris, France ; chloe.salembier@inra.fr

Blanche SEGRESTIN

Affiliation: Professor at MinesParisTech, in management sciences

Article : B. Segrestin, K. Levillain, S. Vernac et A. Hatchuel, eds. (2016), *La Société à Objet Social Etendu : un nouveau statut pour l'entreprise*, Economie Gestion. Paris : Presses des MINES, 2015 Segrestin, B., Roger, B., & Vernac, S. (2014). (Eds.), *L'entreprise, point aveugle du savoir ?* Sciences Humaines.

Institutional contact: MINES ParisTech, PSL Research University, Centre de Gestion Scientifique, UMR 9217 (I3), 75006, Paris, France; blanche.segrestin@mines-paristech.fr

Benoît WEIL

Affiliation: Professor at MinesParisTech, in management sciences

Article : Hatchuel, A., Weil, B., 2009. C-K design theory : an advanced formulation. Res. Eng. Des. 19, 181–192. doi:10.1007/s00163-008-0043-4

Institutional contact: MINES ParisTech, PSL Research University, Centre de Gestion Scientifique, UMR 9217 (I3), 75006, Paris, France; benoit.weil@mines-paristech.fr

Jean-Marc MEYNARD

Affiliation: researcher at INRA, in agronomy

Article : Meynard, J.-M., Jeuffroy, M.-H., Le Bail, M., Lefèvre, A., Magrini, M.-B., Michon, C., 2017. Designing coupled innovations for the sustainability transition of agrifood systems. Agric. Syst. doi:10.1016/j.agsy.2016.08.002

Institutional contact: UMR SADAPT, INRA, AgroParisTech, Université Paris-Saclay, 75005, Paris, France ; jean-marc.meynard@inra.fr

HOW CO-DESIGN PROCESSES CAN CONTRIBUTE TO AND RENEW RELATIONS BETWEEN SCIENTIFIC KNOWLEDGE PRODUCTION AND INNOVATION?

AUTHORS: TOFFOLINI QUENTIN, JEUFFROY MARIE-HELENE, MEYNARD JEAN-MARC, PROST LORENE

Abstract

Although innovation has become a major stake in many agricultural research institutes to face sustainability challenges, research is mainly organized around an "academic polarization", and innovation is generally considered as resulting from the accumulation, aggregation and valorization of knowledge. However, some agricultural scientists' practices can be considered as design and they produce knowledge, but, before all and as primary intention, new technologies and techniques. Design sciences have discussed iterative processes between design and scientific knowledge production, but very few analyses have focused on the production of scientific knowledge throughout design processes. We compare 4 case studies of research projects in the agroecology domain, to analyze the scientific knowledge production within innovation paths. Retracing the design processes to identify the scientific knowledge production process and its relationship with the design intent, this article shows how the knowledge production and originality are based on changes in researchers' representations of agroecological processes or farmers' actions. It then relates such changes to the researchers' confrontations with real situations of actions and the reconfigurations of experiments that they produce.

KEY-WORDS: RESEARCH THROUGH DESIGN, DESIGN PROCESSES, INNOVATIVE DESIGN, AGROECOLOGY, SCIENTIFIC KNOWLEDGE PRODUCTION, EXPERIMENTATION

INTRODUCTION

Innovation has become a major challenge in the strategic orientations of agricultural research institutes (for instance: INRA 2025, WUR 2015-2018, CSIRO 2020) to face the sustainability challenges linked to the multiplicity of expected performances (agronomic, economic, social and environmental) as well as societal expectations (preservation of resources, working conditions and farmers' incomes in a globalization of trade, etc.). Innovation is generally (and particularly in the strategic guidance documents cited) recognized as essential for a necessary radical change in practices in line with agroecological principles.

However, the activities of agricultural research scientists are mostly driven by an "academic polarization" (Bonneuil and Thomas 2009), characterized by (i) a production of knowledge meeting, above all, criteria of scientific excellence and an evaluation that still measures publications citations strengthening specialization processes, rather than assessing the impact of research projects in innovation dynamics and renewed practices institutionalization (Vanloqueren and Baret 2009). Even agronomists' review articles on agroecology make little reference to the contribution of researchers to innovation dynamics but rather insist on the need for knowledge (from a greater diversity of sources) to develop technical alternatives (Altieri and Toledo 2005; Doré et al. 2011; Tomich et al. 2011; Duru 2013; Wezel et al. 2014). This emphasis on the production of knowledge over innovation is consistent with a widespread vision of innovation, in which technical solutions would be built from the accumulation, aggregation and valorization of available scientific knowledge. This is consolidated by the use of the linear scale of Technology Readiness Level, originally developed by NASA (Mankins 1995). This scale is defined in the INRA strategic guidance document as what "assesses the level of maturity of a technology from research to the laboratory prior to its commercialization or deployment", which echoes with the association of innovation with knowledge transfer (e.g. INRA 2025, "[INRA] is involved in the transmission and use of the

results and lessons learned. It wishes to amplify innovation in all its forms, whether it is economically, socially or environmentally").

In this way, even if innovation today appears to be a priority for Agricultural Research institutes, it remains largely subordinated to the scientific knowledge production activity, which is still prioritized. However, the types of problems that some agricultural researchers face addressing sustainability are leading them to put an emphasis on the innovation by producing tools, methods and processes that support and guide the actions of farmers or their advisors and subordinate the production of knowledge to the innovation process (Prost et al. 2016; Matt et al. 2017; Salembier et al. 2018). In such cases, agricultural researchers' practices can be considered as design, considering the ambition to achieve desirable states of the world (which is opposed to a strictly descriptive approach) and an actual transformation (Béguin et al. 2011; Findeli 2015). Several publications address the specificities of design in agricultural field (Duru et al. 2015; Martin et al. 2018; Prost et al. 2018) and question the knowledge that supports these design processes (Berthet et al. 2015; Duru et al. 2015; Toffolini et al. 2017). In contrast, few studies consider the scientific knowledge that is generated during design. However, some stabilized results from Design Studies affirm the existence of close links between design and knowledge production, particularly in two-way interactions between concepts formulations and the production, mobilization or reorganization of formal or informal knowledge (Eekels and Roozenburg 1991; Owen 1998; Glanville 1999; Hatchuel and Weil 2009). Furthermore, the relations between the design process and the scientific production also calls for specific analysis of the changes in experiments in such processes. Experiments for agriculture have largely been analyzed in historical approaches of experimental stations, either concerning their extension and demonstration roles (Bonneuil 2000; Maat 2011), or the forms of participation and interactions between various actors (Henke 2000; Cardona et al. 2018). The long-term time scales of these studies contrast with the specific evolutions of experiment settings and their relations with the innovation process at the scale of a design project addressing sustainability issues.

This article aims to address the relations between the production of scientific knowledge and design processes dedicated to sustainable agriculture issues. To what extent and in what way do agroecological design processes produce original scientific knowledge about the functioning of agroecosystems? How do design and experimentation practices are reconfigured and interact? We conducted to a comparative analysis of case studies of design or co-design practices led by agricultural researchers. In each case, we addressed the innovation process through the point of view of scientists, and with a limited extension of our inquiry in the 'system innovation', also in accordance with our focus on the production of scientific knowledge. We first identify the scientific production and its potential originality. We then relate it to the design processes dynamics with a particular attention to the events that progressively lead to the knowledge production or formulations of the design intent. It finally allows us to show the particular roles of confrontations with the real-life situations of actors' action.

2. FOUR CASE STUDIES OF CO-DESIGN PROCESSES

The case studies were chosen from design work in agricultural research (agronomy, population genetics, ecology) oriented towards agroecology. The existence of a design process was identified by the resulting innovations (e.g. crop management routes, cropping systems, variety mixtures, decision support tools, spatial organizations of agricultural landscapes).

Case selection was based on three criteria: (i) the knowledge produced, as part of the design process, was published in peer-review scientific journals or in conference proceedings; (ii) an initial design intention, relating to a desirable artefact, generally farmers' action or a coherent set of actions that one wishes to make possible, to manage an ecosystem service was clearly expressed; (iii) one (or several) product or process innovation(s) (e.g. decision rules), which potentially take place in farmers' activity, was (were) produced. Our complete analysis concerned nine cases varying in duration of the design process (ranging from 3 to 15 years, completed or still in progress) and in spatial scales (field, farm, landscape mosaic, watershed or a breeding territory), all characterized by specific knowledge production from the design process. For this article, we focused on four out of the nine cases (summed up in the Table 1), which were particularly relevant for re-configurations of experiments during the design process.

The case study approach was inductive, with an "instrumental" approach (Stake 1994). In each case, we retraced the design process from the "innovations" produced, and we identified the scientific knowledge produced throughout the process. We conducted semi-directive interviews with agricultural researchers carrying out the research in each case study, then crossed or supplemented the gathered information by an analysis of published articles in refereed journals, conference proceedings, research projects reports, as well as doctoral

thesis. Interviews were transcribed and coded according to various categories: (1) the resources available and mobilized during the design process (stabilized knowledge, data, existing experimental arrangements); (2) the successive formulations of the desirable artefact that steered the production of new knowledge; (3) the concrete research practices, i.e. the means used to produce data, analyze them, or test the knowledge produced (e.g. experimental or survey devices, modelling, agronomic diagnostics or implementation of prototypes); (4) the partnerships and roles of the different actors involved in the design process in knowledge production; (5) the forms of relation built or maintained with the situations of experiment or agricultural practices. We understand by "situations" both the agronomic and ecological characteristics of farmers' contexts of action, but also the working contexts including the way in which actors (mostly farmers and their advisors) make decisions or face problems, the constraints (technical, organizational) encountered to implement solutions, and the representations that actors have of biophysical processes and the effect of their actions (Cerf et al. 2012).

	Case studies	Case studies selection criteria				
		Publications	Initial intention and actions targeted in the use of innovations	Innovations	Duration	Scale
1	Double density strip	Limaux et al. 1999, *Plant and Soil*, 214 :49-59. Limaux et al. 2001, *Persp. Agri.*,	*Action targeted by the design*: to fertilize wheat (rate and timing of nitrogen applications). *Desirable artefact*: a calculation method of N fertilization rate that does not require any measurement of the remaining nitrogen in soil after winter	A decision support tool to determine the date of the first nitrogen application based on the yellowing of a Double Density Strip (DDS). A N fertilization strategy that maximizes the Nitrogen Use Efficiency and uses the DDS indicator for deciding the first N application.	10 years (1990 – 2000)	Plot
2	Wheat variety mixtures	Borg et al. 2017, *Field Crop Research*, 221: 298-313. Vidal et al. 2017, *Plos One*, 12: e0187788	*Action targeted by the design:* to select wheat varieties to be grown together, in order to reduce crop sensitivity to biotic and abiotic stresses (N and water). *Desirable artefact*: Variety mixtures that have advantage over a pure variety on farms.	Blending rules for stabilizing production and simplifying crop management, adapted to the characteristics of the cultivation situation. Variety mixtures locally designed. A Multicriteria assessment tool for variety mixtures	4 years + (2014 – in progress)	Plot
3	Vegetables intercropping	Salembier et al. 2015, INNOHORT Lefèbvre et al. 2015, FSD	*Action targeted by the design:* to choose the species to associate, their management, and their arrangement in space. *Desirable artefact*: a market gardening organic cropping system, for sale in short circuit, which makes it possible to manage crop health by natural regulations.	An organic vegetable cropping system that promotes natural regulations, for sale in short circuits. Rules of management and blending for a multi-specific stand according to agronomic and commercial criteria.	6 years (2012 – in progress)	Plot
4	Participatory wheat breeding	Goldringer 2001, *Gen. Select. Evol.* Bonneuil et al. 2006, *Cour.env. INRA*, 30: 29-51. Bonneuil et al 2012, *Ecol. Ind*, 23 :280-289 Thomas et al. 2011, *Gen. Res. Crop Evo.*, 58:321-338.	*Action targeted by the design:* to conserve and manage cultivated wheat genetic diversity through mass selection and seed exchanges. *Desirable artefact:* A participatory breeding scheme (dynamic management of genetic diversity) for wheat.	An original participatory selection approach (experimental multilocal system and statistical analysis method). Population varieties adapted to growing environments. An indicator of cultivated genetic diversity.	15 years + (2003 – in progress)	Breeding landscape

Table 1: Description of case studies and selection criteria

2.1 Case 1. A double density strip to maximize Nitrogen Use Efficiency by wheat (Double Density Strip)

At the end of the 1990s, nitrogen fertilization of wheat requires the measurement of soil inorganic N after winter, which is impossible in stony soils. The « Chambres d'Agriculture » of the regions concerned contact INRA to help them adapt the calculation of the N fertilizer rate to their situations. The objective is then to produce a new calculation method of an appropriate fertilizer rate to be applied. An equation was proposed by INRA's researchers, based on the nitrogen uptake by an unfertilized control and the Nitrogen Use Efficiency (NUE) of the fertilizer. Research aimed at a better understanding of NUE sources of variation was then conducted on large networks of plots already existing but classically dedicated to the calculation of soil N contribution to crop uptake. Additional measurements showed that NUE was strongly correlated to the wheat's growth rate at the time of application, an observation brought out by a former technician (who could regularly visit the plots) newly engaged in a research activity. The NUE measurement gives access to a variable of interest for farmers, also allowing learning: it directly reflects N losses from fertilizer. A 15N tracing of the fertilizer, realized and interpreted with scientists specialized on soil physicochemical mechanisms, allowed to explain NUE variations by gaseous losses. This new knowledge opened the door for an innovation concerning the date of fertilizer application: to maximize fertilizer NUE, it was recommended to fertilize plants at high growth rate, thus delaying the application dates. An indicator (yellowing of a more densely sown area, called a Double Density Strip) was developed to trigger fertilizer application.

2.2 Case 2. Rules for building wheat variety mixtures for various agricultural contexts (Wheat variety mixtures)

The project, started in 2015, deals with variety mixtures, whose genetic diversity promotes disease control. In order to implement a network of on-farm trials, design workshops were organized to build mixtures to be tested, and to identify the criteria to be assessed in the farming situations, and finally brought out strategies for building mixtures and the associated blending rules. The workshops gathered together researchers from various disciplines (agronomy, genetics, phytopathology), agricultural advisors and farmers. A new hypothesis emerged, aimed at mixing cultivars with various heights to control the spread of airborne diseases in mixtures. This hypothesis was studied in an ecophysiology PhD that highlighted mechanisms for mitigating the spread of

airborne diseases in cultivar mixtures with large height gradients. Besides, after a first year of experiments, a diagnosis of uses of cultivar mixtures showed that farmers use mixtures either to stabilize production or to simplify crop management at farm scale, two objectives distinct from the maximization of yield classically studied by agricultural scientists. Researchers thus redirected the production of blending rules towards objectives other than productivity, but the whole set of trials could not be re-configured. To better cope with farmers' expectations, trials should compare a mixture to one pure variety which the farmer would have chosen, but scientists still wanted to compare the mixture with all the pure varieties as the overyielding calculation requires it. A multicriteria assessment tool for cultivar mixtures was designed to provide support in the choice of cultivars to be blended. It combined known characteristics of available varieties and the blending rules for diseases control.

2.3 Case 3. Intercropping vegetables in organic systems and for short value chains (Vegetables intercropping)

A system experiment, set up in 2012, aimed at designing, testing and assessing a vegetable-based organic cropping system under tunnels, for sale in short circuits. The wish to mobilize intercrops to promote pest natural regulation raised questions, during the experiment, about the choice of vegetable species, their spatial arrangement and their management (trellising, irrigation, duration of cultivation). Strong interactions between techniques applied to different species within the tunnel, in space (e.g. between trellising, species shading and barrier effect on pests) and time (e.g. between the uprooting dates of the different species and pests' flows), appeared during the first experiment, and lead to reconfigure the experiment from crop cycle to crop cycle, in terms of what the notion of "vegetables intercrops" progressively covered for the agricultural scientists. New knowledge was then produced about these interactions. The experiment, combined with participatory workshops and an analysis of farmers' practices, made it possible to progressively design rules of blending and management, favorable to the regulation of pests and diseases, but also optimizing the use of space by the different species, the duration of the cycle and the possibilities of irrigation and fertilization.

Case 4. A collective setting for participatory wheat breeding (Participatory wheat breeding)

In the early 2000s, the French genetic resources charter did not assign a role to farmers in the conservation of genetic diversity. Some INRA geneticists, familiar with singular situations where farmers cultivate old varieties or even crossbreed them, whished, on the one hand, to evaluate the contribution of these practices in conserving genetic diversity, and on the other hand, to implement and optimize dynamic participatory management. The experimental design (i.e. protocols for trials in farms, network structuration, methods of analysis) was thus central in the study. A diagnosis of practices raised the question of the consequences of numerous seed exchanges on genetic diversity. A database was then produced to follow the seed exchanges, which were also taken into account in the network of trials in farms. During the first experiment for breeding, agricultural scientists and farmers identified the need for methods for intra- and inter-farms cultivar comparisons. It brought out questions about the need for replicates, about the types of inter-farms comparisons of interest in a network in which members breed locally (i.e. to adapt specific population varieties to their farming context). The knowledge produced on the adaptation of population varieties to different farms supported the design and implementation of a method for participatory breeding, that combine (i) a database on seed exchanges and performance in various environments, (ii) a method to compare population varieties, and (iii) a network of trials with common protocols in farms.

3. RESULTS: AN ORIGINALITY OF SCIENTIFIC KNOWLEDGE PRODUCED RELYING ON RENEWALS OF SCIENTISTS' REPRESENTATIONS OF AGROECOLOGICAL PROCESSES OR FARMERS' ACTIONS

The four case studies lead to various innovations or prototypes, supposed to equip the targeted actions in various ways. The fertilization strategy (case 1), or the vegetables cropping systems (case 3), are examples of innovations as coherent sets of practices, which were mostly combined with tools focused on one specific decision-making aspect (e.g. the double density strip indicator for triggering the fertilization in case 1; the

trellising methods in case 3). The blending rules for adapting the choice of varieties to be mixed according to the farming constraints were an instance of innovations as decision rules that focus on adapting action modalities to singular agroecological contexts. Finally, innovations also correspond to experiment designs and methods for varieties' comparisons in case 4.

None of these innovations only resulted from the mobilization of pre-existing knowledge. All the studied design processes provided an opportunity to generate knowledge concerning agroecosystems, and this knowledge was often necessary for design progress (e.g. the causes of NUE variations to determine the appropriate decision rule that maximize NUE, case 1; the effect of height and disease-resistance gradients in variety mixtures on the airborne diseases spreading, used to adapt blending rules, case2). Other knowledge has not been directly remobilized in the design process but opens new fields of knowledge (e.g. the explanation, by gaseous emissions, of the correlation between crop growth rate and Nitrogen Use Efficiency, case 1; the effect of mass selection on cultivated genetic diversity, which namely led to the production of a new diversity indicator taking into account the intra-varietal diversity).

The scientific knowledge on agroecosystem generated during the design processes is of three kinds (Table 2):

5. Identification and understanding of processes related to the functioning of the agroecosystem (in the four case studies; e.g. N gaseous losses explaining the variations of 15N Fertilizer Use Efficiency, case 1; the airborne diseases spreading dynamics in variety mixtures with large height and disease-resistance ranges, case 2);
6. Identification of effects of technical actions on the agroecosystem (in 3 out of the 4 cases; e.g. the impact of mass selection on genetic diversity and adaptation of population varieties, case 9; the effects on insects of the spatial arrangement of vegetable species within a tunnel, case 8);
7. Quantitative models allowing action management (in case 1; e.g. the model of NUE change during the crop cycle).

In the design and innovation literature, the production of innovations through participatory approaches is often associated with "situated" knowledge, either because it is linked with the socio-technical system in which the innovation takes place and by the actors who participated in the design, or because their use requires learning processes (Aggeri et al. 1998; Cerf 2011). We show here that academic knowledge with high level of genericity is also produced during design processes. In other words, even if innovation itself is not always generalizable beyond the contexts in which it has been produced, the way its design has led researchers to explore the reality produces more generic knowledge about agroecosystem entities and processes. However, articles that publish generic knowledge about agroecosystems, generated from the design processes, rarely mention the innovation approach and design intent in which they were produced.

	Cases	**Knowledge generated, gathered in three types:** *i) Agroecosystem functioning processes* *ii) Effect of actions* *iii) Systemic modelling for steering the action*	**Dominant in the field at the time of knowledge production**	**0riginality of the representations on which knowledge is based**	
				New objects or object groupings	Dynamics targeted by the action
1	Double Density Strip	Relation between NUE and the crop growth rate (*i*). NUE variations explained by gas losses (*i*). Modelling of the evolution of NUE (*iii*).	Flow and process modelling of the N cycle in soil. Adjustment of the quantification models of the Balance Sheet method's terms, calculation of a dose.	The plant as a major factor in the variation of N fate in the soil.	The evolution of NUE as a dynamic which makes it possible to set the date of the first fertilizer application.
2	Wheat variety mixtures	Quantification of the mean overyielding. Effect of height diversity between susceptible and resistant varieties on airborne diseases spread (*i*). Influence of cultural factors and varietal characteristics on overyielding (*ii*). Change of the evaluation criteria for mixtures, integrating multiple objectives including the simplification of management (*ii*).	Epidemiology-ecophysiology: spread of diseases in variety mixtures. Evaluation of the overyielding (ratio to the average of the pure) without taking into account the production context and the farmers' objectives.	A "heterogeneous" variety mixture in terms of height and disease resistances.	The behavior of a multivarietal stand in a dynamic of growing conditions of a specific environment (e.g. relative heights all along the crop cycle).
3	Vegetables intercropping	Effects of the composition, the arrangement and the management of intercrops on different pests (*ii*); interactions between technical options (e.g. the spatial arrangement determines the possible irrigation methods) (*ii*)	Modalities of knowledge production: analytical experimentation Object knowledge: monospecific stands, or two species intercrops in rows.	An "intercrop" as an association of both genotypes and modes of management.	Adaptation of species management practices (e.g. cultivation times) according to changes in pest populations.
4	Participatory wheat breeding	Evolution (conservation) of the cultivated genetic diversity through selection and seeds exchanges (*ii*).	Varietal breeding on networks of controlled trials in experimental stations, and non-limiting conditions.	From peasant seeds exchanged and selected to several populations selected from a network of farms (with intra-varietal diversity).	The seeds exchanges participate into the evolution dynamics of the cultivated genetic diversity.

Table 2: Knowledge generated during the design processes, and forms of originality of the representations on which they are based.

But if the design processes are found to produce 'generic' scientific knowledge as do research practices detached from any design initial intention, one may wonder if such scientific knowledge is itself specific in some respects. When comparing this knowledge, produced within the design processes of our four cases, to the available literature, or to the domain knowledge of the interviewees or our own knowledge of the domain, we can show that the knowledge produced is original and we bring out two main sources of originality.

First, knowledge originality is produced by ways of a renewal of processes representations: the knowledge relates to original "objects" (cases 2,3,4) or "objects groupings" (case 1), identified as determinants for the action targeted by the design but which are not studied as such by the discipline. In case 2, the variety mixtures are not "new" for the agricultural disciplines, in the sense that previous works in agronomy, phytopathology or genetics explored the processes at stake within variety mixtures. However, the originality here relies on the fact that the design intent led to consider mixtures with larger heterogeneity in heights and resistances than previously considered. The object "variety mixture" was thus new in terms of component characteristics. In case 1, it is the connections made between objects, generally considered independently, that determines the originality. Thus, the system studied is delimited in an original way for the discipline: the plant itself was never before considered as a factor influencing nitrogen flows and transformations in soil compartments.

Second, knowledge originality lies in a renewal of action representations: the knowledge describes dynamics related to new ways of conceptualizing farmers' actions (Table 2). The generated knowledge can be linked to new forms of farmers' actions that were not previously considered by researchers (cases 3, 4). In case 4, the identification of the extent and quantity of seed exchanges during farmer selection leads to changes in the representation of population varieties and the modelling of cultivated genetic diversity as well as its evolution dynamics. As it has been earlier described (Demeulenaere and Bonneuil 2010), the progressive redefinition and collective learning of what farmers' action corresponds to is acute in this case: the intent to design a participatory breeding scheme led agricultural scientists and farmers to progressively consider that the later are not just cultivating "old varieties", but rather breed, exchange, and grow "peasant seeds" in mixtures.

In other cases, although researchers do not identify new possible actions, they have to pay specific attention to dynamics of agroecological processes in relation with the dynamics of action (cases 1, 2,and 3). In case 3, the transfer of pests and diseases between crops within the intercrop leads to an interest in the dynamics of insect populations' evolution and movement, rather than in the sensitivity of each species.

This analysis of our case studies shows that it is less the degree of technological maturity of the knowledge produced, or any specific characteristics of it, than the renewal of these representations and the production of new academic knowledge consistent with them that lead to innovation. In relation to the literature that insists on the need for in-depth redesign and radical change to move towards agroecology (e.g. Bos et al. 2009; Duru et al. 2015), our results suggest that the changes should concern as much the representations of agroecological processes or farmers' actions as specific technical options or practices.

4. TEMPORAL ORDERING OF KNOWLEDGE PRODUCTION AND OF SPECIFICATION OF DESIRABLE OBJECTS

Sticking to an association between design processes and the renewal of representations would be too simplistic. Rather, we use this observation as a guide in the more processual analysis that follows. The temporal analysis of the design processes shows that the knowledge production evolved jointly with the formulations of the desirable object, and with the evolution of the scientists' ways of representing the agroecological processes or the possible actions on these processes.

In case 3 (Figure 1), for instance, the desirable object first corresponded to a vegetables-based organic cropping system, for sale in short circuit, based on natural regulations (O1). In accordance with this aim of relying on natural regulations, the representation of the processes of interest in an intercrop was linked to the species diversification (R1). The first experiments led to the production of knowledge about the interactions between the choices of species and cultivars and the trellising or irrigation practices within the tunnel (K1). This new knowledge, together with continuous confrontation to the required practices within the experiment in terms of observations and crop management, led to renew the dimensions of "vegetables intercrops" considered by

agricultural scientists: the genetic and plant traits diversification was combined consistently with the main crop management aspects, that are the trellising, the irrigation, the spatial arrangement according to the needs for observation and intervention (R2). This second representation transformed in return the formulation of the desirable artefact, from a cropping system "based on natural regulations" to a cropping system based on intercropping that comprised crop management dimensions. That is, the rules to be defined should not anymore concern only the expected genetic and sensibilities complementarities, but also take into account the effects of management practices on natural regulation processes and intensity (O2). This led to the production of knowledge about these interactions between crop management practices and the potential and realized natural regulation processes (K2), for instance about the flows of pests within a tunnel when only one infested crop in the intercrop was rooted up.

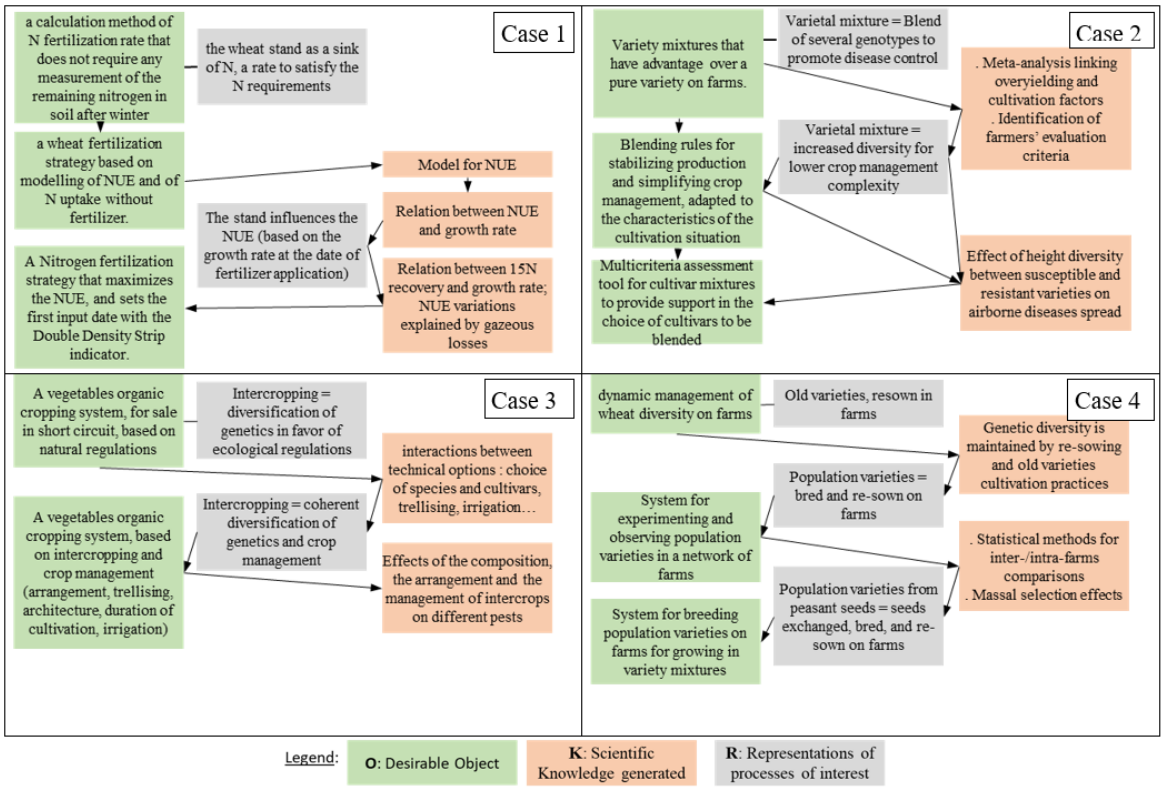


Figure 1: Comparison of the co-evolutions between desirables objects, knowledge production, and representations of processes of interest in the agroecosystems.

Similar evolutions were observed in all case studies (Figure 1). In none of the cases studied are the representations associated with the first formulation of the desirable object retained (Figure 1). In other words, there is no particular moment in the design process in which the accumulation and "technological maturation" of knowledge would be concentrated, such as suggested by the linear scale called Technology Readiness Levels (Mankins 1995), which presupposes a "technological maturation" of the knowledge resulting from academic research, under the effect of "targeting identified goals".

The iterations described recall the literature that relocate the knowledge production and mobilization into the design processes, and namely into the iterations between the problems and solutions formulations (Hatchuel and Weil 2009; Van de Weijer et al. 2014). In agronomy, studies on co-design approaches for sustainability often interpret these iterations as repetitions of successive steps : (i) problem finding, framing and formulating; (ii) problem solving (which include the knowledge production); and (iii) solution implementation, which « progressively improves the design » but do not reformulate the problem or the desirable artefact (Bos et al. 2009; Meynard et al. 2012; Martin et al. 2018). Our findings make possible to specify two aspects of such iterations between the problems and solutions formulations that characterize the relationship between scientific production and design intent, and particularly to show that knowledge production is transversal to these iterations rather than just a step. On the one hand, the alternative formulations of desirable artefacts and production of knowledge intervene throughout the design processes, between the initial formulation of the desirable object and the solution built at the end, and do not correspond to successive iterations between problem formulation and problem solving (a new formulation of the desirable artefact does not always follow the

production of new knowledge and a related solution to a preceding problem). On the other hand, when implementation occurs during the design process, the reformulation of the desirable artefact is not restricted to specifications of the properties of the designed artefact (i.e. which would suggest a "solution implementation" phase), but rather corresponds to changes in the agricultural researchers' representations of the agroecological processes or the actions targeted by the design intent. In other words, the iterations between the reformulations of desirable artefacts and new knowledge production is continuous throughout the design process and relies on transformations of representations, which often make possible to change considerably the problem (e.g. from a N rate calculation to a date of input that prevent from large N losses). As recalled by Béguin (2011), "the desirable, the intention for the future, is not built once and for all at the beginning of the design process". Our case studies indeed reflect a "non-transitive problematization" called by Matt et al. (2017), who refer to the complex innovation paths: "Innovation journeys are very often like Columbus discovery of America that started with the objective of India ». The design approaches studied here thus involve a problematization (in the sense of Dewey 1938) that continues throughout the process, and for which different forms of confrontation with situations play a decisive role.

5. KNOWLEDGE PRODUCTION LINKED TO THE CONFRONTATION WITH THE CONDITIONS OF ACTION IN A REAL SITUATION

5.1 Three types of drivers for reformulating representations and specifications of desirable objects artefacts

To describe more specifically these problematization processes and the role of different forms of interaction that agricultural researchers have with situations in or for which they design, we analyzed the drivers of the reformulations of representations or desirable artifacts. We identified three types of them:

- i) The identification of "singular" minority situations that reveal a weakness in the available artifacts and lead to the reformulation of a desirable object better adapted to these conditions (cases 1, 3 and 4). In these singular situations, the rules of action, reasoning and classic indicators can no longer be considered valid. When researchers confront them at the beginning of the design process, they provide a definition of the desirable that specifies a constraint on action, but not directly a knowledge to be produced (e.g. stony soils that make it impossible to measure the winter residuals and therefore calculate a dose of N to be provided, case 1). They can also appear in the middle of the design process (e.g. a situation in which a crop from an intercrop is pulled out before another and causes a flow of pests, case 3), and more directly lead to new knowledge being produced (e.g. the causes of pests' flow in a tunnel beyond the different appetences and barrier effects between cultures).
- ii) Diagnoses of the diversity of situations in terms of contexts of practices (cases 2, 3 and 4). In all cases, these are characterizations of a variability in the situations in which the action targeted by the design can be carried out, or situations more generally related to the design intent. For instance, in case 1, the diversity diagnosis is based on a network of agricultural plots including unfertilized controls. It is the characterization of the variability of observed NUEs that will reveal the correlation between the NUE and wheat growth rate, and lead to a new representation of the use process of N provided by fertilizer.
- iii) First experimentations of the designed rules of action or prototypes (case 8). In case 8, the experiment shows for instance that compromises have to be considered between the arrangement of crops to allow observation or trellising and maintain the possibility of applying distinct irrigation practices.

Thus, the design approaches studied implement methods and devices that allow the unexpected to emerge in a confrontation with the real situations of the action. This unexpected often justifies the changes in representations of processes of interest in the agroecosystem, and new knowledge needs. The diagnoses (e.g. agronomic diagnosis, diagnostic of the uses, experiments in a large number of situations) described above play a decisive role in the emergence of this unexpected, especially when they are intentionally intended to highlight and analyze the diversity of situations. As emphasized by Louridas (1999), "Design is a continual interplay between events and their handling by the designer; design is successful when it handles contingent events well". These

unexpected, as well as the dialogue between different actors around prototypes (McCown 2001; Cerf et al. 2012), therefore contribute to the evolution of theories of action and the production of scientific knowledge.

5.2 The status of experimentation in the problematization process

But this unexpected inform us above all on the status of experiments in these innovation processes, and the flexibility potentially required on its organizational modes. Mais cet inattendu nous renseigne surtout sur le statut de l'expérimentation dans des processus d'innovation, et la flexibilité potentiellement requise sur ses modes d'organisation. In line with the work that shows that a co-design approach continues well beyond the first implementations of action rules or prototypes (Prost et al 2018), we explore here the status of experimentation and the contribution of the flexibility of its organization in a problematization.

In our four case studies, reconfigurations of the status and modalities of the experiment are taking place or are being questioned. In the case 1, a network of trials with non-fertilized controls could be "reconfigured" to allow the calculation of NUE in a large diversity of situations. In case 2, the experiments are first designed to test, in the farms, the validity of a yield increase provided by variety mixtures. It raises questions on the rules applied to choose which mixtures should be tested, and strategies for such choice. To build the experiment, researchers confront to the farming situations by considering the constraints for action, namely the varieties availability. After a diagnosis of uses, which highlights the objectives of stabilizing yield and simplifying management for farmers using mixtures, the organization of the experimental system is called into question: it seems more relevant to compare the mixture to a single pure variety (the one the farmer would have chosen), rather than to all the pure varieties making up the mixture, as usually done by scientists to calculate the overyielding effect. However, this reconfiguration is being resisted by some of the researchers involved, who maintain that all varieties should be grown in pure form in the trial (mostly the geneticists who were much less in contact with the design process). Questions

The questions relating to the experiment focus more on the modalities to be tested and their link to the action of using the mixtures. The experiment no longer has, at least for researchers involved in the diagnosis of uses, the status of a device for producing evidence of the effectiveness of mixtures to increase yields, but that of a device supporting the collective investigation of researchers and farmers who participate in the experiment, thus helping to redefine the research questions. In this case, the reconfiguration of experiments could not take place completely in the concrete implemented trials, but did play a leading role in the collective problematization.

In case 4, the experimental scheme for mass selection of population varieties is even more explicitly at the center of the discussions among agricultural researchers and farmers, and is the subject of the knowledge production itself (e.g. statistical method of intra- and inter-farm comparisons based on Bayesian methods). The presence of plot replicates has led to discussions for adjustment between geneticists and farmers, around what statistical analyses require, but also about ways to question and observe the effects of selection (e.g. how to take advantage of the network while selecting locally?). The characteristics of varieties observed and the scales used to value them were proposed and selected both by geneticists and farmers, and progressively fine-tuned during the several years of experiment. Later, geneticists got aware that farmers were finally cultivating the selected varieties within mixtures, or adding them to the mixtures of conventional varieties. Such use brought out new questions about the selection practices, and led to new trials arrangements. The reconfigurations of experimentations thus did occur after each confrontation with real-use situations, and with the uses of experiments that farmers performed.

6. IMPLICATIONS FOR THE ANALYSIS OF THE RELATIONSHIPS BETWEEN FORMS OF EXPERIMENTATION AND INNOVATION PROCESSES

The analysis we propose of researchers' confrontations with real action situations, and of the re-configurations of experimental devices, allows us to provide a point of view on the relations between design practices and scientific knowledge production concerning two interdependent aspects.

First, our findings add a dimension to the relationship with a "local" scale in innovation processes. It appears to be a driving force behind collective problematization, particularly through the evolution of researchers' representations of the action and the agro-ecological processes they explore. This relationship to the local level

is thus, indirectly, a driving force for the production of generic knowledge, whereas the literature on agroecological issues addresses it by questioning the adequacy of knowledge and techniques produced elsewhere in specific agro-ecological contexts (e.g. « Place- and space-based diversified practices and farming systems », Duru et al. 2015), or stressing the importance of the hybridization of scientific and expert or local knowledge (Doré et al. 2011; Caron et al. 2014).

Second, we show some reconfigurations of the experiments, in the very time of the innovation process, including the forms of organisation and participation of different actors. These are directly linked to the specifications of the desirable artefacts and the evolutions of representations, which both support the knowledge production throughout the design process. It is classic to observe, over time of a research project, changes in experimentation consistent with the achievement of initial results, whether to introduce new practical modalities to be tested, adjust decision-making rules in a system experiment, or to consider factors of variation of the studied phenomenon not considered a priori.

On the other hand, the re-configurations of agricultural experimentation as regards the contexts of implementation (e.g. the experimentation station, the demonstration plot, the farms), the functions assigned to them (promotion of a technique and construction of its public, training, production of local knowledge) (Henke 2000; Maat 2011), or the forms of participation of non-academic actors and "end users" reflecting different levels of "containment" (Cardona et al. 2018), have been studied more as the results of the functioning of research institutes or long-term trends in the way agricultural research is carried out.

Thus, the confrontations with situations and re-configurations that we observe in research approaches that are based on an explicit and guiding design intention, sometimes lead to original forms of organization and interactivity around experiments. In part, they make it possible to take into account a renewal of the representations researchers have of agro-ecological processes and forms of action by farmers, as well as the objectives and uses of stakeholders, which are involved in the progressive specifications of desirable artefacts. This may echoes some governance rules for experimentation in Living Labs, for instance: an "experimentation in real-life contexts", where researchers, direct and indirect users of the innovation and private actors can interact and lead common inquiries (Bergvall-Kaareborn et al. 2009). We show however that more than a priori governance rules, the experimentation configurations may result from progressive collective problematizations supported by design processes with intended and successive confrontations with the diversity of situations in which a targeted action is supposed to be carried out. This invites us to study the practices of organizing experimentation in innovation approaches both as directly related to the specific design process, and, as Laurent and Tironi (2015) suggest with the concept of « collection of inquiries », taking into account the active role of the non-academic actors in performing and guiding the experimentation.

CONCLUSION

Our study, based on work in the field of agroecology, shows that design approaches renew the production of scientific knowledge. Some knowledge generated during design processes is generic in scope, while the situations in which design approaches take place are local and specific. We have highlighted their originality in relation to the disciplines in which they are inserted and have shown that this originality is based on renewals of agricultural researchers' representations of agroecological processes or farmers' actions on them. Finally, we show that confrontations with action situations have a key role in guiding the design process and organizing experiments, in a strong link with the progressiveness of the problematization process. By analysing the production of scientific knowledge in a design process, we show how the problematization process itself, and the forms of attention to the practice situations on which it is based, can generate re-configurations of experiments that then resemble forms discussed in relation to rules of governance of open innovation.

This study was led under the umbrella of the Initiative for Design in Agrifood Systems (IDEAS). We acknowledge the "Laboratoire d'Excellence Biodiversité Agroécosystèmes Société Climat" (BASC) for funding (INDISS Project), and all the agricultural researchers who were interviewed or who participated in the studied research projects.

REFERENCES

Aggeri, F., D. Fixari, and A. Hatchuel. 1998. Les chercheurs et l'innovation. Regards sur les pratiques de l'INRA. Sciences En Questions. Paris: INRA Éditions.

Altieri, Miguel A., and Víctor M. Toledo. 2005. Natural resource management among small-scale farmers in semi-arid lands: Building on traditional knowledge and agroecology. Annals of Arid Zone 44: 365.

Béguin, Pascal, Benoît Dedieu, and Eric Sabourin. 2011. Le travail en agriculture: son organisation et ses valeurs face à l'innovation. Harmattan.

Bergvall-Kaareborn, Birgitta, Carina Ihlström Eriksson, Anna Staahlbröst, and Jesper Svensson. 2009. A milieu for innovation–defining living labs. In 2nd ISPIM Innovation Symposium, New York, 6–9.

Berthet, Elsa, Cécile Barnaud, Nathalie Girard, Julie Labatut, and Guillaume Martin. 2015. How to foster agroecological innovations? A comparison of participatory design methods. Journal of Environmental Planning and Management: 1–22. doi:10.1080/09640568.2015.1009627.

Bonneuil, Christophe. 2000. Development as experiment: science and State building in late colonial and postcolonial Africa, 1930-1970. Osiris 15: 258–281.

Bonneuil, Christophe, and Frédéric Thomas. 2009. Gènes, pouvoirs et profits: Recherche publique et régimes de production des savoirs de Mendel aux OGM. Editions Quae.

Bos, A. P., P. W. G. Groot Koerkamp, J. M. J. Gosselink, and S. Bokma. 2009. Reflexive interactive design and its application in a project on sustainable dairy husbandry systems. Outlook on Agriculture 38: 137–145.

Cardona, Aurélie, Amélie Lefèvre, and Sylvaine Simon. 2018. Les stations expérimentales comme lieux de production des savoirs agronomiques semi-confinés. Revue d'anthropologie des connaissances 12, N°2: 139–170. doi:10.3917/rac.039.0139.

Caron, Patrick, Estelle Bienabe, and Etienne Hainzelin. 2014. Making transition towards ecological intensification of agriculture a reality: the gaps in and the role of scientific knowledge. Current Opinion in Environmental Sustainability 8: 44–52.

Cerf, Marianne. 2011. Is participatory research a scientific practice? Journal of Rural Studies 4: 414–418. doi:10.1016/j.jrurstud.2011.10.004.

Cerf, Marianne, Marie-Hélène Jeuffroy, Lorène Prost, and Jean-Marc Meynard. 2012. Participatory design of agricultural decision support tools: taking account of the use situations. Agronomy for sustainable development 32: 899–910.

Demeulenaere, Elise, and Christophe Bonneuil. 2010. Cultiver la biodiversité. Semences et identité paysanne. Presses de Sciences Po.

Dewey, John. 1938. The theory of inquiry. New York: Holt, Rinehart & Wiston.

Doré, Thierry, David Makowski, Eric Malézieux, Nathalie Munier-Jolain, Marc Tchamitchian, and Pablo Tittonell. 2011. Facing up to the paradigm of ecological intensification in agronomy: Revisiting methods, concepts and knowledge. European Journal of Agronomy 34: 197–210. doi:10.1016/j.eja.2011.02.006.

Duru, Michel. 2013. Combining agroecology and management science to design field tools under high agrosystem structural or process uncertainty: Lessons from two case studies of grassland management. Agricultural Systems 114: 84–94. doi:10.1016/j.agsy.2012.09.002.

Duru, Michel, Olivier Therond, Guillaume Martin, Roger Martin-Clouaire, Marie-Angélina Magne, Eric Justes, Etienne-Pascal Journet, et al. 2015. How to implement biodiversity-based agriculture to enhance ecosystem services: a review. Agronomy for Sustainable Development 35: 1259–1281. doi:10.1007/s13593-015-0306-1.

Eekels, J., and N. F. M. Roozenburg. 1991. A methodological comparison of the structures of scientific research and engineering design: their similarities and differences. Design Studies 12: 197–203. doi:10.1016/0142-694X(91)90031-Q.

Findeli, Alain. 2015. La recherche-projet en design et la question de la question de recherche: essai de clarification conceptuelle. Sciences du design: 45–57.

Glanville, Ranulph. 1999. Researching design and designing research. Design issues 15: 80–91.

Hatchuel, Armand, and Benoit Weil. 2009. CK design theory: an advanced formulation. Research in engineering design 19: 181.

Henke, Christopher R. 2000. Making a place for science: The field trial. Social Studies of Science 30: 483–511.

Laurent, Brice, and Martin Tironi. 2015. A field test and its displacements. Accounting for an experimental mode of industrial innovation. CoDesign 11: 208–221. doi:10.1080/15710882.2015.1081241.

Louridas, Panagiotis. 1999. Design as bricolage: anthropology meets design thinking. Design Studies 20: 517–535.

Maat, Harro. 2011. The history and future of agricultural experiments. NJAS-Wageningen Journal of Life Sciences 57: 187–195.

Mankins, John C. 1995. Technology readiness levels. White Paper, April 6.

Martin, Guillaume, Sandrine Allain, Jacques-Eric Bergez, Delphine Burger-Leenhardt, Julie Constantin, Michel Duru, Laurent Hazard, Camille Lacombe, Danièle Magda, and Marie-Angélina Magne. 2018. How to Address the Sustainability Transition of Farming Systems? A Conceptual Framework to Organize Research. Sustainability 10: 1–20.

Matt, M., A. Gaunand, P-B. Joly, and L. Colinet. 2017. Opening the black box of impact – Ideal-type impact pathways in a public agricultural research organization. Research Policy 46: 207–218. doi:10.1016/j.respol.2016.09.016.

McCown, R. L. 2001. Learning to bridge the gap between science-based decision support and the practice of farming: evolution in paradigms of model-based research and intervention from design to dialogue. Crop and Pasture Science 52: 549–572.

Meynard, J.M., Benoit Dedieu, and A. P. (Bram) Bos. 2012. Re-design and co-design of farming systems. An overview of methods and practices. In Farming Systems Research into the 21st Century: The New Dynamic, ed. Ika Darnhofer, David Gibbon, and Benoît Dedieu, 405–429. Springer Netherlands.

Owen, Charles L. 1998. Design research: Building the knowledge base. Design Studies 19: 9–20.

Prost, Lorène, Elsa TA Berthet, Marianne Cerf, Marie-Hélène Jeuffroy, Julie Labatut, and Jean-Marc Meynard. 2016. Innovative design for agriculture in the move towards sustainability: scientific challenges. Research in Engineering Design: 1–11.

Prost, Lorène, Raymond Reau, Laurette Paravano, Marianne Cerf, and Marie-Hélène Jeuffroy. 2018. Designing agricultural systems from invention to implementation: the contribution of agronomy. Lessons from a case study. Agricultural Systems 164: 122–132. doi:10.1016/j.agsy.2018.04.009.

Salembier, Chloé, Blanche Segrestin, Elsa Berthet, Benoit Weil, and Jean-Marc Meynard. 2018. Genealogy of design reasoning in agronomy: Lessons for supporting the design of agricultural systems. Agricultural Systems 164: 277–290.

Stake, Robert E. 1994. Case Study: Composition and Performance. Bulletin of the Council for Research in Music Education: 31–44.

Toffolini, Quentin, Marie-Hélène Jeuffroy, Pierre Mischler, Jérôme Pernel, and Lorène Prost. 2017. Farmers' use of fundamental knowledge to re-design their cropping systems: situated contextualisation processes. NJAS - Wageningen Journal of Life Sciences 80: 37–47. doi:10.1016/j.njas.2016.11.004.

Tomich, Thomas P., Sonja Brodt, Howard Ferris, Ryan Galt, William R. Horwath, Ermias Kebreab, Johan HJ Leveau, et al. 2011. Agroecology: a review from a global-change perspective.

Van de Weijer, Marijn, Koenraad Van Cleempoel, and Hilde Heynen. 2014. Positioning research and design in academia and practice: a contribution to a continuing debate. Design Issues 30: 17–29.

Vanloqueren, Gaëtan, and Philippe V. Baret. 2009. How agricultural research systems shape a technological regime that develops genetic engineering but locks out agroecological innovations. Research Policy 38: 971–983. doi:10.1016/j.respol.2009.02.008.

Wezel, Alexander, Marion Casagrande, Florian Celette, Jean-François Vian, Aurélie Ferrer, and Joséphine Peigné. 2014. Agroecological practices for sustainable agriculture. A review. Agronomy for Sustainable Development 34: 1–20. doi:10.1007/s13593-013-0180-7.

AFFILIATION

Quentin Toffolini has a post-doctoral position at UMR Sadapt (INRA/AgroParisTech/Université Paris-Saclay). After a PhD in Agronomy on knowledge building and mobilization in farmers collectives engaged in changes towards inputs use reduction, he more recently studied diverse innovation projects initiated by agricultural researchers on agroecology related subjects.

Institutional contact: UMR Sadapt, Campus de Grignon, 78850 Thiverval-Grignon, France.
Quentin.toffolini@outlook.fr

Marie-Hélène Jeuffroy is research director in agronomy at UMR Agronomie (INRA/AgroParisTech/Université Paris-Saclay). Her research first concerned crops (essentially peas and wheat) ecophysiology and functioning under various management practices and are today dedicated to the redesign of practices to cope with new challenges: design of new fertilization strategies, cultivar ideotypes, decision aid tools designed with users and territorial organization of cropping systems. She also conducts research on the relationship between the production/formalization of scientific and expert knowledge and the innovative design of technical systems, within the framework of the Ile-de-France collective IDEAS (Initiative for the DEsign of Agri-food Systems).

Institutional contact:

UMR Agronomie, Campus de Grignon, 78850 Thiverval-Grignon, France.

Marie-helene.jeuffroy@inra.fr

Jean-Marc Meynard is research director in agronomy at UMR Sadapt (INRA/AgroParisTech/Université Paris-Saclay). Head of the INRA SAD Department (Sciences for Action and Development) from 2002 to 2012, his research first concerned the design of integrated crop management strategies. Today, his research focus on the distributed design of production methods, in relation to socio-technical systems and food systems, and on the agro-ecological transition, also within the framework of the Ile-de-France collective IDEAS.

Institutional contact :

UMR Sadapt, Campus de Grignon, 78850 Thiverval-Grignon, France. Jean-marc.meynard@inra.fr

Lorène Prost is conducts research at UMR LISIS (INRA/UPEM/ESIEE/CNRS). After a PhD in agronomy and ergonomics about the design of decision aid tools with users, her research focuses on the activity of farmers who redesign their practices and in the engineering activity of agronomists who equip and support these redesigns. In particular, it looks at how this engineering activity renews the production of agronomic knowledge. She participates in the governance of INRA's IDEAS collective Institutional

contact : UMR LISIS, 77454, Marne-La-Vallée. Lorene.prost@inra.fr

DESIGNING A RESEARCH AGENDA FOR COUPLED INNOVATION TOWARD SUSTAINABLE AGRIFOOD SYSTEMS: A COLLECTIVE INNOVATION PROCESS TO IDENTIFY COMMON PURPOSES FOR COLLABORATION IN RESEARCH

JULIETTE BRUN, MARIANNE CERF, MARIE-HELENE JEUFFROY, JEAN-MARC MEYNARD, CAROLINE PENICAUD

Researchers studying food production and researchers focusing on food processing constitute two distinct scientific communities that share common interests but often struggle to dialog and work together due to both scientific specialization and existing disconnections between agriculture and food manufacturing standards (Meynard et al, 2017). However, to meet the numerous challenges for sustainable agrifood systems, there is today a crucial need for research to produce new knowledge and concepts that could apply at the food system scale. This paper therefore explores how an innovative design dynamic can be developed between researchers focusing on food production (agriculture) and researchers focusing on food processing. Relyon on design theory and methods, it especially presents a collective exploration that was organized to produce coupled innovative research questions, which could become common purposes for future collaboration between the two scientific communities.

RESEARCH DESIGN, COMMON PURPOSE, COUPLED INNOVATION, KCP PROCESS, C-K DESIGN THEORY, AGRONOMY, FOOD ENGINEERING

INTRODUCTION

The desirable transition towards sustainable food systems requires to promote the innovation capabilities of the agrifood sector (Baroni et al. 2007; Leach et al., 2012; Seebode et al., 2012; Tilman and Clark, 2015; Prost et al., 2016). Today, fostering the development of coupled innovation processes (Gassmann and Enkel, 2004; Enkel et al., 2009), which could efficiently link agriculture and food manufacturing logics, appears as a necessary pre-requisite in achieving this objective (Meynard et al, 2017). To promote a global innovation dynamic that would operate at the food system scale, scientific fields related to the agrifood sector, such as agronomy and food science, also have to build common innovative research questions: in addition to opening new paths for innovation in science, such research could support the development of new coupled innovations between farmers, food manufacturers, but also retailers, consumers and logistics providers (Rivera-Ferre et al., 2016; Francis et al., 2013; Levidow et al. 2014). However, scientific fields tend to become more and more specialized (Kostoff, 2002) and scientists from heterogeneous disciplines often encounter difficulties when it comes to design common research questions (Dewulf et al., 2007). **This paper therefore explores how an innovative design dynamic can be developed between researchers focusing on food production (agriculture) and researchers focusing on food processing.** These two communities indeed share common interests but often struggle to dialog and work together due to both scientific specialization and existing disconnections between agriculture and food manufacturing standards (Meynard et al, 2017). To build an innovation community, where researchers from heterogenous fields could develop original cross-disciplinary research projects, new purposes for collaboration would have to be designed.

Today, researchers focusing on food production and researchers focusing on food processing are two scientific communities significantly involved in the development of agrifood innovations, but they are currently confronted with important disconnections, which sometimes limit the impact of their respective proposals on this innovation dynamic. On the one hand, research focusing on food production studies all the processes related to agriculture: it analyses the relationships between plant, soil, climate and cultivation methods in order to extract from them knowledge that is useful to agriculture (Deffontaines, 1991). Food production is thus a research topic for various scientific disciplines, from ecophysiology to humanities. On the other hand, research focusing on food and food processing studies "the physical, chemical, and biochemical nature of foods and the principles of food processing" (Potter and Hotchkiss, 2012). In this way, this scientific field also mobilizes various disciplines such as food microbiology, food chemistry, sensory engineering and social sciences. Moreover, researchers focusing on food production and food processing are often recognized as prescribers of innovations : research on food processing generates information helping food manufacturers to explore new modes of preservation, processing or packaging for food (Potter and Hotchkiss, 2012; Benatallah et al., 2012; Villemejane et al. 2013; Schifferstein, 2015), whereas research on food production helps providing farmers, engineers and advisors with new innovative solutions regarding cultivation modes that aim to improve crop yields, reduce loss risks and lessen the environmental impacts of agriculture (Meynard et al, 2017; Le Bail and Makowski, 2004; Lacroix et al., 2005; Magrini et al. 2016). In this way, the innovation processes of agriculture and food manufacturing significantly rely on the new proposals and recommendations of these two scientific fields regarding concepts to be explored and knowledge to be applied. In other words, the innovation processes of agriculture and food manufacturing significantly rely on the respective innovation processes of research in food production and research in food processing (Chen et al, 2017).

However, if they seem to complement one another, the two scientific fields encounter significant disconnections that strongly impact the innovation capability of the agrifood sector (Figure 1). These disconnections rely on scientific specialization, but they also reflect existing disconnections between agriculture and food-processing industry standards. Indeed, both agriculture and food manufacturing present their own specifications and requirements, which necessarily apply to the development of innovations, but several new concepts developed according to the standards of one field quickly prove to be incompatible with the standards of the other (Meynard et al, 2017). Therefore, even if researchers of both fields explore and propose innovative solutions towards sustainability, their impact prove to be limited at the food system scale. For instance, agronomic research as shown that a lesser use of fertilizers allows reducing nitrogen loss in the environment (Makowski et al, 1999) and thus helps controlling agricultural water pollution (Lacroix et al., 2005). However, reducing nitrogen inputs, without changing the recommended splitting, also involves a decrease in the protein content of wheat flour (Makowski et al, 1999), which impacts the quality and aspect of bread (Veraverbeke and Delcour, 2002) and thus is not accepted by the food-processing industry. In the same way, researchers have shown that varietal mixtures help avoiding aerial disease risks, and thus reducing fungicide use (Finckh et al., 2000) but millers do not accept this practice because it prevents them to compose their own mixtures, which are adapted to the dominant baking process. In this way, in order to enhance the impact of the new proposals made by science regarding new agricultural practices or new food processes, researchers studying food production and researchers focusing on food processing may join forces and coordinate their research to explore common innovation topics (for instance, develop new types of bread (e.g. gluten-free bread) and explore original cultivation modes for wheat in a coordinated way). The identification of coupled innovative research questions could thus allow considering the respective constraints of both agriculture and food manufacturing to better challenge them. Furthermore, these coupled questions could help reconnecting the innovation processes of research focusing on food production and research focusing on food processing (Figure 1).

However, identifying common innovation topics between two different scientific fields requires a dedicated effort: indeed, each field presents specific vocabulary and notions (Kostoff, 2002), and the scientists involved tend to be fixed by knowledge related to their own area, expertise or discipline (Vourc'h et al., 2018; Jansson and Smith, 1991). To allow researchers studying food production and researchers studying food and food processing to build innovative research questions that could constitute common purposes for long-lasting collaboration, it is therefore necessary to organize the dialog between the two scientific fields with relevant tools and methods.

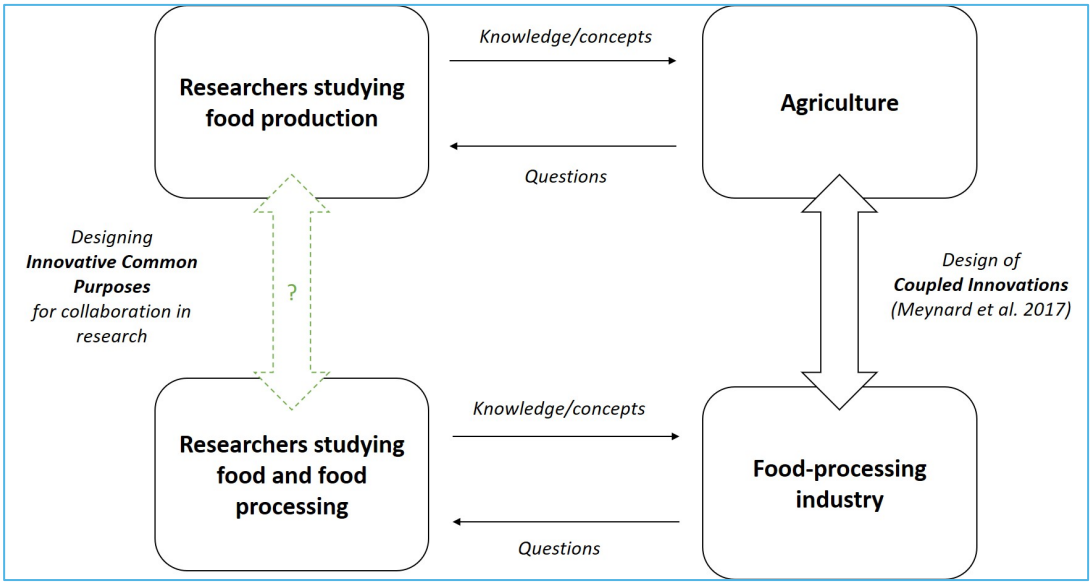


Figure 1. Addressing a missing link to enhance the innovation dynamic of the agrifood sector: the design of Innovative Common Purposes between researchers focusing on food production and researchers focusing on food processing

ORGANIZING THE GENERATION OF COMMON PURPOSES IN RESEARCH: AN INNOVATIVE DESIGN ACTIVITY

The identification of a common purpose for collaboration appears as a necessary condition to build a lasting and fruitful partnership between two different scientific fields. This notion of "common purpose" has been largely developed in management studies, which have shown its strategic importance regarding the design of new collaborations between heterogeneous partners (Wildridge et al., 2004; Weck, 2006; Gillier et al., 2012): the common purpose may consist for instance in economic benefit, expertise and knowledge sharing, environmental protection or resources sharing to achieve a common project. However, the purpose for collaboration is not always clear and well-defined from the very beginning of the partnership: sometimes, initiating a collaboration with a very different field may be seen as a good opportunity to innovate and "think out of the box", even if it is not guaranteed that the collaboration will result in a joint work on common projects. In this case, a dedicated work to collectively design new common purposes may help fostering a long-lasting cross-fertilization between heterogeneous fields (Gillier et al., 2012).

In research, common purposes for collaboration may commonly take a wide variety of forms, such as the identification of relevant areas for data sharing or the development of cross-disciplinary research projects. Such common purposes are not always radically innovative. However, a common purpose allowing to reconnect research focusing on production and research focusing on food and food processing in order to promote innovation at the food system scale will necessarily involve innovative research topics that address both fields' expertises. The collective design of such common purposes therefore consists in building radically new research questions and corresponds to an innovative design activity, where both unknown knowledge and concepts have to be explored (Hatchuel and Weil, 2009).

But if several methods have already been developed to design innovative common purposes for collaborations in industry, they have rarely been applied by research centers to design new research questions that would favor the development of common purposes for scientific innovation. However, research is intrinsically a design activity (Glanville, 1999) and such design methods could prove to be relevant for the organization of scientific collaboration. Fostering researchers' design reasoning with dedicated methods could indeed help exploring new ideas and developing new research programs. Moreover, innovative design methods - such as the C-K method (Hatchuel and Weil, 2009) and the KCP process (Elmquist and Segrestin, 2009; Hooge et al., 2017) - have recently been applied to develop cross-disciplinary research programs and foster cross-fertilization of knowledge

and scientific expertise (Vourc'h et al, 2018). In the same way, it can be expected that design methods could provide relevant tools to support a reconnection between research focusing on food production and research focusing on food and food processing through the development of innovative common purposes for collaboration.

The next section presents how we built a collective process based on design theory in order to help scientists studying food production and scientists studying food processing developing innovative research questions that could become common purposes for long-lasting collaborations. We first explain the theoretical framework of our methodology and detail the different steps of this process, which mobilized about twenty researchers from various disciplines in a co-exploration of new concepts and knowledge. We then present the results of this innovation process through a concept map, as well as a list of innovative research questions, which correspond to the common purposes generated during the process. In conclusion, we present further lines of development to foster the exploration of these common purposes.

AN INNOVATIVE DESIGN METHOD TO COLLECTIVELY BUILD COMMON PURPOSES WITHIN A COMMUNITY OF RESEARCHERS

Mobilizing design theory to generate innovative common purposes in research

To support the collective design of common purposes by researchers studying food production, food and food processing, we especially relied on the OPERA method (Gillier et al., 2010): this methodology aims at reducing the uncertainty and instability of co-explorations by mapping innovative concepts and associated knowledge that could present a common value for heterogeneous fields. To foster the design of common purposes, the method provides an overview of attainable and very original concepts, as well as acquired and missing knowledge. Such innovative design approach aims at fostering the exploration of both new ideas and new information: the proposition of new concepts will allow building new projects (for instance, projects of innovations or research projects), whereas the identification of missing information will allow identifying knowledge gaps that still need to be explored

The theoretical framework of OPERA relies on C-K theory (Hatchuel and Weil, 2009), which offers a framework to build methods addressing both cognitive and organizational barriers to innovation. The C-K theory distinguishes two spaces: the Concept space (or C-space) and the Knowledge space (or K-space). C is the space of ideas: it includes verbal statements without logical status (it is impossible to say if the statement is true or false, or if its object exists or not). However, K includes statements with a logical status (the statement is either true or false, its object exists or does not exist). For instance, the proposition "a blue chair" will belong to the K-space, whereas "a footless chair" will belong to C because it is impossible to say if such object exists or not. According to C-K theory, innovation emerges from a dialog between the C-space and the K-space, which leads to a co-expansion of concepts and knowledge (Hatchuel and Weil, 2009). The Figure 2 below illustrates these dynamics of co-expansion by starting with the initial concept "a naturally pink chocolate". To develop such concept, a designer may mobilize knowledge regarding the different existing types of chocolate (dark, white and milk chocolate) before exploring a first conceptual path: for instance, white chocolate "using pink food coloring". In order to design a "naturally pink" chocolate, another strategy may be explored: "avoiding pink food coloring". Such constraint will involve acquiring new knowledge in K: for instance, knowledge regarding cocoa pods with natural shades of pink. A new transformation process can then be used to enhance this natural shade of pink and create a "natural" pink chocolate. Such concept actually corresponds to the Ruby chocolate (the fourth official type of chocolate, which was introduced in 2017 by the Barry Callebaut company). The associated C-K-map, which addresses both agriculture and food processing issues, therefore shows how innovation emerges from a co-expansion of concepts and knowledge.

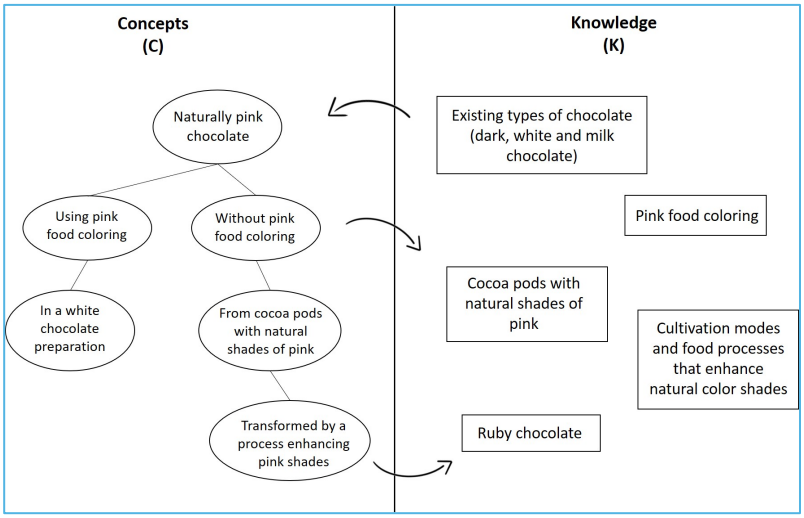


Figure 2. The C-K dynamics: a co-expansion of the C- and K-spaces

Moreover, C-K theory offers several logical steps to build original concepts, such as suppressing essential properties of objects (e.g. "footless chair" or "pink chocolate without food coloring") or playing on alternative definitions of the same word: for instance, working on the concept "childhood coffee", designers may develop a first path regarding a concept of "coffee suitable for children", but also new paths regarding "coffee with the taste of childhood" or "coffee that makes fall back into childhood".

The C-K theory has often been used as a framework to propose new innovation methods: the C-K map, for instance, is used to foster the development of disruptive ideas and original concepts paths, thus tackling fixation effects (Hatchuel and Weil, 2019). The KCP process - which distinguishes a Definition phase, a Knowledge phase, a Concept phase and a Project phase – (Elmquist and Segrestin, 2009; Vourc'h et al., 2018) helps developing an innovative design reasoning in a collective context without showing C-K trees to the group participants (Figure 3).

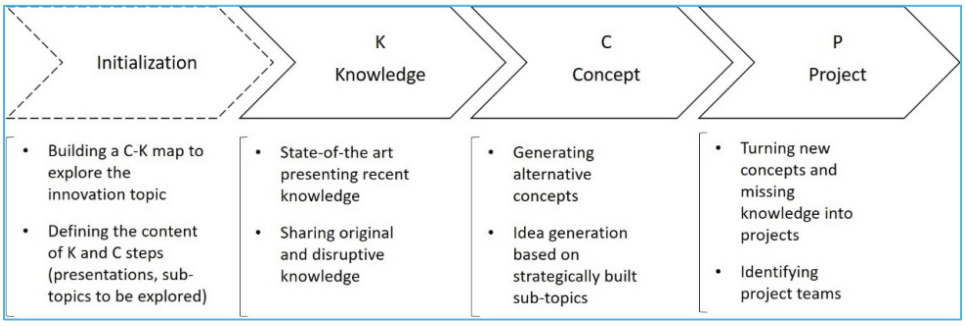


Figure 3. The four main steps of the KCP process

In this work, our goal was to foster the collective exploration of new concepts for coupled innovation and the development of associated research questions. To do so, we especially rely on the KCP process (Figure 3), as well as OPERA, the C-K based approach used by Gillier et al (2010) in order to facilitate the formulation of common purposes (common concepts of interest for collaboration) by working on C-K maps in groups during collective sessions. The latter method uses matching and building strategies to design the C-K tree: Concept matching and Knowledge matching consist in identifying common original concepts and missing knowledge that could be of interest for all stakeholders, while concept and knowledge building consist in developing these paths (Gillier et al., 2010). The next section presents the innovation process that has been created in order to help researchers focusing on food production and scientists studying food processing to collectively design new innovative research questions, which could become common purposes for collaboration.

A series of three workshops to collectively explore the issue of coupled innovation

The innovation process was organized by a team of four researchers: two researchers in agronomy, a researcher in food engineering, and a researcher in innovative design. To lead this collective exploration for common purposes, the team invited scientists from various disciplines: agronomy, food engineering, ergonomics, economics or management science. It was decided that the different sessions of the process would be held during a short period of time (between April and June 2018). According to the answers of potential participants, it was thus decided to hold three workshops: some researchers were registered in the three sessions, others could only attend one or two sessions. The organizing team therefore decided to adapt the content of the three sessions according to the expertise areas of registered participants.

Initialization - To prepare the three workshops and define their content, the steering committee relied on the preparation phase of the KCP process: first, the topic of the series of workshops was defined as "Coupled innovations for the sustainable development of food systems". This concept indeed allowed to address food production, food and food processing and food consumption, and also to easily mobilize researchers in both fields, who were already used to work in relation with the development of innovations. Starting with this initial concept, the team built a C-K tree to identify various and original concept paths, as well as relevant missing knowledge. This C-K map was built according to a matching-building methodology (Gillier et al., 2010), which aims to systematically formulate ideas that could be interesting for both agriculture and food-processing industry and thus ensure the generation of concepts actually addressing common topics. The map (see the results' section) allows identifying interesting knowledge that could be presented to the participants during the workshops. It also helps building specific exploration sub-topics, which we call "spotlights". The goal of the spotlights is to propose original statements to the participants - such as "terroirs to be invented" - as a starting point for collective exploration and idea generation. Each day of workshop was then organized as a small KCP process: the session begun with presentations of knowledge and continued with concepts generation sessions. The result section presents the detail of the workshops' agenda.

Knowledge-phase - Each workshop begun with presentations given by the participants regarding recent results associated to coupled innovation in the agrifood sector, as well as original knowledge from other fields - but nonetheless related to the workshop theme (See the workshop's agenda in Table 1)-. The aim of these presentations was to provide participants with informations that could be used to generate original propositions during the concept phase.

Concept-phase - After the presentations, participants entered in the Concept generation phase. This exercise could take two forms: first, a brainstorming session to explore a "spotlight" concept (according to a KCP methodology), and second, a work led on the C-K map by all the participants to develop the map and build new concepts (according to a matching-building methodology). Both exercises had the same goal: exploring new ideas regarding coupled innovation and identifying new research questions. While the exploration of the spotlights fosters divergence and idea quantity in small groups, the expansion of the C-K map was led with the all group to foster ideas organization in a common tool and allow participants following the progress made along the series of workshops.

Project-phase – The brainstorming sessions of the C-phase were directly followed by the initiation of the Project-phase. It consisted in selecting the most interesting concepts and knowledge gaps to develop scenarios of actual research projects, which could include theses, experimentations or new studies. After the workshops, the P-phase consisted in developing these scenarios of projects and to identify potential project leaders and the associated teams. This part still constitutes ongoing work. The next section presents the results of the initialization phase, details the workshop agenda and explains how the spotlights concepts were selected. It then presents the outputs of the collective exploration, especially the concept paths and research questions generated during the series of workshops. These research questions correspond to innovative common purposes for collaboration between scientists studying food production and researchers focusing on food processing.

A COLLECTIVE EXPLORATION OF INNOVATIVE PATHS TO DESIGN A RESEARCH AGENDA ADRESSING BOTH FOOD PRODUCTION AND FOOD PROCESSING

The creation of a collective design dynamic

Initialization phase – During the initialization phase, the C-K tree built by the steering committee started with the initial concept "Coupled innovations for the sustainable development of food systems". This first C-K map distinguished four innovation paths, around four concepts that were carefully worded to avoid mobilizing specialized vocabulary: such formulation prevented building paths concerning only one of the two scientific fields, which would have hindered the exploration of common purposes for collaboration. The four paths were:

- Coupled innovations reducing wastes along the value chain (from food production to consumption)
- Coupled innovations promoting local food
- Coupled innovations enhancing (bio)diversity
- Coupled innovations developing "terroirs" (a French word describing provinces or lands, which present special properties (geography, climate or local craftsmanship) that express in the quality of typical food products)

From the first C-K map, the steering committee identified 7 spotlights concepts, which could guide the exploration of researchers:

- "0 waste" food
- A collective catering from 100%-local food
- A fridge filled with 100%-local food
- A mixture of species, from farm to fork
- A plant-based gastronomy
- A sustainable terroir
- Terroirs to be invented

The agenda of the three workshops were built to (1) ensure optimal mobilization of the expertise of registered participants and (2) introduce knowledge fostering for the exploration of coupled innovations and addressing the spotlights concepts. Each workshop presented a K-phase and a C-phase.

		Workshop 1	**Workshop 2**	**Workshop 3**
K-phase Knowledge sharing		*Presentation 1* "Designing coupled innovations to promote the development of sustainable food systems" *Presentation 2* "Towards more resilient and efficient logistics systems: the concept of Physical Internet"	*Presentation 1* Briefing regarding the concept of coupled innovation *Presentation 2* "Introduction to the concepts of Terroir et Typicality" Presentation 3: "Generative Heritage: Knowledge transmission in cuisine to promote creation"	*Presentation 1* Briefing regarding the concept of coupled innovation *Presentation 2* "Multispecies mixtures in fields: which one for which performance?"
C-phase	**C-exercise (1)** Exploration of spotlights concepts in sub-groups	*Spotlight 1* "A collective catering from 100%-local food" *Spotlight 2* "A plant-based gastronomy"	*Spotlight 1* "A sustainable terroir" *Spotlight 2* "A fridge filled with 100%-local food" *Spotlight 3* "Terroirs to be invented"	*Spotlight 1* "A mixture of species, from farm to fork" *Spotlight 2* "0-waste food"
	C-exercise (2) Expansion of the C-K map	/	Expansion of the initial C-K map with the entire group	Expansion of the C-K map obtained at the end of workshop 2, again with the entire group

Table 1. The workshops' agenda

Exploration phase (C and K-phase) – During each workshop, after a time dedicated to knowledge sharing, participants begin to explore spotlights in small groups: this exercise allowed to generate ideas through concepts formulation, but also to identify missing knowledge and interesting knowledge gaps. During the second and third workshops, participants also expand the C-K map, which allowed to immediately organize ideas they had explore when working on the spotlights concepts. The Figure 4 below presents the results achieved by the participants when exploring one of the main conceptual paths: the concept of coupled innovations that could help promoting local food, its virtue and its desirability for all.

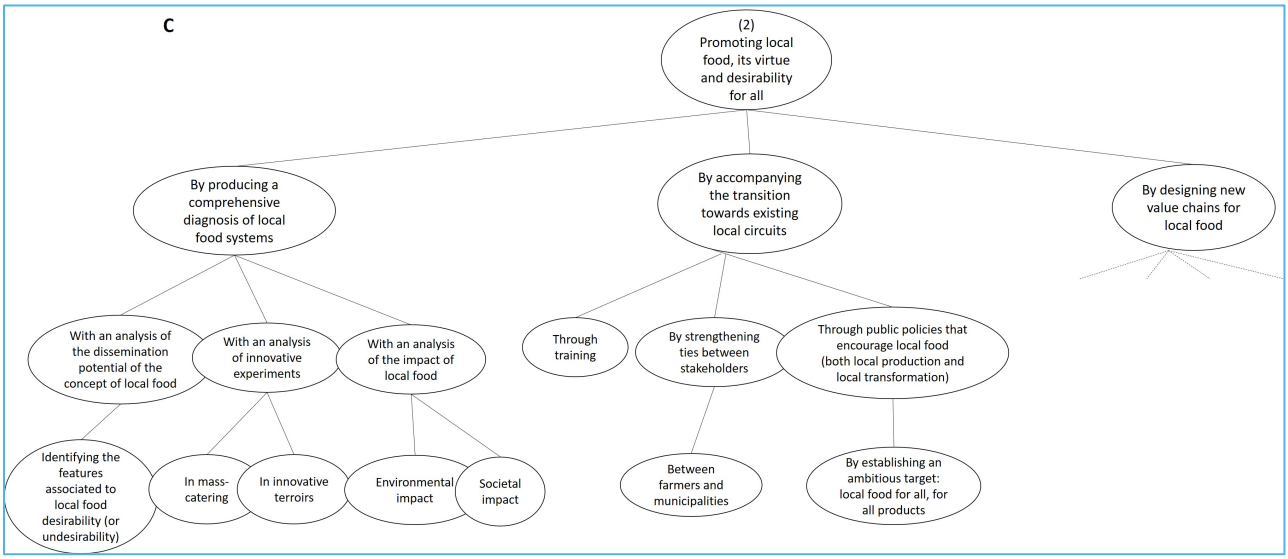


Figure 4-1. Concepts explored by the participants in relation to the topic "coupled innovations promoting local food, its virtue and desirability for all" (1/2)

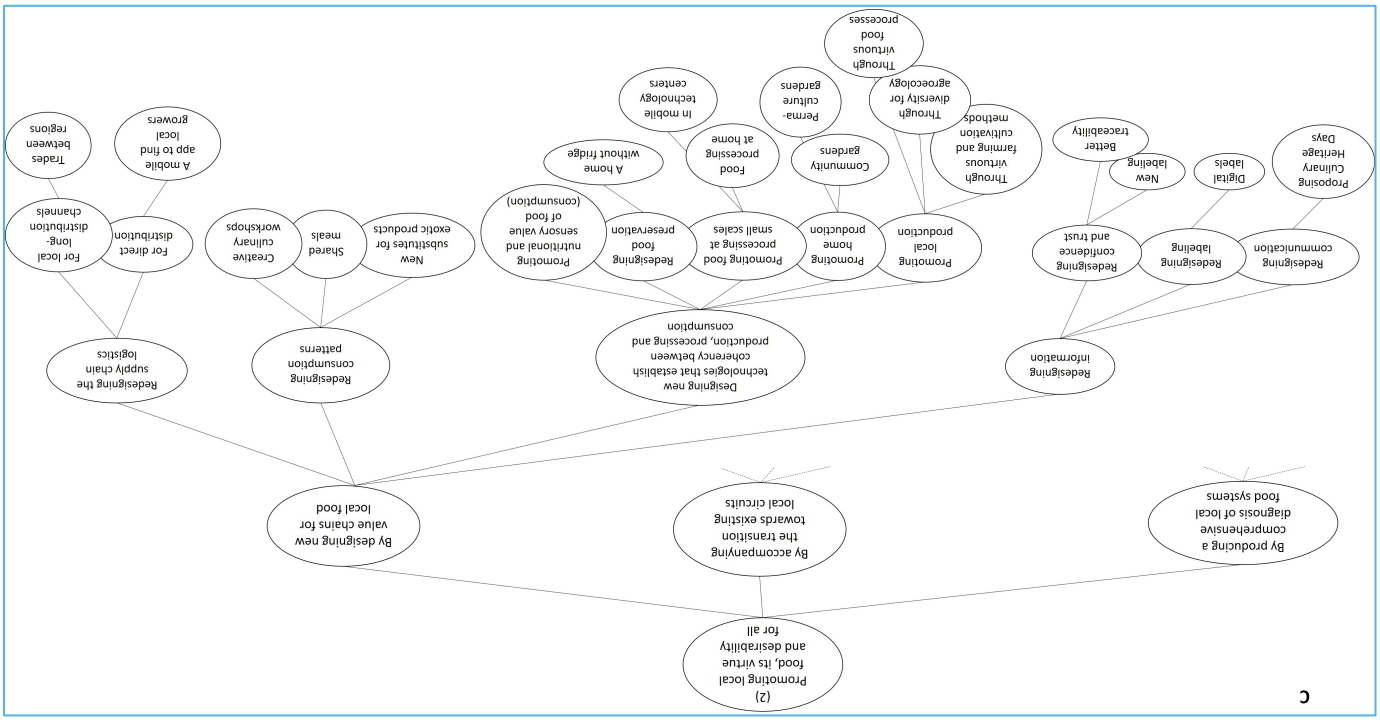


Figure 4-2. Concepts explored by the participants in relation to the topic "coupled innovations promoting local food, its virtue and desirability for all" (2/2)

Final C-K tree – The work achieved by the participants during the successive C-phases allowed to expand the initial C-K map, and especially to add two main innovation paths: coupled innovations reinventing food systems engineering on the one hand, and coupled innovations developing a symbiotic economy on the other hand (Figure 5). The participants also modified the formulation of the four other main concepts: the Figure 5 below presents the main concepts of the final C-K map (these concepts correspond to the first partitions of the C-K tree). Both concepts and knowledge generated by the participants were opening new research questions (these questions are presented in the next sub-section). Therefore, the three workshops allowed to successfully initiate both a dialog and a collaborative work between researchers focusing on food production and scientists studying food processes, which resulted in the establishment of a collective design dynamic.

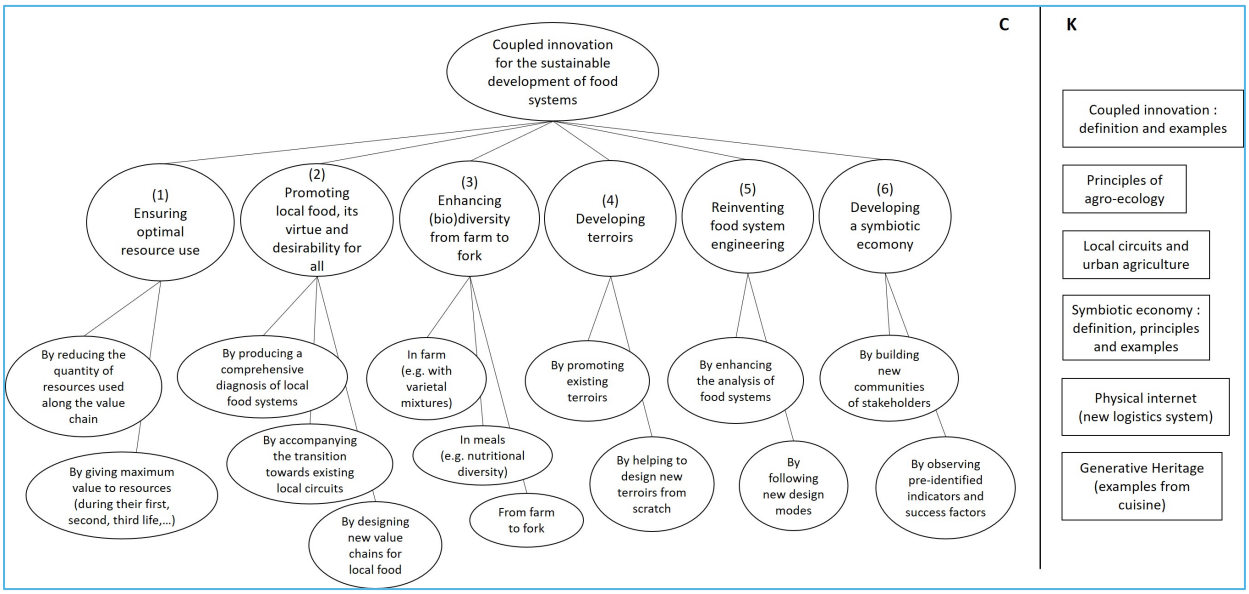


Figure 5. The main conceptual paths of the final C-K map

The design of a research agenda based on innovative common purposes

At the end of the three workshops, the steering committee selected several research questions among the questions generated and discussed by the participants. These research questions were selected according to the following criteria: (1) the questions had to address the two scientific communities, (2) they had to seem original in comparison to the state of the committee's knowledge and (3) they had been mentioned several times during the workshops. Twenty innovative research questions that could become common purposes for collaboration between the two scientific communities were thus identified: the Table 2 below presents the list of the selected research questions.

Main topics	*Research questions*
Engineering for coupled innovation	1/ Which diagnostic approaches can we propose at the food system scale? How to analyze a food system to identify both areas for improvement and innovative paths to be explored in order to enhance its sustainability?
	2/ Which multi-actor systems to design and evaluate coupled innovations?
	3/ Which public policies to promote the development of coupled innovation?
Learning Processes	4/ How to generate learning processes that could help educate stakeholders about sustainability practices for food systems?
	5/ Regarding health, environment and nutrition indicators, how to shift from prescription processes to learning processes?
Local food	6/ Is local food a source of confidence and desirability? What are the effects of its production modes, its traceability, its logistics circuits and the associated social link?
	7/ What is the generative power of local food? What kind of innovation does it help to generate? What stakeholders are involved?
	8/ Which processing technologies at small scales (small volumes, small devices)? In which sociotechnical system these technologies could they be included?
Terroirs	9/ How to reconcile innovation and tradition in a terroir with a significant historic legacy?
	10/ How to assess and improve the sustainability of a terroir, as well as its contribution to overall sustainability?
	11/ How to invent new terroirs and new typical products?
Sensory properties	12/ How to produce foods with exceptional taste and sublimate them while cooking?
	13/ How to define the naturalness of food products? How to manage such property from farm to fork?
Biodiversity	14/ What are the agronomic performances of mixtures? What are their environmental and nutritional benefits? Which processes are involved (e.g. repulsive effects)?
	15/ Regarding the value of amateur gardeners' practices: What is the extent of the diversity of practices? What are the links with culinary practices? What are the effects on biodiversity?
	16/ What is the effect of endogenous microorganisms on production modes? How capturing their value during food processing?
Symbiotic economy	17/ How to know when a food system is following the principles of symbiotic economy? How to characterize such food system (operation mode, conditions of success, sustainability)?
	18/ Which technologies could allow to promote symbiotic economy? What could be the implications on employment and expertise?
	19/ Is the « 0 waste » objective attainable towards 0 pesticide, 0 antibiotic and 0 additive?
	20/ Regarding food waste engineering: how to process wastes (or not) in order to promote a wider diversity of uses?

Table 2. A list of twenty coupled research questions addressing expertises in both food production and food processing

CONCLUSION

Based on the observation that significant disconnections between researchers studying food production and food processing are currently limiting the impact of the innovations proposed by science on the improvement of the sustainability of food systems, our work aimed at initiating a dialog between these two scientific communities through the design of common purposes for collaboration. Even if there is today an increasing demand regarding the development of cross-fields and cross-disciplinary research projects, finding

common purposes for collaboration in science, and especially designing common innovative research questions, still prove to be very difficult without relevant management tools and methods.

In this paper, we explained how we mobilized design theory and methodologies to help researchers studying food production and researchers focusing on food processing to collectively build common purposes for future partnerships, which resulted in the design of twenty innovative research questions. The two scientific communities being used to deal with research topics that aim to support the development of innovations in the agrifood sector, this collective design process was organized around the concept of coupled innovations between agriculture and food manufacturing. This choice helped avoiding the use of vocabulary specific to each scientific field in order to start building a new shared vocabulary and common desirable concepts. Therefore, organizing a dialog between researchers in food production and researchers in food processing according to an innovative design approach successfully allowed scientists from different fields to identify new common purposes for future collaboration.

The next step of this work now consists in building a sustainable community of researchers, who could continue to collectively develop these research questions and also explore new innovative common purposes. The modality according to which such community must be organized also constitutes a management issue, as well as a new research question (see for instance Thomas and Wind, 2013 and Dubois et al., 2014.). Besides studying organizational patterns, consideration should also be given to the potential involvement of new stakeholders (farmers, advisors, industrial partners, water agencies, SMEs, etc.) in order to know if they shall be included in this community and what place they should be given in the collective innovation process.

This work was carried out under the umbrella of IDEAS (Initiative for Design in Agrifood Systems) and was funded by the Food and Bioeconomy Scientific Direction of INRA and by the Scientific Direction of AgroParisTech.

REFERENCES

Baroni, L., Cenci, L., Tettamanti, M., Berati, M., 2007. Evaluating the environmental impact of various dietary patterns combined with different food production systems. European Journal of Clinical Nutrition, 61 (2), 279-286.

Benatallah, L., Zidoune, M. N., Michon, C., 2012. Optimization of HPMC and water addition for a gluten-free formula with rice and field bean based on rheological properties of doughs. International Review of Chemical Engineering, 4 (5), 474-481.

Deffontaines, J. P., 1991. L'agronomie, science du champ. Le champ, lieu d'interdisciplinarité: de l'écophysiologie aux sciences humaines. Agronomie, 11(7), 581-591.

Dewulf, A., François, G., Pahl-Wostl, C., Taillieu, T., 2007. A framing approach to cross-disciplinary research collaboration: experiences from a large-scale research project on adaptive water management. Ecology and Society, 12(2).

Dubois, L. E., Le Masson, P., Weil, B., Cohendet, P., 2014. From organizing for innovation to innovating for organization: How co-design fosters change in organizations. In *AIMS 2014*.

Enkel, E., Gassmann, O., Chesbrough, H., 2009. Open R&D and open innovation: exploring the phenomenon", R&D Management, 39 (4), 311-316.

Finckh, M., Gacek, E., Goyeau, H., Lannou, C., Merz, U., Mundt, C., Munk, L., Nadziak, J., Newton, A., de Vallavieille-Pope, C., Wolfe, M., 2000. Cereal variety and species mixtures in practice, with emphasis on disease resistance. Agronomie, 20 (7), 813-837.

Gassmann, O., Enkel, E., 2004. Towards a theory of open innovation: Three core process archetypes. Proceedings of the R&D Management Conference, Lisbon, Portugal, July 6–9.

Chen, M., Aknin, P., Lagadec, L. R., Laousse, D., Masson, P., Weil, B., 2017. Designing the missing link between science and industry: Organizing partnership based on dual generativity. In International Conference on Engineering Design.

Elmquist, M., Segrestin, B., 2009. Sustainable development through innovative design: lessons from the KCP method experimented with an automotive firm. International Journal of Automotive technology and management, 9 (2), 229-244.

Francis, C., Breland, T. A., Østergaard, E., Lieblein, G., Morse, S., 2013. Phenomenon-based learning in agroecology: a prerequisite for transdisciplinarity and responsible action. Agroecology and Sustainable Food Systems, 37(1), 60-75.

Gillier, T., Piat, G., Roussel, B., Truchot, P., 2010. Managing Innovation Fields in a Cross-Industry Exploratory Partnership with C–K Design Theory. Journal of product innovation management, 27 (6), 883-896.

Gillier, T., Kazakçi, A., Piat, G., 2012. The generation of common purpose in innovation partnerships: a design perspective. European journal of innovation management, 15 (3), 372-392.

Glanville, R., 1999. Researching design and designing research. Design issues, 15 (2), 80-91.

Hatchuel, A., Weil, B., 2009. CK design theory: an advanced formulation. Research in engineering design, 19 (4), 181.

Hooge, S., Béjean, M., Arnoux, F., 2017. Organising for radical innovation: The benefits of the interplay between cognitive and organisational processes in KCP workshops. In The Role of Creativity in the Management of Innovation: State of the Art and Future Research Outlook (pp. 205-237).

Jansson, D. G., Smith, S. M., 1991. Design fixation. Design studies, 12 (1), 3-11.

Kostoff, R. N., 2002. Overcoming specialization. BioScience, 52(10), 937-941.

Lacroix, A., Beaudoin, N., Makowski, D. (2005). Agricultural water nonpoint pollution control under uncertainty and climate variability. Ecological Economics, 53 (1), 115-127.

Leach, M., Rockström, J., Raskin, P., Scoones, I., Stirling, A. C., Smith, A., ... Folke, C., 2012. Transforming innovation for sustainability. Ecology and Society, 17 (2).

Levidow, L., Pimbert, M., Vanloqueren, G., 2014. Agroecological research: Conforming—or transforming the dominant agro-food regime?. Agroecology and sustainable food systems, 38(10), 1127-1155.

Le Bail, M., Makowski, D., 2004. A model-based approach for optimizing segregation of soft wheat in country elevators. European journal of agronomy, 21 (2), 171-180.

Magrini, M. B., Anton, M., Cholez, C., Corre-Hellou, G., Duc, G., Jeuffroy, M. H., Meynard, J.M., Pelzer, E., Voisin, A.S., Walrand, S., 2016. Why are grain-legumes rarely present in cropping systems despite their environmental and nutritional benefits? Analyzing lock-in in the French agrifood system. Ecological Economics, 126, 152-162.

Meynard, J. M., Jeuffroy, M. H., Le Bail, M., Lefèvre, A., Magrini, M. B., Michon, C., 2017. Designing coupled innovations for the sustainability transition of agrifood systems. Agricultural Systems, 157, 330-339.

Potter, N. N., Hotchkiss, J. H., 2012. Food science. Springer Science & Business Media.

Prost, L., Berthet, E. T., Cerf, M., Jeuffroy, M. H., Labatut, J., Meynard, J. M., 2017. Innovative design for agriculture in the move towards sustainability: scientific challenges. Research in Engineering Design, 28 (1), 119-129.

Rivera-Ferre, M. G., Pereira, L., Karpouzoglou, T., Nicholas, K. A., Onzere, S., Waterlander, W., ..., Dogra, A., 2016. A vision for transdisciplinarity in future earth: Perspectives from young researchers. Journal of agriculture, food systems, and community development, 3(4), 249-260.

Schifferstein, H.N., 2015. Employing consumer research for creating new and engaging food experiences in a changing world. Current Opinion in Food Science, 3, 27-32.

Seebode, D., Jeanrenaud, S., Bessant, J., 2012. Managing innovation for sustainability. R&D Management, 42 (3), 195-206.

Thomas, R. J., Wind, Y. J., 2013. Symbiotic innovation: getting the most out of collaboration. In Evolution of Innovation Management (pp. 1-31). Palgrave Macmillan, London.

Tilman, D., and Clark, M., 2015. Food, Agriculture & the environment: Can we feed the world & save the Earth?. Daedalus, 144 (4), 8-23.

Veraverbeke, W. S., Delcour, J. A., 2002. Wheat protein composition and properties of wheat glutenin in relation to breadmaking functionality. Critical reviews in food science and nutrition, 42(3), 179-208.

Villemejane, C., Roussel, P., Berland, S., Aymard, P., Michon, C., 2013. Technological and sensory tools to characterize the consistency and performance of fiber-enriched biscuit doughs. Journal of cereal science, 57(3), 551-559.

Vourc'h, G., Brun, J., Ducrot, C., Cosson, J. F., Le Masson, P., Weil, B., 2018. Using design theory to foster innovative cross-disciplinary research: lessons learned from a research network focused on antimicrobial use and animal microbes' resistance to antimicrobials. Veterinary and Animal Science, 6, 12-20.

Weck, M., 2006. Knowledge creation and exploitation in collaborative R&D projects: lessons learned on success factors. Knowledge and Process Management, 13(4), 252-263.

Wildridge, V., Childs, S., Cawthra, L., Madge, B., 2004. How to create successful partnerships—a review of the literature. Health Information & Libraries Journal, 21, 3-19.

AFFILIATION

Juliette BRUN

INRA, UMR211 Agronomie

juliette.brun@inra.fr

Marianne CERF

INRA, UMR1326 LISIS, CNRS, ESIEE Paris, INRA, UPEM

marianne.cerf@inra.fr

Marie-Hélène JEUFFROY
INRA/AgroParisTech, UMR211 Agronomie
marie-helene.jeuffroy@inra.fr

Jean-Marc MEYNARD
INRA/AgroParisTech, UMR SAD-APT
jean-marc.meynard@inra.fr

Caroline PENICAUD
INRA, UMR GMPA, Génie et Microbiologie des Procédés Alimentaires
caroline.penicaud@inra.fr

PS7: ASSEMBLING INNOVATIVE PRACTICE AND CONTRASTED INCENTIVES: INNOVATION CLUSTER AND POLICY INSTRUMENT

Identifying the actors' interactions within an agricultural innovation system towards sustainability. The case of a French cluster for agritech innovation.

Davide Rizzo, Fatma FOURATI, LUCIAN CEAPRAZ, MARIIA Ostapchuk, Hanitra Randrianasolo, Anne Combaud, Mehdi Jaber and Michel Dubois

Building legitimacy in and with agroecological transitions. Results and learnings from a collaborative observatory of social dynamics in innovative agricultural and rural projects

Marc Barbier and Claire Lamine

IDENTIFYING THE STAKEHOLDERS' INTERACTIONS WITHIN AN AGRICULTURAL INNOVATION SYSTEM TOWARDS SUSTAINABILITY

The case of a French cluster for agritech innovation

DAVIDE RIZZO, FATMA FOURATI, LUCIAN CEAPRAZ, MARIIA OSTAPCHUK, HANITRA RANDRIANASOLO, ANNE COMBAUD, SIMON RITZ, MEHDI JABER, MICHEL DUBOIS

Abstract

The paper explores novel connections between human and technology driven innovation in a French agritech cluster. It focuses on the whole system innovation and addresses specifically the impact of digitalisation related to the precision agriculture deployment. The cluster under investigation has been settled by the Beauvaisis municipalities agglomeration. It comprises interactions between local authorities, firms and knowledge institutions. The analysis covers various perspectives of the stakeholders' interactions, the role of intermediary actors and introduces the concept of floating prescriber. The early results and the following analyses will contribute to highlight the way an ecosystem (a cluster) is developed around the issue of digital technologies and sustainable agriculture.

KEYWORDS : SUSTAINABILITY, AGRICULTURAL INNOVATION SYSTEM, PROXIMITY, PRESCRIBER/FLOATING PRESCRIBER, AGRITECH

INTRODUCTION

Agricultural machinery and digital technologies, main components of the "agritech" sector, play a crucial role in farming innovation and its transitions towards sustainability, for instance to operationalize agroecology [1,2]. The agritech sector involves a heterogeneous set of stakeholders operating at multiple levels. Structural recent evolutions of agriculture – such as the expectation of increased production and better environmental performances from a decreasing number of farmers, digitalization allowing for deeper understanding, control and automatization of practices, etc. – are requiring the agritech stakeholders to redefine their interactions. In France, a joint report of the agricultural equipment stakeholders called for a clarification of the innovation ecosystem, especially through regional initiatives [3]. On the one hand, regional characteristics and location factors remain fundamental determinants of a place-based activity like agriculture. On the other hand, digitalization and technology development risk to weaken or lose the linkage with local activities. Indeed, important innovations (e.g., GPS, Internet of Things, artificial intelligence, telemetry, robots) are currently and for the most exogenous, thus potentially opaque, to the agricultural sector. Research is therefore required to grasp the new economic-environment linkages in the agritech innovation [4,5]. In this regard, the adoption of an agricultural innovation system (AIS) approach can help to clarify the existing and emerging interactions [6], as well as to evaluate their relevance to stimulate transition towards sustainable agriculture [7].

In this paper we aim at identifying the stakeholders' interactions within an agricultural innovation system and their relevance for the transition towards sustainability. We focus on a French agricultural cluster ("pôle territorial" in French) for agritech innovation and digital farming, recently launched in the Hauts-the-France

region (northern France). The cluster and our scientific observation are planned to last several years, so we conclude by drawing the major challenges ahead.

AGRITECH FOR SUSTAINABLE FARMING

Agriculture is challenged to feed a growing world population. Yet, further expansion of cropland would encroach land devoted to fundamental ecosystem services [8]. As so, farming is expected to increase productivity by improving the resource use efficiency [9]. Insofar, two major approaches emerge to support the transition towards sustainable agricultural production: (a) the resource efficiency/substitution and (b) the biodiversity-based agriculture [7]. The former aims at providing the optimal environment for crop and animal husbandry, so as to maximize the achievement of potential yields and growth. The latter addresses instead the environment structure, processes and services to improve the fitting of crop and animal husbandry accordingly through a context-wise management [10,11].

The so-called "precision agriculture" fosters the accuracy of farming operations promising the right dose at the right place and time. Accordingly, it seems to operationalize the context-wise approach, even though it is firstly expected to provide a more efficient use of resources. Historically, precision agriculture can be dated back to some traditional practices focused on the individual plant or animal management. We can include in such a perspective the knowledge intensive practices that designed terraced and other cultural landscapes before the availability of mechanized equipment [12] or some tree hundred years old native American seed management practices [13].

In recent times, precision agriculture is dated back to the deployment of global positioning system technologies, which firstly allowed the place-based description and understanding of cropland management [14]. Following, further sensors were made available and adopted, steadily improving the capability to collect and process and increasing number of physical variables. The availability of cheaper and more efficient sensors further enhances the development of connectivity between pieces of equipment (the "internet of things") and with the cloud computing facilities through various types of network, such as internet, smartphone, Lora, etc. [15].

Actually, the deployment of precision agriculture is leading the transition towards the digitalization of farming activities. In this sense, digital is compared to analogue, the former implying the use of numbers, the latter being instead a simple model of the reality [16,17]. In particular, the shift from an analogue to a digital agriculture is expected to increase accuracy of operations [18], where accuracy is meant as the conformity to truth or to a standard or model [19].

Altogether, digital agriculture allows to draw crop and animal husbandry on a better understanding of the field and herd truth. This data and information framework finally enriches the description and management of the farming system components (soil, crops, herds, machinery, etc.). As so, it might be a practical way to operationalize the biodiversity-based approach mentioned here above [10]. Though, as stated by Kritikos in a thematic report for the European Parliament: "precision agriculture (also referred to as precision farming, smart farming, site-specific crop management or satellite farming) is a data-based management approach that is characterized by the collection and use of field-specific data" [20]. Hence, precision agriculture, while enabling the technologies for sustainable innovation of agricultural systems, is boosting the shift towards digital agriculture and, in the end, the collection and use of data. In this way it empowers the exploitation and integration of complementary data sources, thus enriching the data value for information and knowledge creation.

The data intensive agriculture based upon the precision agriculture deployment is reducing the uncertainties through a transition from heuristic to fact based and data intensive agriculture. The digitalization of farmers' practices and know-how will be a game changer of the primary sector. Similar dynamics can be observed in other economic sectors (e.g., industry 4.0 and e-). Yet, agricultural digital (r)evolution is characterized by the strong and unavoidable environmental exposure that increases the complexity for the operational development of such a fusion of the physical-virtual worlds [21]. In such conditions, precision is more in the decision than in the localisation.

According to the European machinery industry, 70 to 80% of new farming equipment currently on the market embarks some form of precision agriculture component technology [22]. However, the real use of the various data-related technologies is still low compared to the potential. Mains reasons for that include: the lack of adequate training of farmers, agricultural operators and the intermediary actors (e.g., extension services, dealers) [23,24]; the vague legislative framework about non-personal data usage rights and protection, especially

aggregated and analysed data [20]; the technical accessibility and affordability, with rural areas still suffering of a weak connectivity, while the average age of legacy tractors and equipment continue to increase [29]. In this perspective, the European Agricultural Machinery Association called for the recognition of the intrinsic link between agriculture and farm machinery industry, namely through the promotion of the *agritech* [26].

Agritech encompasses the most advanced technologies that supports the agri-food value chain. This includes a vast array of solutions ranging from mechanization equipment and robots, to management software, data capturing devices, decision support software and big data analytics [27]. Further improvements will be achievable by promoting the cross-industry interactions and technologies application. Nevertheless, this adds complexity and radically changes the agricultural industry organization.

AGRITECH STAKEHOLDERS' INTERACTIONS

The paper builds upon available scientific concepts and approaches for the description and the evaluation of system innovation. In particular, we focused on the geography of innovation and proximity measures [28] to investigate the role of prescribers and boundary actors and elements [29].

To understand and describe the stakeholders' interactions, we started from the industrial and rural "district" framework, as defined by the Italian legislation. This framework acknowledges the status of "district" to those areas having: (i) a high concentration of enterprises, mostly of small and medium size; (ii) a specific internal organization of the production system; (iii) a production specialization [30]. Hence, our hypothesis is that geography plays a role in the context of technology transfer and development. Starting from the industry-university-industry (U-I) interface, three further dimensions can be added to the simple geographical proximity: (i) *cognitive proximity*, concerning the way of perceiving, analysing and understanding research; (ii) *organizational proximity*, measures onto similarity in regulations, representations, and beliefs; (iii) *social proximity*, related to the degree of common (generally personal) relationships between actors [31]. In this line, a study by Huang and Chen [32] identified three factors to improve the innovation performance of universities in U-I interactions: (i) the definition of formal management mechanisms; (ii) the actual implementation of regulated U-I collaborations; (iii) the inherent innovation environment in the university. In the case of agritech stakeholders, we can further add the notion of *technology proximity* [33], which can be compensated by the *institutional proximity* when there is a need for a partnership between firms. In this regards, institutional differences can become an obstacle for interactions, for instance in the collaboration between firms and universities [33].

Governance may play a role to catalyse synergies and to deploy the potential of the geographical proximity between stakeholders of a given sector, in particular when other proximity dimensions are not yet developed. In this regards, national and regional authorities can operate in two different ways: through promotion-and-facilitation or with goal-oriented efforts [34]. On the one hand, the institutions rely on their organic role of providers of infrastructures, to be populated and exploited through incentives and regulatory flexibility. On the other hand, a visionary goal might instead be identified to channel synergies and helping attracting and coordinating partners. The latter appears to be preferred to support the agritech sector development.

CASE STUDY: A FRENCH CLUSTER IN AGRITECH INNOVATION

The European Union aims to play a role as world leader in agritech innovation. Precision agriculture and related technologies were identified as major game changer in the agricultural sector [22] and expected to significantly impact the life of European citizens [35,36]. In this context, France is fostering a relevant place, namely in the development of agricultural robotics and farming digitalization [37]. This ambition draws upon a list of nine recommendations formulated by relevant stakeholders to be addressed for the future of the agricultural equipment sector [3].

We focus here on a recent French cluster for agritech innovation to investigate the stakeholders' role as system builders. First, we describe the stakeholders' missions and their previous interactions. Then, we characterize the upcoming collaborations as fostered by the new organizational framework, finally introducing the concept of floating prescriber.

Involved stakeholders and previous collaborations

The study case is composed by four main stakeholders of the agricultural equipment and agritech sector that are located in northern France, namely in the Beauvaisis agglomeration community (53 municipalities in the Hauts-de-France region).

The cluster draws around the Beauvais campus of the Polytechnic Institute UniLaSalle that proposes high education courses and degrees in agriculture, geology and food and health (www.unilasalle.fr). In its earlier form, it dates back to 1865 as section in the local school for teachers. Since the first years, the founders addressed the synergies between the agricultural and the industry sectors as main engines of the national development. Accordingly, the educational program included the purchase of a farm and the creation of an experimental station. Throughout its history, two societies of software development stemmed out: ESCORT, based on a study office created in 1969, and ISAGRI, created as a spin-off in 1983.

More recently, UniLaSalle further strengthen its involvement in the agritech sector through the creation of two new bodies. First, it hosts and backs the chair in agricultural machinery and new technologies, with the patronage of AGCO and the Michelin Corporate Foundation, as well as the funding by the Region Hauts-de-France and the EFDR European program. The chair fosters the design and development of research, education and training in agricultural equipment and new technologies to support the transition towards sustainable agrosystems [38] by acting at the interface between students, industry sector and farmers and their organizations (e.g., CUMA, cooperatives, and technical institutes). Second, AgriLab® (2018), co-financed by the Beauvaisis agglomeration, the Oise Department and the Region Hauts-de-France, as an open innovation platform participating to the sustainable development program of UniLaSalle. It is inspired to the Fab Lab model and initiatives such as Open Ecology and Atelier Paysan. Its novelty is to be completely oriented and equipped to support innovation by and for farmers and other stakeholders of the agrifood sector.

The Beauvaisis agglomeration identified the UniLaSalle campus as a pivot in its territorial development strategy on the agritech sector. Accordingly it branded the area nearby the campus to attract the establishment of agfood sector enterprises in a so-called technology park.

ISAGRI is a European leader in the development of computer based tools for farm management. It was created by Jean-Marie Savalle, current CEO, and a few teachers of the Agricultural Engineer School of Beauvais (currently UniLaSalle). In 1995 they left the school buildings where the spin-off was born, yet remaining in the neighbour area so as to keep the proximity and ease the students' recruitment.

Massey-Ferguson, currently part of the AGCO group, built its most important European tractor production plant in Beauvais in 1960. Its current vice president & managing director for Europe and Middle East is Thierry Lhotte, a former student of the Agricultural Engineer School of Beauvais. The group continues to strengthen the plant and the territorial anchorage through the construction of a 2nd and a 3rd production plants in the same area. In addition, in 1994, AGCO-Massey Ferguson created, in a joint venture with Renault agriculture (then become CLAAS tractor), GIMA to develop and produce transaxles systems for agricultural application.

Finally, Cetim is the French most important technical centre for mechanical industry, established in 1965 to improve companies' competitiveness through mechanical engineering, transfer of innovations and advanced manufacturing solutions.

The new organisational framework

Drawing upon the geographical proximity and the social and historical relations, the Beauvaisis agglomeration wanted to develop other proximity dimensions so as to facilitate innovation emergence and cross-industry technology development. They constituted a cluster to address agritech innovation, previously identified as the distinguishing feature of the local economy through a national and international benchmarking.

By cluster we mean a form of geographic and sectoral agglomeration of enterprises or firms [39] which are interconnected with various institutions or public organizations (like universities, research institutes, knowledge intensive business services and customers [40]) in order to stimulate the innovation through different mechanisms or processes [41]. In this sense, an agricultural cluster is a sort of agricultural knowledge and information system where geographical proximity is maximised. By invoking the first law of geography [42], we focus on non-spatial dimensions of proximity, such as organizational, cognitive and social and on the role of boundary actors and objects that could bridge distances and increase proximity [31]. The underpinning

hypothesis is that the various proximity dimensions between stakeholders have to maximised to facilitate cross-sectoral and the overall system innovation capabilities.

The studied cluster is composed of several stakeholders sharing the goal to ally agricultural machinery and digital technologies with farmer-oriented innovation. The cluster is materialized by a series of public-private investments and buildings for the agritech innovation. On the one hand, the above mentione AgriLab®. On the other hand Pim@tech, a high-technology test bench for machinery constructors being built on a mix private-public funding including the Beauvaisis agglomeration and Cetim, with the support by the Region Hauts-de-France, AGCO Massey-Ferguson and GIMA.

Such a heterogeneous panel of agritech stakeholders can consider the various sustainability components both as a constraint or a promoting factor for innovation. Their perspectives can sit anywhere in the range going from the conviction that technology alone can reduce the negative externalities of farming, to the call for a purely agronomy-driven change of farming systems. Hence, it becomes important to understand and describe the stakeholders' interactions in the absence of formal intermediate actors.

Introducing the floating prescriber concept as innovation broker

This paper makes an attempt to clarify the relationship between different stakeholders within the French agriculture cluster on agritech innovation building on the concept of prescriber. First, we will give a brief overview of the concept of prescriber, second, we will compare the roles of prescribers with innovation brokers. Then, we will propose a definition of floating prescribers. This definition will help us to understand the different interactions that can be potentially considered within the cluster and define the role of each stakeholder.

In his seminal paper, Hatchuel [43] introduced the notion of "prescriber" [44]. This concept seems to be particularly useful in analysing the dynamics within the cluster (in comparison with innovation brokers). Prescribers not only perform functions of innovation brokers (intermediaries), but are also involved in one way or another in the interaction between other parties [45]. Berghozi and Paris [46] analyse a prescription on the internet and the authors highlight that "prescribers are not simple intermediaries but third parties: they act alongside producers and consumers – not between them – in order to structure the product or service supply or to assume responsibility for some aspect of the consumer decision".

Initially, Hatchuel's study [43] discusses the role of prescriber in the relationship between seller and buyer. We adapt this framework to interactions within agricultural innovation systems. Our study allows to enhance the existing concept by introducing a new dimension, which deals with a duality of the roles of some stakeholders ("floating").

The proximity across multiple stakeholders can be increased by intermediate or boundary players such as the prescribers. Literature provides multiple definitions of prescriber, also known as *innovation intermediaries* or *innovation brokers* [47].

Innovation broker is defined as "an organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, for bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations" (Howells (2006, p.720) as cited in [52].

Their role, defined by Klerkx and Leeuwis [47], is central between parties and they act as "facilitators of innovation", or even "sources" or "carriers of innovation". Neutrality is a particular feature as regards of their position in the interactions between different actors. Indeed, the innovation intermediaries act neutrally as long as "their existence remains limited to the lifecycle of the issues they represent in societal debate" [49]. We refer here to the "neutrality or impartiality paradox" firstly used by Laschewski et al. [50]. These authors emphasize that intermediaries adopt a non-neutral position as they act with "a certain degree of steering". Altogether, proximity remains mostly characterized by personal and individual relationships but where "intervention is connected with a degree of formalization of structures and goals" [50,51].

Several authors have defined three main functions of brokers as demand articulation in the context of agritech innovations, linkages creation within an agriculture innovation system and "innovation process management" [52,53]. While intermediation and prescription are linked, the main functions of a prescriber are knowledge transfer and decision-making process support [46].

The phenomenon of prescription occurs in different fields and the interaction is not limited to product purchases. Public authorities', specialized magazines, a doctor, a theatre critic - these are all examples of prescribers. A client (buyer) with limited knowledge might need a prescription to ease a decision-making process related to a potential transaction. A prescriber can help a client get oriented by structuring the existing knowledge or suggesting substitutes which have not been perceived as such. For example, "white wine can be served as an aperitif".

There are three types of prescriptions: factual, technical and judgment prescription. Prescriptions for buying a car can be considered as factual prescriptions. These prescriptions demand a commitment to the truth [43,54]. Factual prescription is used by Hatchuel [43] to mean a prescription which allows clients to broaden their knowledge or to understand the benefits they get. Technical prescriptions refer to a way of doing something or a technique that a client might not have employed due to a lack of knowledge. A technical prescriber can indicate alternative suppliers or develop a new strategy. Doctors, architects and engineers fit into this category of prescribers. A "judgment prescription" deals with values and preference. An act of consuming is not only about an acquisition of something, but also about getting pleasure out of something. An art critic makes judgment and provides a way to judge which helps a client to make a decision [43,54].

We propose a definition of "*floating prescriber*" in which one stakeholder plays several roles depending on the type of project and other parties involved in the interaction. The role can be shifted from one stakeholder to another.

Several characteristics of a prescriber – defined by Hatchuel [43] – and a floating prescriber are identical. Knowledge transfer occurs on the basis of mutual trust. A client and prescriber pursue the same interest: the interest of the client. A prescriber endeavours to keep the knowledge up to date and agrees not to join a competitor. A prescriber tries to be independent wither from the seller or a third party. As soon as a prescriber is identified, a seller might be interested in influencing the prescriber, taking advantage of potential existence of asymmetric information. The prescriber-supplier relationship passes through knowledge transfer as a prescriber needs some information about other partners. A seller might challenge a prescriber and might want to maintain a direct relationship with a buyer or propose a new prescriber [43].

The concept of floating prescriber generates considerable interest in terms of shifting roles of stakeholders which eases the transfer of knowledge from one stakeholder to another. Being in possession of knowledge and criteria for judgment, any stakeholder within the cluster can be a potential floating prescriber.

CONCLUSION

Agritech emerges as a game changer in the system innovation towards sustainable agriculture. We focused here on the genesis of a French cluster on agritech innovation and on the involved stakeholders' interactions based on geographical and other proximity dimensions. Further analysis of the cluster should include the comparison of the innovation and sustainability strategies of each stakeholder, starting from a text analysis of their mission and official documents (e.g., fact sheet distributed at the inauguration of the cluster, stakeholder' website, and activity reports). This could enhance the understanding and description of the role of floating prescriber in the stakeholders' interactions.

Stakeholders' interactions imply an exchange of knowledge and expertise. This exchange helps to articulate demand, to forge links with "supporting services", and to manage innovation selection process and other phases of innovation management routine. As so, the specific role of prescriber, in the interaction between other parties, is enabled only where knowledge, know-how and decision-making skills are established in a way to balance and limit mere "power relations". In perspective, our study could enhance the understanding of prescribers and advisory, through the test of a "floating prescriber" concept, addressing the dynamic role that each stakeholder can play in the operationalization of the transition towards sustainability.

Finally, the decrease in the number of farmers and the increase of their training level should empower their role within a new agritech innovation system configuration. They can help putting agricultural system innovation as a boundary object to structure the agricultural information system dynamics and its transition towards sustainability [55,56]. In this regard, farmers can help to elicit the different agritech stakeholders' perspective on sustainability, provided that they are trained for this new emerging role of mediators.

REFERENCES

[1] G. Machenaud, P. Klein, F. Terrien, E. Pasco, Agroéquipement et triple performance. Freins et leviers pour la transition agroécologique., ABSO conseil, 2014. http://agriculture.gouv.fr/ministere/agroequipements-et-triple-performance-freins-et-leviers-pour-la-transition-agroecologique.

[2] V. Bellon Maurel, C. Huyghe, Putting agricultural equipment and digital technologies at the cutting edge of agroecology, OCL. 24 (2017) D307. doi:10.1051/ocl/2017028.

[3] J.-M. Bournigal, Définir ensemble le futur du secteur des agroéquipements, 2014. http://agriculture.gouv.fr/ministere/definir-ensemble-le-futur-du-secteur-des-agroequipements (accessed May 16, 2017).

[4] D.K. Munroe, K. McSweeney, J.L. Olson, B. Mansfield, Using economic geography to reinvigorate land-change science, Geoforum. 52 (2014) 12–21. doi:10.1016/j.geoforum.2013.12.005.

[5] J. Horbach, Do eco-innovations need specific regional characteristics? An econometric analysis for Germany, Rev. Reg. Res. 34 (2014) 23–38.

[6] L. Klerkx, N. Aarts, C. Leeuwis, Adaptive management in agricultural innovation systems: The interactions between innovation networks and their environment, Agric. Syst. 103 (2010) 390–400. doi:10.1016/j.agsy.2010.03.012.

[7] M. Duru, O. Therond, M. Fares, Designing agroecological transitions; A review, Agron. Sustain. Dev. (2015) 1–21. doi:10.1007/s13593-015-0318-x.

[8] M.F. Acevedo, Interdisciplinary progress in food production, food security and environment research, Environ. Conserv. 38 (2011) 151–171. doi:10.1017/S0376892911000257.

[9] M. Pisante, F. Stagnari, C.A. Grant, Agricultural innovations for sustainable crop production intensification, Ital. J. Agron. 7 (2012) 300–311. doi:10.4081/ija.2012.e40.

[10] M. Duru, O. Therond, G. Martin, R. Martin-Clouaire, M.-A. Magne, E. Justes, E.-P. Journet, J.-N. Aubertot, S. Savary, J.-E. Bergez, J.P. Sarthou, How to implement biodiversity-based agriculture to enhance ecosystem services: a review, Agron. Sustain. Dev. (2015) 1–23. doi:10.1007/s13593-015-0306-1.

[11] G. Martin, M. Moraine, J. Ryschawy, M.-A. Magne, M. Asai, J.-P. Sarthou, M. Duru, O. Therond, Crop–livestock integration beyond the farm level: a review, Agron. Sustain. Dev. 36 (2016) 53. doi:10.1007/s13593-016-0390-x.

[12] P. Tarolli, D. Rizzo, G. Brancucci, Terraced Landscapes: Land Abandonment, Soil Degradation, and Suitable Management, in: World Terraced Landsc. Hist. Environ. Qual. Life, Springer Nature Switzerland AG, 2019. https://www.researchgate.net/publication/327894266_Terraced_Landscapes_Land_Abandonment_Soil_Degradation_and_Suitable_Management (accessed September 27, 2018).

[13] T.A. Brase, Precision agriculture, 1st ed, Thomson/Delmar Learning, Clifton Park, NY, 2006.

[14] G. Grenier, Agriculture de précision, Editions France Agricole, 2018. https://www.editions-france-agricole.fr/site/gfaed/NOUVEAUTES__gfaed.4464.35285__/fr/boutique/produit.html (accessed May 2, 2018).

[15] M. Dubois, F. Fourati-Jamoussi, J. Dantan, D. Rizzo, M. Jaber, L. Sauvée, The agricultural innovation under digitalization, in: Bus. Transform. Era Digit., IGI Global, 2018. https://www.igi-global.com/book/business-transformations-era-digitalization/205238 (accessed October 16, 2018).

[16] digit | Origin and meaning of digit by Online Etymology Dictionary, (n.d.). https://www.etymonline.com/word/digit (accessed October 26, 2018).

[17] analogue | Origin and meaning of analogue by Online Etymology Dictionary, (n.d.). https://www.etymonline.com/word/analogue (accessed October 26, 2018).

[18] CEMA, Digital Farming: what does it really mean?, (2017). http://www.cema-agri.org/page/digital-farming-what-does-it-really-mean (accessed October 26, 2018).

[19] Definition of ACCURACY, (n.d.). https://www.merriam-webster.com/dictionary/accuracy (accessed October 26, 2018).

[20] M. Kritikos, Precision agriculture in Europe. Legal, social and ethical considerations, European Parliamentary Research Service, 2017. http://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_STU(2017)603207.

[21] A.-T. Braun, E. Colangelo, T. Steckel, Farming in the Era of Industrie 4.0, Procedia CIRP. 72 (2018) 979–984. doi:10.1016/j.procir.2018.03.176.

[22] A. Lamborelle, L.F. Álvarez, Farming 4.0: The future of agriculture?, Euractiv.Com. (2016). https://www.euractiv.com/section/agriculture-food/infographic/farming-4-0-the-future-of-agriculture/ (accessed October 26, 2018).

[23] S. Ritz, D. Rizzo, F. Fourati, J. Dantan, A. Combaud, M. Dubois, Training in agricultural technologies: a new prerequisite for smart farming, in: Sustain. Agric. Oppor. Innov. Mach. Syst., AXEMA - EurAgEng, Villepinte (FRA), 2019.

[24] EIP-Agri, EIP-AGRI Brochure Shaping the digital (r)evolution in agriculture - EIP-AGRI - European Commission, (2017). /eip/agriculture/en/publications/eip-agri-brochure-shaping-digital-revolution (accessed October 26, 2018).

[25] 365Farmnet, Agriculture 4.0 – Rendre l'agriculture connectable, n.d. http://www.xn--landtechnik-anschlussfhig-machen-6yc.com/Livreblanc_Agriculture4.0_Janvier2017.pdf (accessed August 25, 2018).

[26] CEMA, AgriTech 2030 – CEMA launches Strategic Vision for Europe's Agricultural Machinery Industry, (2017). http://www.cema-agri.org/publication/agritech-2030-%E2%80%93-cema-launches-strategic-vision-europe%E2%80%99s-agricultural-machinery-industry (accessed October 26, 2018).

[27] E. Cosgrove, R. Leclerc, L. Burwood-Taylor, R. Chauhan, AgFunder Agrifood Tech Investing Report 2017, AgFunder, 2018. https://research.agfunder.com/2017/AgFunder-Agrifood-Tech-Investing-Report-2017.pdf (accessed April 1, 2018).

[28] A. Rallet, A. Torre, Geography of innovation, proximity and beyond, in: Elgar Companion Innov. Knowl. Creat., 2017: pp. 421–439.

[29] B. Segrestin, F. Aggeri, A. David, P.L. Masson, Armand Hatchuel and the Refoundation of Management Research: Design Theory and the Epistemology of Collective Action, in: Palgrave Handb. Organ. Change Think., Palgrave Macmillan, Cham, 2017: pp. 1–15. doi:10.1007/978-3-319-49820-1_80-1.

[30] S. Tarangioli, La normativa di riferimento del distretto rurale e agro-alimentare di qualità e lo stato dell'arte nelle regioni italiane, in: ReteLeader-INEA (Ed.), Lead. E Distretti Rurali – Sinergie E Complement., 1997. https://www.researchgate.net/publication/277669503_La_normativa_di_riferimento_del_distretto_rurale_e_agro-alimentare_di_qualita_e_lo_stato_dell'arte_nelle_regioni_italiane (accessed October 26, 2018).

[31] E. Villani, E. Rasmussen, R. Grimaldi, How intermediary organizations facilitate university–industry technology transfer: A proximity approach, Technol. Forecast. Soc. Change. 114 (2017) 86–102. doi:10.1016/j.techfore.2016.06.004.

[32] M.-H. Huang, D.-Z. Chen, How can academic innovation performance in university–industry collaboration be improved?, Technol. Forecast. Soc. Change. 123 (2017) 210–215. doi:10.1016/j.techfore.2016.03.024.

[33] M. Woerter, Technology proximity between firms and universities and technology transfer, J. Technol. Transf. 37 (2012) 828–866. doi:10.1007/s10961-011-9207-x.

[34] M. De Clercq, A. Vats, A. Biel, Agriculture 4.0 – The Future Of Farming Technology, World Government Summit, 2018. https://www.oliverwyman.com/our-expertise/insights/2018/feb/agriculture-4-0--the-future-of-farming-technology.html (accessed October 26, 2018).

[35] C. Kempenaar, K. Lokhorst, Briefing Paper 3. Trends in precision agriculture in the EU, in: Precis. Agric. Future Farming Eur., 2016: pp. 111–137. http://library.wur.nl/WebQuery/wurpubs/521075.

[36] C. Kurrer, J. Tarlton, eds., Ten more technologies which could change our lives: in-depth analysis, 2017. http://www.europarl.europa.eu/RegData/etudes/IDAN/2017/598626/EPRS_IDA(2017)598626_EN.pdf (accessed August 25, 2017).

[37] J.-M. Bournigal, F. Houiller, P. Lecouvey, P. Pringuet, Agriculture – Innovations 2025 : 30 projets pour une agriculture compétitive & respectueuse de l'environnement, Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt, Paris (FRA), 2015. http://agriculture.gouv.fr/agriculture-innovation-2025-des-orientations-pour-une-agriculture-innovante-et-durable (accessed August 25, 2017).

[38] D. Rizzo, M. Dubois, A. Combaud, Innovation des agroéquipements : au carrefour entre agriculteurs, industriels et formation., in: Beauvais, FRA, 2018: p. poster.

[39] H. Schmitz, On the clustering of small firms, IDS Bull. 23 (1992) 64–69.

[40] World Bank, ed., Agricultural innovation systems: an investment sourcebook, World Bank, Washington, D.C, 2012. https://openknowledge.worldbank.org/handle/10986/2247 (accessed July 13, 2018).

[41] European Commission, Community framework for state aid for research and development and innovation, Off. J. Eur. Union. 323 (2006) 1–26.

[42] W. Tobler, On the First Law of Geography: A Reply, Ann. Assoc. Am. Geogr. 94 (2004) 304–310. doi:10.1111/j.1467-8306.2004.09402009.x.

[43] A. Hatchuel, Les marchés à prescripteurs. Crises de l'échange et genèse sociale, in: A. Jacob, H. Vérin (Eds.), L'inscription Soc. Marché, Editions L'Harmattan, Paris, 1995: pp. 205–225.

[44] B. Segrestin, F. Aggeri, A. David, P. Le Masson, Armand Hatchuel and the Refoundation of Management Research: Design Theory and the Epistemology of Collective Action, in: C. Palgrave Macmillan (Ed.), Palgrave Handb. Organ. Change Think., 2017: pp. 1–15.

[45] R. Camerani, N. Corrocher, R. Fontana, Drivers of diffusion of consumer products : empirical evidence from the digital audio player market, Econ. Innov. New Technol. 25 (2016) 731–745. doi:10.1080/10438599.2016.1142125.

[46] P.J. Benghozi, T. Paris, The economics and business models of prescription in the Internet, in: Internet Digit. Econ. Princ. Methods Appl., 2007. doi:10.1017/CBO9780511493201.010.

[47] L. Klerkx, C. Leeuwis, Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector, Technol. Forecast. Soc. Change. 76 (2009) 849–860. doi:10.1016/j.techfore.2008.10.001.

[48] J. Howells, Intermediation and the role of intermediaries in innovation, Res. Policy. 35 (2006) 715–728. doi:10.1016/j.respol.2006.03.005.

[49] S. Davenport, S. Leitch, The Role of Boundary Organizations in Maintaining Separation in the Triple Helix, in: Capital. Knowl., Edward Elgar Publishing, 2010. doi:10.4337/9781849807180.00018.

[50] L. Laschewski, J. Phillipson, M. Gorton, The Facilitation and Formalisation of Small Business Networks: Evidence from the North East of England, Environ. Plan. C Gov. Policy. 20 (2002) 375–391. doi:10.1068/c0066a.

[51] R. Huggins, The success and failure of policy-implanted inter-firm network initiatives: motivations, processes and structure, Entrep. Reg. Dev. 12 (2000) 111–135. doi:10.1080/089856200283036.

[52] L. Klerkx, A. Hall, C. Leeuwis, Strengthening agricultural innovation capacity: are innovation brokers the answer?, Int. J. Agric. Resour. Gov. Ecol. 8 (2009) 409. doi:10.1504/IJARGE.2009.032643.

[53] M.H. Batterink, E.F.M. Wubben, L. Klerkx, S.W.F. (Onno) Omta, Orchestrating innovation networks: The case of innovation brokers in the agri-food sector, Entrep. Reg. Dev. 22 (2010) 47–76. doi:10.1080/08985620903220512.

[54] A. Hatchuel, O. Favereau, F. Aggeri, Activité marchande et Prescription : à quoi sert la notion de marché ?, in: L'activité Marchande Marché, Presses des Mines, 2010: pp. 159–179.

[55] M. Dubois, G. Lavier, H. Randrianasolo, Opérationnalisation d'une agriculture durable, (2017). http://www.costech.utc.fr/CahiersCOSTECH/spip.php?article59 (accessed July 13, 2018).

[56] P. Steyaert, M. Barbier, M. Cerf, A. Levain, A.M. Loconto, Role of intermediation in the management of complex sociotechnical transitions, in: Agroecol. Transit. Chang. Breakthr. Mak., Wageningen University Research, 2016: pp. 257–281.

AFFILIATION

DAVIDE RIZZO

Chair in Agricultural Machinery and New Technologies, and INTERACT research unit UP 2018.C102, UniLaSalle, Beauvais, France. Email : davide.rizzo@unilasalle.fr

FATMA FOURATI

InTerACT research unit UP 2018.C102, UniLaSalle, Beauvais-Rouen, France. Email: Fatma.Fourati@unilasalle.fr

LUCIAN CEAPRAZ

InTerACT research unit UP 2018.C102, UniLaSalle, Beauvais-Rouen, France. Email: Lucian.Ceapraz@unilasalle.fr

MARIIA OSTAPCHUK

InTerACT research unit UP 2018.C102, UniLaSalle, Beauvais-Rouen, France. Email: Mariia.Ostapchuk@unilasalle.fr

HANITRA.RANDRIANASOLO

InTerACT research unit UP 2018.C102, UniLaSalle, Beauvais-Rouen, France. Email: Hanitra.RANDRIANASOLO@unilasalle.fr

ANNE COMBAUD

InTerACT research unit UP 2018.C102, UniLaSalle, Beauvais-Rouen, France. Email: Anne.COMBAUD@unilasalle.fr

SIMON RITZ

Chair in Agricultural Machinery and New Technologies, UniLaSalle, Beauvais, France. Email : Simon.RITZ@unilasalle.fr

MEDHI JABER

AgriLab®, UniLaSalle, Beauvais, France. Email : Mehdi.JABER@unilasalle.fr

MICHEL J.F. DUBOIS

InTerACT research unit UP 2018.C102, UniLaSalle, Beauvais and Rouen, France. Email: Michel.DUBOIS@unilasalle.fr

BUILDING LEGITIMACY IN AND WITH AGROECOLOGICAL TRANSITIONS

Results and learnings from a collaborative observatory of social dynamics in innovative agricultural and rural projects

BARBIER, MARC

LAMINE, CLAIRE

Abstract

The objective of this communication is to present the results of a research project, which aimed at setting a collaborative observatory of social dynamics in innovative rural initiatives in France, placed under the umbrella of the agroecological policy launched by the French Ministry of Agriculture in 2012. After establishing the purpose of this observatory in its political and social context, we present the modus operandi of this collaborative research and its methodological framework. It follows key findings of our sociological analysis of a portfolio of 16 case studies of ecologization of farming and rural development practices. In conclusion we account for the necessity to articulate such an analysis of ecologization and rural development projects with an account of how the policy instrument that framed these project was applied and what it performed.

KEY-WORDS: AGROECOLOGY ; COLLECTIVE ENQUIRY ; RESEARCH METHOD DESIGN; METHODOLOGY; REFLEXIVE PRACTITIONERS

INTRODUCTION

The present and still rather timorous environmental turn within agricultural public policies follows a long process of ecologization of public action starting in the mid 1980's (Deverre & de Sainte Marie, 2008) and institutionalized under the 1992 CAP reform (Fouilleux, 2000). It shows very complex trajectories of transcodage[20] of agricultural and environmental policy making (Lascoumes, 1996) under the influence of environmental, biodiversity and sanitary concerns expressed in various situations of land-use conflicts expressed in various criticism over the incumbent « agro-industrial model », but also of the numerous claims and initiatives aiming at reconnecting food production and sustainable food consumption practices (Goodman et al., 2011).

However, discourses of agri-environmental policies have often been reported as being more "greening and washing" than transformative (Lowe et al., 2010), not least because they have not allowed for coordinated changes at the scale not only of agroecosystems but also of agrifood systems. In this context, the emergence of agroecology in agricultural policy in diverse national contexts seems to go beyond the "treadmill of sustainable development in agriculture" (Barbier, 2010) since it proposes the re-assembling of sustainable consumptions with technological choice in farming and with societal attempts on environmental issues. This is what suggest recent studies about national agricultural policies that have chosen agroecology as a key paradigm for agricultural change, either for a specific part of the agricultural world as is the case in Brazil for example with the focus on family agriculture (Petersen et al., 2013), or as an encompassing vision aimed at involving and mobilizing a large part of the farmers as was the case in France with the program launched in 2012 (Lamine, 2017). At the European level, this agroecological turn – with or without an explicit reference to agroecology as such - seems to contribute to a

[20] The notion of transcodage means, on the one hand, aggregating scattered information and practices, and also constructing and presenting them as a whole; and finally, transferring them to other repertoires of action based on different logics in order to ensure their dissemination within and outside a given social field (see Lascoumes, 1996 : 334-335).

potential sustainability transitions pathway that can be observed in a landscape of various design practices of innovation and system innovation in agriculture (Barbier et al., 2012; Elzen, et al. , 2012; Elzen et al., 2017).

The objective of this communication is thus to present the results of a collective research that has been launched in 2014, while the French agroecological policy was enforced, and focusses on the first specific policy instrument of this new agricultural program, called "Mobilisation Collective pour l'Agro-Ecologie" (meaning Collective Mobilization for AgroEcology, hereafter MCAE). The particularity of this instrument was to open a call for proposals of projects carried by groups of farmers, possibly with the support of accompanying organizations. This instrument was therefore linking a national policy directly allowing direct support to farmers groups and not through through the regular incumbent system of agricultural development. The setting of a collaborative observatory was thus intending to establish a knowledge capacity in order to study and follow-up the initiatives and the collective dynamics that this policy instrument would up-take. This observatory was called MCAE-ObsTAE.

After establishing the context, purpose and modus operandi of this observatory (1), we present the methodological framework and results of this collective enquiry based on a textual analysis of projects intentions and of the sociological analysis of a portfolio of 16 case studies of collective dynamics aimed at ecologizing farming and rural development practices at the scale of farmers and multi-actors groups (2). In the discussion, we argue for the necessity to articulate an analysis of ecologization and rural development projects with an account of the policy instrument that framed these projects (3).

CONTEXT, PURPOSE AND MODUS OPERANDI OF AN OBSERVATORY OF COLLECTIVE DYNAMICS OF AGROECOLOGICAL TRANSITIONS

Context

During the last ten years, one can witness an agroecological turn in French policy making, which results from the weaving of three transforming processes that have affected French agriculture and its place in public debates: a long march of organic farming and alternative food systems institutionalization at the local level (Lamine, 2012), a reconnection of agriculture and food in alternative networks based on territorial innovative socio-economic arrangements (Dubuisson-Quellier & Lamine, 2008; Lamine & Chiffoleau, 2012), and a technological and knowledge turn based on diverse models of "ecological" agriculture such as the pioneer organic agriculture and more recently the booming of conservation agriculture (Goulet, 2008). All these trajectories are not necessarily coupled and governed at the territorial level, but they seem to share a profound transformation of the production and circulation of knowledge, whatever the type of farming systems (Compagnone et al., 2018). Indeed, they have had significant effects on the advisory system and on the search of farmers groups or network for more autonomy.

In this context, the French Ministry of agriculture has launched an ambitious Agroecological Plan in 2012 aimed at fostering agroecological transitions in agriculture and in agrifood systems. Various public action instruments have been mobilized to enhance this Plan, among them this innovative call for tenders entitled "Collective Mobilisation for AgroEcology", which has been launched in 2013 with the aim to support directly local initiatives and innovative groups without necessarily using the incumbent roads of the Agricultural Knowledge System to reach groups of farmers. Many researchers and young scholars are thus at work at present to understand this possible turn in agricultural and rural policy under the agroecological promise[21].

Purpose

[21] A large research project called IDAE is ongoing, joining almost all social scientists that have targeted agroecology as a field of enquiry and scientific questions at various scale (farm, territory, policy arenas, international expertise), see the URL . Authors are participants of this project.

Thanks to this call, 103 collectives of farmers and intermediaries - among 469 initial candidates - have been selected, committed and financed to carry out breakthrough initiatives and projects. This collection of groups echoes the coexistence of multiple types of farming systems and attachments to agrifood chains and food markets (Hervieu & Purseigle, 2015) that characterize the new challenge of the French agricultural development policy. The study of these distributed processes of change enables to prolong the research program open by Van der Ploeg et al. (2000) and to adopt a sociological perspective on endogenous rural development (Shucksmith, 2010; Vanclay, 2011). However, our own ambition is to understand development processes as the outcomes of dynamics at the interface of public policy instruments and of situated systems of collective action. Doing so, our perspective intends to capture agroecological transitions as exploratory processes that, includes socio-political configurations or socioeconomic arrangements, at the territorial level. Our research framework enables to unfold a pragmatist perspective, taking into account the fact that the collectives under study have also their ways of understanding and enacting institutional frameworks, and particularly to give meaning, agency and materiality to agroecology.

In light with previous attempts to establish a coordinated sociological enquiry at the level of rural development instruments like the LEADER European program (Ray, 2000; High & Nems, 2007), and to foster participatory research practices, we have constituted a group of 12 social researchers and set up a research project aimed at analysing the landscape of the initiatives and projects, those submitted and the 103 groups that have been funded by this agroecological scheme, and concomitantly at assessing and accompanying the collective dynamic at work in 16 innovative groups over these 103 (Barbier & Lamine, 2017).

Project rationale and modus operandi

Our project is at the crossroads of the social studies of public action and environmental and rural social research. The design and enactment of a prototype of observatory directly addresses this interplay and intend to question the present processes of institutionalization of agroecology in France while carrying out social studies of transition processes. Its originality is to cross various methodological streams towards the establishment of a permanent social observatory that would promote inclusiveness and direct discussions and uses of social science outcomes. This project relies on three articulated tasks.

(1) A global appraisal of submitted projects based on advanced documentary methods to depict and discuss the landscape of agroecological initiatives at the national level, and to position the selected projects within this large set of submitted projects. A similar methodology has been used by Riverra-Ferre (2018) through a lexicometric analysis of policy documents which leads to identify five narratives crossing different dimensions of agroecology with different scales of action (from farm to the food system). Ollivier and Bellon (2013) have also studied scientific literature with lexical and network analysis methods. Our lexical and network approach interestingly targets the writing of projects by actors who answered the call for tender under the MCAE policy instrument[22].

(2) A long term collaborative study and follow-up of 16 projects based on interviews, participant observations and action-research methods. The in-depth study of these 16 initiatives made it possible to analyse what "agroecology" and "agro-ecological transition" mean for a diversity of actors involved in these projects, and what kind of action they have purposefully carried out. Our approach is clearly anchored in a pragmatist perspective of studying the ecologization of agricultures (Lamine, 2017), whereby we analyse in an articulated manner the visions and discourses held by the actors involved in these projects, and the projects and actions they carried out within this specific program.

(3) A reflexive open seminar with practitioners involved in the projects under study to discuss findings, purposes and issues of the subpolitics of the agroecological turn, which is actually in France very much linked to debates and contentions about the efficiency of the reduction of pesticides use (Barbier, 2017). Four "open seminars" were organized between May 2015 and January 2017, involving members of the collectives (a total of about thirty different actors) as well as about fifteen members of the administration. The final conference of the project in 2018 has been organized as an extension of this process of stakeholder involvement, enabling groups to report about their own trajectories[23]. This observatory is thus also anchored in a research action perspective, as one of the key principles or our project was to elaborate and discuss our findings with the actors.

[22] The methodology of studying projects has been shaped thanks to a previous research about research projects financed by the French National Agency (ANR) during 3 programs targeting the ecologization of French Agriculture (Barbier,)

[23] See the website : https://colloque.inra.fr/mcae-obs/.

RESULTS

Based on our analysis and observation of the call and of the 16 groups during the three years of their projects and after, our results offer a dual account of how groups of farmers have responded to the MCAE call: firstly describing what a policy instruments has triggered and secondly how some supported projects have enacted this instrument in practices. Our results intend to report what has been generated globally and enacted locally, taking the lenses of project as a relevant object of enquiry.

The analysis of the "landscape of projects"

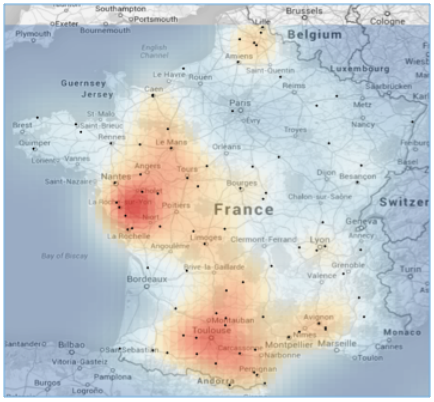
Method

Our analysis is based on a qualitative study of the texts of the projects, as the applying farmers groups have shaped them following a very formal grid defined in the call. The homogeneity of the structure of documents could thus easily fit with a textual analysis using Natural Language Processing (NLP) methods. A database was created containing information on the 469 projects, including full texts of the projects in the 5 rich textual fields of the 103 selected projects (C1 Definition of the project; C3 Description of the collective; C4 Objectives of the project; C6 Innovative dimension of the project; C7 composition of the Partnership).

The textual analysis of project texts (frequent processing of occurrences, lexical analyses and analyses of co-occurrence networks) mobilised the existing descriptors in the headings of the call for projects, but also produced new descriptors resulting from terminology extraction work and the use of categories provided by typologies.

The landscape of intention

The distribution of the submitted projects throughout the French metropolitan territory shows a differentiated involvement of regions in the MCAE instruments (see map 1). The spatial distribution of subsidies is fairly homogeneous in the regions whose departments have posted a significant number of projects. In addition, the size of projects is significantly larger in regions with a low submission rate. The Rhône corridor is a significant source of projects supported by non-agricultural structures. Farmers' economic organisations depict a specific feature of agroecological transition in the south of France. The location of alternative associations' projects also appears to be specific (more numerous in the South-East, Pays de Loire, Nord and Champagne-Ardennes). There is a clear geography of involvement of famers' group in this agroecological policy instrument.



On the side of accompanying structures for famers' groups that carried the project, here also the frequential analysis deliver interesting features (Table 1). The chambers of agriculture are very present in the companioning of submitted projects (35% in blue), companioning by incumbent development groups, and professional organizations represent 24% (in red); cooperatives and organic farmers organization or AMAP represent 26% (in green); the rest forms a set of diverse private or public organisations (in grey). It is also to be noticed the strong presence of livestock issues in projects, 22% of all submitted projects deal with cattle and 27% with crop-livestock farming systems.

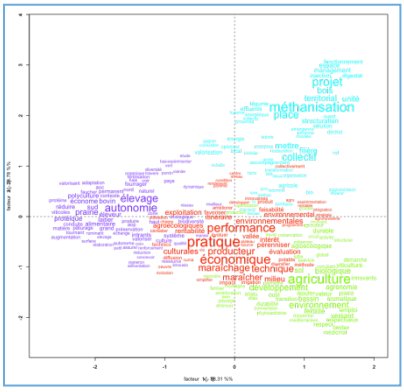
In terms of the origin of the groups of farmers, half of the collectives can be qualified as "emergent", meaning they have been created to answer the call, whether they were born as a sub group in an existing organization or created as a new association for the occasion. The bottom-up nature of projects is a category that enables to qualify how the project has been shaped in the work done between farmers' collectives and companioning structures: 40% of the projects were co-constructed with the farmers and 20% completely controlled by farmers. The emergence of new collectives and the attempt to involve farmers in the construction of the project is also a feature of this agroecological policy instruments.

When looking at the partnerships involved in projects with a relational approach based on network analysis, the average number of partners is 7. The projects supported by companioning structures that have opportunistically "created" the collective for the call are significantly those that include non-agricultural

organizations (including NGOs) or agricultural farmers unions. When projects are more directly shaped and lead by famers groups or collectives, others partners appear such as private advisors, consulting firms and non-agricultural agencies or organisations. Finally, projects managed directly by a structure without a clear contributing collective of farmers (but with farmers as beneficiaries) are significantly composed of incumbent actors of the agricultural development system.

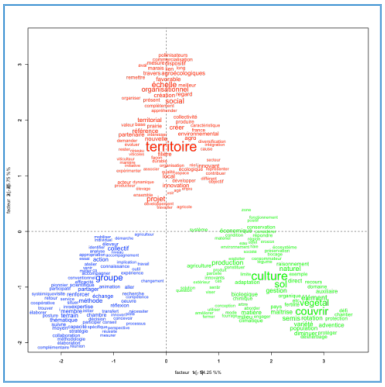
These main features of the submitted projects define an interesting landscape of capacities that are involved in this agroecological scheme. It particularly shows how structuration process of projects by emerging groups tend to set their heteronomy in the co-construction of projects with a companioning structure and in the mastery of partners' relationship. Moreover, we bring evidence that this emergence is territorialised with strong differences between French departments..

The landscape of submitted projects



To go further in the analysis of the lexical repertoire of submitted projects, a factorial analysis of the terms obtained thanks to a hierarchical classification with Iramuteq[24] gives four classes with a very good result (73% cumulative percentage for the first 2 axes). This analysis reveals 4 classes of project titles:

- A class concerning agro-ecological practices and economic performance (the term efficiency is prominent) and marked by market gardening (class 1, red).
- A class concerning environment and sustainability, marked by the reference to soil agronomy and fertilization at the scale of catchment areas (class 2, green).
- A class concerning methanisation projects, the valorisation of the wood sector and space management (class 3, blue).
- A class very clearly concerning breeding and the question of fodder and protein autonomy (class 4, violet).



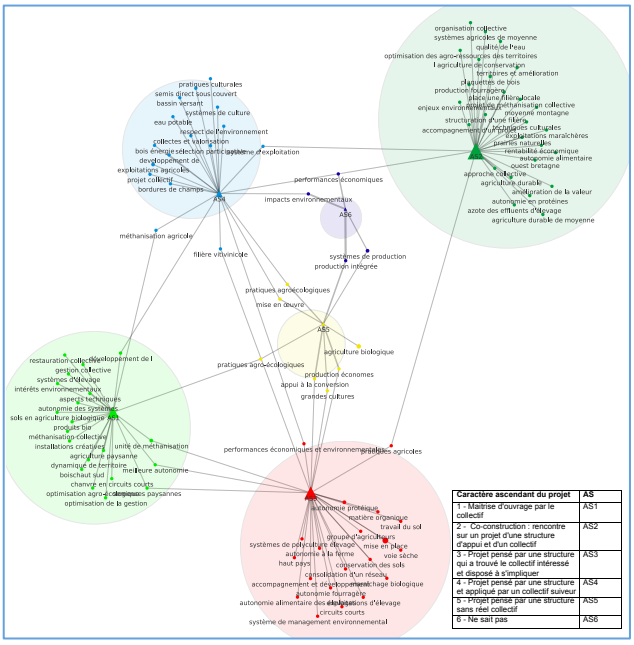
To complement this first level account, a textual analysis of the section declaring the innovative dimension of projects reveals the three main qualification of innovation: territorial innovation (red), social innovation (blue) and agronomic innovation (green). This triptych shows what is considered to be novel by groups, and it conveys certainly this new dimension of social innovation on more casual discourses about place, identity and agri-environmental technology.

The upward nature of project design

To finish this outlook on the landscape of intentions, we shall consider how the indicator that values the bottom-up nature of project design is clustered with multi-terms to be automatically extracted from project title[25]. Based on a 5 levels scale established by the administrative services of the Agriculture Ministry the bottom-up nature of the project as such: AS1 the group master its project; AS2 the project is constructed; AS3 the project is defined by a structure and implemented by a group; AS4 the project is defined by a structure and applied by a collective of farmers; AS5 the project is defined and carried by a structure for un-organized beneficiaries). The map is based on the network analysis the co-occurrence of the variable and associated words (indirect metric of Chi2 and Louvain Clusterisation).

[24] See URL http://iramuteq.org/

[25] The CorTextManager online instrument has been used to provide this analysis (see at URL cortext.net)



The map shows a very interesting result since it allows noticing a preferential thematic orientation according to the existence of an upward dynamics in the constitution of projects. This is an indication that the bottom-up type of process corresponds to particular sociotechnical commitments: AS1corresponds to innovative projects that concern territorial innovations, which target the autonomy of systems in organic farming, collective methanization, livestock and peasant agriculture; AS2 correspond to conservation agriculture, market gardening and issues about grazing in relation to fodder autonomy with indications of social dimension (companioning structure and collective action).

The sociological analysis of a portfolio of 16 case studies

Method

If a textual analysis of intention enables to charaterize the landscape of intentions that have been positively declared within this agroecological policy instrument, the big challenge of this collaborative project was to organize, synchronize and mutualize depth longitudinal case studies on 16 selected projects (over the 103 that were funded). The composition of this portfolio results from practical reasons (localization of the researcher and of the place of enquiry) and from our willingness to focus on groups of farmers whose initiatives where as much bottom-up as possible. We have also tried to cover breakthrough initiatives in relation to claims of ecologization of practices to be up-taken by the project.

The portfolio of the case studies

Name of project	Region	Type of companioning structure
Amap de Provence	PACA	Farmer/Consumer Organization / Organic
Civam PACA	PACA	Association of farmers and advisors / Organic
Scara	Rhône Alpes	Consultancy firm
ADDEAR 42	Rhône Alpes	Rural development social economy organization
Fricato	Languedoc Roussillon	Farmers group and city council / Organic
Salsa	Midi-Pyrénées	Farmers'group
Adear 32	Midi-Pyrénées	Association for the Development of Agricultural and Rural Employment
CAVAC	Pays de Loire	Cooperative
APAD	Nord Pas de Calais	Farmers group in Conservation Agriculture
Assos Sols en Caux	Normandie	Farmer group in Conservation Agriculture
Vallée de l'Oise	Picardie	Agricuture Chamber
Aladear 57	Lorraine	Farmers group
CEDAPA	Bretagne	Farmers Association promoting sustainable grazing
Terres et Bocages	Bretagne	Association of land owners for the development of grove
Cuma de Brutz (44)	Pays de la Loire	Cooperative for the Use of Agricultural Equipment
Cuma d'Elgarrekin (64)	Aquitaine	Cooperative for the Use of Agricultural Equipment

In order to study those 16 projects, a common methodological framework has been established and a shared format of reporting on each case study has enabled comparisons of groups' dynamics. This framework allowed describing the emergence of these collectives as well as their trajectories, to analyse their objectives, the actions that had been carried out, their internal organisation and external partnerships, as well as their visions and definitions of agricultural change and of agroecological or ecological practices. The group of researchers has met regularly (4 times a year) to conduct a transversal analysis based on the feedback and debates held in the 4 joint

seminars with the leaders of the 16 projects selected for in-depth analysis. This transversal analysis was focussed on three main dimensions:

- The meaning of agro-ecological practices as groups forge it in action
- The dynamics of organization and coordination of collectives in their context of action
- The production and dissemination of knowledge and know-how attached to the collective experience of groups

Key outcomes of the cross-cutting analysis

Making sense of AE transitions and searching for legitimacy

The first crosscutting theme is the visions of agroecology that are at stake in these groups. Agroecology as such is not often mentioned in the text of projects – or when it is, it is mainly to "tick the good boxes" of the call – whereas the agricultural models previously adopted by the groups are much more present, such as organic agriculture, peasant agriculture, conservation agriculture etc.

These formulations of objectives related to agroecology are varied and can be structured into four main groups that also define different ways of anchoring agroecology in practices:

- the search for autonomy from a peasant agriculture point of view;
- the management of agro-ecological infrastructures;
- soil conservation agriculture as an archetype of an intensive agroecology;
- a diversity of changes in technical systems and redesign of agricultural activities.

The analysis of the interviews and collective exchanges allowed us to identify two main ways in which groups relate to a reference to agroecology: on the one hand, "natural" convergence with already legitimate models (such as Organic Agriculture), and on the other hand, agroecology as a support point for "intermediate" models in search of legitimacy. The latter are often closer to conventional agriculture and have a more controversial "ecological" dimension (such as soil conservation agriculture) than more established and legitimate models. It should be noted that some collectives do not explicitly display a reference agricultural "model".

These modalities correspond to different visions of the agroecological transition and therefore different objectives for the projects. Some groups adopt a more technical vision (adopting a particular practice, a particular technical itinerary, recomposing technical itineraries with a defined sustainability objective) often emphasises the double environmental and economic performance, while others adopt a more procedural vision (exchanging on practices, accompanying new entrants, collective learning). However, these different visions converge on the notion of autonomy, which is perhaps the most shared in the end. Finally, the collectives emphasize more or less their articulation with food issues and consumers, and with the territory, through quite differentiated partnerships. However, almost all collectives seek support outside the agricultural space, through these partnerships, in order to build their legitimacy outside the existing incumbent systems of actors of agricultural development.

Dynamics of organization and coordination of collectives

The second key transversal themes dealt with collective dynamics. The groups under studied range from 5-6 farmers to about 40, most of them around 15 farmers (classic scale of farmers' groups) that most of the time carry the continuation of a previous collective dynamic.

Our 16 studies have shown differences in terms of farmers' involvement: in some cases, farmers had initiated the projects and all along the 3 years of these projects maintained a leading role in the on-going actions and interactions with other actors (including institutions and funders), whereas in other cases, the projects had been elaborated and were mainly carried out by various types of agricultural and rural development institutions, ranging from the "conventional" actors that are the French chambers of agriculture to more alternative actors such as rural development organisations or consumers-farmers networks.

The group facilitation is carried out by employees already present in the companioning structures, or by intermediaries recruited thanks to the project (especially in "alternative" networks), often combining technical consulting and facilitating functions.

The involvement of farmers is very variable, and in many case we have found a "core subgroup" of leaders with a belt of others who follow the actions in an "à la carte" mode. Some collectives show difficulties in maintaining the initial core of mobilized farmers, but some, on the other hand, tend to expand over time -

especially those that embody technical models or development paths that have become particularly legitimate and attractive in the current context (for example, conservation agriculture, or changes in dairy farming production models in the context of the current dairy crisis).

Another focus of our comparative analysis dealt with the key objective that were tackled by these groups, that could be farming equipment, experiments, specific agricultural practices, seeds, or approaches such as those dealing with farmers support and knowledge exchanges processes. These different key objects led us to characterize these 16 groups in two categories of technical-centred or ethical-centred approaches.

The collectives were committed to building internal coherence in their collective action, while taking into account the requirements of the associated professional and economic environment of each farm and around the group. Maintaining the internal dynamics and the partnership dynamics generated has been identified as a major difficulty. This has been increased by the later introduction by the Ministry of Agriculture (in 2015, i.e., in the course of the projects) of a new instrument to support groups involved in the agroecological turn in the form of a label (called GIEE) to be delivered by public regional authorities of the agricultural sector. New opportunities, accumulation of institutional contexts and multiplication of requests have required greater structuring and new organizational and leadership needs. The collectives supported by small associative structures appeared therefore to be more fragile, whereas they often carried out radical collective experiments.

The production and exchange of knowledge

Finally, our third crosscutting theme dealt with the way the production and exchange of knowledge was viewed and performed in these groups.

Despite their diversity, the actions carried out show a common attachment to the production and circulation of knowledge. All projects combined individual paths, those of each farmer, and a common approach to experimentation based on shared mechanisms for building knowledge from experience, often with the help of facilitators. We report for a variety of knowledge production intentional procedures. Agricultural trials are often conducted in networks linked to conservation agriculture, but not always in other projects, some of which explicitly claim, rather than technical experimentation, for reflexive approaches, "experience sharing" and formalization of these approaches, particularly around tutoring or coaching training.

Three main situations have been identified: some groups have mainly produced data and references linked to the agronomic and socio-economic performances of their agroecological practices (this "triple" performance echoes here one of the key concepts of the agroecological policy), when some have mainly carried out experiments and demonstrations of their practices, and finally others have focused on the capitalisation of their experiments and approaches inside the group in order to foster their larger diffusion and adoption in a second stage (which also echoes one of the program's expectations).

This has raised a key paradox between the fact that the knowledge that is produced is intrinsically situated (anchored in the groups' specific geographical, agronomical and social contexts) and the fact that the public program expected a possible transfer of these practices to other situations.

DISCUSSION OF RESULTS

A policy instrument in search of legitimacy in bottom-up uptakes of agroecology

Through a call aimed at directly financing farmers' groups agroecological transitions' projects, the MCAE program has been designed as an innovative public policy instrument under the larger policy labelled "Agro-ecological plan for France". Its innovative characteristic relies certainly on the positive orientation of changing conventional agricultural production systems in France and therefore the whole knowledge and innovation system[26]. Of course, this ambition has initially received the sceptical mockery of many actors of the conventional agrifood system while on the other end of the spectrum, this political "agroecological flag" has been criticized for being two fuzzy and not radical enough for many alternative networks (Lamine, 2017)..

[26] The « agroecological plan for France » also entails a dedicated program for teaching agriculture in from college to bachelor classes, called « Teaching differently ».

A less visible innovative feature is to be found in the fact that this program differs from the more standard ways of allocating public subsidies for agricultural development. It assumes to take into account the multi-functionality of agriculture for sustainable development and seeks to direct support groups able to ensure economic and social cohesion on projects with a territorial impact. From this point of view, the MCAE program echoes that of a previous transient instrument called Territorial Farming Contracts (CTE), launched in the late 1990s. Both shift the scale of public support from individual farms to eligible groups of farmers with a territorial inscription, whether these groups were already existing or emergent. The novelty of the MCAE instrument is then to target exploratory processes and not obligation of means per hectares of cultivated areas (individual commitment for adopting practices are not confronting to any efficiency check-up), and that's a considerable step forward.

Through this MCAE instrument, this agroecological plan is genuinely searching its legitimacy in the mobilization of collective initiatives, while more locally and around each project, it favours the uptake of a surrounding system of actors in line with the objectives of the project. What we have called the landscape of submitted projects deciphers the web of agroecological visions and intentions in France. It mainly offers the capacity to read a breakthrough in policy making and to ensure that the project will be innovative and having an ascending character.

Making sense of the web of visions and intentions in projects

The study of the web of intentions in submitted projects show obviously very heterogeneous objectives and rather surprisingly with a poor direct account or reference to agroecology. A majority of projects have a bottom-up nature, within organisational assemblages that put groups of farmers and their companioning structure at the heart of a network of partners. This is where the policy instrument induces an alignment between endogenous dynamics in collectives and rural dynamics at play.

Our statistical and textual approach show evidence that the commitment of groups is reflecting the main following features: territorial differences in uptake at the national level, a prevalence of concerns for livestock certainly echoing the difficult situation of most livestock systems if not their distress, and a directionality of innovative pathways based on a triptych assembling technological, social and territorial matters within a systemic framework of agroecological practices. The description of the ascending nature of project shows that this MCAE program has operated as a filter of exposure of collectives: from quite "conventional" projects led by incumbent actors, where farmers have a position of beneficiaries, to more emergent collectives putting the incumbent agricultural development system at a distant.

It comes that the link to agroecology has to be found elsewhere than in the intentions that structure the submitted projects, and this is possible precisely through a more refined account of collective action in some projects that were selected and carried out.

In search of local resignification around agroecology and global recognition of ecologization of practices

The groups that we have chosen to study and accompanied during 4 years have all intentionally anchored their collective mobilization on agricultural production in territorial and professional community based networks. They have given themselves the means to experiment the articulation and inclusion of farmers' objectives and practices within territorial logics, giving sense to their mobilization beyond the scope of each individual farming system.

The feature of collective mobilization has of course expressed many managerial issues within group' s dynamics, being placed under the competencies of intermediaries from accompanying structure. But, all these groups are also organizational nexus of various structures, for which the projects appear to be catalysers for collective experiments in organizing new ways for agricultural development and for the production of knowledge. The committed collective dynamics that we have observed in and around projects are rather atypical in relation to "ordinary" agricultural development dynamics, and this point is instructive:
- on the reality of agro-ecological transitions, in terms of the meaning given to ecologization processes by these groups (with very varied visions of agro-ecology, without it always being explicitly displayed);
- in terms of the way in which local projects are conducted, with a desire both for the autonomy of farmers and groups, and for numerous relationships in order to support the transition processes at work;

- in terms of the knowledge produced, showing a strong need to promote experiential knowledge and a valorisation of the vocational identity, with a strong questioning on the relationship of this capacity to experiment to the AKIS apparatus.

CONCLUSION

The concept of agroecology seems to play the role of a trans-epistemic attractor to redefine matters of concern in agronomic science based on the proposals of recognized pioneers (Altieri, 1995; Francis et al., 2003) but also under the influence of alternative international movements that strive to link the agroecological paradigm to food sovereignty issues and claims (La Via Campesina, 2017). Indeed, the transformative effect of agroecological research remains questioned (Levidow et al., 2014) and much challenged by the food sovereignty debate. The FAO has gradually welcome this movement in its own agenda (FAO, 2017), while contentions have been issued to foster an inclusive global agenda - meaning dealing also with food sovereignty, education, and social justice (IATP, 2014). The legitimacy of agroecology in relation to definitional struggle and issues-ownership in agricultural research appears to be then at stake to unlock the growth of alternative agricultures (de Witt & Iles, 2016).

As social scientists, the risk when dealing with agroecological dynamics, is to be trapped into an uncomfortable situation of either deflating discourses about agroecology in policy making on one hand (i.e., unveiling the persistent productionist stance within current agroecological policies and/or the lack of consideration of socio-political dimensions – see Rivera-Ferre, 2018) or naively valuing experiential knowledge and innovative initiatives on the other hand. To overcome this discomfort, a pragmatic answer is to develop a capacity to observe and analyse initiatives aimed at ecologizing farming practices within projects and groups, whose activities are supported and framed by policy instruments promoting agroecology as a driver. The present agroecological turn in French policy-making offers such an opportunity, and we have taken it to establish a prototype of collaborative observatory of collective dynamics of ecologization in innovative agricultural and rural projects.

Our work is pretty much in line with the debates over the legitimation or marginalisation processes for agroecology and other forms of alternatives, and our study has shown that the groups are very much concerned by legitimation processes and by the recognition of their project. What is to be noticed is that the quest for legitimacy is as much at play on the side of the design and implementation of the policy instrument, as it is on the side of the realization of projects in their very specific way and attempts to concretise their own ecologization processes at a territorial level. We can refer here to the three pathways of legitimacy proposed by de Witt & Iles (2016)[27]: 1) building on and revising the existing standards and practices of science; (2) extending influence into policy, legal, practical, and civic arenas; and (3) centering attention on the ethical legitimacy of food systems. Indeed, we have shown (1) that the relation to knowledge production and circulation at the level of groups is precisely questioning the existing standards and practices of agricultural science through a claim for experiential knowledge. Moreover (2), all the groups we have studied are clearly reflexively conscious of having a role of creating new frontiers and in a sense proving the condition of possibility of the ecologization of their practices in the local matrix of socio-political and socio-economical stakes. Groups have claimed for the autonomy of their mobilization while contrastingly basing their operational actions on a large number of relations. Finally (3), the relation of groups to the issue of the ethical legitimacy of food systems is more difficult to assess as a general feature. Some groups, such as those aligned with organic farming or peasant agriculture are of course linking their action to these ethical considerations, but others are much less directly concerned by this issue in the practical orientation of their project.

After four years of coordinating this observatory, we expect to open a reflection on the methodological design in use and on the problems and performativity of collective enquiry in a context of redefinition of agricultural and rural development policies and in a context where simultaneously, agroecology appears to be unstable and differently invested by policy makers, researchers, intermediaries and farmers (Kumaraswamy, 2012; Ollivier & Bellon, 2013; De Molina, 2013; Meek, 2016; Wezel et al. 2016). Through this collective research we have purposefully tried not to adopt a normative approach of agroecology, based on pending scientific definitional struggles, but rather to pay attention to the ways an ecologization of practices, meaning and social relations are

[27] de Witt & Iles (2016 :16) proposes these three possible pathways to be experimented by agroecologists in order to achieve greater legitimacy.

(or not) at stake in situated initiatives. Many actors have expressed the need, particularly during the final colloquium of this project, of gaining recognition of their action within the incumbent system of agricultural development and of having more direct linkage between their experiential approaches of changing their own systems and the techno-scientific ways of constructing evidence. It should be noticed that many actors of the public or private organizations of agricultural and rural development policy both at the regional of national level are sharing this point of view. This strengthens the idea of not being trapped in definitional struggles of agroecology and to be more openly working on the thick legitimacy (de Witt & Iles, 2016) of agroecological transition in the making (Barbier et al., 2017).

We are also eager to confront the research practices and scientific results to be obtained in different countries and within different socio-political situations of agroecologcal transition in the making. This comparative perspective is much needed, and it calls for an articulated pragmatist analysis of agricultural and rural development practices with that of the design and implementation of policy instruments.

We thanks all the researchers of theMCAE-ObsTAE group who have been taking part to this observatory and to the production of case-studies and cross-cutting analysis: Stéphanie Barral, Nathalie Couix, Catherine Darrot, Floriane Derbez, Camille Lacombe, Véronique Lucas, Martine Napoleone, Guillaume Ollivier, and Jessica Thomas.

REFERENCES

Barbier, M. (2010). The ecologization of agricultural development and the Treadmill of sustainable development. A critique a state of transition. Przegląd Socjologiczny, 2(59), 9-28.

Barbier, M., & Elzen, B. (2012). System innovations, knowledge regimes, and design practices towards transitions for sustainable agriculture. System innovations, knowledge regimes, and design practices towards transitions for sustainable agriculture. .(Download at https://sisacop.wixsite.com/mysite).

Barbier (2015). Les effets d'une programmation thématique des activités de recherche publique, Rapport d'étude pour l'ANR, Marne La Vallée INRA SenS Edition, https://www.cortext.net/programming-research-by-the-means-of-programmes/

Barbier, M., Elzen, B., et al., (2017). Conclusion: a Curiosity Cabinet of AgroEcological Transition Studies, in Elzen, B., Augustyn, A M., Barbier, M., van Mierlo, B., (2017). AgroEcological Transitions: Changes and breakthroughs in the making, Wageningen University & Research - ISBN 97894634311 49 – pp.312-325.

Barbier, M., & Lamine, C. (2017). Doing Social Science in Agroecological Transition. In The setting of a collaborative observatory of social dynamics in innovative rural projects, ESRS Congress, Cracovie.

Barbier, M. (2017). The institutionalisation of pesticide reduction in France. The sub-politics of building futures based on a critique of neo-corporatism, Communication to the SASE CONFERENCE, Lyon 29 June 1 July 2017 (full paper).

Compagnone, C., Lamine, C. & Dupré, L. (2018). La production et la circulation des connaissances en agriculture interrogées par l'agro-écologie: De l'ancien et du nouveau. Revue d'anthropologie des connaissances, vol. 12, 2,(2), 111-138. doi:10.3917/rac.039.0111.

de Molina, M. G. (2013). Agroecology and politics. How to get sustainability? About the necessity for a political agroecology. Agroecology and Sustainable Food Systems, 37(1), 45-59.

Deverre, C., & de Sainte Marie, C. (2008). L'écologisation de la politique agricole européenne. Verdissement ou refondation des systèmes agro-alimentaires. Revue d'études en agriculture et environnement, 89(4), 83-104.

de Wit, M. M., & Iles, A. (2016). Toward thick legitimacy: Creating a web of legitimacy for agroecology. Elem Sci Anth, 4. DOI: http://doi.org/10.12952/journal.elementa.000115

Dubuisson-Quellier, S., & Lamine, C. (2008). Consumer involvement in fair trade and local food systems: delegation and empowerment regimes. GeoJournal, 73(1), 55-65.

Elzen, B., Barbier, M., Cerf, M., & Grin, J. (2012). Stimulating transitions towards sustainable farming systems. In Farming Systems Research into the 21st century: The new dynamic (pp. 431-455). Springer, Dordrecht.

Elzen, B., Augustyn, A M., Barbier, M., van Mierlo, B., (2017). AgroEcological Transitions: Changes and breakthroughs in the making, Wageningen University & Research - ISBN 97894634311 49. .(Download at https://sisacop.wixsite.com/mysite).

FAO. 2017. The State of Food and Agriculture. Rome, FAO. 132 pp. (also available at www.fao.org/3/a-l7695e.pdf).

Fouilleux, È. (2000). Entre production et institutionnalisation des idées: la réforme de la politique agricole commune. Revue française de science politique, 277-305.

Goodman, D., DuPuis, E. M., & Goodman, M. K. (2012). Alternative food networks: Knowledge, practice, and politics. Routledge.

Goulet, F. (2008). Des tensions épistémiques et professionnelles en agriculture: Dynamiques autour des techniques sans labour et de leur évaluation environnementale. Revue d'anthropologie des connaissances, vol. 2, 2,(2), 291-310. doi:10.3917/rac.004.0291.

Hervieu, B., & Purseigle, F. (2015). The sociology of agricultural worlds: from a sociology of change to a sociology of coexistence. Revue d'Études en Agriculture et Environnement, 96(01), 59-90.

High, C., & Nemes, G. (2007). Social learning in LEADER: Exogenous, endogenous and hybrid evaluation in rural development. Sociologia Ruralis, 47(2), 103-119.

IATP (2014). Scientists' Support Letter for the International Symposium on Agroecology,18–19 Sept. 2014 https://www.iatp.org/sites/default/files/2014.09.17_AgroecologyFAOLetter.pdf

Kumaraswamy, S. (2012). Sustainability issues in agro-ecology: Socio-ecological perspective. Agricultural Sciences, 3(02), 153.

Lamine, C. (2012). «Changer de système»: une analyse des transitions vers l'agriculture biologique à l'échelle des systèmes agri-alimentaires territoriaux. Terrains & travaux, (1), 139-156.

Lamine, C., & Chiffoleau, Y. (2012). Reconnecter agriculture et alimentation dans les territoires: dynamiques et défis. Pour, (3), 85-92.

Lamine, C., (2017). La fabrique sociale de l'écologisation de l'agriculture. Editions La Discussion, 2017, 225 p.

Lascoumes, P., (1996). Rendre gouvernable: de la "traduction" au "transcodage". L'analyse des processus de changement dans les réseaux d'action publique. La gouvernabilité, 1996, p. 325-338.

Levidow, L., Pimbert, M., & Vanloqueren, G. (2014). Agroecological research: Conforming—or transforming the dominant agro-food regime?. Agroecology and sustainable food systems, 38(10), 1127-1155.

Lowe, P., Feindt, P.H., and Vihinen, H., (2010). Introduction: greening the countryside? changing frameworks of EU agricultural policy, Public Administration, 88: 287-295

Meek, D. (2016). The cultural politics of the agroecological transition. Agriculture and Human Values, 33(2), 275-290.

Ollivier, G. & Bellon, S. (2013). Dynamiques paradigmatiques des agricultures écologisées dans les communautés scientifiques internationales. Natures Sciences Sociétés, vol. 21,(2), 166-181. doi:10.1051/nss/2013093.

Petersen, P., Mussoi, E. et Dal Soglio, F., 2013, Institutionalization of the agroecological approach in Brazil: advances and challenges, Agroecology and Sustainable Food Systems, 37, 1, 103-114

Ray, C. (2000). The EU LEADER programme: rural development laboratory. Sociologia Ruralis, 40(2), 163-171.

Rivera-Ferre, M.G. (2018): The resignification process of Agroecology: Competing narratives from governments, civil society and intergovernmental organizations, Agroecology and Sustainable Food Systems, DOI: 10.1080/21683565.2018.1437498

Van der Ploeg, J-D., Renting, h., Brunoru, G., et al. Rural development: from practices and policies towards theory. Sociologia ruralis, 2000, vol. 40, no 4, p. 391-408.

Vanclay, F. (2011). Endogenous rural development from a sociological perspective. in. Stimson R.J., Stough R., and Nijkamp P. (eds.), Endogenous Regional Development: Perspectives, Measurement and Empirical Investigation, Edward Elgar Publishing, pp. 59-69.

Wezel, A., Brives, H., Casagrande, M., et al. (2016). Agroecology territories: places for sustainable agricultural and food systems and biodiversity conservation. Agroecology and sustainable food systems, 40(2), 132-144.

AFFILIATION

Marc Barbier

INRA, UMR LISIS, Paris Est Marne la Vallée ; marc.barbier@inra.fr

Marc Barbier is Research Director at INRA. As a Researcher in organizational sciences and Sciences Studies he has been working on the transformations of the regime of knowledge production and innovation in agriculture for the past 20 years. This work programme has led him to follow configurations of transformation in agricultural research: environmental crises, normative and effective deployment of sustainable development, biosecurity issues and emerging diseases and more recently to agroecology. He has also taking part to the development of the CorTexT platform to foster online analysis of textual corpora.

Claire Lamine

INRA, UR Ecodeveloppement, Avignon ; claire.lamine@inra.fr

Claire Lamine, is Research Director at INRA. As a pragmatist sociologist, she has been working for about ten years on organic food and agriculture as well as on alternative systems linking producers and consumers. Beyond this interest in organic farming, she now devotes herself more broadly to the study of agroecological transitions and to the social configurations where changes from conventional agriculture to more ecological forms take place. She recently published a survey of her research on ecologization processes in agrilculture: Lamine, C., (2017). *La fabrique sociale de l'écologisation de l'agriculture*. Editions La Discussion, 2017, 225 p.