Improving water supply from rain-fed "traditional naulos". A novel climate-smart experience from rural area of Far West, Nepal

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Abstract

The population in the mid-hills is faced by increasing challenge of water source depletion. With unpredictable climate hazards and increasing droughts the people run the risk of insufficient water for drinking and other domestic purposes. This has led to longer travel distances down- and up-hill to fetch water, increasing substantially the drudgery of especially women. Without viable water sources in the vicinity, many communities depend upon traditional local "Naulos" for water. These Naulos consist of open dug wells situated near or within the village and have average water flows of less than 0,1 lts/per second and 300-400 liters of storage capacity. This paper presents the case of climate-smart rain-fed, low cost project intervention for drinking water in a typical water scarce community in the RVWRMP project area.

Nauli village in Alital RM of Dadeldhura is situated at approx. 1000 m altitude in the Chure range. There is a severe water scarcity in this community. There are 32 households, mostly of the Magar ethnic groups, who depend on a Naulo which can be locked by a wooden door. Every morning, a designated person from the community opens the Naulo door and distributes water equally to all the households. This distributed water is around 10-25 liters per household per day, which is barely sufficient for drinking. For all other domestic needs, the people have to travel around 1 hour to fetch water from a stream down-hill. In case of visitors, the family is allowed to receive 1 extra liter of drinking water. This community was prioritized by RVWRMP in the Water Use Master Plan (WUMP), a bottom up water resources use planning. The project initiated source conservation and protection activities based on the 3R principle (Re-charge, Retain and Re-use). This is a way to conserve scarce water and are an adaptive measure to tackle the drying of the water sources caused by changes in the climate. This paper presents a rain-fed sustainable and low cost approach for drinking water in a water scarce community in Dadeldhura.

During rain, the Naulo overflows very quickly. The project took this as an opportunity to supply stable water through "re-charge, retain and re-use" for the lean period. The run-off water, otherwise going to wastage, is made to infiltrate in to the spring-shed of the Naulo through constructed pits, trenches and weirs, which has supported the recharge of the Naulo during the rainy season.

The community now gets more than 60 liters/HH per day year-round which has relieved the female members from daily trips to fetch water from far away. The sustainability of the water supply from the Naulo is ensured through sanitation and hygiene activities, the setup of an Operation and Maintenance fund and the appointment of a special care-taker. Home garden groups are trained to collect and use the excess water and the waste-water. The recycled water is collected in a pond of 1 or a few m3 and is used for producing vegetables to improve nutrition of the family or is sold on the local market. Every drop of water is used and care is taken not to let it go to waste.

The project has replicated this type of water harvesting and storage systems in other water scarce areas of Dadeldhura, Dailekh, Achham and Doti districts. Over time additional improvements have been made such as marking the water level on the outside of the storage structures so that community can observe the water level inside the tank and manage water demand themselves.

Key Words:

Water Use Master Plan, source improvement, 3R, Climate change adaptation, sustainable basic livelihoods,

INTRODUCTION

This article presents the experiences of the Rural Village Water Resources Management Project (RVWRMP), receiving technical assistance from FCG international Ltd Finland and funded by the Government of Nepal (GON), the Government of Finland (GOF), European Union (EU), as well as local rural municipalities and communities. The project has dealt with the risks from climate change through implementation of sustainability measures in constructed services since 2006 in ten district (Achham, Baitadi, Bajhang, Bajura, Dadeldhura, Dailekh, Darchula, Doti, Humla, and 2 hill Rural Municipality of Kailali). The project has also continuously strengthened the capacity of beneficiaries in managing water resources and being more resilient in coping with climate risks. RVWRMP works with populations that are extremely challenged by remoteness, rugged terrain, food insecurity and water scarcity. The project is fully embedded in Nepal government system of planning, financing and reporting.
RVWRMP is a water resources management project to improve the livelihood of the rural population. In addition to water supply and sanitation, the project supports community-based irrigation, micro-hydro power, multi-use services, improved cooking stoves and water mills, environmental protection as well as home gardens. Institutional capacity building activities are the backbone to create full ownership and participation of beneficiaries. User Committees (UC) plan, implement and operate village level schemes. The projects are identified and prioritized through a participatory process to design Water Use Master Plan (WUMP). The project falls under the Department of Local Infrastructure (DoLI), and the Ministry of Federal Affairs and General Administration (MoFAGA).

DESCRIPTION OF THE SERVICE AREA

Nauli village is situated in ward no 7 of Alital rural municipality in Dadeldhura district of the Sudurpachhim province of Nepal. The area is in the heart of Chure hills range and is situated at an altitude of approximately 1000 m on the ridge of Chure hills. The area is accessible by rough earthen road from Gharelu bazar, situated on the Budar-Jogbudha road corridor, at a distance of roughly 14 km South. Thick forest surrounds the village and goat raising is the main occupation of the residents. Most of the population is from the Magar ethnic community who have the occupation of forest based livelihoods. The nearest bazar is at Budar.

EXISTING WATER SCENARIO (before intervention)

Chure hills area is known for its water scarcity and water with high levels of calcium. The geology is such that the infiltrated water drains quickly through the coarse soil strata. There are no permanent spring sources with sufficient discharges.

Beneficiary (as per the WUMP):

Table 1: beneficiary Households

Dalit	Janjati (Magar)	Other	Total
3	26	3	32

Table 2: beneficiary population

Dalit		Janjati		Other		Total	
Female	Male	Female	Male	Female	Male	Female	Male
11	6	64	83	13	14	88	103

As per the Water Use Master Plan (WUMP) of the former Alital VDC prepared in 2014, 3 spring sources are used by the residents of which 2 Naula sources were used for collecting water, mainly for drinking and cooking purposes.
A ***Naula*** is a semi-protected traditional dug well tank with a super-structures to protect the source. Naulas, generally catch sub-surface water and quickly replenished after rainfall. The Naula is dug in the run-off

drainage area to capture the sub-surface water flow in the Naula. The Naula has an opening at one side to access the water including by animals. Since water in the Naula can be accessed by animals the quality of water is generally turbid and unsafe to drink directly.

Table 3: Naula sources for drinking and cooking water uses

S.N	Source Name	Source code	Source discharge measured, lps	
			2071.3.6 (WUMP)	2072.11.13 (DFS)
1	Bashupani Naula	73000206S117	0.02	0.006
2	Raujali Naula	73000206S118	0.03	0.023

The above discharge figure shows that water depletion was high in traditional Naula.

For all other uses like bathing, washing cloths and animal drinking purposes, the beneficiaries travel down to a stream source which takes around 2 hours for a round trip.

Table 4: Alternative source for other water uses

S.N	Source Name	Source code	Source discharge measured, lps	
			2071.3.6 (WUMP)	2072.11.13 (DFS)
1	Melgajkhola mul	73000206S123	0.13	0.1

The service level of traditional water collected from above Naula was under basic service third level. Basic service level according to the DWSS guideline in Nepal is categorized and defined by the indicators as quality safe source, quantity as minimum 45 lpcd, water fetching time not more than 15 minutes round trip, reliability of 12 months and continuity as minimum 6 hours per day. RVWRMP from early RWSSP, Lumbini project has categorized basic service level to 3 categories as below:

Table 5: service level categorization indicators

Service level	Fetching time, min	Quantity, lpcd	Quality	Reliability, months/year	Continuity, hrs/day	Hardship mark
1	≤ 15	≥ 45	Safe	12	≥ 6	0
2	>15 ≤ 30	> 25 ≤ 45	Average	≥ 11 < 12	≥ 5 < 6	>0≤100
3	> 30	< 25	Bad	< 11	< 5	>100≤200

Raujali Naula is bigger in size and is used by 18 HHs, Bashupani Naula by 5 HHs and rest 7 HHs depends upon the other sources. For this article, Raujali Naula with 18 HHs with 119 population has been taken for presentation. The capacity of Raujali Naula is approximately 350 liters and water overflows if full. People used to take water in the morning and in the evening. The Naula is full in the morning but mostly not completely full in the evening. A maximum of 700 liters of water is collected per day during dry season in 2 shifts. Water during times of high recharge is lost through the overflow, once the Naula is full. Which means each household could receive maximum of 35 liters of water every day during wet season. This comes out to be barely 6 lpcd. From table 3, within 5 months of monsoon had stopped (after Ashoj), the Raujali Naula recharge decreased by 24 % and Bashupani Naula recharge decreased by 70 %. This trend of depletion of sources translated during peak dry season, when recharge is very low households were allocated only 0.5 liters per person. If guests visited the area, 1 liters of water per guest was allocated additionally.

Traditional practice: The Naula was locked with wooden door to avoid water loss by various means and to distribute water equally among the households. A care taker unlocked the door every morning and distributed water equally to all and then locked it again so that seeped water gets stored in the Naula. People even used to wait more than 20 minutes to get water. During wet season, the Naula was operated 24 hours a day. During the dry season restrictions on water consumption from the Naula was enforced by the

community. As the majority of the community is a single caste, any decision is easily enforced and obeyed by the households.

During the dry season when the Naula becomes dry, the female members used to travel more than 2 hours to fetch additional water down from the Dharapani spring. They used to carry 20 liters jerry can 2 times a day to fetch the water. During that time there used to be many outbreaks of diarrheal related diseases. Sanitary conditions in the community were very poor. No green vegetables were grown due to lack of irrigating water.

Hardship mark: A so-called hardship mark was designed to indicate how much the community is suffering from water stress in terms of quality, quantity, fetching time, reliability and continuity. The mark is used to compare the water situation among different communities so that prioritization for the intervention could be made without any hassle by RM. The hardship marking is in practice from Lumbini RWSSP funded by Government of Finland and Government of Nepal back in 1990.

Hardship mark, H = (0* SL1) + (1*SL2) + (2*SL3) where
SL 1= % of households in service level 1
SL 2 = % of households in service level 2
SL 3 = % of households in service level 3

Existing water supply situation and service level (WUMP 2071)

Annex 9: Present status of water supply

S.N	ward no	Community	Total HHs	primar source use							Water quality				Available quantity				Fetching time, min			
				PSP	Spring	**Naulo**	Kulo	Kholsi	stream	Spot	Good	Average	bad	**Worst**	Sufficient	Ok	**Inadequate**	Scarce	< 15	**16-30**	31-60	>60
61	6	Nauli, Dudekhali	32			**32**								**32**			**32**			**32**		

As all 32 households depends upon the 2 Naula sources which has insufficient water (<6 lpcd) with bad water quality, the service level is 3 and hence;

Hardship score = (0*0/32*100)+(1*0/32*100)+2*32/32*100) = 200

The Nauli cluster is in a very water scarce area and received high priority for intervention in the WUMP. The project started implementation with appropriate and affordable technology in FY 072/073.

Annex 15: Proposed water supply schemes

Priority	Scheme name	Scheme code	Source description			Discharge	Investment	Beneficiary			Population	Approx. lpcd	Investment
			Name	Code	Type			ward	cluster	HH			
1	Nauli WS	73000206PW1	Dharakhola	73000206S12	SP	1.14	New	6	Nauli, Dudekhali	32	176	474	968000

DESIGN CONSIDERATION:

As per the WUMP inventory of the Alital Village Development Committee (VDC; 2071), the community of Nauli proposed a gravity system with a source which was located very far away. The scheme had priority no. 1. The pre-feasibility study found that the scheme was not feasible with the proposed source and hence source improvement was included in the project proposal.

The project was a Source Improvement (SI) scheme with storage facility with spring revival measures based on recharge, retain and reuse (3R) principle. The major principle behind it was *"retaining the surcharge water from Naula during wet period in a storage tank to be used during the dry period".* For 18 HHs with a total population of 119 persons with a minimum 10 lpcd demand, a water retaining structure of 40 cum capacity was designed to provide a stable minimum of 60 liters per HH all-round the year. The overflow and waste water is collected and used for irrigating home gardens and nurseries at the household level down-stream of the water tank. Two public water points with water conservation fittings were placed at the watertank site.
The project provided improved water safety and a more climate resilient water supply through multiple interventions.

a) Raujali Naula		
Total HHs :	18	
Total Population :	119	
Design Demand , minimum:	10	lpcd
Available dischsrge at source (in dry period) :		
i. In dry period :	0.008	lps
Dry period :	3	month
Water demand for 1 day in dry period :	1190	litre
Water demand for 3 month in dry period :	107100	litre
Water collected by dry season discharge in 1 day :	691.2	litre
Water collected by dry season discharge in 3 month :	62208	litre
Deficit water for 3 dry month :	44892	litre

The preparatory phase of the intervention started 2072.11.30 and construction was completed on 073.8.27. Water treatment by filtration was ensured by providing 14 liter capacity filters to all households. The cost of the filters were paid by the users. The following improvements were implemented.

Recharge:

- Water safety measures like fencing and closing original door closed etc were enforced.
- Upstream of the Naulo recharge pits were dug to capture run-off during the rains, also trenches and small water holding mud structures were built to increase the infiltration and recharge of ground water flow. The measure included the protected of the site with trees and other vegetation.
- The water stored in the pits and trenches is also used for cattle and other purposes.
- An additional advantage of the recharge measures is the erosion control.

Retain:

- 40 cum ferro-cement reservoirs were designed to hold the water during wet season.
- The original door of the Raujali Naulo was removed and the opening closed by a masonry wall to avoid direct access to the source water to reduce risk of contamination. The Naulo area was fenced and access to the Naulo was restricted.
- Two 20 m^3 ferro-cement reservoirs were constructed just below the existing Naulo. The water from the Naulo discharges in to the reservoir through a pipe of 63 mm diameter.
- All construction activities were done during the rainy season to avail sufficient water for construction, curing and storing while protected under a temporal roof.
- 2 locking faucets with water conservation fittings were placed at the watertank site to avoid untimely opening and wastage of water.

- A care taker was trained for small maintenance and repairs. The UC hired the care taker for day to day operation of the system.

Reuse:

- The overflow of the Naulo and waste water at household level is collected and used for irrigating home gardens and plant nurseries.
- Drip irrigation technology is promoted for efficient use of the limited water resources.
- Capacity building for water wise use of the water and awareness about the Recharge, Retain and Reuse:
- The user committee and water users were orientated and capacitated on different subjects as per Step by Step guideline of RVWRMP including water safety measures.

OBSERVATIONS AND DISCUSSIONS:

The system is now functioning very well. The enforcement of the regulation on water collection is relatively easy as the community belongs to a single caste. The people use water from overflow pipe upto Mangsir (November-December) and there is no restriction on using water, (unlimited quantity) till Magh (January-February). The UC starts controlling water collection as water become scarcer from Phagun (February-March) onwards, 2 times a day through care taker by opening the locked faucets in the morning and evening or as agreed time by the community. All other time, the faucets are kept locked till next opening. There is a strict social discipline in the community regarding collecting water. A minimum of 60 liters per household is available throughout the year. When there is an average rain fall, the reservoirs are full within 2 days and more water can be distributed to the households. Last year, even in the driest period there was enough water available for domestic use.

The area is known for its winter rainfall. The winter rains are important for the replenishment of water in the Naula through infiltration by pits and trenches constructed upstream of the Naula. Water retaining structures, bunds and pits have been constructed in the spring-shed of the Naula to capture the surface run-off water and increase infiltration in to the ground from which it ultimately finds its way to the Naula. The temporally stored water in the pits and trenches is used for different purposes. Plantation has also been done to protect the spring-watershed.

Livelihood promotion: The communities have practiced not only to better conserve water but also to utilize excess and used water for watering vegetables and domesticated animals drinking purpose. Not a single drop goes unused. Every households has at least a small vegetable garden where green vegetables are grown from waste water collected after hand and dish washing. Water smart irrigation technologies like drip irrigation are practiced to produce off-seasonal vegetables growing inside the poly houses have resulted positively in the local economy and supported nutritional value on the diet of family members.

The community has established an Operation & maintenance (O&M) fund with NRs. 65,000 in the local Cooperative, Chetana Krishi Sahakari Sanstha (Chetana Agriculture Cooperative) for emergency maintenance of the system. Each households pays NRs. 50 per month as water tariff which is deposited in the cooperative. The cooperative provides interest to the deposited amount and loans are accessible to shareholders for different livelihood activities especially vegetable production, goat and chicken farming.

Conclusion: The RVWRMP is a water management project with and integrated livelihood component. The water supply scheme construction included a set of actions to structurally deal with the problem of source depletion by using the the “3R” principles of Recharge, Retain and Reuse. Besides the project includes as a standard activities to promote water use efficiency, equality and sustainable water management.

The excess run off and collected water in the Naula, otherwise drained off is now stored in wet season and optimally and rationally utilized during dry season. This has impacted on the day to day business of the beneficiaries especially female members who traditionally have the responsibility of fetching and handling water in the household. The women travel less for collecting unsafe water for domestic use and water for animals. The community manages and regulates the recharge and utilization of the water to have optimal water storage for the dry season. Waiting time at the source is reduced and the time saved for fetching water has been utilized for productive uses by the women. The community now have safe and abundant water available for at least 10 months (FGD meeting with women 2018).

Present water supply status, 2018

Present status of water supply

S.N	ward no	Community	Total HHs	primar source use							Water quality				Available quantity				Fetching time, min			
				PSP	Spring	**protected Naulo**	Kulo	Kholsi	stream	Spot	**Good**	Average	bad	Worst	**Adequate**	Ok	Inadequate	Scarce	**< 15**	16-30	31-60	>60
1	6	Nauli	18			**18**					**18**				**18**				**18**			

Tapping water from distant sources located in other communities, always generate disputes and competing demands which is a threat to the functionality and sustainability, wasting budgets without any impact. Rain-fed source improvement with extra storage capacity is an economically effective and sustainable solution for increasing water availability for the community, where water sources with adequate discharge are lacking.

The availability of more water has contributed to better sanitary conditions and hygiene of the water users. Diarrhoeal diseases have practically vanished from the area.

Replication: "Achieving stable drinking water supply through rain fed traditional Naulo" is a novel climate smart- approach" that is now being replicated to other water scarce communities with traditional water points suffering from very low discharge. New innovation like the "water level" pipe is now installed on the outer wall of the water tank so that UC and care taker can observe the water level inside the tank and allocate & distribute water optimally and rationally. Key project staff visited the area so that they can observe, learn, interact with beneficiaries and share the observation for communities for replication in their districts. External agencies like United Mission to Nepal staffs from Dhading visited the project area for learning and replication.

Dadeldhura, Achham, Dailekh, Bajura, Doti and Baitadi districts have already initiated activities in this line.

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1. *Alital VDC water use master plan 2071* by Alital VDC and supported by RVWRMP
2. *Coping with climate uncertainty in rural water supply systems: rvwrmp's experiences* by P. Shrestha and D. Shrestha; international conference on water, environment and climate change knowledge sharing and partnership, 10-12 April 2018, Kathmandu Nepal
3. *RVWRMP MIS 2075*
4. The beneficiaries of Nauli communities and RVWRMP staffs