Water at the BoP

India and East Africa

Fall 2015

About Beyond Capital Fund

Beyond Capital Fund ("BCF") is an impact investment fund that promotes economic development in impoverished communities through our investments. Our focus is in the water, waste and sanitation, healthcare, energy, and agriculture sectors in India and East Africa. We are registered as a public charity. By addressing the lack of seed capital for social businesses, we specialize in providing early-stage financial investment along with management assistance, mentoring and expert advisory services. With our rigorous investment process, our aim is to achieve sustainability and scaled social impact for businesses that operate for the advancement of the population at the base of the economic pyramid.

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Executive Summary

Water is becoming an increasingly scarce resource. More than one in every sixth person globally is living in water stressed conditions. Water stress, a situation where the availability of water is a major constraint on human activity, is intensifying in regions such as China, India, and Sub-Saharan Africa, where almost one fourth of the population is living in water stressed countries. This report focuses on India and East Africa - Kenya, Tanzania, Uganda, and Rwanda - specifically on people living at the bottom of the economic pyramid. The reduction of water scarcity is a stated goal of countries and governments across the world. The United Nations recognized the importance of reducing the number of people without sustainable access to clean water and sanitation in its Millennium Development Goals (MDG). The Millennium Development Goals within the United Nations Millennium Declaration stated that by 2015 we aim to 'halve the proportion of people who are unable to reach or to afford safe drinking water.' The world has now met the target of halving the proportion of people without access to improved sources of water. Between 1990 and 2015, 2.6 billion people gained access to improved drinking water sources.[1] In September 2015, the UN re-emphasized the commitment to solving water access issues in its publication of the Sustainable Development Goals. SDG #6 ensures availability and sustainable management of water and sanitation for all by 2030.

Although the Millennium Development Goal reporting indicates progress, there are still major challenges remaining. Those challenges include insufficient water availability, poor water quality, over-extraction of water resources, continued degradation of water catchment areas, insufficient funding, high water tariffs, and lack of water accessibility, primarily in remote areas across the water-stressed nations. Rural areas are typically more severely affected than urban areas in water stressed zones. Often, the remaining challenge at the BoP is not one of the availability of water, but rather of the availability of clean water. Thus, the more difficult challenge today, and the problem that most urgently needs to be solved is of distribution – how to distribute the clean, filtered water to the BoP at the very last mile at a cost low-enough to ensure sustainability.

Governments around the world have taken an active role in resolving water issues by undertaking various initiatives and instituting multi-year plans and welfare programs. Corporates and NGOs are responsible for an increasing number of initiatives as well. Some of the major NGOs contributing to the water cause are WaterAid, Water.org, and Charity:Water. The projects are funded by donations and increasingly with support from foundations/corporations as part of corporate social responsibility activities.

Projects are increasingly relying on innovative technologies. Today's frequently used technologies include wells (bore wells, tube wells and drilled wells), ever more effective filters and purifiers (sand and electric purifiers), electrolytic de-fluoridation plants, rainwater harvesting, and water ATMs.

Several other new technologies are in the pipeline for deployment in the near future. Among the technologies that may see broader adoption in the near future are pore-water extraction, playpumps, smart monitoring, AKVO flow and nanotechnology in filtration. These new technologies are expected to be more effective, and importantly, more cost-effective, than existing technologies.

As regions of major focus for the impact investing community, India and East Africa are seeing an increased interest from investors in the water space.[2]

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[1] http://www.un.org/millenniumgoals/environ.shtml

[2] http://www.thegiin.org/binary-data/ExecutiveSummary_GIIN_eastafrica.pdf

Improved Water Source is defined as one that, by nature of its construction or through active intervention, is protected from outside contamination

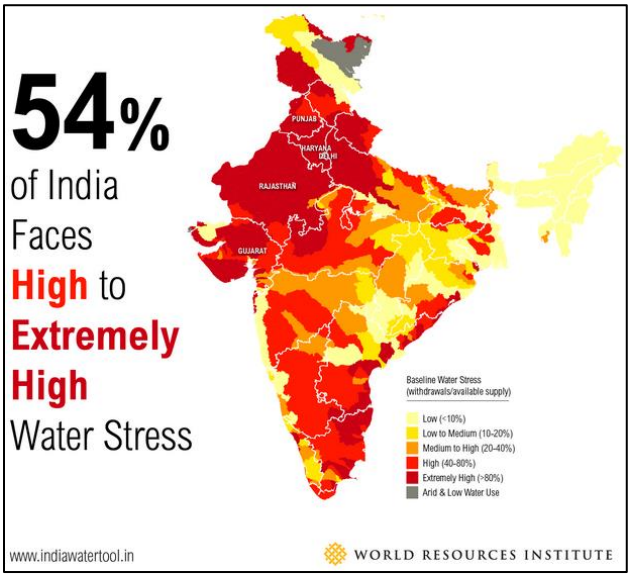
Industry Overview

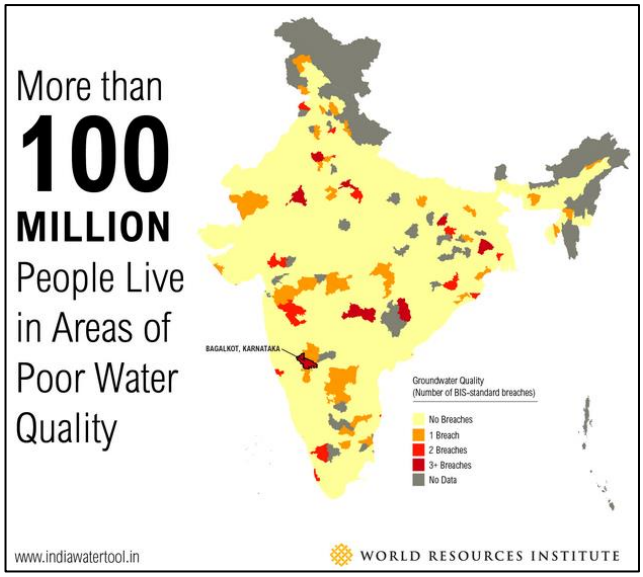
India

Overview

India is the 2nd most populous country in the world, with a population of approximately 1.2 billion, and is home to almost 18% of the world's population. Nearly a quarter of people in India live in poverty.[3]

India is considered one of the most water-scarce countries in the world. 85% of the population of India is dependent on groundwater,[4] which has decreased 0.15 meters per year in some parts of the Western Ganges Plains. A growing population in the country has led to severe water and sanitation issues. Untreated sewage spills into water bodies and eventually pollutes aquifers.[5] Much of the pollution issues stem from slums, where at least half the urban population resides. Typically, only half the urban slum population has adequate access to safe water.[6]





Per capita availability of fresh water in India has dropped from 5,177 cubic meters in 1951 to 1,155 cubic meters in 2013. Water per capita is much higher in regions like the US, Europe, and other parts of Asia. The global availability is 6,055 cubic meter per capita. In the US and European Union it is 8,903 and 2,970 cubic meter per capita, respectively.[7] Around 76 mm people in India don't have access to safe water and every year approximately 140,000 children die from diarrhea caused by unsafe water and poor sanitation.[8]

Pressures of development are changing the distribution of water in India, and the lack of access to adequate water has been cited as the primary factor responsible for limiting development. Due to the increasing population figures and continued decline in water availability, it is estimated that by 2020 India will become a water stressed nation.

[3] http://indiamicrofinance.com/wp-content/uploads/2014/06/povert-in-india-2014-205.pdf
[4] http://www.nbr.org/research/activity.aspx?id=356
[5] http://www.iwmi.cgiar.org/regions/asia/south-asia-region/india/
[6] http://infochangeindia.org/agenda/the-politics-of-water/2015-334-million-indians-will-still-lack-access-to-safe-water-supply.html
[7] Water Scarcity and Security in India_ Dr. Narayan G. Hegde
[8] http://www.wateraid.org/where-we-work/page/india

Macro-economic Indicators[9]

Total Population (2014)	1,267,401,849
Rural Population (2014)	857,194,567
Population without access to safe water	~76,000,000
Number of child deaths every year from preventable diarrheal disease	~140,000
Percentage of Population in Rural Areas (in % of Total Population) (2014)	68%
Per capita income (USD) (2014)[10]	1,610
Poverty Headcount Ratio (2011/2012)[11]	23.6%
Poverty Headcount Ratio at National Poverty Lines (% of population) (2011)	22%
Improved Water Source (% of population without access) (2012)	7%
Improved Water Source, Rural (% of rural population with access) (2012)	91%

Challenges Faced

India's water security crisis* is rooted in three causes:

- **Insufficient water per person** as a result of population growth is one cause for concern. The total amount of usable water is estimated to be between 700 to 1,200 bn cubic meters (bcm). India has a little over 1,000 cubic meters of water per person.[12]
- **Poor water quality** resulting from insufficient and delayed investment in water-treatment facilities is another cause for concern. Water in most rivers in India is not fit for drinking, and in many stretches not fit for bathing. Sanitation facilities are not properly maintained because an adequate salary is often not provided for the service
- **Dwindling groundwater supplies** is perhaps the most major cause for concern. Farmers are over-extracting groundwater because it is an open-access resource meaning anyone can pump water from under his or her own land[13]

Government Involvement

Traditionally, the water sector in India has been regulated by the Indian government. However, because it has been unable to resolve the water issues, the government is increasingly encouraging the private sector to become involved and to introduce various reforms.

Example Initiatives

- **Jal Gram Yojana**: This is a convergence program in which two villages in every district, facing acute water scarcity, shall be selected as 'Jal Grams'. An integrated water security plan, water conservation, water management and allied activities shall be undertaken for the villages to ensure optimum and sustainable utilization of water[14]

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[9] World Bank
[10] http://databank.worldbank.org/data//reports.aspx?source=2&country=&series=NY.GNP.PCAP.CD&period=
[11] http://data.worldbank.org/indicator/SI.POV.DDAY
[12] http://data.worldbank.org/indicator/ER.H2O.INTR.PC
[13] http://www.nbr.org/research/activity.aspx?id=356
[14] http://wrmin.nic.in/writereaddata/JalKrantiAbhiyan_StepByStepGuide.pdf
***Water security:** the reliable availability of an acceptable quantity and quality of water for health, livelihoods and production, coupled with an acceptable level of water-related risks.

- **Mission Clean Ganga**: Focuses on the efforts of the Central and State governments for effective abatement of pollution and conservation of the river Ganga so as to ensure that by the year 2020 no untreated municipal sewage or industrial effluent will flow into the river.
- **Integrated Watershed Development Program**: Works towards harvesting every drop of rainwater for the purposes of irrigation and plantation to create sustainable sources of income for the village community as well as for drinking water supplies, with a cost of INR 6,000 per hectare[15]
- **National Water Policy**: Efforts are being made to provide improved water supply in rural areas with proper sewerage facilities. Least water intensive sanitation and sewerage systems with decentralized sewage treatment plants should be incentivized

Millennium Development Goals (MDG)

The Millennium Development Goals (MDGs) are the world's time-bound and quantified targets for addressing extreme poverty in its many dimensions-income poverty, hunger, disease, lack of adequate shelter, and exclusion-while promoting gender equality, education, and environmental sustainability. Water Security and Sustainability are covered under Goal 7 - Ensure Environmental Sustainability, Target 10 that details the goal of *'Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation.'*[16]

India has made some progress towards the Millennium Development Goal of ensuring environmental sustainability. India, as the poorest country in the world in terms of number of people, correspondingly has the highest number of people without access to water in absolute terms. [17]

The Twelfth 5-Year Plan (2012-2017)

The Five-Year Plans are developed, executed, and monitored by the Planning Commission of India. The following are the outlooks that the government envisages in the near future:

- By 2017 (drinking water facilities)
  - At least 50% of rural households are provided with piped water supply;
  - At least 35% of rural households have piped water supply with a household connection; less than 20% use public taps and less than 45% use hand pumps or other safe and adequate private water sources
  - All services meet set standards in terms of quality and number of hours of supply per day
- By 2019 (rural sanitation facilities)
  - To attain a clean and open defecation free India by 2nd October, 2019
- By 2022 (drinking water facilities)
  - At least 90% of rural households are provided with piped water supply
  - At least 80% of rural households have piped water supply with a household connection; less than 10% use public taps and less than 10% use hand pumps or other safe and adequate private water sources

Welfare Programs[18]

- **Rajiv Gandhi Drinking Water Mission**: The Rajiv Gandhi National Drinking Water Mission (RGNDWM) has three key objectives: (i) providing safe drinking water to all villages; (ii) assisting local communities to maintain sources of

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[15] http://www.archive.india.gov.in/citizen/health/viewscheme.php?schemeid=1353
[16] http://www.unmillenniumproject.org/goals/gti.htm#goal7
[17] http://infochangeindia.org/agenda/the-politics-of-water/2015-334-million-indians-will-still-lack-access-to-safe-water-supply.html
[18] http://www.yourarticlelibrary.com/india-2/5-special-programmes-and-plans-made-for-rural-development-in-india/11201/

safe drinking water in good condition; and (iii) giving special attention for water supply to scheduled castes (SCs) and scheduled tribes (STs)

- **Watershed Development Programs:** The Department of Land Resources in the Ministry of Rural Development is administering three area-based watershed programs for development of wastelands or degraded lands. These programs are namely, Drought-Prone Areas Program (DPAP), Desert Development Program (DDP), and Integrated Wastelands Development Program
- **Rural Sanitation Program:** The efforts of the states are supplemented by the Central government through technical and financial assistance under the Central Rural Sanitation Program (CRSP). The program provides rural sanitation facilities with a view to improving quality of life and upholding the dignity and privacy of rural women

East Africa

In this section we focus on the conditions of water and water access in Kenya, Rwanda, Tanzania and Uganda. These four countries have a combined population of nearly 150 million, of which the large majority lives in rural and peri-urban settings. Anecdotal evidence from a regional industry expert suggests that in many areas, there is now a worse chance of accessing *safe* drinking water in urban settings than in a rural village. NGO and charity focus has been on providing wells to the rural BoP, which in some instances has meant largely neglecting the urban BoP who still lack access to safe drinking water.

As a general guideline for water in the region, it should be understood that about 20% of the population be considered BoP. The middle portion of the pyramid for water access contains about 70% of the population and the top portion of the pyramid, the remaining 10% of the population. For purposes of focusing our efforts on the most in-need of better water access, our focus should really include the bottom 90%. Like the BoP class, the middle portion of the pyramid cannot afford safe drinking water regularly, and children are just as much at risk of disease from unclean water.

In September 2013, Kenyan authorities announced the discovery of a large underground aquifer in the northwest Turkana region of the country. The initial discovery was hailed as a chance for the arid northern region of East Africa to finally feed its people. While tests of the water are still ongoing, initial test results have been disappointing. The first tests indicated salt levels in the water that were seven times higher than World Health Organization safe limits. Desalinating the water before it can be used for human consumption, livestock, or irrigation is an expensive and energy-intensive process, meaning its sustainable distribution becomes much more difficult.

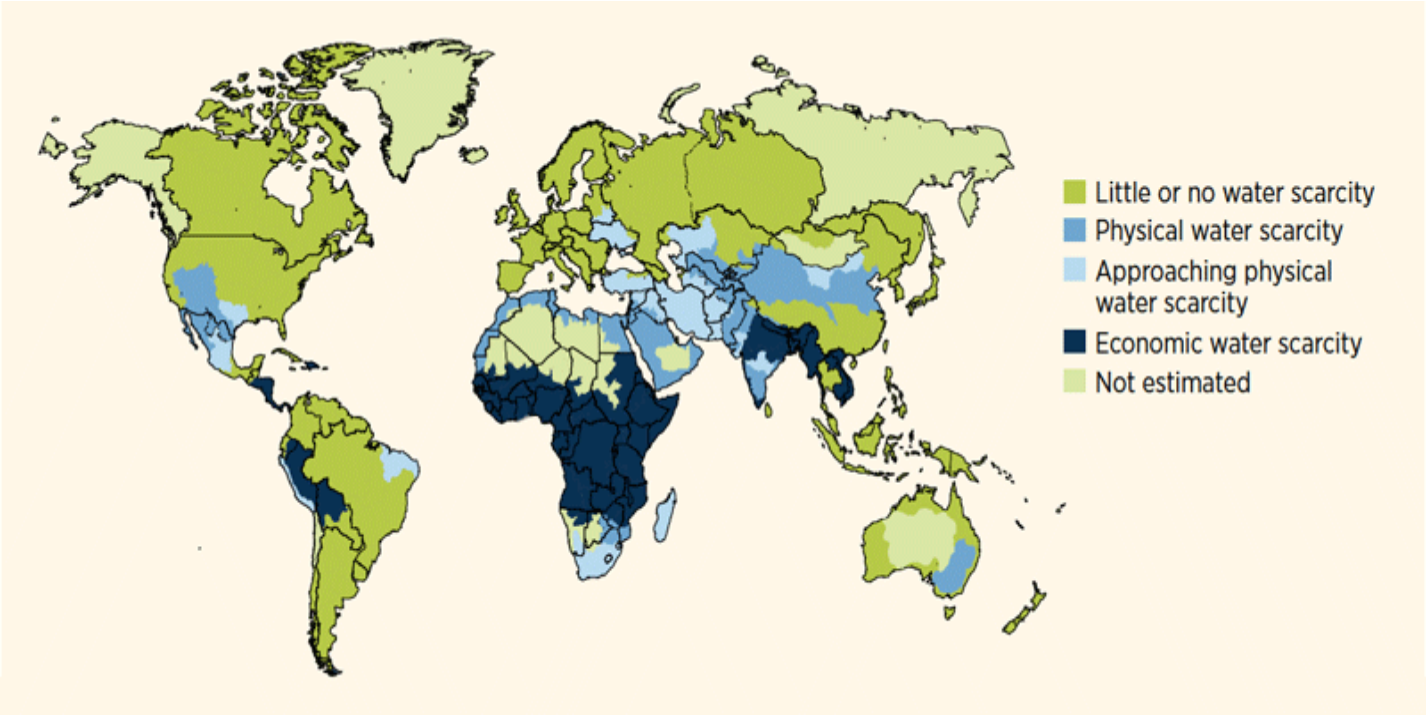
As the reader will see in the "Economic vs. Physical Water Scarcity" chart below, the challenge for water in East Africa is not primarily one of supply or available technology, but rather one of economic capacity to support the sustainable distribution of water. Focus of investment in the region is to identify the viable business models and provide them with sufficient capital to establish a sustainable means of distributing safe water.

Macro-Economic Indicators[19]

	Kenya	Rwanda	Tanzania	Uganda
Total Population (2014)	45,545,980	12,100,049	50,757,459	38,844,624
Rural Population (2014)	34,069,759	8,731,274	35,072,897	32,720,381
% Population in Rural Areas (% of total population) (2014)	75%	72%	69%	84%
Per capita income (USD) (2014)[20]	1,280	650	930	660
Poverty Headcount Ratio (% of population) (2011/2012)[21]	NA	63%	43.5%	37.8%
Improved Water Source (% of population with access) (2012)	62%	71%	53%	75%
Improved Water Source (% of rural population without access) (2012)	45%	32%	56%	29%
Adjusted Net National Income per Capita (current USD) (2013)	1,116	516	784	515
Renewable Freshwater Resources per Capita (cubic.m.) (2013)	467	807	1,705	1,038

[19] World Bank
[20] http://databank.worldbank.org/data//reports.aspx?source=2&country=&series=NY.GNP.PCAP.CD&period
[21] http://data.worldbank.org/indicator/SI.POV.DDAY

Economic vs. Physical Water Scarcity



Source: https://www.southasiawaterinitiative.org/SAWIAbout

Economic water scarcity is caused by (1) a lack of investment in water or (2) insufficient human capacity to satisfy the demand of water in areas where the population does not have the necessary monetary means to utilize an adequate source of water.

Physical water scarcity is the situation when water is not abundant enough to meet all demands required by an ecosystem to function effectively. Arid regions frequently suffer from physical water scarcity. It also occurs where water seems abundant but where resources are over-committed.

Kenya

Overview

Only 2% of Kenya's 582,646 square km of territory is covered by water. Kenya's annual fresh water availability is estimated to be about 467 cubic meter per capita of water.[22] Water per capita is much higher in regions like the US, Europe, and other parts of Asia. The global availability is 6,055 cubic meter per capita. According to wateraid.org, 17M people in Kenya do not have access to safe water, and 10,000 children die from preventable diarrheal disease every year.

Water scarcity in various regions of Kenya has been an issue for decades, as a very small percentage of the country's land is optimal for agriculture, and the year-round climate is predominantly arid. Kenya's water politics are unique, as there has been a divide between areas that have already been privatized and sectors where investors have been discouraged from developing. Water privatization is seen as a negative in developing countries due to high costs that are passed along to the impoverished, lack of development and sanitation or tanker service. Rural areas of Kenya are

[22] http://www.water.go.ke/downloads/NWQMS.pdf

* Point source means any discernible, confined and discrete source of pollution; Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification

left without water and urban areas aren't much better off, as Kenya's government does not have the funds to run pumping stations and existing piping systems are often pirated and in disrepair.[23]

As the initial test results from the recently-discovered Kenyan aquifer suggest, the problem with most water from bore wells in Kenya is that it contains very high levels of salt and fluoride. Removing salt and fluoride prior to human consumption or use requires expensive and wasteful filtration solutions, often reverse osmosis.

Challenges Faced

Kenya's biggest hurdle is reliable availability of acceptable quantity and quality of water, which are a must for any water secure nation.

- **High levels of salt and fluoride** in water from Kenyan wells
- **Access to water resources:** It is a challenge to provide the poor and underserved water and sanitation services within a reasonable distance of 2 km for rural areas. This goal has not been realized in most of the country
- **Continued degradation of water catchment areas:** Degradation of the catchment areas leads to decreasing water flows in rivers, which may, consequently, cause conflict over water use

Government Involvement

Initiatives

The development of a **National Water Quality Management Strategy (NWQMS)** is the most important initiative undertaken by the government of Kenya. The NWQMS has outlined the below as stated goals:

- Improved water quality by reducing pollution from point and non-point sources*
- Enhanced water quality monitoring programs, water quality data management, information management and sharing in rural areas
- Harmonized water quality management guidelines recognizing differences in institutional, social and natural conditions[24]

Kenya National Water Master Plan 2030 - Vision 2030 aims to transform Kenya into a newly industrialized, "middle income country providing a high quality of life to all its citizens by the year 2030" and recognizes water as an enabler in socio-economic development. It is developed by Ministry of Environment, Water and Natural Resources.

Amongst its objectives are:[25]

- Improved water and sanitation available and accessible to all by 2030
- In agriculture, to increase the area under irrigation to 1.2 mm hectares by 2030

Regulations and Reforms

The government has implemented reforms in the Water sector under the legal and institutional framework provided by the Water Act of 2002. These reforms include:

- Enhanced governance
- Creating institutions to manage water resources and provide water services
- Introduction of Sector Wide Approach to Planning (SWAP)
- Involvement of local communities in the management of water resources through formation of Water Resource Users Association (WRUAs)
- A Nile Basin cooperative framework for management and development of the shared water resource[26]

[23] http://thewaterproject.org/water-in-crisis-kenya
[24] http://www.water.go.ke/downloads/NWQMS.pdf
[25] http://www.afriwater.org/articles/339-kenya-national-water-master-plan-2030

Welfare Programs[27]

- **Thwake Water Supply & Sanitation Project:** Aims to increase the amount of water available for the use of domestic, irrigation and hydropower generation purposes through construction of a multipurpose dam on the Athi river. The immediate objective is to increase the availability and access to water for domestic and productive use
- **Scaling up rainwater management:** The goal of the program is to contribute to the mainstreaming of rainwater harvesting and management (RHM) in response to rural development challenges posed by climate change in drought prone regions of Kenya. The purpose is to promote scaling up of integrated RHM systems and complementary technologies in three semi-arid districts of Kenya

Rwanda

Overview

Rwanda is divided into two major drainage basins: the Nile to the east covering 67% and delivering 90% of the national waters and the Congo to the west which covers 33%. Nyungwe natural forest is one of Rwanda's water towers: it contributes up to 60% of the country's water.[28] Rwanda supports the densest population in continental Africa. According to the 2013 Joint Monitoring Program (JMP) report by UNICEF and the World Health Organization (WHO), access to sanitation is very low, with an estimated 61% of urban and rural dwellers using improved sanitation facilities.

Approximately 25% of the population has no access to a safe water supply and over 40% of Rwandans have no toilet. This has a huge impact on health and infant mortality in the country. [29] According to wateraid.org, 3M people in Rwanda do not have access to safe water, and 2,000 children die from preventable diarrheal disease every year.

Challenges Faced

In order to increase the accessibility of water and to ensure water security, Rwanda needs to address the following major challenges:

- **Insufficient funding** for the water and sanitation sector
- **Low sustainability** of water supply services in rural areas, and high infrastructure rehabilitation costs
- **High water tariffs** in rural areas
- **Unplanned and scattered settlements** in both urban and rural areas, making it difficult to reach the entire population[30]

Government Involvement

Initiatives

Name of Project	Development Partner	Objectives
National Rural Drinking Water and Sanitation Program (PNEAR)	African Development Bank	Achievement of MDGs for drinking water and Sanitation in Rwanda
Rural Water and Sanitation Program (PEPAPS)	Belgium Government and European Union	Increasing access to water and sanitation
African Towns Water Supply Project (EVA II)	UN-Habitat	Tackle funding problems

[26] http://www.water.go.ke/downloads/STRATEGIC%20PLAN.pdf
[27] http://www.afdb.org/en/projects-and-operations/project-portfolio/project/p-ke-e00-008/
[28] Rwanda _ POLITIQUE_ENVIRON__Anglais
[29] http://www.rema.gov.rw/soe/chap7.php
[30] Financing of the water, sanitation and hygiene sector in Rwanda_James Sano

Regulations and Reforms[31]

- **Sector financing:** The Government of Rwanda has dedicated to increase government budgetary allocation for WASH* sector by at least 18% every year, through the end of 2016
- **Private sector participation:** The private sector is encouraged to participate in the interventions within the WASH Sector by implementing large scale infrastructure projects through a public-private partnership arrangement
- **Sector coordination and governance:** In line with the ongoing formalization of the sector-wide approach (SWAP), the government of Rwanda ensures effective and efficient WASH sector coordination, planning, resource mobilization, implementation and monitoring with the aim to achieve Economic Development and Poverty Reduction Strategy (EDPRS-II) and MDG targets
- **Ownership and accountability:** The government of Rwanda streamlines and strengthens the existing performance contracting mechanism for WASH between local and central government by end 2015
- **Sanitation and hygiene:** In order to increase access to sanitation and promote safe hygiene practices, the government of Rwanda, through a consultative process, will develop, and initiate implementation of, a national sanitation and hygiene strategy, by the end of 2015
- **Sector reforms:** In order to improve service delivery, the government will establish an autonomous water and sanitation public corporate to ensure efficient service delivery and sustainability, by the end of 2015

Millennium Development Goals

The government of Rwanda has also set other, more ambitious national targets. With the Vision 2020, the 7-year program, and EDPRS II, Rwanda committed to achieving 100% water supply coverage country wide by 2017.

National water supply and sanitation targets

Sub Sector/Horizon	2005	2010	2012	2015	2017	2020
Water Supply	44%	80%	86%	92%	100%	100%
Sanitation	38%	47%	65%	75%	100%	100%

Source: EDPRS, MDGs, government 7-year program and Vision 2020

Five Year plan (2011-2015) [32]

The Rwanda IWRM Strategy seeks to achieve 7 outcomes and 39 outputs to reach its goal of increasing water accessibility. The major strategic actions are:

- An effective water resources governance framework that reflects the principles of IWRM
- Cost-effective water resources assessment and monitoring system in place and operational
- Critical watersheds and catchments rehabilitated
- Efficient and equitable water allocation and utilization framework built
- An effective framework for water-related disaster management established

To accelerate the move towards the national 2017 targets of 100% access to water supply and sanitation country wide, Rwanda adopted a 7-year program to achieve 100% access to improved water supply and sanitation facilities by 2017. To monitor progress, the government established a management information system (MIS), through the Energy, Water and Sanitation Authority (EWSA), which has been functional since 2012.[33]

*WASH: Water, Sanitation and Hygiene

[31] Rwanda - Rwanda Statement of Commitments for the 2014 HLM

[32] Water And Sanitation Sector Strategic Plan 2013/14 - 2017/18_ Ministry Of Infrastructure

[33] Financing of the water, sanitation and hygiene sector in Rwanda_James Sano

Tanzania

Overview

Tanzania's water problems are prevalent in almost all regions of the country. Over one third of East Africa's largest country is semi-arid.

With few rivers and diminishing levels of clean groundwater, 48% of Tanzania's 45 mm citizens lack access to safe water.[34] Additionally, according to wateraid.org, 7,000 children die from preventable diarrheal disease every year. Despite the vast amounts of fresh water available, many Tanzanians are still faced with water shortages due to insufficient capacity to access and store it both in rural and urban areas. A large majority of rural households (more than 70%) were more than 15 minutes away from their main water source in 2010.[35]

Challenges Faced

Tanzania's ground water is the major source of water for the nation's people; however it is not always clean. Many of these ground water wells are located near or next to toxic drainage systems, which leak into the fresh ground water and contaminate it. Consequently, Tanzanians turn to surface water which contains bacteria or human waste; and people have no choice but to drink from, bathe in or wash their clothes in this water.

Government Involvement

Initiatives and Reforms

The Ministry of Water and Irrigation (MoWI) is the agency responsible for the overall water sector development strategy policy setting, co-ordination, monitoring, evaluation and regulating community water supplies. The national Water Sector Development Program (WSDP) of 2006-2025 is centered on commercial service provision including private sector participation in urban areas and community ownership and management in rural areas. It also sets out to implement "demand driven approaches".

In rural areas, water supply and sanitation services are provided by community owned water supply organizations (COWSOs). They have been established through the local government framework of village councils following the adoption of the Water Sector Development Strategy. The role of COWSOs is to operate and maintain the water supply systems on behalf of the community. They are expected to meet all the costs of operating and maintaining their water supply systems through charges levied on water consumers.

The PSP Process

Donors and consultants since the early 1990s have suggested p**rivate sector participation** (PSP) as a policy reform solution to Tanzania's water and sanitation problems. In 1995, Howard Humphreys conducted a study in the 'Feasibility Report on the Rehabilitation of the Dar es Salaam Water Supply System' report for the Tanzanian region which resulted in the conclusion that if current and future demands were to be met, five major tasks need to be implemented, namely[36]:

Refurbishment of the existing infrastructure	Extension and upgrading of the network
Rehabilitation and augmentation of the extraction	Improvement of other raw water sources
Treatment and transmission facilities from the Ruvu River	

[34] http://www.theguardian.com/sustainable-business/tanzania-water-shortage-business-private-public-partnership
[35] http://blogs.worldbank.org/africacan/tanzania-water-is-life-but-access-remains-a-problem
[36] http://www.ucl.ac.uk/dpu-projects/drivers_urb_change/urb_infrastructure/pdf_public_private_services/W_WaterAid-PRS_Dar_es_Salaam_Tanzania.pdf

Uganda

Overview

Access to water supplies throughout Uganda is approximately 70%.[37] According to a regional industry expert, tests of bore wells, 'treated' municipal water, and NGO projects suggest that access to *safe* water supplies is likely closer to 5%. Uganda is a very wet country with lots of available water, so the issue really boils down to access to 'safe' water. Although the number of people with access to safe water and sanitation has improved over the past 10 years, there are still many communities (both rural and urban) that rely on contaminated water sources such as streams and open wells. As of June 2014, the urban population with access to safe water was just 72.8%. The rural population with access to safe water remains stagnated, which is mainly attributed to the inadequate funding to the district local governments that have the responsibility for water and sanitation service provision.[38] According to wateraid.org, 8M people in Uganda do not have access to safe water, and 8,000 children die from preventable diarrheal disease every year.

The government (on-budget) allocation for Water and Environment translated into 2.8% of the total national budget of UGX 10.9 tn (USD 3.1 bn). There is concern that present funding levels are insufficient to meet National Development Plan (NDP) targets for the sector.

Challenges Faced

In Uganda, the water supply and sanitation (WSS) sub-sector faces the following key challenges[39]:

- **Insufficient funding** levels to reach the NDP and MDG targets
- **Inadequate capacity** at district and lower levels to plan and implement sector activities. This has consequently resulted in low absorption of funds by the local governments
- **Limited private sector capacity** to cope with the increased water and sanitation activities
- **Weak coordination** and management at both national and local governments level
- **Inadequate involvement of local communities** in the planning, financing, implementation, monitoring and management of community based water and sanitation developments

Government Involvement

Initiative and Reforms[40]

In order to cope with the challenges faced, the government has taken steps to revamp the urban water sub-sector through comprehensive policy, legal and institutional reforms aimed at increasing the performance of the sub-sector in terms of outputs but also the efficiency in service delivery.

Those reforms include:

- **Sector Wide Approach to Planning (SWAP) Framework:** Since the adoption of the SWAP framework, government and most development partners have agreed to finance the water sector through general budget support, which gives the government a high degree of flexibility in allocating both local and donor financial resources according to the national priorities and development objectives
- **Private sector participation** in the development and management of urban water and sanitation services has brought in technical, financial and managerial expertise that has greatly improved on the performance of the sub-

[37] http://changealifeuganda.org/about/facts-about-uganda/
[38] Water and Enviornment Sector performance report 2014
[39] http://unesdoc.unesco.org/images/0014/001467/146760e.pdf
[40] http://unesdoc.unesco.org/images/0014/001467/146760e.pdf

sector and made it more economically viable. The introduction of private operators in the management of small town water supplies has not only attracted the necessary technical expertise, which was lacking, but has also significantly reduced the government burden in subsidizing these towns

Millennium Development Goals Status

Uganda has made progress on both safe water and basic sanitation since the publication of the 2010 MDG Report. The proportion of the Ugandan population with access to improved drinking water sources has increased significantly from 52% in 2001-02 to 70% in 2011. If current trends continue, Uganda is on course to meet both the safe-water and sanitation MDGs by 2015 in rural areas. Currently only 64% of the urban population has access to piped water.[41]

[41] http://www.ug.undp.org/content/dam/uganda/docs/UNDPUg-2013MDGProgress%20Report-Oct%202013.pdf

Technology

Throughout this section of the report, the reader will see various types of water extraction, filtration, and distribution methods and technologies used by social enterprises serving the BoP in India and East Africa. These technologies have varying degrees of adoption and notably, do not represent all technologies available or used to extract, filter, and distribute water.

As the reader will notice, technological innovation has largely focused in the realm of filtration. Membrane technology has improved, such that there now exist more effective membranes at more affordable prices for filtration solutions. When considering a filtration system, a Company can elect between micro-filtration, ultra-filtration, nano-filtration, and pair a filtration solution with reverse osmosis depending on the required cost vs. effectiveness breakdown. While this is an important analysis for any social enterprise serving the bottom of the economic pyramid, the more difficult challenge today is solving the problem of distribution – how to distribute the clean, filtered water to the BoP at the very last mile at a cost low-enough to ensure sustainability. There are some innovative approaches to the distribution problem outlined in this section of the report as well.

Current Technology

India

Interest in water technology in India has been growing amidst the continued concern over droughts, water shortage, sanitation, and a warming climate. Foundations and large corporations fund projects by non-profit organizations. Big corporations like Coca Cola are also taking an interest in conserving and recycling water. The interest spark can also be seen in the hardware startups that are creating new, more efficient, and more cost-effective water filters and purifiers, among other technologies.

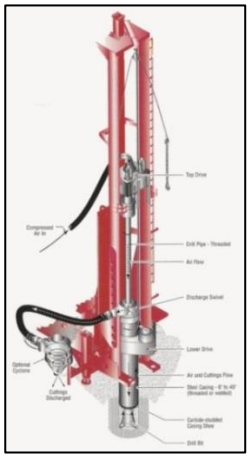
Water technologies can broadly be categorized under three different verticals including extraction, treatment, and distribution. Below are a representative set of technologies currently being employed in India:

Extraction

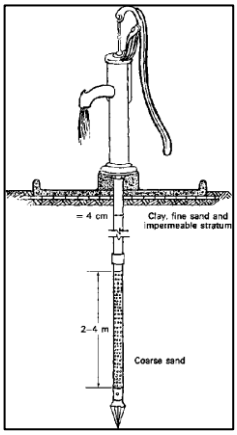
Borewells and Tubewells

Borewells and tubewells are vertically drilled wells, bored into an underground aquifer in the earth's surface, to extract water for various purposes. The differences between the two lie in the type of casing used, the depth of this casing, and the type of soil where they are drilled.[42]

Borewell



Tubewell



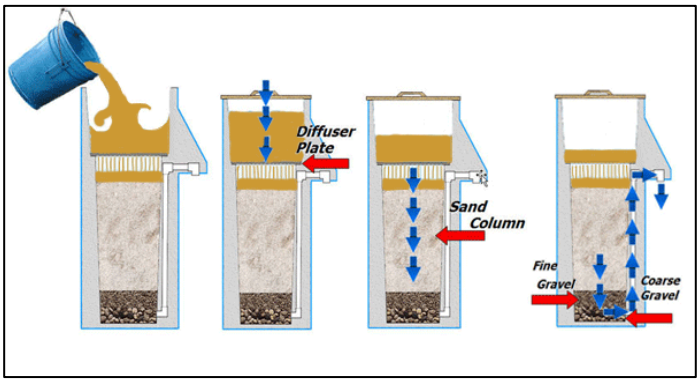
[42] http://www.indiawaterportal.org/topics/borewells-and-tubewells

Filtration

Bio-sand Water Filter

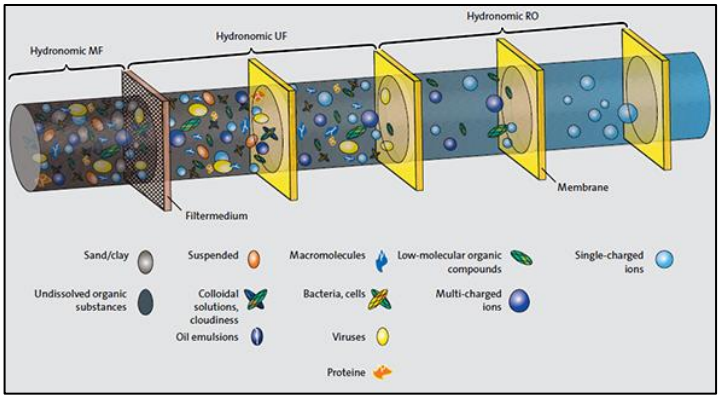
Bio-sand water filters are low cost filters that through a slow purifying process manage to remove up to 98% of bacteria, up to 100% of viruses, up to 99% of parasites, protozoa, amoebae, and worms, up to 95% of heavy metals, and with a slight modification, up to 93% of arsenic. Bio-sand water filters are useful for eliminating illnesses such as Typhoid, Cholera, Hepatitis A, Rotavirus, E-coli bacteria, and others. Bio-sand filters cost about INR 3,000 (USD 47) and have a useful life of 30 years. To date, SAPWII (South Asia Pure Water Initiative, Inc.) has distributed 12,000 filters, positively impacting 150,000 villagers. [43]

How the Bio-sand Filter works



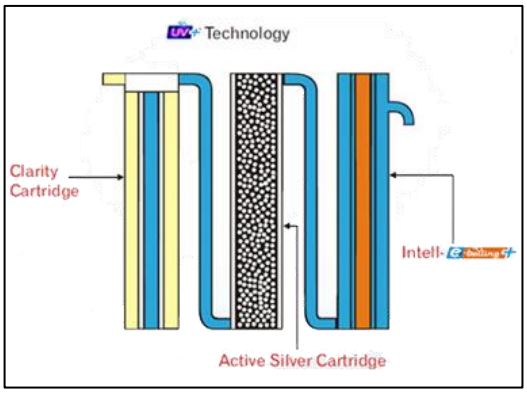
Membrane Technology

Membrane filtration can be used as an alternative for sediment purification techniques, adsorption (sand filters, active carbon filters, and ion exchangers), extraction and distillation. Membranes occupy a separation wall, allowing certain substances to pass through the membrane, while other substances are caught. When membrane filtration is used for the removal of larger particles, micro filtration and ultra-filtration techniques are applied.[44]



Water Purifiers

This technology helps purify and filter the water at the bore well extraction stage. Using advanced monitoring systems and central diagnostics, purifiers can track the level of impurity in each stage of extraction in real-time. The technology is being used in villages in Hyderabad, Bangalore, Mumbai, and Delhi among other places.[45]



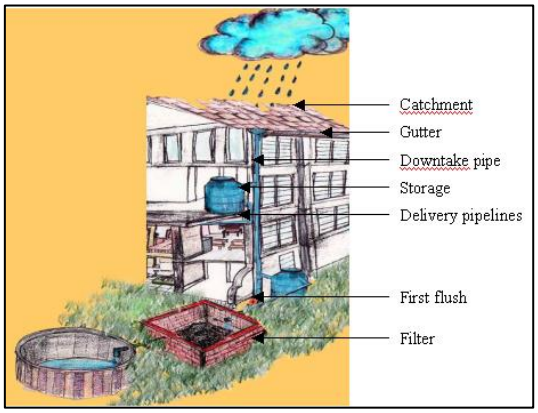
[43] http://www.huffingtonpost.in/the-better-india/a-simple-technology-that-_b_6578478.html
[44] http://www.lenntech.com/membrane-technology.htm
[45] http://forbesindia.com/article/real-issue/eureka-forbes-purifies-water-for-rural-india/35737/1

Electrolytic De-fluoridation (AQUA-EDF)

Electrolytic de-fluoridation tries to address the serious problem caused by fluoride as well as other chemical poisoning by developing an effective and affordable product for fluoride removal based on electrolysis. Across India, 237 districts in 16 states are affected by excessive fluoride contamination in ground water. This puts 66 mm people at the risk of consuming fluoride contaminated water. Fluoride is removed through co-precipitation as aluminum hydroxyl fluoride compounds that are insoluble.[46]

Distribution

Rainwater Harvesting



Rainwater harvesting is the most commonly used technology in India to meet water demands. Since many villages in India do not have access to machinery to dig for ground water; they have to rely on harvesting rainwater. It is a technique used for collecting, storing, and using rainwater for landscape irrigation and other uses. About 50% of the funds for India's rural employment act are being used for water harvesting systems [47]

Water ATM

This affordable technology takes only a few minutes to convert unclean water into safe drinking water. Some water ATMs can produce 3,000 litres of clean drinking water in just one day and have a life span of around 10 years. The villagers can avail the pure water at just 20 paise per litre from the closest water ATM.[48] Water ATMs have benefitted over 75mm Indian villagers to date.

The plants require 2 units of electricity to generate 1,000 litres of clean water. The quantity of potable water obtained depends on the contamination levels of the raw water. For example, if the input water is highly contaminated, only 40% of it might be available for drinking purposes while the rest of the water can be used for washing, toilet cleaning, gardening, etc.

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[46] http://ruralinnovations.gov.in/rite-water-solutions-pvt-ltd.htm

[47] http://www.circleofblue.org/waternews/2010/world/india-cities-focus-on-rainwater-harvesting-to-provide-clean-drinking-water/

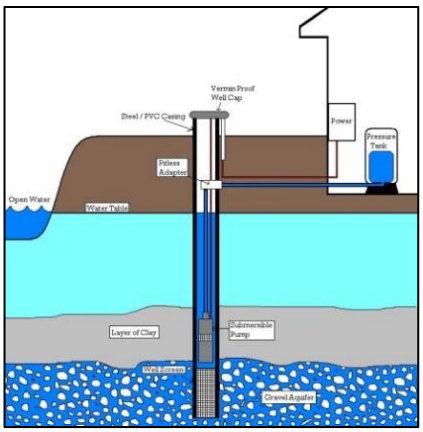
[48] http://www.thebetterindia.com/17569/technology-that-is-providing-clean-drinking-water-to-the-villagers-in-just-20-paise-smaat-india/#sthash.16mxzrnw.dpuf

East Africa

Extraction

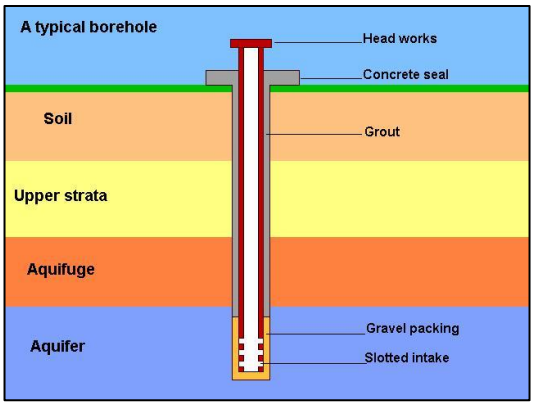
Water Wells

Water well is an excavation or structure created in the ground by digging, driving, boring, or drilling to access groundwater in underground aquifers. Water wells are the most frequently deployed technology to extract water in Kenya.[49]



Borehole Wells

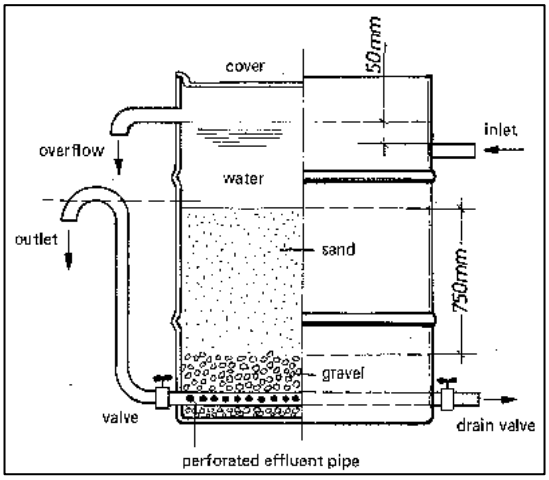
Boreholes have many purposes: in oil drilling, geological surveying and extracting water for irrigation and drinking. Wells can be bored with hand-operated machinery such as augers, which are drilled into the ground by steel rods and handle and usually are best for soft ground. Sometimes percussion drilling, such as with a steel hammer, is required for harder ground.[50]



Filtration

Slow Sand Water Filtration

Slow sand filtration is a system that can be installed as part of a community wide water distribution system to provide filtered water for consumption. The biggest advantage of slow sand filtration is that water treatment is centralized at a small number of locations. A slow sand filtration system consists of a combination of the following parts: source water storage tanks, an aerator, pre-filters, slow sand filters, disinfection stages, and filtered water storage tanks. The number of filters and filter types that are used in a given slow sand filtration system will depend on the quality of the source water and will be different for each community.[51]



[49] http://wellsforkenya.org/
[50] http://wellsforkenya.org/
[51] http://www.engineeringforchange.org/solution/library/view/detail/Water/S00025

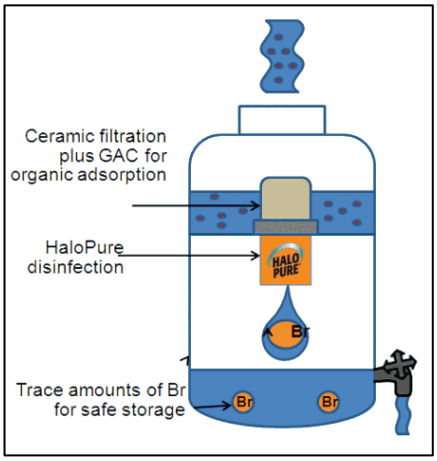
Ceramic Water Filter

Most ceramic filters are effective at removing bacteria and the larger protozoans, but not at removing the viruses. They often rely on colloidal silver to ensure complete removal of bacteria in treated water and to prevent growth of bacteria within the filter itself. A 60-70% reduction in diarrheal disease incidence has been documented in users of these filters.

Locally manufactured ceramic filters can range in cost from $7.50-$30. Distribution, education, and community motivation can add significantly to program costs. If a family filters 20 liters of water per day (running the filter continuously) and the filter lasts 3 years then the cost per liter treated (including cost of filter only) is 0.034-0.14 US cents. [52]

HaloPure

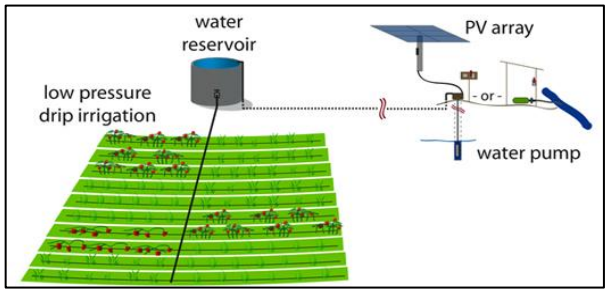
HaloPure is an innovative water-purification technology that helps make drinking water cleaner. HaloPure solutions are versatile and can be applied to a variety of point-of-use devices*, both gravity and pressure. Combined in a water treatment train with suitable physical filtration and adsorption/absorption components, HaloPure can power POU treatment devices to high levels of effectiveness for daily consumption of water.[53]



Distribution

Solar Market Garden

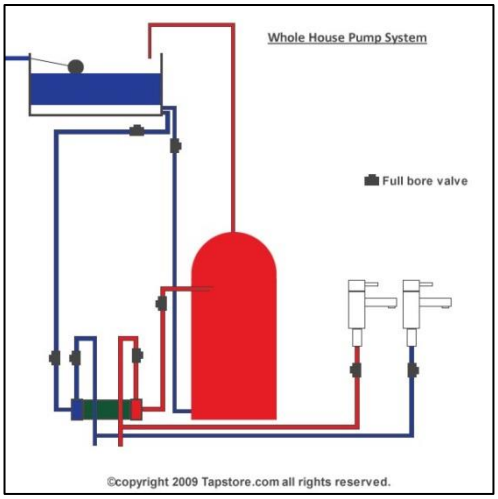
Solar-powered drip irrigation is the combination of two systems drip irrigation and Solar-powered (photovoltaic, or PV) pumps. Drip irrigation is an efficient mechanism for delivering water and fertilizer directly to the roots of plants. It increases yields and allows for introduction of new (potentially high-value) crops in regions where they cannot be sustained by rainfall alone. A Solar Market Garden costs approximately USD 20,000. When used to cultivate high-value crops, the payback time for this investment is 2-3 years. [54]



[52] http://www.cdc.gov/safewater/ceramic-filtration.html
[53] http://www.waterworld.com/articles/wwi/print/volume-25/issue-1/regional-spotlight/middle-east-africa/power-to-the-people-point-of-use-technology-in-africa.html
[54] http://web.stanford.edu/group/solarbenin/data/SolarMarketGardenInfo/Solar%20Market%20Garden.pdf

Gravity Water Systems

In this method, water flows downhill from a source, using gravity, through a system of pipelines, and tanks to tapstands within a local community. A source for a gravity-fed system may be an unpolluted spring or stream, a catchment area, or a purpose-made dam in a river or stream.[55]



* Point-of-use (POU) treatment devices are placed on a single tap and used when treated water is only for drinking and cooking purposes

[55] http://wellsforkenya.org/

Other Disinfection Technologies

Chlorination

Chlorination is the most widely used method for drinking water disinfection. It is effective and economical. Chlorination is the addition of chlorine gas or some other oxidizing chlorine compound (sodium or calcium hypochlorite, chlorinated lime, chlorine dioxide) to water. Due to its ability to penetrate cells of microorganisms, only small amounts of chlorine are required to destroy many different strains of bacteria. Similarly, many types of viruses and macro-organisms can be killed. A contact time of at least 30 minutes is required, at the end of which the residual chlorine concentration in the water must still be between 0.1 and 0.5 mg/L.[56] Chlorination should not be performed prior to slow sand filtration (residual chlorine destroys biological agents). However, sedimentation and filtration preceding chlorination enhance the disinfection effect. The lower the turbidity, the smaller the amount of chlorine necessary for effective disinfection.

Iodine

Iodine is another excellent disinfectant, effective against bacteria, amoeba cysts, cercerea and some viruses. It is added to water mostly in the form of an aqueous solution. The World Health Organization recommends the application of 2 droplets per liter of water of a 2% iodine tincture. Iodine preparations are also available in tablet form.

Iodine is effective against more pathogenic organisms within shorter times and is easier to use and handle than chlorine. However, because higher concentrations of iodine are needed to be effective and iodine is about 20 times as expensive as chlorine, the use of iodine for disinfection is recommended only in certain circumstances.[57]

Ozonation

Ozone (O3) is one of the most effective disinfectants. In water, Ozone reduces the contents of iron, manganese, and lead, and eliminates most of the objectionable taste and odor. Since ozone is relatively unstable, it is generated almost invariably at the point of use. Ozone is obtained by passing a current of dried and filtered air (or oxygen) through between two electrodes (plates or tubes) subjected to an alternating current potential difference. A portion of the oxygen is then converted into ozone.[58]

Capital costs for the instrumentation of ozone production and feeding, as well as operating costs due to the electrical energy requirements, are very high. Moreover, operation of ozonizers requires continuous and skilled monitoring. The costs and operational requirements therefore exceed the resources available in rural areas of most developing countries. As such, ozonation is not technique widely used by social enterprises.

Ultra-violet Radiation

In principle, UV radiation is imitating the effect of sunlight on surface water in a more intense and controlled way. Disinfection by UV radiation is a "clean" process, since no chemical additives are used, residual matter does not occur, and there is no effect on taste or odor in the water.[59]

Due to the high capital costs of UV lamps, a dependence on steady power supply, and the fact that effectiveness declines with high turbidity and impurities in water, UV radiation is ineffective for use by social enterprises.

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[56] http://ces.iisc.ernet.in/energy/water/paper/drinkingwater/simplemethods/disinfection.html#chlorination
[57] http://ces.iisc.ernet.in/energy/water/paper/drinkingwater/simplemethods/disinfection.html#chlorination
[58] http://ces.iisc.ernet.in/energy/water/paper/drinkingwater/simplemethods/disinfection.html#chlorination
[59] http://ces.iisc.ernet.in/energy/water/paper/drinkingwater/simplemethods/disinfection.html#chlorination

Future Outlook

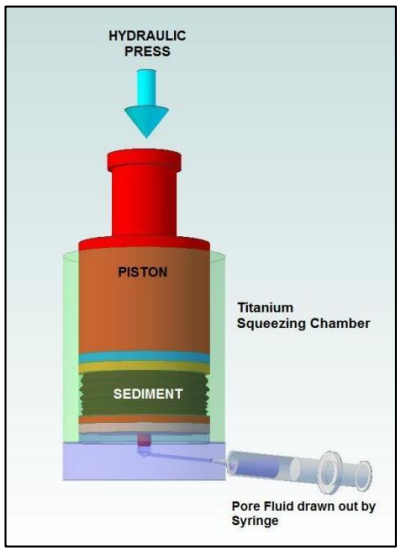
Whilst technology has not always been the savior of ecological problems in Africa, it has recently become apparent that much of the continent is sitting on a number of vast underground aquifers. Studies indicate that there is actually 100 times the water volume underground than on the surface of Africa and this could hold the key to the development of the continent and its people.

Technologies such as nanotechnology, desalination and membranes have been widely used for water treatment depending upon the quantity and quality of water/ wastewater and the available funds as per the specific use. As energy-efficient processes are the need of the hour, forward osmosis, hybrid desalination and solar desalination will gain importance over the years.[60]

Extraction

Pore-Water Extraction

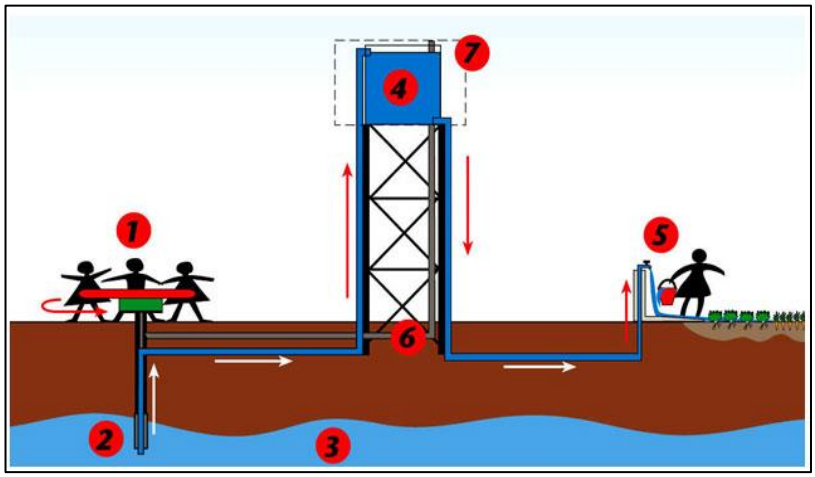
Sediment interstitial water, or pore water, is defined as the water occupying the spaces between sediment particles. Scientists are trying to come up with a model to extract water in the semi-arid regions of many of the world's countries through this method.[61] The main advantage of the use of this method is related to the costs, as there is often no need for extra equipment in the laboratory, no chemicals are involved. The preparation is easy and the use widespread.[62]



Playpumps

The PlayPump is a specifically designed roundabout that drives a conventional borehole pump. The revolutionary pump design converts rotational movement to reciprocating linear movement by a driving mechanism.

As the children spin on the roundabout, water is pumped from underground into a Polyethelene tank standing seven meters above the ground. A simple tap provides easy access for the mothers and children drawing water. Excess water (overflow) is directed from the storage tank back down to the borehole.[63]



[60] http://www.chemtech-online.com/WAT/frost_sullivan_April12.html
*EPA – Environmental Protection Agency
[61] http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-21882.pdf
[62] http://nora.nerc.ac.uk/3943/2/Di_Bonito_et_al_final.pdf
[63] http://www.playpumps.co.za/index.php/how-it-works/

Water-Gen Technology

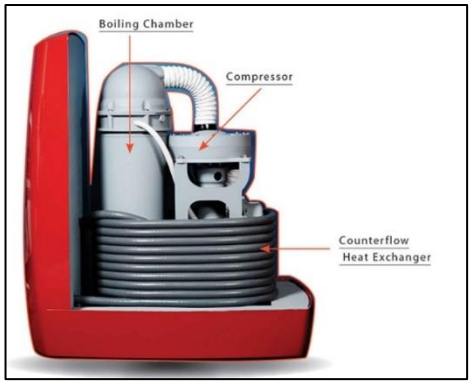
Water-Gen, based in Rishon LeZion, Israel, specializes in water generation and water treatment technologies integrated with tactical military vehicles and ground units. Their technology extracts water from the ambient air humidity, and turns it into drinking water. Israel's water purification firm Water-Gen is in talks with domestic companies for making a foray into the Indian market this year.[64]

WarkaWater

WarkaWater is an alternative water source to rural populations that face challenges in accessing drinkable water. Warka Water is a vertical structure designed to harvest potable water from the atmosphere (it collects rain, harvests fog and dew). It is estimated to collect up to 26.4 gal (100 L) of drinking water every day.[65]

Filtration

Slingshot technology



Slingshot technology can produce 1,000 litres of drinking water from contaminated water or even sewage. The water purifier, the size of a dormitory refrigerator, works by vapor compression distillation. Requiring no electrical power, instead its generator runs on cow dung.[66]

High-tech Filtration

This technology uses an anaerobic digester, which takes waste and produces energy, combined with an ultrafiltration, reverse osmosis system to create the water byproduct. The water can be fed back to livestock as drinking water. About 100 gallons of manure can generate 50 gallons of clean water.[67]

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[64] http://articles.economictimes.indiatimes.com/2015-01-06/news/57747896_1_drinking-water-products-vibrant-gujarat-summit
[65] http://www.architectureandvision.com/warkawater/
[66] http://science.howstuffworks.com/environmental/green-tech/remediation/slingshot-water-purifier1.htm
[67] http://www.techrepublic.com/article/10-ways-technology-is-changing-the-future-of-water/

Nanotechnology in Filtration

This technology removes microbes, bacteria and other matter from water using composite nanoparticles, which emit silver ions that destroy contaminants. It is a positive signal that low-cost water purification may finally be round the corner and be commercially viable.[68]

Easy water purifying system

The technology utilizes sunlight to purify water. The system incorporates a cocktail of two ingredients – TiO2 (catalyst) and graphene (A catalyst is something that quickens a reaction without being utilized itself, but which usually relies on UV light). it can be used to rid water of stubborn and harmful molecules[69]

Tata Swach

The Tata Swach is a water purifier designed by TRDDC (Tata Chemicals and Tata Research, Development and Design Centre). Swach is a water purification machine targeting mainly low-income population in India who are short of access to clean drinking water. Processed rice husk ash impregnated with nano silver particles is utilized to purify the water and to obliterate disease causing germs, bacteria, and others[70]

HYDRO-POD Water Recycling Technology

The Hydro-Pod water recycling technology treats hydraulic frac. Hydraulic fracturing is the use of fluid and material to create or restore small fractures in a formation in order to stimulate production from new and existing water wells. It is the only technology that addresses more than 9 impurities in one treatment to mitigate the risks associated with reusing produced water. The Hydro-Pod design enables users to easily and efficiently process disposal waters that can be reused in the frac process[71]

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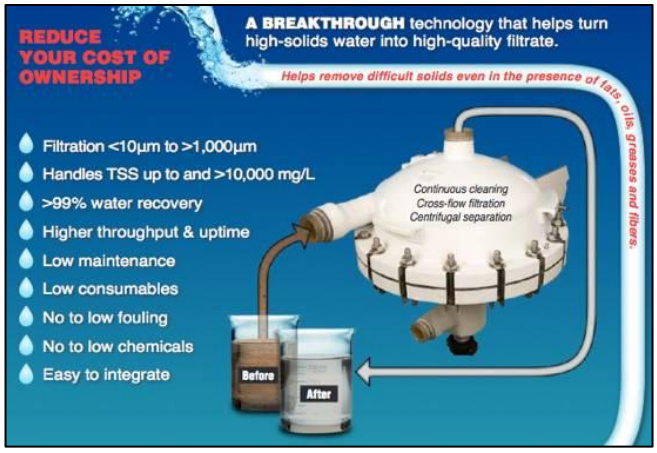
[68] http://www.theguardian.com/sustainable-business/new-water-technologies-save-planet
[69] http://www.entrepreneurial-insights.com/water-purification-new-technologies-change-world/
[70] http://www.entrepreneurial-insights.com/water-purification-new-technologies-change-world/
[71] http://recycle-frac-water.com/

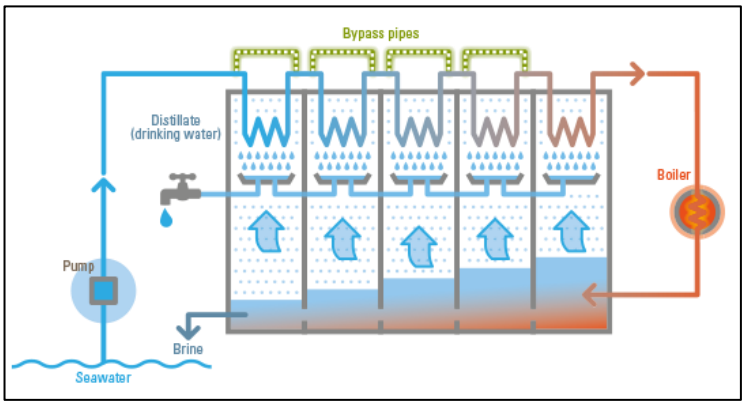
TEQUATIC™ PLUS Fine Particle Filter

The technology assists with processing a wide variety of difficult, high-solids water. This provides a cost-efficient solution for wastewater treatment in manifold industry verticals, ranging from industrial wastewater treatment and reuse applications[72]



Seawater Desalination

Seawater desalination is extremely expensive, as it uses reverse osmosis technology consuming a vast amount of energy (around 4 kilowatt hours of energy for every cubic metre of water. One solution being explored is biomimicry - mimicking the biological processes by which mangrove plants and euryhaline fish (fish that can live in fresh briny or salt water) extract seawater using minimal energy.[73] There has been a historic downward trend to the cost of desalination. This is generally associated with technology improvements such as improved SWRO (Sea water reverse osmosis) membrane performance and significant advances in the ability to recover more energy from the desalination process.[74] The power consumption of sea water desalination has gone down with the improvement of technology. The total power cost to produce desalinated seawater for a family of four is equivalent to the power consumption of about one household refrigerator. This has resulted in the improvement of the amount of usage of sea water desalination.



[72] http://www.entrepreneurial-insights.com/water-purification-new-technologies-change-world/
[73] http://www.theguardian.com/sustainable-business/new-water-technologies-save-planet
[74] https://www.watereuse.org/sites/default/files/u8/WateReuse_Desal_Cost_White_Paper.pdf

Distribution

Smart Monitoring

In developing countries, it is estimated that 45m cubic metres is lost every day in distribution networks. New monitoring technologies help companies to ensure the integrity of their vast water supply networks. Electronic instruments, such as pressure and acoustic sensors, connected wirelessly in real time to centralised and cloud-based monitoring systems will allow companies to detect and pinpoint leaks much quicker. The problem with this technology is that it is costly, and difficult to execute at this moment at village level.[75]

AKVO FLOW

FLOW stands for Field Level Operations Watch. It is a system to collect, manage, analyze, and display geographically-referenced monitoring and evaluation data. Until now, FLOW has been used mainly to track the condition of water points such as wells and pumps, however, it can be used to monitor any kind of local infrastructure.

It brings together three elements:

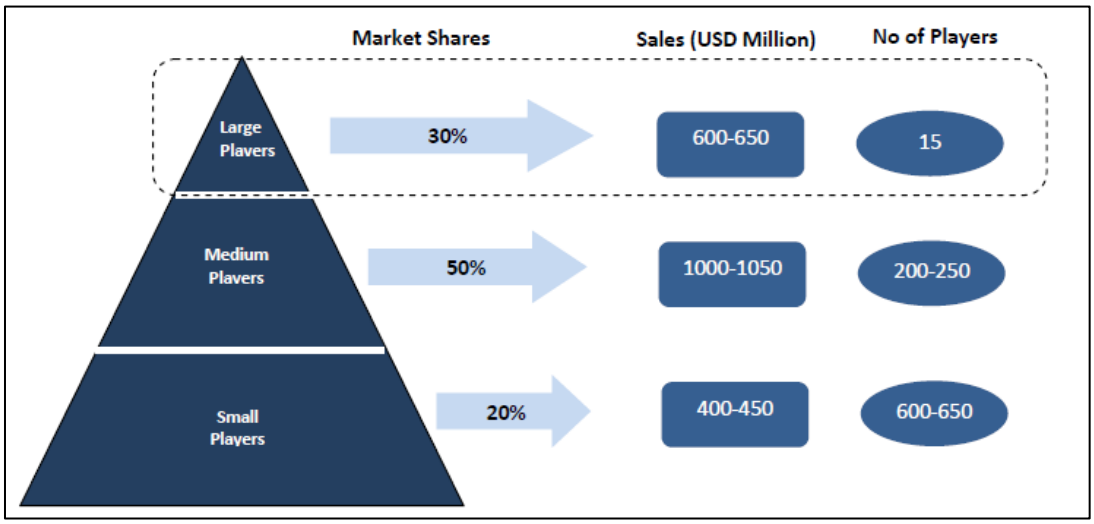
- Handheld data collection: The FLOW Field Survey application runs on Android phones and devices with integrated GPS, camera, and custom adaptive surveys
- A web-based dashboard where users manage and analyze FLOW surveys and data
- Visual map-based reporting tools are displayed in Google Maps and Google Earth[76]

[75] http://www.theguardian.com/sustainable-business/new-water-technologies-save-planet
[76] http://www.waterforpeople.org/what-we-do/

Competitive Landscape

The competitive landscape for water at the BoP in India and East Africa comprises mainly of non-profit organizations working to provide access to water with a recent increase in the number of private sector players providing solutions and technologies to address water problems not solved by the non-profit players.

In **India**, the market for water and waste water treatment is fragmented with about 15 large players accounting for approximately 30% share.



Most of the Tier 1 players in India have global alliances. The tier 1 players are as follows:

#	Tier 1 company	Global Alliances
1	VA Tech Wabag	Wabag Germany
2	Degremont India	Joint venture with Degremont, France
3	Doshi Ion	Joint Venture with Veolia solutions , France
4	Driplex	Partnership with Best water Group Austria and Lanxess Germany
5	Ion Exchange India	Joint Venture with Waterleau, Belgium
6	Paramount	Pilkenwood Water, UK for oil water separation; Koch Glitch, UK for bio-tower plastic media
7	Thermax	Wehrie Unwelt Gmbh - Technology for treatment of hard to treat effluents; GE Water - Ultrafiltration & MBR technologies of India

In **East Africa**, the major players in the water sector for the bottom of the pyramid are non-profit organizations trying to improve the availability and accessibility of water across these water scarce countries.

Water at the BoP (India and East Africa) – Market Map

In the diagram below, you will find a mapping of companies competing to meet the water needs of the BoP in India and East Africa. The categorizations are subjectively based on business model, size and traction.

Ability to execute

Challengers

- Aqua-Aero Water Systems
- DelAgua
- Ecosoft
- Naandi
- NetWas
- Safe Water Now
- Sarvajal
- Spring Health
- Swades Foundation
- The Water Project
- Ugandan Village Project
- Voltas
- Waterlife

Leaders

- GE Water
- Global Water Initiative
- Grundfos
- Hindustan dorr-oliver limited
- Ion Exchange
- Just a Drop
- Living Water
- Metito
- NETFUND
- Rwandans4water
- SFC Environmental Technologies Private Limited
- Siemens
- VA Tech Wabag Ltd
- VC4A - Susteq
- Water Aid

Niche Players

- Aquasafi
- Aquastar Water System Technologies
- Charity: Water
- Drinkwell
- eHealthPoint
- Guardian MFI
- Koosongo
- Pota Vida
- Spouts of Water
- SweetSense
- Ugandan Water Project
- Water for People
- Waterlines
- Waves for Water Org
- WelloWater
- Wishing Well: Water for the World
- Waterhealth International

Visionaries

- Aqua Nirvana foundation
- Doshion
- I Thirst International
- Jibu
- NextDrop
- Ryan's Well
- Swajal
- Thermax India
- Water Org
- WSUP

Completeness of vision

Competitor Profiles

Niche Players

Overview[77]	AquaSafi was set up to provide underprivileged people in villages access to safe drinking water while opening up employment and micro-entrepreneurship avenues
Partnership	Biocon Foundation, MicroGraam, Milaap, Shree Kshetra Dharmasthala Rural Development Project
Products and solutions	Water purifying systems
Technology	RO technology
Strategy	Aquasafi is currently distributing its water purification systems to rural areas of India through an NGO partner who is covering the up-front capital cost of the equipment
Location	They have started their operations in several villages in Karnataka, India
Website	www.aquasafi.com

Overview[78]	Aqua Star Water Technology is based in Karnataka. They are involved in manufacturing and supplying various forms of water purification equipment and accessories
Partnership	NA
Products and solutions	RO & UV Water Purifier, Water Purifier, Water Dispenser, Water Softener, Water Purifier Installation Service
Location	They are currently based in Bangalore, India

Overview[79]	Charity water bring clean and safe drinking water to every person in the world
Partnership	NGOs and corporations - A Glimmer of Hope, Rest, Action against Hunger, BRAC, Clear Cambodia, Concern Worldwide, GOAL, Gram Vikas, Water for Good, Nepal Water for Health, Samaritan's Purse, Splash, Rescue, Water For People, World Vision
Products and solutions	Wells (hand-dug and drilled), rain water catchments, gravity fed systems, piped systems, water purification systems, bio sand filters, spring protections, latrines etc.
Technology	Sensors: along with Google.org developed a remote sensor technology that could tell whether water is flowing at any of the projects, at any given time, anywhere in the world
Funding/Financials	Invested over USD 28.7 mm to the field to fund over 3,900 clean water projects
Strategy	They currently operate 2,413 projects in East Africa providing clean and safe water to the communities
Website	www.charitywater.org

[77] http://www.aquasafi.com/
[78] http://www.indiamart.com/aquastarwatertechnology/about-us.html
[79] http://www.charitywater.org/projects/partners/

Overview[80]	Drinkwell transforms existing arsenic-affected tubewells, which are a source of stigma and hardship, into local profitable water enterprises. These enterprises deliver clean water by employing local villagers and build local markets that catalyze economic opportunity, ultimately allowing villagers to realize their full potential
Partnership	ACS, Action for India, AEESP, AIChE, ASCE, Clean Tech Open, and other NGOs
Products and solutions	Community-based wellhead arsenic removal units
Strategy	Micro-franchise model to establish local water businesses in arsenic-affected areas
Location	Focusing on villages in West-Bengal, India
Website	drinkwellsystems.com

Overview[81]	e-HealthPoint (eHP) delivers improved health and productivity to low income – rural and small town communities in India via clean drinking water facilities
Partnership	Calvert Foundation, Ashoka, athenahealth, USAID Grand Challenge Award
Products and solutions	Clean water, medicines, tele-medical consultations with licensed medical doctors and trained health workers
Technology	Reverse osmosis filtration systems
Strategy	Provide families in villages and smaller towns with clean drinking water, generic medicines, comprehensive diagnostic services, and advanced tele-medical services that "bring" a doctor and modern, evidence-based healthcare to their community
Location	Rural India
Website	ehealthpoint.com

Overview[82]	Guardian is an acronym of Gramalaya urban and rural development initiatives and network, a micro finance institution. Guardian provides access to household water and sanitation facilities through microcredit. They have provided loans worth USD 9.8mm till date
Partnership	Indian Overseas Bank, Water.org, Gramalaya NGO, Milaap, National Bank for Agriculture and Rural Development, Acumen
Products and solutions	Ecological wastewater treatment solutions; provide loans for the following products: new water connection, new toilet construction, renovations (water / toilet), rain water harvesting, water purifier, bio gas plant
Location	Operations in Kerala, India
Website	guardianmfi.org

[80] http://drinkwellsystems.com/#landing-page
[81] http://ehealthpoint.com/
[82] http://guardianmfi.org/index.php

Overview[83]	Koosongo is a social venture founded by the BARKA Foundation which produces and sells low-cost ceramic water filters in urban and rural markets in Burkina Faso
Partnership	Various NGOs, Koosongo Filter Ambassadors, retail stores in urban markets
Products and solutions	Ceramic water filters
Strategy	In the urban market, filters are sold and distributed through a network of pre-existing retail stores; in peri-urban and rural regions, a team of trained entrepreneurs will travel from village to village to educate on hygiene and the importance of clean drinking water while providing filter demonstrations and selling at a subsidized price
Location	Burkina Faso
Website	barkafoundation.org

Overview[84]	PotaVida aims at lowering the cost of providing safe water in disaster relief and development contexts, while automating recording of usage behavior to enable effective monitoring and evaluation
Products and solutions	The Smart Solar Purifier
Location	Uganda
Website	potavida.com

Overview[85]	Spouts of Water provides clean water to nearly 10 mm Ugandans by providing affordable filters
Partnership	McCloskey, Suffield Academy, Shell Energy, WT, HiVos, etc
Products and solutions	Filters to schools, community centers etc.
Strategy	Opened a new factory in Kajjansi, located in the southern region having close proximity to Kampala—the most populous city in Uganda
Location	Cover rural areas in Uganda
Website	www.spoutsofwater.org

[83] http://ehealthpoint.com/
[84] http://potavida.com/#techsum
[85] http://www.spoutsofwater.org/

Overview[86]	SweetSense provides low cost remote sensors
Partnership	NGOs and corporations - Portland State University, Living Water, UKaid, DelAgua, Vestergaard Frandsen, USAID, Berkeley Air Monitoring Group
Products and solutions	• SweetSense Water: SWEETSense WATER provides environmental water level and quality monitoring in domestic, industrial, outdoor, and remote environments • SweetSense Flow: SWEETSense FLOW provides water flow measurements non-intrusively through differential pressure across an orifice without reducing pressure head
Location	Developed to serve non-governmental organization (NGO) and government funded humanitarian aid agencies in 12 countries in the world, including India and countries in East Africa
Website	www.sweetsensors.com

Overview[87]	The Ugandan Water Project is a non-profit humanitarian organization working to provide clean, safe, accessible drinking water and other catalyst resources to communities in Uganda
Partnership	NGOs and corporations – Impactnations, I thirst, Pharaoh's Hairum Salon & Spa, Hackers for Charity, HumanKind, Sawyer International, Wine to Water, Web Instinct, Woo Themes, etc
Products and solutions	Rainwater collection systems, borehole rehabilitation and sawyer point one filters
Website	ugandanwaterproject.com

Overview[88]	Water for people provides all people with safe, continuous water
Partnership	Government, NGOs and Corporations: Challenge 21, Earthprotect, CloverbyClover, 3For5, Mile High Organics, Drenched 5K
Products and solutions	Water and sanitation facilities
Technology	AKVO FLOW
Location	Rwanda, Uganda, and India following a targeted approach towards efficient development
Website	www.waterforpeople.org

[86] http://www.sweetsensors.com/
[87] http://ugandanwaterproject.com/who-we-are/partners/
[88] http://www.waterforpeople.org/

Overview[89]	Waterlines' purpose is to aid other organizations in providing clean drinking water and adequate sanitation to rural communities in developing countries
Partnership	NGOs and corporations
Products and solutions	Waterlines works primarily with gravity-flow water systems, rainwater-catchment tanks, and spring protection improvements. In some school projects, Waterlines also sponsors the construction of latrines and establishes a complete educational program
Funding/Financials	• Drinking-water projects range from USD 3,000 to USD 15,000 • A typical rainwater-catchment tank for a primary school in Kenya costs USD 3,000
Location	Kenya, India
Website	waterlines.org

Overview[90]	Waves for Water provides access to clean drinking water filters
Products and solutions	Water filters: • Renegade Filter - The Renegade Filter is the lightest and most versatile filtration system. It weighs 3 ounces, rolls up, and takes up virtually no space in your pack • Faucet Adapter: They attach to the MVP filter and the other end to most faucets. This eliminates the need for a bucket. Kit includes faucet adapter only • MVP Filter: The MVP Filtration system is the fastest, easiest and most cost efficient way to get pure potable water to communities in need
Location	East Africa and few regions of India
Website	www.wavesforwater.org

Overview[91]	Design and deliver affordable innovations and increase opportunities for people who lack access to water
Partnership	Government, aid agencies, NGOs, corporate social responsibility initiatives, micro finance initiatives, social enterprises
Products and solutions	Waterwheel, rolling billboards
Location	Rural areas in India
Website	wellowater.org

[89] http://waterlines.org/
[90] http://www.wavesforwater.org/
[91] http://wellowater.org/about_us.html

Overview[92]	Wishing Well: Water for the World empowers communities to transform their world by bringing clean water to those in need
Partnership	NGOs and corporations; Living Water International
Products and solutions	Boreholes, captured springs, well rehabilitations, bio-sand filters and more
Location	Conduct health and hygiene as well as water treatment training in Rwanda
Website	www.wishforwater.com

Overview[93]	WaterHealth centers deliver a scalable and sustainable solution to purify any source of water to WHO- quality drinking water standards
Partnership	Coca-Cola Company, International Finance Corporation, A. K. Khan Group, Diageo
Products and solutions	WaterHealth develops and runs de-centralized WaterHealth Centers
Technology	Reverse Osmosis (RO) technology and UV filtration
Location	Rural areas in India
Website	www.waterhealth.com

Visionaries

Overview[94]	Aqua Nirvana foundation gives access to safe, clean water by investing in technologies that are fully sustainable in the long-term future
Partnership	Basecamp Foundation, Wetsus
Products and solutions	Water purification system, clean water storage tanks, water towers, plumbing, solar panels, solar driven pump, purification systems, etc.
Funding/Financials	Funding is provided through a long established family trust managed by Sabaro Investment Limited
Website	aquanirvanafoundation.com

[92] http://www.wishforwater.com/our-story/2fwuh6x30gx92rkxzintbi002j7gpt
[93] http://www.waterhealth.com/
[94] http://aquanirvanafoundation.com/

Overview[95]	Doshion combines systematically innovative technologies with economic products. Deliver cost effective, reliable, industrial pure water solution to customer
Partnership	Pacific Pipes
Products and solutions	• Water transmission mains • Sewage collection & transmission networks • Development of intake facilities • Plant water supply mains and municipal networks • Metering solutions, booster stations and hydraulic distribution
Location	India – Ahmedabad, Mumbai, Kolkata, Chennai, Hyderabad, Bhopal, New Delhi
Website	www.doshion.com

Overview[96]	I Thirst International aims to provide clean water through water filtration, pump repair, and well drilling.
Partnership	NA
Products and solutions	Sawyer Point ZeroTwo Water Purification Kit, Sawyer 3 Way Water Filter, Sawyer Mini Water Filtration System, etc
Technology	Sawyer's Hollow Fiber Membrane filters
Location	Uganda – Kalonga (current project); Kenya – Nairobi (current project)
Website	www.ithirstinternational.org

Overview[97]	Jibu equips African entrepreneurs to launch drinking water franchises. Provide seed-financing for business-in-a-box franchises designed to make drinking water affordable and convenient for the under-served
Partnership	EY, GSBI, Healing Waters, IFA, dloHaitiA4ID, etc
Products and solutions	Jibu equips local co-invested African entrepreneurs to launch high-visibility storefronts having leading-edge water filtration equipment, functional and returnable bottles
Technology	Solar-powered ultra-filtration
Strategy	Creating franchisees and empowering local entrepreneurs
Location	Operate in rural areas of Rwanda and Uganda
Website	www.jibuco.com

[95] http://www.doshion.com/pages/
[96] http://ithirstinternational.org/
[97] http://jibuco.com/jibus-solution/

Overview[98]	NextDrop uses real-time data to inform subscribers about when they're receiving water, when there's a delay, when pipe damage is likely to affect them, and when someone in the community has water updates to share. A company can use NextDrop data to send water to families that aren't receiving water on a particular day.
Products and solutions	Leverage mobile technology to gain unprecedented visibility into distribution systems and resource efficiency
Strategy	Strategy revolves around creating sticky customers who rely on unique Next Drop data to make their water purchasing or allocation decisions.
Location	Southern parts of India
Website	nextdrop.org

Overview[99]	The Ryan's Well Foundation is a Canadian charitable organization providing sustainable solutions to the water crisis in the poorest regions of the worlds' developing countries. They focus on building clean drinking water sources
Partnership	Orezone, KW Cares, Uganda Aromo Sub-county Water and Sanitation and Project, EnvisionUP, Design Choice, Banfield Seguin Ltd, impossible2Possible(i2P)
Products and solutions	Some of the active projects they are working on are water for ashanti, training for schools, wells for villages and primary school
Location	Ryan's Well has supported projects in 16 countries across the globe
Website	www.ryanswell.ca

Overview[100]	Swajal is trying to provide affordable, intelligent and energy smart water purification solutions for communities
Partnership	UNDP, REEEP, Saurya and Goldman Sachs
Products and solutions	Solar pumps
Technology	They provide high energy efficient, weather proof, remote management, high quality solar panels
Location	Rural India
Website	swajal.in

[98] http://nextdrop.org/#
[99] https://www.ryanswell.ca/
[100] http://swajal.in/

Overview[101]	Provides end-to-end solutions in water treatment, wastewater treatment, effluent recycle and zero liquid discharge solutions to global customers, consultants and OEMs
Partnership	Delhi Metro (along the 144 km stretch of the Delhi metro line, Thermax service 33 stations for water and sewage treatment); Naandi Foundation (distribution of customized RO units to rural villages)
Products and solutions	Cost effective raw water treatment solutions, filtration, sea-water desalination, nano filtration, ultra filtration, reverse osmosis, effluent treatment solutions for industrial waste water, sewage treatment and recycling
Technology	Compact and modular RO blocks, Tulsion resins with high resistance to mechanical shock, demineralization plant, Klarimax (used for raw water clarification), Ultrapure water systems
Location	Provide water management solutions to a wide region in India
Website	www.thermaxglobal.com

Overview[102]	Water.org provides innovative, market-based solutions that change lives every day through safe water and sanitation
Partnership	NGOs and Corporations - PepsiCo Foundation, Charitable Foundation, Swiss Re Foundation, Stella Artois, Helmsley Charitable trust, Bank of America, Conrad N. Hilton Foundation, etc
Products and solutions	Wells and Water Credit Initiative
Technology	WaterCredit puts microfinance tools to work in the WASH sector
Funding/Financials	• WaterCredit loans made: 573,067 • Water.org has invested: USD 11.3 mm in WaterCredit • WaterCredit has leveraged: an additional USD 120 mm in commercial and social capital • People benefited directly from WaterCredit: 2.4 mm • WaterCredit partners: 53 active partners • WaterCredit countries: 9 – Bangladesh, Cambodia, Ghana, India, Indonesia, Kenya, Peru, Philippines and Uganda
Strategy	• Identifying and prioritizing new markets and models for WaterCredit expansion, including new products and channels for deployment • Consulting with socially-motivated and blended-value investors in search of bankable deals • Engaging civic organizations, such as local governments and water utilities, to foster the growth of civic, grassroots and public sector capital in watsan solutions and systems over the long-term • Refraining from making investments that distort credit and environmental services markets • Playing an active role to improve knowledge and foster best practices within the watsan and microfinance sectors, recognizing the value of exchanges and partnerships
Location	Kenya - Kisumu region; Uganda - Kampala; India - Andhrah Pradesh, Karnataka, Madhya Pradesh, Orissa, and Tamil Nadu
Website	water.org

[101] http://www.thermaxglobal.com/
[102] http://water.org/

Overview[103]	WSUP focus on developing commercially viable models to help water utilities and municipal authorities reach citizens in their city with improved water and sanitation. Aim to provide sustainable water and sanitation services and promote good hygiene
Partnership	Care, Halcrow, borealis, Unilever, Water Aid, Thames Water, Vitens Evides
Products and solutions	Ecological wastewater treatment solutions, development of a national Integrated Urban Sanitation and Hygiene Strategy and Strategic Action Plan, assessment of water and environmental sanitation needs, etc
Location	Nairobi, Naivasha, Nakuru, Mombasa
Website	www.wsup.com

Challengers

Overview[104]	Aqua-Aero Watersystems BV delivers unique, sustainable solutions for water and sanitation
Partnership	Cordaid, Caritas, Rain, Aqua for all, Hofstad Lyceum, etc
Products and solutions	Fresh water purification system, rainwater harvesting, saline water purification
Technology	UV WaterBox system, WaterPyramid, foil sheet plastic tank
Location	A Dutch company whose operations in India are limited to small villages of Gujarat, India
Website	www.aaws.nl

Overview[105]	DelAgua supplies NGOs, Governments and companies with testing solutions, lab equipment and other products
Partnership	Republic of Rwanda Ministry of Health, Vestergaard Frandsen, Ecozoom, Paddy's Bathroom, number of additional research and project partners
Products and solutions	DelAgua water testing kits, product catalog with almost 3,500 additional products and kits on sale
Location	Rwanda
Website	www.delagua.org

[103] http://www.wsup.com/programme/about/
[104] http://www.aaws.nl/
[105] http://www.delagua.org/

Overview[106]	Decentralized management of water, wastewater and environmental services
Partnership	Gram Vikas, Sulabh International, eKutir, World Toilet Organization, XentiQ, Environmental & Water Technology Centre of Innovation, University of Chile
Products and solutions	Water conservation devices, electronic control devices, water smart homes, rainwater harvesting systems, extraction & distribution systems, wastewater and grey water recycling and reuse systems
Technology	Aerobic biofilter without sludge (ABWS), air intermittent recirculating reactor (AIRR), airlift circulating floating-carrier bed (Poseidon), electronic water management console
Location	Large areas in India
Website	ecosoftt.org

Overview[107]	Working with village bodies and the community to give them cleaned drinking water at a nominal user fee (between 10 to 20 paise per litre) became the design for a safe drinking water delivery model that is today being followed by a wave of small and micro entrepreneurs across the country as their own social business.
Partnership	Government, danone communities
Products and solutions	Deliver efficient water purification and delivery services for the poorest class to use
Location	More than 400 water purification centres operating across Punjab, Haryana, Rajasthan, Andhra Pradesh and Karnataka
Website	www.naandi.org/naandi-community-water-services-ltd

Overview[108]	Network for Water and Sanitation (NETWAS Uganda) is a local non- profit making organization that provides water supply, sanitation and hygiene (WASH) sector
Partnership	NGOs and Corporations – IRC, SIMAVI, SEI, DANIDA, EcosanRes, CERFORD, YSP, CIDI, KWDT, Triple-S, Water Aid Uganda etc
Products and solutions	1 stop center for WASH information; research in water, sanitation and hygiene
Location	Urban slums of Kenya and Uganda
Website	www.netwas.org

[106] http://ecosoftt.org/soul/
[107] http://www.naandi.org/about-naandi/
[108] http://www.netwas.org/

Overview[109]	Safe Water Now's strategy is to cultivate local, sustainable enterprises that deliver high quality, fairly-priced, and reasonably available household or community-level water treatment
Partnership	NGOs and corporations – partnership with local organizations to create local businesses and jobs in manufacturing, sales, education, and transportation to serve the need for safe drinking water in the community – Dauhaus, Suidar Solutions, PWG Paulway Group, Flambeau Valley Software, DeJong Family Foundation, Katica Law Group LLC and CFCI
Products and solutions	Ceramic water filter
Strategy	• Implement local and sustainable enterprises to manufacture and distribute water treatment alternatives that are microbiologically effective and affordable, transferring the expertise and providing employment to the local project team • Work in developing countries using established best business, administrative, and manufacturing practices to identify, evaluate and implement safe water programs • Expand the global footprint and influence of SAFE Water Now to spread viable water treatment solutions to all parts of the globe which have a need for safe and affordable drinking water
Location	Poverty stricken communities in Tanzania
Website	www.safewaternow.org

Overview[110]	Sarvajal creates affordable access to safe drinking water for the under-served at the last mile, accomplished through a wide network of decentralized safe drinking water treatment and distribution technologies
Partnership	Local entrepreneurs, government agencies, philanthropic organizations, private companies
Products and solutions	Water ATM and Soochak
Technology	**Soochak**: Cloud-based remote monitoring systems combined with reverse osmosis and ultrafiltration units; give real-time intelligence, quality management, and reduced operational cost
Location	Rural areas in India
Website	www.sarvajal.com

Overview[111]	Spring Health builds radically decentralised model that partners kirana shops in small villages in Eastern India to treat and sell water with an enterprise model that is affordable and scalable
Partnership	Windhorse International Inc., Antenna Foundation, Idiom Design and Consulting Ltd
Products and solutions	Water tanks
Location	Currently work in Khurda, Jajpur, Puri and Dhenkanal districts covering 200 villages
Website	www.springhealth.co.in

[109] http://www.safewaternow.org/?page_id=45
[110] http://www.sarvajal.com/#
[111] http://www.springhealth.co.in/index.php/water

Overview[112]	The core objective of the Swades Foundation water and sanitation initiative is to ensure safe drinking water as per accepted health standards and create 100% open-defecation free communities
Partnership	NGOs and corporations
Products and solutions	Water structures (water harvesting structures, wells, check dams, Kolhapuri type weirs, underground bunds) and sanitation
Location	India – Raigad, Ratnagiri
Website	www.swadesfoundation.org

Overview[113]	The Water Project has helped communities gain access to clean, safe water by providing training, expertise and financial support for water project construction through its staff and implementing partners
Partnership	NGOs and corporations - African Sand Dam Foundation (ASDF), The Bridge Water Project, The Water Trust, Mariatu's Hope, Living Water International, Pamoja Trust, WeWaSaFo
Products and solutions	Drilled wells, sand dam, rainwater catchment, hygiene and sanitation and spring protection
Location	Kenya and Uganda
Website	thewaterproject.org

Overview[114]	The Uganda Village Project (UVP) facilitates community health and well-being in rural Uganda through improved access, education, and prevention
Partnership	NGOs and corporations – Marie Stopes, Global Health Council, See Your Impact, Fistula Foundation, ICODEI and GHEI
Products and solutions	Healthy Villages – provide rural health care and promote public health on a village level;
Funding/Financials	In 2014, 9 Shallow wells installed providing safe water to 540 total households and 186 new latrines built
Location	Iganga District, Uganda
Website	www.ugandavillageproject.org

[112] http://www.swadesfoundation.org/ourwork.htm
[113] http://thewaterproject.org/partnership
[114] http://www.ugandavillageproject.org/

Overview[115]	Voltas offers appropriate engineering solutions in the form of products, projects and services. Its vision is to drive value through smart engineering
Partnership	Terrot GmbH, it also has joint ventures with many companies in UAE
Products and solutions	Number of industrial products for various solutions for water and wastewater management/treatment
Location	India – Maharashtra (Mumbai – Corporate office). Has contracts and agreements with a lot of major companies in India
Website	www.voltas.com

Overview[116]	Waterlife's primary work is in installing, operating and maintaining Community Water Systems. Waterlife takes care of Operation and Maintenance of these plants for 10-15 years. To maintain the plant, Waterlife charges a user fee which makes it economically sustainable (INR 2-7 per 20 Litre jar/3-12 cents per 5.3 gallon jar). The Capex is paid by the respective state government, and the O&M contracts provide additional fees from government. The day to day opex is generally directly covered by the user fees.
Partnership	Matrix Partners, Aavishkaar, SEUF, SAFE
Products and solutions	Aquifer recharge, house hold system, community water harvesting, industrial water filtration system, reverse osmosis drinking water solutions
Technology	Waterlife provides solutions with specific emphasis on technologies that are green and environmentally sustainable, they also use moving bed biofilm reactor (MBBR) and reverse osmosis technology
Location	Waterlife has presence in 12 states with 4,000 outlets in villages, urban centres and corporates
Website	www.waterlifeindia.com

Leaders

Overview[117]	GE Power & Water enables customers to meet increasing water demands and population needs, overcome scarcity challenges, enhance their environmental stewardship and comply with regulatory requirements
Products and solutions	Dust control, hydrocarbon, wastewater treatment, reverse osmosis, sanitizers, boiler water treatment, filters and membranes, cooling water treatment etc.
Location	East Africa and India
Website	www.ge.com/in/water

[115] http://www.voltas.com/voltas_water/index.html
[116] http://www.waterlifeindia.com/cws.html
[117] http://www.gewater.com/product-directory.html?cid=ProductsNavBar

Overview[118]	Global Water Initiative in East Africa is focused on developing evidence that highlight solutions to the challenges of water management. They seeks to achieve three main strategic outcomes which are greater political attention to water problems, increased investment and greater food security
Partnership	CARE, Catholic Relief Services (CRS), The International Union for the Conservation of Nature (IUCN), The International Institute for Environment and Development (IIED)
Products and solutions	GWI EA is an action research, advocacy and policy influencing program that seeks to use evidence to support greater investment in water for smallholder agriculture in East Africa
Technology	Water point mapping
Location	Kampala, Addis Ababa, Dar es-Salaam, Gulu
Website	globalwaterinitiative.org

Overview[119]	Grundfos delivers water solutions for water utility applications, water treatment solutions for each stage of the entire water treatment cycle, and water supply solutions for the developing world
Products and solutions	• AQtap: Grundfos AQtap is an intelligent water dispenser that addresses some of the main challenges of providing reliable and sustainable water supply in the developing world • SQFlex: The pump system offers a water supply solution in remote areas where water is scarce and the power supply is non-existent or unreliable • SP: Grundfos SP pumps represent state-of-the-art hydraulic design. Built to deliver optimum efficiency during periods of high demand, the SP pumps provide low long-term costs and high operating reliability • Grundfos Remote Management: Grundfos Remote Management is a secure, internet-based system for monitoring and managing pump installations in commercial buildings, supply networks, wastewater plants, etc • Water Kiosk: The dispenser unit can be connected to the public water network, for a single water kiosk or a complete grid of grouped water kiosks. This is the cost-efficient solution for improving and expanding water supply services in urban and peri-urban areas. All water kiosks are easily monitored via the online water management system. Furthermore, the water price of connected dispensers can be managed centrally from the water management system, or locally on the dispenser with a Service Card
Location	East Africa and India
Website	in.grundfos.com

[118] http://www.gwieastafrica.org/
[119] https://www.grundfos.com/market-areas/water/lifelink.html

Overview[120]	HDO are involved in major industrial projects in areas of Mining and Minerals, Water and Wastewater, Fertilizers and Chemicals and Pulp and Paper. Water management and effluent treatment for all major refineries in India. HDO Technologies, provide complete range of engineering services
Partnership	GE Infra, Canada, Aquatech, USA, SFC, Austria, Dewa, Finland
Products and solutions	Drinking water treatment plants, industrial process water treatment plants, recycle technologies such as reverse osmosis, domestic sewage treatment plants, industrial effluent plants for all industries, desalination plants, rotary drum filters, disc filters, press drum belt filters, raw water filter (skid mounted system), water turbines
Location	India – Mumbai, Ahmedabad, Kolkata, Chennai, Bengaluru
Website	www.hdo.in/main

Overview[121]	Provide water treatment, liquid waste treatment, recycle and solid waste management solutions
Partnership	Waterleau, Belgium
Products and solutions	Waste water treatment and recycling plants using various physico-chemical processes for settling, clarification, filtration, disinfection, membranes and ion exchange technology, ion exchange resins; polymers and p polyelectrolyte's for water and non-water processes; boiler cooling water and fireside treatment chemicals
Location	India – Maharashtra, Mumbai; works in most major cities of India
Website	www.ionindia.com

Overview[122]	Support communities through the construction of wells, boreholes, pipelines, hand pumps and latrines and establish health and sanitation programmes for some of the poorest and remotest regions in the world
Partnership	A number of businesses from within and outside of the travel industry have supported the charity's work by becoming a Premier Partner, Corporate Partner or Corporate Sponsor
Products and solutions	Borehole wells, hand dug wells, gravity water systems, spring sources, hand pumps, rainwater harvesting, water storage tanks, sand dams
Location	Eastern regions of India; Tanzania, Uganda, Kenya – urban slums and rural regions
Website	www.justadrop.org

[120] http://www.hdo.in/aboutus/introduction.html
[121] http://www.ionindia.com/
[122] http://www.justadrop.org/our-work/asia/india/rural-water-sanitation-awareness-training/

Overview[123]	Living Water International helps communities create sustainable water, sanitation and hygiene
Partnership	NGOs and corporations - Alex and Ani, Advent Conspiracy, BGR, Bear Creek Water, Conrad N. Hilton Foundation, Calvert Foundation, Caris Foundation, Drop in the Bucket etc
Location	A total of 15,451 projects to date rural regions of both India and East Africa
Website	www.water.cc

Overview[124]	Metito is a provider of choice for total intelligent water management solutions in the emerging markets with operations covering three business areas: design and build, chemicals, and utilities
Partnership	PPP - The Water and Sanitation Corporation (WASAC), Rwanda Development Board (RDB) and Ministry of Infrastructure (MININFRA) with Kigali Water Limited, a Rwandan-registered company wholly-owned by Metito
Products and solutions	Membrane separation (RO/ MF/ UF/ NF), low temperature distillation (LTDis), ion exchange (two bed and single bed), electro-deionisation (EDI), membrane bioreactor (MBR), sequencing batch reactor (SBR), moving bed biofilm reactor (MBBR), Turbo4Bio© bioreactor, activated sludge wastewater treatment, chlorination / ozonation / ultra-violet (UV) disinfection
Funding/Financials	Metito has signed a concession agreement for a public private partnership worth USD 75 mm with the government of Rwanda to develop a new, sustainable bulk water supply plant to meet 40% of the potable water needs of Kigali, the capital city
Location	They have completed approximately 200 successful projects to date building innovative designs for water management solutions
Website	www.metito.com

Overview[125]	National Environment Trust Fund (NETFUND) is a government organization established under the EMCA 1999 by the Ministry of Environment and Natural Resources
Partnership	Government of Kenya, Embassy of Sweden, Kenya Climate Innovation Center, Green Africa Foundation, The Jomo Kenyatta Foundation, United Nations Industrial Development Organization (UNIDO), World Wide Fund for Nature (WWF), etc
Location	Kenya
Website	www.netfund.go.ke

[123] http://www.water.cc/partnerships
[124] http://www.metito.com/who-we-are/
[125] http://www.netfund.go.ke/

Overview[126]	An NGO whose team coordinates a wide range of activities such as hosting advocacy events, drilling water wells, training the local people, and developing affordable technologies that benefit vulnerable areas in Rwanda
Partnership	NGOs, government and corporations – Oklahoma Christian University, Wishing Well, Waterfull, Drilling for Hope, Co2 Balance, Rwanda Ministry of Infrastructure, ROC partners, WHOlives.org
Products and solutions	• Gatsibo water campaign – initiative to build/ rehabilitate 100 water wells in Gatsibo District, Eastern province • Carbon reduction project – partnership with UK based CO2 BALANCE to rehabilitate broken boreholes in Gatsibo District • Water For All (WFA) is a project undertaken to provide clean water to over 150 remote rural communities
Strategy	Assist the Government of Rwanda: The Government of Rwanda is aiming at bringing safe water and sanitation to all Rwandans by 2018. Both the EDPRS 2 and Vision 2020 plans highlight the goal
Location	Gatsibo District (Rwanda) is their current major ongoing project
Website	www.rwandans4water.org

Overview[127]	SFC is a global water and wastewater company
Products and solutions	Design water treatment plant, SFC supplies Cyclic Activated Sludge Technology (C-Tech), an advanced sequential batch reactor technology. This technology is extensively used for treating domestic sewage and industrial effluents. It also supplies other technology such as C-MEM, C-FLOC, C-FLIT, etc
Technology	C-MEM (Submerged hollow fibre micro-/ultra-filtration technology for elimination of suspended solids), C-FLOC (High rate contact flocculation and sedimentation for surface water treatment and precipitation algae, bacteria, virus and flocculation products), C-FILT Gravity fed continuous backwashed filtration in steel vessels for any kind of water filtration), C-RO (Reverse osmosis technology for TDS removal, seawater desalination and waste water recycling)
Location	India – Maharashtra, Navi Mumbai
Website	www.ctechsbr.com

[126] http://www.rwandans4water.org/our-partners/
[127] http://www.ctechsbr.com/home.php

Overview[128]	Siemens offers high-tech water treatment systems for agricultural and industrial applications and drinking water. Focus includes drinking water, industrial water, waste water and water transport, to water treatment, plant automation, electrical systems, to building technology and requisite services (including financing, design and planning, commissioning, maintenance and emergency support), to modernization
Partnership	Governments, business institutions and local communities
Products and solutions	Waste water treatment (aeration, biological treatment, anaerobic treatment, wastewater clarification, digestion separation, chemical feed system, disinfection residuals management, reuse and recycling), drinking water treatment (desalination, conventional water, filtration, membrane filtration, clarification, UV disinfection), energy and automation in water systems (physical treatment, biological treatment, disinfection systems)
Technology	Chemical feed and disinfection systems, reuse and recycling system, odor control systems and controls, high-purity water technology for pharmaceutical and solar cells, intercom and radio systems, fire-alarm systems
Location	India – Maharashtra; other major Indian cities
Website	www.siemens.com/entry/in/en

Overview[129]	WABAG designs, completes and operates drinking water and wastewater plants for both the municipal and industrial sectors
Partnership	NGOs, government and corporations
Products and solutions	Drinking water treatment, industrial water treatment, desalination, water reuse, municipal wastewater treatment, industrial wastewater treatment etc.
Technology	Activated sludge process, advanced oxidation, an-OPUR, nitrate removal, Biofiltration, sludge disintegration, electrodialytical nitrate removal
Location	India - Chennai, Kolkata, New Delhi, Pune, Vdodara
Website	www.wabag.com

[128] http://www.siemens.co.in/en/about_us/index/our_business_segments/industry/industrial_solutions_services/water_technologies.htm

[129] http://www.wabag.com/

Overview[130]	Susteq provides reliable water access via micro-payments to people without fixed connection in their homes; also helps organizations with installation of prepaid water meters in rural and urban communities. Because people in these communities pay a small amount for water access, their water points can be maintained sustainably
Partnership	HDIF, akvo.org, aqua for all, SNV, ICS, schoeller water
Products and solutions	• Susteq|Hub is the payment module. It supports one to three water taps. End users need a RFID tag to get prepaid water access. • Susteq|Base is the payment system for the local entrepreneur. This enables the sales of prepaid credits on the end users RFID tags. • Susteq|Front is the on-line management tool for a kiosk operator to (1) follow how much water is tapped from water points, (2) Monitor your water points and check if they needs maintenance, and (3) monitor the number of people using water points every day
Location	Currently supplying hundreds of BoP-users in Kenya
Website	www.susteq.nl

Overview[131]	Helps communities to set up and manage practical and sustainable water, sanitation and hygiene projects. WaterAid also campaigns locally and internationally to change policy and practice to ensure water and sanitation's vital role in reducing poverty is recognized
Partnership	Governmental organizations, civil society groups, government agencies, academic institutions, private companies, journalist networks and many more
Location	India - Jharkhand, Orissa, Bihar, Uttar Pradesh, Chhattisgarh, Madhya Pradesh, Andhra Pradesh, Karnataka, Tamil Nadu and Delhi; Rwanda, Tanzania, Uganda, Kenya
Website	www.wateraid.org

[130] https://vc4africa.biz/ventures/susteq/
[131] http://www.wateraid.org/what-we-do

Impact Investing and Funding

According to Citigroup, the global drinking and waste water business is worth approximately USD 450 bn and is growing at an annual rate of 6%. The assets of investment funds with a focus on water nearly doubled between 2010 and 2011 alone, from just over USD 12 bn to nearly USD 24 bn. It is projected AUM will reach USD 50 bn by the end of 2015.

India

India's water sector is awash with private equity flows poised to increase in the coming years. Players eyeing India's water sector are aplenty making it a marketer's delight viz. Organica Water, which is providing treatment and recycling of wastewater, the International Finance Corporation and WLR China Energy Infrastructure Fund, RNK Capital and Gamma Capital Partners, to name a few.[132] The Indian water sector could require investment of around USD 130 bn between 2011 and 2030. Wastewater management, in particular, is emerging as a key thrust area. Currently, only 60% of industrial and 26% of domestic wastewater is treated in India. Metros and large cities are treating only about 30% while smaller cities treat a minuscule 3.7% of their wastewater.[133]

Indian water and wastewater companies are receiving a lot of interest from private equity funds and venture capitalists. Impact investment in India totaled close to INR 550 crores in 2012 and is expected to grow at 30% per year.

See below for a few recent examples of closed rounds of funding for water businesses serving the BoP:

- In August 2015, Swajal Water raised $1.2 million (Rs 7.5 crore) in a Series A round of funding. Swajal will use the funding for innovation in energy efficient and low cost community based water purification systems.
- Since 2011, SpringHealth has received over $130,000 in funding from Acumen alone
- Singapore-based CLSA Capital Partners invested USD 9.2 mm in Gurgaon-based Luminous Water Technologies in July 2013, through its two funds. In 2012, the alternative asset management firm had invested USD 15 mm in Delhi-based Earth Water Group, which invests into water and wastewater treatment projects[134]
- In 2011, The Capital Group, one of the leading global privately-owned investment management companies, acquired about a 10% equity stake in India's leading engineering services company VA Tech Wabag that focuses on water and wastewater treatment
- Saisudhir Infrastructures raised over USD 23 mm in its second round of funding from US-based Global Environment Fund (GEF). The funds were used to enhance the company's focus on the water and water treatment sectors
- Aditya Birla Capital Advisors (ABCAP) invested about USD 9 mm in New Delhi-based water and wastewater treatment company SMS Paryavaran Ltd[135]

East Africa

Impact investing activity has grown strongly throughout East Africa over the past five years. Among a handful of other industries, water remains one of the key focus areas that incoming investors are exploring.

More than USD 9.3 bn has been disbursed in the region in more than 1,000 direct deals by development finance institutions (DFIs) and other impact investors active in East Africa today.

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[132] http://nexusnovus.com/water-hot-investment-india
[133] http://www.businesstoday.in/magazine/features/water-treatment-business-in-india/story/200284.html
[134] http://www.the businessline.com/companies/private-equity-flows-into-water-sector-may-top-rs-7500-cr-in-2-years/article5042317.ece
[135] http://www.indiawaterportal.org/news/private-equity-interest-robust-indian-water-industry

In total, over 150 impact investors currently manage 203 active investment vehicles in the region, and many more are considering the region for future commitments.

Kenya, and its capital city Nairobi, is the regional hub of East African impact investing. At least 48 impact fund managers have staff placed in Nairobi, which is more than three times as many local offices as in any other country in the region. Almost half of the USD 9.3 bn in impact capital disbursed in East Africa has been in Kenya — more than triple the amount deployed in each of Uganda and Tanzania, the countries with the next highest amounts at around 13% and 12% respectively.

Despite having the largest economy in the region (in PPP terms), Ethiopia has received only around 7% of disbursements to date. Rwanda, with an economy just one-eighth the size of Ethiopia's, has received half as much impact capital, or 4% of all disbursements in the region.[136]

Conclusion

While the United Nations Millennium Development Goals and subsequently Sustainable Development Goals have helped garner international attention for the issue of safe water access and distribution, and while the world has seen significant progress towards achieving those goals, there is a lot left to accomplish.

At the BoP in India and East Africa, the challenge is not exclusively one of availability of water resources (alluded to earlier in the report as physical water scarcity). Rather, in both regions, the bigger hindrance to safe water distribution is the economic capacity of the regions to support the infrastructure required. Given the difficulty of establishing that infrastructure alone, national governments in both regions have encouraged private sector involvement. Social enterprises, and subsequently private equity, venture capital, and impact investment funds have risen to that challenge and have the opportunity now to sustainably solve one of the world's most challenging issues and roadblocks to enabling broader economic development. The right technologies are available at the right cost. The solution now will be one of enabling the business models with sustainable distribution potential and supporting broader economic growth to make these business models affordable to BoP communities. Easier said than done.

[136] http://www.thegiin.org/binary-data/ExecutiveSummary_GIIN_eastafrica.pdf

Fluoride Addendum

Fluoride, a naturally occurring mineral, is found in most water sources around the world, rivers, lakes, wells and oceans. When consumed at appropriate levels fluoride can benefit both children and adults by strengthening tooth enamel and thereby preventing tooth decay. Because of the important role it has played in the reduction of tooth decay in the United States, the Centers for Disease Control and Prevention has proclaimed community water fluoridation one of ten great public health achievements of the 20th century.[137] Notably, the U.S. is the only developed nation to fluoridate its public water sources. When ingested at higher levels of concentration, fluoride can be particularly dangerous. The most recognizable forms of fluoride poisoning are dental and skeletal fluorosis. Dental fluorosis is a condition in which the tooth enamel is damaged and fails to crystallize properly, which can lead to staining and pitting of the teeth. Teeth can appear brown and corroded. In more extreme cases, when high levels of fluoride are ingested over a long time, skeletal fluorosis can occur. In skeletal fluorosis, fluoride accumulates in the bone progressively over many years. The early symptoms of skeletal fluorosis include stiffness and pain in the joints. In severe cases, the bone structure may change and ligaments may calcify, with resulting impairment of muscles and pain.[138]

Waters with high levels of fluoride content are mostly found at the foot of high mountains and in areas where the sea has made geological deposits. There are known fluoride belts in both India and East Africa, as well as many other regions in Africa, the Middle East, Asia and the Americas. The World Health Organization safe-guideline amount for fluoride is 1.5 mg/L, with a target of between 0.8 and 1.2 mg/L to maximize benefits and minimize harmful effects. Fluoride levels in the body can be dependent on climate and in-take of the chemical from drinking water and other sources, the WHO says. The WHO also advises that fluoride levels above 1.5 mg/L are more likely to cause pitting of tooth enamel and deposits in bones. Levels above 10 mg/L cause the crippling skeletal fluorosis.[139]

India

The maximum government-permissible level of fluoride in drinking water in India is 1.2 mg/L. In order to reduce the high fluoride levels from industrial waste and mineral deposits in a number of areas throughout the country, the Indian government has installed removal plants of various technologies. Reverse osmosis plants are widely used. As of 2014, there are 14,132 habitations in 19 states which still contain above permissible-levels of fluoride in drinking water. Rajasthan has the highest number of habitations (7,670) with excessively high levels of fluoride in available drinking water. Telangana has 1,174, Karnataka has 1,122 and Madhya Pradesh has 1,055 habitations. Assam, Andhra Pradesh, Bihar, Chhattisgarh, Maharashtra, Odisha, West Bengal and Uttar Pradesh also have habitations containing high fluoride levels.[140]

The government of India launched the National Programme for Prevention and Control of Fluorosis in 2008-09. In 2013-14, the programme was brought under the National Rural Health Mission, which has so far covered 111 districts. The programme includes surveillance of fluorosis in the community, training and manpower support, establishment of diagnostic facilities, treatment and health education.

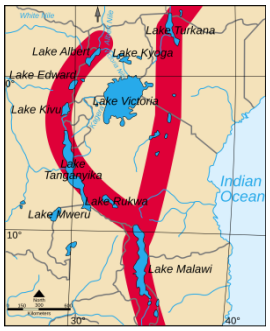
State governments also play a significant role in de-fluoridation of water sources. In 2014, the state government of Rajasthan planned to set up 1,000 reverse osmosis plants under a scheme to provide clean drinking water to the rural areas of the state.[141]

East Africa

One of the regions of the world most affected by fluoride is located in the East African Rift Valley through Kenya, Tanzania and Uganda among other countries. These naturally-created veins of fluoride are associated with historical volcanic activity. A survey completed in 1982 tested groundwater samples throughout Nairobi, the Rift Valley, and the

[137] http://www.mouthhealthy.org/en/az-topics/f/fluoride
[138] http://www.who.int/water_sanitation_health/diseases/fluorosis/en/
[139] http://m.thehindu.com/sci-tech/health/policy-and-issues/huge-population-at-fluorosis-risk/article6733103.ece/
[140] http://m.thehindu.com/sci-tech/health/policy-and-issues/huge-population-at-fluorosis-risk/article6733103.ece/
[141] http://www.business-standard.com/article/news-ians/ro-water-for-rajasthan-villages-114040401124_1.html

Central Province in Kenya. Fluoride levels were high in these regions, with maximum concentrations reaching between 30 to 50 mg/L, far above levels that can cause skeletal fluorosis if ingested over the long-term. On average, over half of tested sites within these areas reached fluoride levels from 1.1 to 8.1 mg/L.[142]



The lakes and groundwater through the East African Rift Valley contain extremely high levels of fluoride.

Unfortunately, while government and non-governmental organizations are the largest suppliers of drinking water in both urban and rural areas throughout East Africa, they are only able to effectively remove excess chlorine. This means that families and local communities often take the responsibility of ensuring that the water they consume is at appropriate fluoride levels.

"It is very expensive to run an industrial defluoridation plant," explains the managing director of Naivasha Water, Sewerage and Sanitation Company, a registered private limited liability company wholly owned by the County Government of Nakuru. Because of its high cost the government, and similar publicly owned companies, encourage the use of small defluoridation units which can be used in home or at the local community level. [143]

Among such products is one invented by the Nakuru Defluoridation Company, a firm run by the Catholic Diocese of Nakuru, which removes excess fluoride from cooking and drinking water. The product is made from the bones of domestic, herbivorous animals such as cows, goats, sheep and camels. Depending on the availability of resources, bone char is a usable defluoridation technique, though it is not universally acceptable. For other materials effective in defluoridation, see the table in Appendix I.

Social Enterprises in Defluoridation

Due to the difficulty for government and NGOs to sustainably provide expensive defluoridation services, this responsibility is increasingly falling to social enterprises. In both India and East Africa, there are examples of social enterprises addressing this market need. As evidenced by the social enterprise examples below, in regions where high fluoride levels are rampant, social enterprises are relying on the high-tech filtration systems like ultra- and nano-filtration, and reverse osmosis to remove excess fluoride.

India

AquaSafi, a social enterprise based in Karnataka, India, has developed a low-cost reverse osmosis water filtration system optimized to provide clean drinking water to remote villagers in India. According to Aquasafi, an extensive survey in Karnataka revealed that 60% of sources tested exceeded 1 ppm (mg/L) of fluoride, 20% of sources tested positive for nitrate contamination, while 38% had bacteriological contamination.[144] AquaSafi will partner with villages to provide a "water store" for daily delivery of 20L of filtered water to monthly subscribers for $2 per month. The Company will monitor and maintain the system on an ongoing basis.

A similar business in India, Naandi Community Water Services has more than 400 water purification centers operating across Punjab, Haryana, Rajasthan, Andhra Pradesh and Karnataka. Working with village bodies and the community to give them cleaned drinking water at a nominal user fee (less than $0.01 per litre) became the design for a safe drinking water delivery model that is today being followed by a wave of small and micro entrepreneurs across the country as their own social business. As noted earlier in the report, there are still tens of thousands of habitations that drink unsafe water. It is Naandi's vision that by 2020 everyone in rural India will be drinking safe water. This means approximately 50,000 villages will need to be reached every year. [145]

SpringHealth, a social enterprise based in Odisha, India is operational in 250 villages in rural Odisha. The company relies on electro-chlorination technology to purify water and utilizes a decentralized hub-and-spoke model to keep

[142] http://water.jhu.edu/index.php/magazine/a-nationwide-problem-in-kenya-overexposure-to-fluoride-in-drinking-water
[143] http://www.nation.co.ke/lifestyle/DN2/Fluoride-levels-cause-concern/-/957860/2051572/-/p5vx0k/-/index.html
[144] http://www.aquasafi.com/
[145] http://www.naandi.org/naandi-community-water-services-ltd/

operational costs low and enable rapid expansion. In each distribution zone, SpringHealth first identifies a central location in which to install the electro-chlorination plant. The business then identifies up to 50 end-user distribution entrepreneurs, with access to water, to install 1,000L or 3,000L purification water tanks. Each plant is staffed with up to four Business Associates ('BAs') and one Senior Marketing Officer, who are responsible for distributing chlorine to entrepreneurs for on-site water purification and continual water purity monitoring. After dosing the water and waiting for 30 minutes, the water is tested for free residual chlorine to ensure safety for distribution. The water is then sold in 10L increments in reusable dispensers for INR 2 ($0.04) with home delivery costing an additional INR 1 ($0.02). The Company delivers clean water to over 30,000 households (over 150,000 people) on a daily basis at a price of $0.07 per day. The approximate per liter cost of water is less than $0.01. [146]

East Africa

Jibu, a social enterprise operating in Rwanda and Uganda, is serving thousands of customers daily through its highly decentralized network of entrepreneurs. Jibu equips entrepreneurs who operate a locally-owned drinking water franchise. The local franchise uses solar-powered, ultra-filtration equipment to filter water drawn from any source and seal it in re-usable bottles. Jibu drinking water is sold profitably to the underserved market within walking distance of each storefront (about a 2km radius) at a price lower than the cost of charcoal required to boil water and at a fraction of the price of the cheapest commercially bottled water. The price per liter of Jibu water varies by country, but the baseline is approximately the cost of charcoal required to boil a liter of water. This equals about $0.04-$0.05 per liter on average, less than $1 for 20L, which lasts a family of five about 3 days. [147]

Conclusion

As discussed above, there are still large populations in both India and East Africa whose drinking water is above recommended World Health Organization fluoride limits. Because it is usually too expensive to operate large-scale, industrial de-fluoridation plants, the government solutions that do exist remain focused at the local community levels. Social enterprises are becoming responsible for providing similar community level solutions where government-run programs cannot yet reach.

The filtering of fluoride, as well as chlorine, salts, and other microbes and contaminants in water is requiring both governments and social enterprises to operate expensive filtration and de-fluoridation technology, usually in the form of micro-, ultra- or nano- filtration, or reverse osmosis. A highly effective filtration system typically costs upwards of $5,000. For social enterprises, this cost can take a long time to recoup and still does not account for the ultimate challenge of distribution of the clean water. A sustainable solution will thus match a low-cost, effective filtration system with a low-cost, efffective distribution network and will require a company to manage very slim margins. These types of enterprises are attractive to traditional investors only if there is a clear path to scale. As such, there is a unique role for investment funds which can tolerate the higher risk and longer time horizon to scale.

[146] http://www.springhealthindia.com/#mission
[147] http://www.jibuco.com/#tab-1

Appendix I [148]

Technology/ Material	Typical capacities (mg/g)	The science	Strengths	Limitations
Activated alumina	3.5– 10.0	Precipitations involving Al2O3 and in F− ions water	High selectivity for fluoride	lowers pH of water, residualAl^{3+}
Nalgonda	0.7 – 3.7	Reactions of Alum, Al2(SO4)3 and lime (CaO)	Same chemicals used for ordinary water treatment	High chemical dose, high sludge disposal required
Bone char	2.3 – 4.7	Filtration and ion exchange in Ca5(PO4)3OH structure	Availability of raw materials	Not universally acceptable
Bauxite	3.0 – 8.9	Precipitations involving Al2O3 and F− and other oxides e.g. Fe2O3 ions water	Available locally in some areas. High capacity	Residual colour and turbidity in treated water if used raw
Gypsum	1.1 – 6.8	Ion exchange involving CaSO4 and F− and other compounds e.g. Ca(OH)2	Locally available in some areas	High Residual Calcium sulphate
Magnesite	1.0 – 3.7	Ion exchange and precipitation involving MgO and F− and other compounds e.g. Mg(OH)2	Simple technique, locally available in some areas	High pH & residual Mg.
HAP	0.5 – 2.9	Ion exchange and precipitation involving Ca5(PO4)3OH and F− and other compounds e.g. Ca5H(PO4)3(OH)2	Naturally available in some areas	Residual Phosphate
Bauxite, gypsum, magnesite composite	4.2– 11.3	ion exchange and precipitation in reactions of Al2O3,CaSO4,MgCO3,MgO	Simple and versatile. Better than use of each of the materials	Energy intensive, fairly novel technique.
Zeolites	28 - 41	ion exchange and surface complexation reactions	High capacity	Limited availability
Other advanced techniques	**High**	**Nano-filtration, Reverse osmosis, distillation, precipitation, electrolysis**	**Very high capacities**	**High cost. Need for special training**

[148] http://www.intechopen.com/books/perspectives-in-water-pollution/ground-water-contamination-with-fluoride-and-potential-fluoride-removal-technologies-for-east-and-so