Revised and Final Report

Market Study on market opportunities for renewable drinking water technology in rural, remote and hard-to-access areas in India

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Abbreviations

AWG	Atmospheric Water Generators
BPL	Below Poverty Line
CAPEX	Capital Expenditure
CSR	Corporate Social Responsibility
DBT	Direct Benefit Transfer
DFU	De-fluorination Unit
ETP	Effluent Treatment Plants
FHTC	Functional Household Tap Connection
FGD	Focused Group Discussion
FSM	Faecal Sludge Management
Ft	Feet/ Foot
GLR	Ground Level Reservoir
GOO	Government of Odisha
GP	Gram Panchayat
GPS	Global Positioning System
GSDA	Groundwater Surveys & Development Agency
HHs	Households
HUDCO	Housing and Urban Development Corporation
IHHL	Individual Household Latrines
IPC	Irrigation Potential Created
IPU	Irrigation Potential Utilized
JJM	Jal Jeevan Mission
LPCD / LPD	litres per person (capita) per day / litres per day
LTR	Litre
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MIDC	Maharashtra Industrial Development Corporation
MJP	Maharashtra Jeevan Pradhikaran
Mm^3	Cubic Million metres
NAPCC	National Action Plan on Climate Change
NGO	Non-Governmental Organization
NRW	Non-Revenue Water
OMBADC	Odisha Mineral Bearing Areas Development Corporation
O&M	Operation and Maintenance
ODF	Open Defecation Free
OPEX	Operation Expenditure
PHED	Public Health Engineering Department
PFMS	Public Finance Management System
PFMS	Public Finance Management System
PPP	Public Private Partnership
PPS	Population Proportion to Size method
PSU	Primary Sample Unit
PV	Photo Voltaic
PVC	Polyvinyl Chloride
PWD	Public Works Department
QA/QC	Quality Assurances and Checks
RH	Relative Humidity
RO	Reverse Osmosis
RSM	Rural sanitary Marts
RTDC	Rajasthan Tourism Development Corporation
RTE	Right to Education
RWSS	Rural Water Supply and Sanitation

SAPCC	State Action Plan on Climate Change
SBM-G	Swachh Bharat Mission-Gramin
SDG	Sustainable Development Goals
SFC	State Finance Commission
SHG	Self Help Group
SSU	Secondary Sample Unit
STP	Sewage Treatment Plant
ToR	Terms of Reference
UNOPS	United Nations Office for Project Services
VWSC	Village Water and Sanitation Committee
WaaS	Water-as-a-Service
WB	World Bank
WHO	World Health Organization
WSSO	Water and Sanitation Support Organization

Executive Summary

Project Background

India is one of the most vulnerable countries to tackle the issues related to climate change. Less than 50 percent of the population in India has access to drinking water. Lack of awareness and limitation of sources of water along with climate change are creating complex moments for the rural and remote population of India. Private sectors are now showing their potential to tackle climate change and its effects on water resources at the same time. India's National Water Mission aims to increase water use efficiency by 20%, ensure a significant proportion of the water needs of urban areas are met through water recycling and advanced desalination technologies. Both the National Action Plan on Climate Change and sub-national level State Action Plans (SAPCC) are working to address the challenges related to water and climate change.

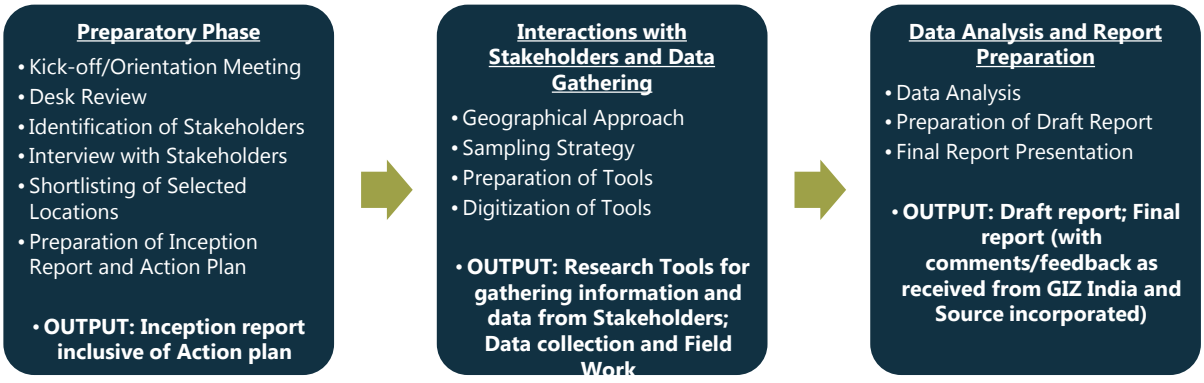
The project aims to identify areas in India where decentralized, renewable drinking water solutions are required and feasible to implement with maximum development and adaptation impacts and Sustainable Development Goal (SDG) 6 compliance. GIZ will provide technical assistance support such as information, tools, and capacities to market or scale adaptation of relevant technologies and services. This assignment focuses on 4 states, 8 districts, 32 villages prioritized for market assessment of current strategies and regional understanding of selected locations, to achieve the project objectives. The geographical details of coverage are provided below:

Table 1: List of selected States, Districts and Villages

Rajasthan		Odisha		Uttar Pradesh		Maharashtra	
Jodhpur	**Jaisalmer**	**Balangir**	**Sundargarh**	**Mahoba**	**Jalaun**	**Beed**	**Raigarh**
Basni	Deora	Ambapali	Bargarh	Chandpura	Ethaura Vanvi	Beed	Kurul
Ranisar	Basna	Champasar	Sundargarh/Balkdihi	Mirtala	Khutmils	Mogra	Pen Rural/Umbarde
Jhalamand	Jajlya	Haldi	Raurkela/Japanga	Bamhori	Parausa	Shirur	Amboli
Luni	Morant	Juba	Hatibari	Raheliya	Majhwar	Wadwani	Morbe

Limited coverage, poor service, and a struggle to recover O&M costs were all features of the rural water distribution industry. The lack of dependable water sources and the summertime drying up of wells further emphasised the difficulties, inconvenience, and time wasted when fetching water, especially for women. In villages with fewer residents and more homogeneous social backgrounds, societies can be encouraged more effectively. When there are 10,000 or more people, execution becomes more challenging and calls for multiple approaches. In a majority of settlements, toxic substances have been damaging the groundwater resources.

Methodology



Key Findings at State, District and Village-Level

The livelihood dependency of all the districts from all the states is majorly on agriculture, seasonal labour work and on service sector in a few cases. The average income ranges from **₹3,000-25,000/ month.** The Climatic conditions and groundwater level varies for all the districts. The water quality is saline in many cases and has fluoride content in Rajasthan. The current water sources and systems are groundwater, surface water

from seasonal dams, canals, rivers and open ponds and hand pumps, tube wells and tap water. Currently, all the states have some programs and schemes going-on in their rural areas, and are reaching the selected villages slowly. RO and DFU units are installed in a few cases and chlorine chemical is used to purify water in some cases. Currently, villagers, pay less than ₹5 for 1000 litres of water. There is a demand of new technology in some of the villages from Rajasthan and Odisha.

There are incidences of droughts like conditions, flooding, water scarcity and water-borne diseases in many cases. Medical expenses on such diseases are maximum in case of Maharashtra and lowest in Uttar Pradesh. In some cases, people are aware about the ill-effects of drinking contaminated water and new systems of treating water and vice versa. Overall, around **87% are willing** to use the new technology and around **97% people are willing** to pay and 3/4th of them are willing to pay in the range of **₹0-50/ month**. Current operating cost of SOURCE Global for a unit with 6-8 LPD capacity) is **₹2500/year**, similar to the solar panel) i.e., around **₹0.98/ litre.** The current operating cost of URAVU for a unit with 6-8 LPD capacity) is **₹0.05/ litre.** The Government officials at State, District and Village Level are willing to support such new technology in its implementation and operation phase. Right stakeholders/ institutional partners to be involved in the implementation are present almost in all the states.

Key Findings for Renewable Drinking Water Technologies

Since there are very limited technologies for drinking water based on renewable sources, the value chain of 2 such technologies were considered for the purpose of this study namely i.e., 1) SOURCE Global and 2) URAVU providing renewable drinking water using a sustainable water technology to extract water. They were studied based on various aspects: Purpose and Concept of the Technology, Workability, Market Demand and Cost Benefits, Equipment Size, Production Capacity and types of available units in the market, Installation Cost, Operation and Maintenance Costs, Cost Recovery, Demand Aspects, Supply Aspects, Operation and Maintenance Recovery, Affordability, Benefits, and Impacts.

A typical Cost Benefits Analysis basis the available information and data obtained from primary surveys including literature review has been developed separately for both. Drinking water cost per litre for the identified markets based on a 'True-cost' approach was calculated. The parameters considered under the approach include **Current cost of drinking water alternatives, Wholistic value of impacts to communities** (Health Benefits and Better Hygiene Benefits), **Opportunity cost of water** (Time savings, Increased Productivity of women and Livelihood opportunity for women) and **Direct environmental cost of current solutions** (Plastics, RO reject water, Brine from desalination plants).

URAVU provides free maintenance for first 5 years but after that the users will have to pay 5 paisa/ litre so, the cost for the first 5 years is ₹ 40,000 as the installation cost. This analysis has been done for a unit with 5-20 litres/ day of production capacity at individual level. The cost to benefit ratio is higher in the state of Uttar Pradesh where the annual medical expenditure for a non-hospitalised and a hospitalised treatment for water-borne diseases by a rural HH is higher while it is lowest in Odisha where the overall per HH medical expenditure is less for both SOURCE Global and URAVU. Highest benefits are observed in Uttar Pradesh while the lowest benefits are observed in Odisha. The reason being maximum medical expenditure on health check-ups due to water-borne diseases in Uttar Pradesh, so this technology will save the cost of rural communities in the state on medical expenditure. For Odisha, since the cost of medical expenditure on such diseases are very less, so their benefits are lesser. Overall, the cost benefits for each rural HH in all the states will be significantly higher, if compared with the annual income of each HH.

State wise Rating of the Identified Criteria

Some key criteria that could be considered while selecting the target market(s) for the implementation of the renewable drinking water technologies were identified from the study. The criteria have been rated state-wise on a scale of 1 to 5 (1 being the lowest, 5 being the highest). The rating done is based on the primary analysis and is relative for all the states. Based on the obtained results from the analysis and keeping in mind the various parameters and their identified ratings, **Rajasthan and Odisha are the most feasible states to commence the implementation followed by Maharashtra and Uttar Pradesh respectively**. Rajasthan and

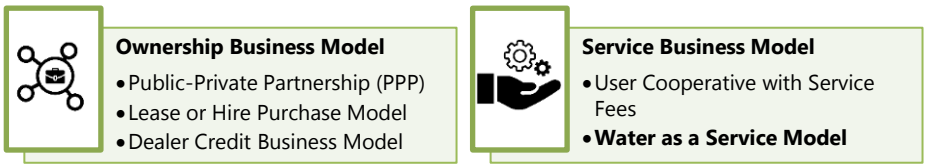
Odisha are chosen because of their lower rating in all the parameters which shows their scope of improvement in all of those parameters.

Potential Business Models for Implementation of Renewable Water Technology

Business models contain essential finance, delivery, and monitoring aspects and outline how financial investments can be planned, executed, and overseen. The most suitable business model for a particular project will be determined by the regional circumstances, the economic and legal climate, as well as the institutional mechanisms and support systems in existence. Along with the target audience, the scope and goal of the project or service must be clearly stated. Business models are not predefined frameworks; instead, they must each be customised to the specific local conditions and risk levels of the chosen enterprise. Factors influencing the selection of a suitable business model are the concerns for a product or service, project scope, the client, the public, and the legal framework.

Identified Potential Suitable Business Models

Some business model options designed for renewable drinking water supply have been identified from which the most suitable one for the focused areas will be selected.



Most Suitable Business Model: Water-as-a-Service Model

By considering all the analysis outcomes, **Water-as-a-Service Model** (WaaS) is the selected model to implement the technology. New service at a community level will be the most efficient one where the rural community along with different stakeholders will maintain and operate the service. Also, the reach of the technology will be maximum in such case and can increase access to improved technology benefitting consumers, service providers, renewable water technology, and perhaps society as a whole. Water-as-a-service is a word that can be used to refer to a variety of business models in the water supply industry, including subscription-based water usage patterns. Customers and society have benefited from WaaS in the past, and it may be useful for extending the usage of new technologies in the future.

The WaaS paradigm could be used to more effectively match consumer incentives with overall unit operating restrictions. Company can install and maintain a renewable water technology unit at community level with higher production capacity. The business is open to working with a variety of partners, including GP, government agencies, private businesses, NGOs, CSRs, women and youth associations, VWSC, etc. The business model and its components were analyzed to understand the building blocks of the business model, value proposition of the offering, its infrastructure, market and finances, etc. The objective of the analysis was to assist GIZ to align their activities accordingly.

Table 2: Analysis of the Business Model

Business Value proposition	To create renewable drinking water with hydro panels that will produce potable water from sunlight and moisture using solar energy i.e., safe drinking water using renewable sources of energy - best suited for remote areas
Key Activities	Provision of Drinking Water as a service to the key beneficiaries
Key Resources	Financial resources can be obtained from govt stakeholders, donor agencies, CSRs, community funds, grants, other philanthropy etc. Community can also pay a service or user fee service model. Other resources include technical expertise, community mobilization, BCC/IEC, O&M etc.
Key Partners	Authorities from various public, private and other sectors can be partnered with the rural community to deliver a Value Proposition
Cost Structure	Costs towards capital expenditure are prohibitive and may restrict uptake of individual HH level uptake or installation – business model to look at co-financing models with other partners and rural communities Some part of CAPEX can be borne by SOURCE Global/development partners/CSRs etc. Local GP and Community funds can be explored as well.

Customer Segments	Rural Communities from remote and inaccessible settlements, those living in areas suffering from drought-like conditions and having no government schemes
Channels	SOURCE Global along with its Partner Organization → State Water Supply and Sanitation Department → District Level Officials → Gram Panchayat → User (Villagers/ Community)
Customer Relationships	SOURCE Global to look at effective BCC and IEC campaigns, Effective marketing and can provide technical support in collaboration with different GPs, NGOs or any other groups to train the community
Revenue Streams	User fees/service fees from communities and Alternate revenue streams from different funding sources

Implementation strategy at rural level and Way Forward

Two models of implementation strategy, Primary model and Cluster model, will be implemented at Gram Panchayat Level using 10-fold approach. The steps include detailed water audit, institutional clarity, planning solutions - DPR/ norms/standards, financing the implementation, collaboration of service providers with different organizations and agencies, communication campaigns, capacity building, infrastructure services development, operation management and monitoring and grievance redressal system. The **Typical cost estimation for incorporating a Water Supply System at Community Level will** consist of 60% of the total cost – Infrastructure development/ Hardware component cost, 20% of the total cost – Capacity Building, IEC/ Software component cost and 20% of the total cost – Operation and Maintenance. Further steps include detailed technical feasibility of renewable drinking water technologies, detailed financial feasibility i.e., development of detailed financial models, undertake project scoping and structuring, setting up of partnerships/signing of MoUs and kick off drinking water service provision model.

Chapter 1: Introduction

1.1. Project Background

Climate is emerging as a major issue globally and India is one of the most vulnerable countries to tackle the issues related to climate change. More than 833.1 million of the population in India are from rural areas and it is almost more than half of the total population (1210 million). In addition, the climate change is badly affecting the lives of people in different parts of the country, and its major target is the rural population (69% of India population). India is historically vulnerable to climate variability: floods, floods, droughts, vector borne disease, cyclones, ocean storm surges, etc. Change in temperature is disturbing the climate gradually including the ecosystem. As per a report of CEEW, the temperature has increased almost 0.7^0Celsius from the year 1901 to 2018, which is a matter of concern in the current situation for the country and its population. As per experts, most parts of India are going to face droughts in the coming years.

Among all the issues of climate change, the rise in temperature is directly affecting the water sources in India. Climate change is disrupting the water pattern, leading to extreme weather events, unpredictable water availability, exacerbating water scarcity and contaminating water supplies due to warming temperatures, changes in precipitation and runoff patterns, polluted surface and ground water and sea level rise[1]. This drastically affects the quantity and quality of water that human beings need to survive. Unavailability of water, diseases due to contaminated water are some of the major issues and rising temperatures can lead to deadly pathogens in freshwater sources, making the water dangerous for people to drink. The rural population in India is closer to all the issues as there is a lack of security related to the water source. As per UNICEF, less than 50 percent of the population in India has access to drinking water. Lack of awareness and limitation of sources of water along with climate change are creating complex moments for the rural and remote population of India. Some of the issues related to water supply in rural areas of India include no centralized piped water infrastructure, shortage or absence of primary water sources, contaminated ground/surface water sources etc.

Figure 1: Illustration[2]

To address the water issues in developing countries like India, private sectors are now showing their potential to tackle climate change and its effects on water resources at the same time. Understanding the importance of the water in life support system, both the National Action Plan on Climate Change (NAPCC) of and the sub-national level State Action Plans on Climate Change (SAPCC) are working to address the challenges related to water and climate change. National Water Mission (NWM) is one of the measure missions under NAPCC, which focuses on the water issues with an aim of increasing water use efficiency by 20%, ensure that a significant proportion of the water needs of urban areas are met through water recycling, ensure that the water needs of coastal cities are met through advanced desalination technologies, management strategies and collaboration with states on water catchment issues to deal with rainfall variability. Other than this, at the

[1] https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-water-resources
[2] https://www.unicef.org/india/what-we-do/clean-drinking-water

Sub-national level, all 36 SAPCCs are aligned as per the National Missions and have dedicated state wise targets and goals for water missions that focus on both adaptation and mitigation efforts.

1.2. Project Objectives and Scope

GIZ project[3] provides technical assistance support such as information, tools, and capacities to market or scale adaptation of relevant technologies and services to their current and potential investees of CRAFT. The project Objectives is to identify rural, and remote areas in India where decentralized, renewable drinking water solutions are required and feasible to implement with maximum development and adaptation impacts and Sustainable Development Goal (SDG) 6 compliance. The project focusses the following problems, and these are:

- A cost-effective, decentralized piping solution for sparsely populated rural and remote location, where extending centralized pipe infrastructure isn't viable
- Providing a resilient drinking water source in areas subject to supply shortage or absence of primary water sources.
- Providing high quality clean drinking water to replace contaminated ground/surface water sources.
- Quickly implement scalable solutions to provide immediate relief in informal settlements such as displaced populations, informal housing, or relief camps in the aftermath of war or natural disasters.

1.3. Location and Context

As per NITI Aayog, some of the major cities of India could face day zero (no resources for freshwater water) in coming year. Almost 75% of the total population don't have the drinking water access on premise and the situation is 84% for rural India. The distribution of water is also not even for all (per capita water per day) in all areas of India. Freshwater supply is becoming a major concern day by day throughout the world. National program like JJM is focusing the priority areas (water scares area, quality affected villages, aspirational districts etc.) including other districts to provide piped water connection. Good quality of water (laboratories tested) to all rural households of India through tapped water service by 2024 is the focus of the Mission. This mission is operating in a distributive manner from national level to the local level for better institutional management. Groundwater resources is an essential and vital component being utilised for drinking. Irrigation and industrial purposes. The growing concern on deterioration of groundwater quality due to geogenic and anthropogenic activities. The quality of groundwater has undergone a change to an extent that the use of such water could be hazardous. Increase in overall salinity of the groundwater and/or presence of high concentrations of fluoride, nitrate, iron, arsenic, total hardness, and few toxic metal ions have been noticed in large areas in several states of India.

Figure 2: Women travelling far distances to fetch drinking water in rural areas of India[4]

[3] to strengthen the financing and implementation of Nationally Determined Contributions (NDC)
[4] https://www.downtoearth.org.in/blog/water/india-s-deepening-water-crisis-how-villages-had-water-before-govt-took-over-65311

In States like Rajasthan, Haryana, Punjab, and Gujarat and to a lesser extent in Uttar Pradesh, Delhi, Madhya Pradesh Maharashtra, Karnataka, Bihar, and Tamil Nadu has inland salinity in groundwater. About 0.2 million sq.km area has been estimated to be affected by saline water of Electrical Conductivity more than 4000 µS/cm. There are several places in Rajasthan where EC values of groundwater is greater than 10,000 µS /cm making water non-potable. Inland salinity is also caused due to practice of surface water irrigation without consideration of groundwater status.

In India, coastal salinity problems have been observed in several places in coastal areas of the country. Problem of salinity ingress has been noticed in Minjur area of Tamil Nadu and Mangrol – Chorwad- Porbander belt along the Saurashtra coast. In Odisha in an 8-10 km. wide belt of Subarnrekha, Salandi, Brahamani outfall regions in the proximity of the coast, the upper aquifers contain saline horizons decreasing landwards. Salinity ingress is also reported in Pondicherry region, east of Neyveli Lignite Mines.

High concentration of fluoride in groundwater beyond the permissible limit of 1.5 mg/L is a major health problem in India. Nearly 90% of rural population of the country uses groundwater for drinking and domestic purposes and due to excess Fluoride in groundwater, a huge rural population is threatened with health hazards of Fluorosis especially in all the districts of Rajasthan State.

Arsenic contamination in groundwater has been found in the states of Bihar, Chhattisgarh, and Uttar Pradesh &Assam. Arsenic in groundwater has been reported in 12 districts In Bihar, 5 districts in U.P and one district each in Chhattisgarh & Assam states. The occurrence of Arsenic in the states of Bihar, West Bengal and Uttar Pradesh is in Alluvium formation but in the state of Chhattisgarh, it is in the volcanics exclusively confined to N-S trending Dongargarh-Kotri ancient rift zone.

High concentration of Iron in groundwater has been observed in more than 1.1 lakh habitations in the country. It as an essential element for both plant and animal metabolism. The highest value (49 mg/L) has been found in a hand pump at Bhubaneswar, Odisha. Groundwater contaminated by iron has been reported from Assam, West Bengal, Odisha, Chhattisgarh, and Karnataka. Localized pockets are observed in states of Bihar, UP, Punjab, Rajasthan, Maharashtra, Madhya Pradesh, Jharkhand, Tamil Nadu, Kerala, and Northeastern States.

Nitrate is a very common constituent in the groundwater, especially in shallow aquifers. The source is mainly from manmade activities. In India, high concentration of nitrate (more than 45 mg/l) has been found in many districts of Andhra Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Tamil Nadu, Rajasthan, West Bengal, and Uttar Pradesh. The highest value being 3080 mg/L found in Bikaner, Rajasthan.

This assignment focused on 4 states, 8 districts (2 districts for each state), 32 villages (4 locations for each district) prioritized for market assessment of current strategies and regional understanding of selected locations, to achieve the objectives of the project. The geographical details of coverage are provided below:

Table 3: List of selected States, Districts and Villages

State	District	Taluka	Villages
Rajasthan	Jodhpur	Osian	Basni
		Phalodi	Ranisar
		Jodhpur	Jhalamand
		Salawas	Luni
	Jaisalmer	Fatehgarh	Deora
		Jaisalmer	Basna
		Jaisalmer	Jajlya
		Pokaran	Morant
Odisha	Balangir	Balangir	Ambapali
		Patnagarh	Champasar
		Tilagarh	Haldi
		Belpara	Juba
	Sundargarh	Sundargarh	Bargarh
		Sundargarh Town	Sundargarh/Balkdihi

		Raurkela PS/Japanga	Raurkela/Japanga
		Hatibari	Hatibari
Uttar Pradesh	Mahoba	Mahoba	Chandpura
		Mahoba	Mirtala
		Kulpahar	Bamhori
		Mahoba	Raheliya
	Jalaun	Jalaun	Ethaura Vanvi
		Kalpi	Khutmils
		Kalpi	Parausa
		Kalpi	Majhwar
Maharashtra	Beed	Beed	Beed
		Manjlegaon	Mogra
		Shirur	Shirur
		Wadwani	Wadwani
	Raigarh	Alibaug	Kurul
		Pen	Pen Rural/Umbarde
		Murud	Amboli
		Panvel	Morbe

1.4. Literature Review

Various studies have been done to identify different technologies going on in different places of the world towards extraction of renewable drinking water. The current scenario of drinking water supply has also been studied to identify current landscape of schemes, key challenges, requirements and opportunities.

1.4.1. Extraction of Potable Water from Atmospheric Air Using Solar Stills[5]

Both drinking water and utility water are necessary for many tasks that keep life on earth alive, especially for drinking, cooking, and cleaning. Due to pollution, population growth, and inadvertent agricultural irrigation, humanity must deal with the issue of water scarcity. In particular, the amount of drinkable water is decreasing due to climate change and global warming, making it difficult to access clean water sources. Drinking water sources are less used and some even disappear during high-temperature seasons. Due to this situation, it is now crucial to hunt for alternative sources of drinking water. Another of these methods is the extraction of potable water from water-rich air.

According to studies, 2.7 billion people live in areas where there is at least one drought every year, while 1.1 billion people have water shortages. 2.4 billion disadvantaged people worldwide suffer from waterborne infections like cholera, typhoid, and others as a result of sanitation issues with potable water. By 2025, it's predicted that more than 60% of the world's population would experience severe water scarcity problems due to the existing situation.

The issue of providing fresh water to desert locations can be overcome with the help of the following tactics.

- Waterborne travel to and from other locations
- Dehydrating salt water
- Collecting water from your atmospheric air

Transporting water from other locations can be expensive, particularly at initially in those remote regions. The process of desalinating salty water (both above and below the surface) is pricy, has a high cost, and is reliant on a steady supply of water. Only around 1200 km^3 of the estimated 14,000 km^3 of water in the atmosphere is present in pure water in rivers and lakes on Earth.

Compared to other methods, this one has a number of advantages (decentralized, sustainable, and clean). Additionally, using renewable resources like solar power to address the problem of a water shortage in remote places is advocated. The air supply and the region for collecting solar radiation are particularly present. This process has the added benefit of making fresh water available in parched rural areas and small villages. Because it is feasible to create drinking water utilising innovative technology that capture water from the atmosphere, unconventional methods of collecting water are crucial. Bringing the air's temperature below the dew point is one of the methods.

- Clearing the fog
- Air moisture can be taken out using desiccants, which can then rehydrate

It has been found that by using the right designs, certain desiccant materials with good water absorbers, like calcium chloride and silica gel, can be successfully used in the processes of removing drinking water from ambient air. It has been shown that the high ambient air temperature, which is a major contributor to water scarcity, may be turned into an advantage by the utilization of solar energy.

[5] https://dergipark.org.tr/en/download/article-file/2145332

1.4.2. Bringing clean drinking water to rural Kenya with 100% renewable resources[6]

Kitui Africa's Kitui county capital is located in a location that is frequently dry and hot. The neighbourhood, like many others, lacks access to safe drinking water and the necessary infrastructure. The Kitui desalination system, a prototype project that will lay the groundwork for 200 more to be erected around Kenya in 2023, provides the locals with affordable, sustainable, and clean drinking and agricultural water that is powered solely by solar energy.

Problem-solution and Results:

Kitui is a remote, challenging-to-reach area with a shoddy municipal electrical and water supply infrastructure. This means that in order to combat the town's tainted brackish water, neither it nor conventional water treatment technologies or on-site management and monitoring can be supported. Additionally, a treatment system's pressure is affected by changes in water temperature, salt content, and other solvents, necessitating continuous adjustment for optimum performance.

Containerized and decentralised SolarRO water purification systems from Solar Water Solutions are designed to operate completely without energy storage or a dependable grid in remote areas utilising renewable energy. Reverse osmosis system SolarRO also has SWS's distinctive Adaptive Nozzle Valve System (ANVS), which maintains pressure while consuming the least amount of electricity of any RO system.

Kitui receives 1,200 litres/hour of moderately priced drinking water from the SolarRO desalination plant, ensuring a reliable and sustainable water supply. Following the achievements in Kitui, Solar Water Solutions and its partners plan to build 200 additional desalination units in Kenya, which, by 2023, would provide drinking water for about 400,000 people.

1.4.3. Solar thermal forward osmosis to desalinate sea water in a Tamil Nadu hamlet suffering from drought[7]

The village of Narippaiyur is located in the drought-prone Ramanathapuram District in the southeast of Tamil Nadu. The chronic scarcity of drinkable water in Tamil Nadu's Ramanathapuram District is a result of salinity, brackishness, and insufficient sources. It is a well-known fact that the Ramanathapuram district has a long history of water shortages, making it challenging to provide even the bare minimum of 40 LPCD of potable water.

Narippaiyur will benefit from a daily supply of 20,000 litres of freshwater produced from seawater. The customised demand-driven convergent water solution that employs forward osmosis will provide each of the 10,000 people of the hamlet with two litres of high-quality drinking water each day.

Seawater FO technology operates at about 2 bar pressure, as opposed to saltwater RO, which operates at 50 bar pressure. It is flexible, extremely energy-efficient, and costs less to operate and maintain than other systems. The produced water would be given to the locals with the help of the people and panchayats. In order to address the nation's drinking water shortage, this DST project may pave the way for the expansion of cutting-edge technology in various rural coastal locations.

[6] https://www.danfoss.com/en/service-and-support/case-stories/dds/clean-drinking-water-rural-kenya-renewable-resources/
[7] https://vigyanprasar.gov.in/wp-content/uploads/vigyan_samachar_dst_02_19June2021.pdf

1.4.4. Salt and sweet: When sun turned saline water[8]

Only 10 kilometres separate Solawata, a small town in the Jaipur district, from Sambhar, India's largest salt-lake and a significant salt production hub that generates about two lakh tonnes of salt annually. However, Solawata is buzzing with enthusiasm because of a solar workshop organised by the neighbourhood NGO Prayatna Sansthan. Particularly in the communities close to the Sambhar Lake, the majority of the village's subsurface water sources are very salty. The people of Solawata have developed a solution to deal with the issue of too much salt in the water with the aid of a solar-powered reverse osmosis desalination plant that supplies the town with clean drinking water.

An associated neighbourhood partner NGO of Barefoot College in Tilonia, Prayatna Sansthan, has been actively working on community-based sustainable solar solutions here since the 1990s. Prayatna had been developing the fabrication for a while, and installation of solar components used in various solar lighting systems, such as the villagers' lanterns. The power grid had entirely ignored the Bagariyas because they were far from the hamlet and lived on its outskirts, depriving them of electricity.

The locals rely on unreliable water tankers when the water runs out in the heat. The Coca-Cola India Foundation-Anandana provided assistance to Prayatna, which has been operating in Dudhu block, Jaipur, to establish a reverse osmosis plant in Solawata. The Central Salt and Marine Chemicals Research Institute (CSMRI), Bhavnagar, created the membrane distillation-based plant. The factory, which was established in July 2012, distils using three membranes. The locals have received training from the CSMRI to run and maintain the solar-powered system with a daily capacity of 5000 litres.

With the exception of a brief four-month period this year, the facility has been operating smoothly for the last five years and cost roughly ₹3.5 Million ($0.043 Million) in 2012. In order to assist the intricate repairs and replacements associated to the plant, Barefoot College and Prayatna Sansthan have now decided to work with vendors in Jaipur rather than the original manufacturer in Pune. The community is responsible for covering the costs of ongoing operations. The facility uses solar energy; thus, the capital cost is slightly more but the operating costs are considerably lower.

For distant areas like Solawata that are outside the water-energy grid, solar-based desalination might be a game-changer. Communities without access to clean drinking water can do so with the least amount of energy use in this way. as well as decentralised. The state should fund these systems to promote the use of renewable energy sources.

[8] https://www.indiawaterportal.org/articles/how-sun-bringing-water-rajasthan-village

1.4.5. Innovative applications for water re-use[9]

The well-established residential hamlet of Dunedin, which has 40,000 residents and borders the Gulf of Mexico, is located on Florida's west coast in northern Pinellas County. The city's groundwater supply meets all of its needs for potable water. The aquifer beneath the city contains a little amount of freshwater with a chloride level of under 250 mg/l. In 1992, reverse osmosis (RO), which can extract groundwater with TDS concentrations as high as 600 mg/l, was added to the water treatment plan. In order to minimise iron and hydrogen sulphide, all well water is first pretreated, and 73.5% of it is then given further RO-treatment. Water that has undergone RO-treatment is mixed with water that has not before delivery. A typical of 2006 3.5 milligrams of potable water were produced.

In order to ensure an adequate supply of potable water of the proper quality and quantity and to sustain the groundwater resource over the long term, the city realised its need for water in the 1980s and produced a management plan for the adjacent groundwater resources. Although well-field and water-saving measures had been implemented, it soon became clear that these would not be adequate to ensure future water supply. The possibility of seawater leaking into the aquifer that provides drinkable water was also a concern due to increased groundwater pumping with highest flow. Therefore, finding a second source of supply was vital to assist the city in meeting its water needs to use recovered water for irrigation.

Significant problems with seasonal rainfall, low pressure, and maintaining storage tank levels plague the Dunedin recovered water operation. The recycled water satisfies all DEP regulations for irrigation of public access areas. Reclaimed water frequently has the following characteristics:

- There were no detectable faecal coliforms/100 mL CBOD 2 mg/L TSS 1 mg/L.
- 0.7 NTU Turbidity
- Total nitrogen 2 mg/L, residual 2 mg/L, and phosphorus 0.2 mg/L Cl

System of Distribution

The roughly 10.6 km long transmission mains that make up the distribution infrastructure for recycled water. Four storage tanks make up the system's total of 21 million litres of storage, with capacities ranging from 1.9 to 7.57 million litres. There are no storage facilities at the WWTP. Individual residential houses, golf courses, parks, recreation spaces, and commercial enterprises all use reclaimed water for industrial processes, cooling systems, and landscape irrigation.

Public Support

Reclaimed water has been exceptionally favorably accepted by the city, with more than 3,100 customers now being provided under normal operational conditions. A little break due to the city's extensive public education programme, which uses water, is available through brochures, videos, workshops, tours, and local television. It was partially other means, and water reuse has been accepted by the community and regulatory bodies as an environmentally responsible way to use the limited water resources. The upgrade of the WWTP from secondary treatment to advanced wastewater treatment cost the city ₹1187.5 Million ($14.4 Million).

The improvement of the WWTP from secondary to advanced wastewater treatment cost the city ₹1187.5 Million ($14.4 Million). The repair cost was covered by ₹7.14 Million ($86,600) in trust fund funding and municipal financing. Southwest Water Management District (SWFWMD) has allotted more than $6 million in matching grant funding for the ₹1072.04 Million ($13 Million) in storage, pumping, transmission, and distribution components of Dunedin's recovered water system. Reclaimed water costs for the project were paid for in part by SWFWMD.

[9] https://watereuse.org/wp-content/uploads/2015/10/WRA-103.pdf

1.4.6. Water Resource Management and Sustainability: A Case Study in Faafu Atoll in the Republic of Maldives[10]

Following the 2004 tsunami, the lens freshwater natural reservoir of many of The Republic of Maldives' offshore islands was badly damaged. The only drinking water accessible to remote atoll residents is imported water in plastic bottles and rainfall. We evaluate the potential of two possible actions: a desalination system driven by a diesel plant or a photovoltaic (PV) plant with batteries, to offer secure and renewable drinking water. The current condition, or business as usual (BAU), is also evaluated and utilised as a benchmark. Desalination and PV plant technical and financial elements are highlighted, and then a financial and environmental analysis of the two choices plus BAU is conducted.

The outcomes show that the desalination supplied by the PV plant optimises both the financial and environmental factors. For each alternative, the levelized cost of water (LCOW) and levelized CO2 emissions (LEOW) are calculated. The case study was made on Magoodhoo Island in the Faafu Atoll, but it can be utilised by small island developing states generally and other islands in the Maldives (SIDS).

To provide enough clean, drinkable water, it is proposed to install a desalination plant powered by diesel or a PV plant with battery storage. The combination of a RO plant and a PV plant, according to the results, has favourable economic and environmental effects. Utilizing water brought in from the mainland can reduce costs enough to pay for the initial investment in less than three years. Additionally, RO + PV is environmentally friendly. This is one of the earliest initiatives. We sincerely believe that if all islands undertake and work to dramatically change how they manage water and energy, The Maldives will benefit from a major reduction in CO2 emissions while assuring a good water supply in the upcoming years.

[10] https://www.mdpi.com/2071-1050/13/6/3484/pdf?version=1616462915

1.4.7. Solar mini-grids deliver clean water to rural India[11]

In India, there are 138 million rural families without access to treated water. There are 43 million rural households without electricity. Public health and safety are impacted by the spread of water-borne diseases and the absence of adequate healthcare services that are independent on power. These two glaring shortcomings in rural utilities have a particular impact on women because they usually spend a few hours each day gathering water, often from a distance. Reverse osmosis (RO) water purification facilities in India are being powered by mini-grids of renewable energy, which is a revolutionary strategy being developed by Grassroots and Rural Innovative Development (GRID) and an increasing number of private companies. In order to deliver clean water, solar-powered electricity is used.

Figure 3: Solar mini-grids to supply clean water[12]

The Haryana prototype, operating for 10 to 15 hours daily, generates 2,000 litres of drinkable water per hour at the cost of ₹0.16 ($0.002) per litre, serving 1,000 houses every day. Pick-up and delivery are the two subscription models. Prices start at roughly ₹247 ($3) per month for 20 litres per day supply. Users are provided with an ID. Free water is provided to school students.

In India, other firms are also constructing RO facilities, like DESI Power. To assist flood victims in Bihar, it has launched its first unit with a 70 litres hourly capacity. Rural residents fill their water bottles 3 times each day. It plans to build larger potable water facilities and more efficient decentralised water purification plants at its additional mini-grid locations. The Rockefeller Foundation-funded Smart Power India initiative has partnered with many private energy service companies (ESCOs), including DESI Power, which operates numerous RO water purification plants in Bihar and Uttar Pradesh.

1.5. Scenario of Drinking Water Dependency in India

Although it is only one in a longer series of measures needed to deliver truly sustainable services, building actual infrastructure facilities is a fundamental prerequisite for utilities and services, especially, water supply provision, according to NITI Aayog. India has identified the elements of rural water supply that give rise to "crisis villages." Coverage has been described as a "dynamic process," with a number of factors contributing to it. These include sources that dry up, degrade, outlive their useful lives, or drop in groundwater level; systems that operate below valued capacity due to poor O&M; an increase in population that reduces per capita availability; and construction delays brought on by seasonal water shortages[13].

1.5.1. Current Landscape of drinking water technology in India

[11] https://medium.com/energy-access-india/solar-mini-grids-bring-clean-water-to-rural-india-36ea8bb16c4b
[12] http://microgridmedia.com/renewable-mini-grids-begin-to-take-root-in-rural-india/
[13] https://niti.gov.in/planningcommission.gov.in/docs/plans/mta/mta-9702/mta-ch20.pdf

JJM app provides information on water quality and the expenses of enhancing it. The government has also created sensor devices, flow metres, and water-quality surveillance kits built on the Internet of Things for affordable ways to offer clean tap water to every HH in rural regions of the country by the year 2024. The village water committee and the GP choose small initiatives. Three technological innovations, primarily for providing the potable water, have been proposed by an inter-disciplinary Technical Committee at the Ministry of Jal Shakti.

- *Ultrafiltration is used at the solar-power equipped water treatment system Grundfos AQpure.*
- *Online Presto Chlorinator: It cleans and disinfects water of contaminants and bacterial contamination without the usage of power.*
- *To deliver drinkable water to homes, the IoT equipped EV Janajal Water on Wheel utilizes GPS.*

Guidelines for supplying drinking water to the rural areas under JJM

People from the rural regions need to receive 55 LPCD of drinkable water every day to meet their minimal demands. The respective state governments can examine this and determine their particular higher criteria based on the amount of water available, the amount needed to meet those needs, the cost of finding alternatives to unsafe water sources, and the feasibility of doing so[14].

Best Practices

For combating bio-pollution, Jalanidhi has created highly effective water purifying procedures, such as silver ionisation technology. Jalswarajya and Jalanidhi SDMs launched extensive awareness-raising campaigns to inform the public about the advantages of the programme and to promote private donations. However, these CBOs and GPs are in charge of determining who should pay what amount and deciding whether to cross-subsidize the neediest households in the village. The sole organisation that makes this decision is the community[15].

Monthly payments made for ongoing programs: The water rates offered by the Tamil Nadu Swajaldhara SDM complied with the requirements set by the state government for residential connections, that are ₹30-50 ($0.36-0.61)/ HH/ month which However, this wasn't enough to cover its O&M costs. This was caused by the inadequate assistance provided while making such judgments, the novelty of the monthly cost of water and the absence of observable advancement in service delivery. However, in Maharashtra, Kerala, and Gujarat, where price decisions are taken by the villagers and confirmed by the GPs, such pricing is meant to completely meet the costs of running and maintaining each individual programme.

As a result, connection charges and monthly bills in the SDMs differ between villages, mostly because different forms of infrastructure were created and constructed in response to local needs. These SDMs showed improved service performance, which facilitated effective user fee collection and more than covered O&M costs. Furthermore, the CBOs in these SDMs have considerable bank balances and thus are able to fund even significant enhancements to their systems of water supply because they can use funds from other government programmes[16].

1.5.2. Key Challenges - Problems identified by government agencies:

[14] https://www.ibef.org/blogs/jal-jeevan-mission-making-water-accessible-across-india
[15] https://www.researchgate.net/publication/320830801_Lessons_for_Rural_Water_Supply_India_-_Assessing_progress_towards_sustainable_service_delivery
[16] https://jalshakti-ddws.gov.in/sites/default/files/Swajal_PPT.pdf

A recent review found that just about 62,000 of the 86,681 towns and habitations had infrastructure in place that can supply ample and safe water. Up to 7,000 of the 24,681 remaining villages and settlements lack access to safe potable water and a water supply, or have a very limited supply of 10 LPCD or less. Infrastructure in the remaining 17,681 localities and habitations is only designed to deliver water at a rate of 10 to 30 LPCD, with summer water availability being much lower.

As per reports, a lot of water supply facilities are either not running up to their design potential or have stopped working for lack of the essential repairs and replacements, which is made worse by the failure to get electricity because of unpaid dues to the state energy board.

Figure 4: Acute water shortages in rural areas of India[17]

Limited coverage, poor service, and a struggle to recover O&M costs were all features of the rural water distribution industry. It was likewise target-driven and directed by the government. The lack of dependable water sources and the summertime drying up of wells further emphasised the difficulties, inconvenience, and time wasted when fetching water, especially for women. The vulnerable population was compelled to go further, which exacerbated the issues, as they often reside in difficult, steep terrain with few close sources of water[18].

1.5.3. Key Requirements and Opportunities

According to local governments, increasing ownership requires a financial contribution which can happen more easily with improved service quality. Nevertheless, some relaxation in the paying regulations (such as a smaller share of initial investment contributions, follow-up collection, and fees paid in instalments) can be met with a more positive response. Indirect evidence for this was provided by the sizeable sums of public donations that the WASMO, Jalswarajya, and Jalanidhi SDMs had amassed. This illustrates how higher service standards can promote civic engagement. Despite common assumption, when services are delivered better, community collections perform better rather than the opposite[19].

Periurban and quasiurban settings have particular needs. Important lessons learned from the project's execution: In villages with fewer residents and more homogeneous social backgrounds, societies can be encouraged more effectively. When there are 10,000 or more people, execution becomes more challenging and calls for multiple approaches. The performance of larger villages is more akin to that of small towns, where the end users are less eager to take part directly in installation and O&M[20].

In a majority of settlements, toxic substances have been damaging the groundwater resources. Fluoride, nitrate, chloride, arsenic, sulphide, iron, zinc, chromium, and salinity have a negative impact on a significant portion of people living in rural areas of India. Chemical fertilisers, pesticides, and other hazardous compounds also have a negative impact. Less than 185 locations or districts throughout the country have been pinpointed by the government and other agencies as having detrimental effects from such contaminants[21].

[17] https://www.orissapost.com/villages-facing-acute-drinking-water-problem/
[18] https://www.worldbank.org/en/results/2016/05/24/bringing-clean-water-india-villages
[19] https://www.worldbank.org/en/results/2016/05/24/bringing-clean-water-india-villages
[20] https://documents1.worldbank.org/curated/en/692411468284123478/pdf/ICR13930ICR0P01fficial0use0only0910.pdf
[21] https://oaji.net/articles/2017/1330-1491312179.pdf

1.6. Methodology

This project focuses on market opportunities for renewable drinking water technology in rural, remote, and hard-to-access areas in India. The Study team has used a tailor-made assessment framework to collect and assemble information and develop the **Market Assessment Report** in a phased manner.

1.6.1. Preparatory Phase

Kick-off/Orientation Meeting

The kick-off meeting provided all stakeholders with an effective means for dealing with complex project issues; develop the work plan, align the key project deliverables with objectives

Desk Review

Taru team has undertaken an in-depth desk review of the secondary data, documents, literature to contextualize the topic and issues and developed a comprehensive project framework.

Identification of Stakeholders

Through the learnings and case studies from literature review, key stakeholders such as NGOs working in the Water and Sanitation sectors, industry professionals, relevant government authorities, private players, etc. who are vital in gaining a thorough understanding of the prevalent status of drinking water technology in India were short-listed. These stakeholders include household & community level beneficiaries as well as government functionaries at District and Block Level.

Interview with Stakeholders

Following the identification of stakeholders, several interviews with stakeholders were conducted to understand the landscape of drinking water technology, challenges, market inhibitors, requirements, and opportunities that will help probable investors enter the market in India. This helped in shortlisting and narrowing down possible locations with greater viability and market response to decentralized water technologies.

Shortlisting of Selected Locations

Based on the learnings from the desk review and stakeholder interactions, the regions (not exceeding four districts/ regions) that will be prioritized for conducting a market assessment were finalized to achieve the objectives of the project. A potential list of criteria for prioritizing the districts and identifying and analysing rural and remote areas (target markets) for implementing renewable drinking water technology was developed. This detailed list is provided in Annexure 1.

Preparation of Inception Report and Action Plan

The Team developed an inception report which includes the detailed work plan and note on the study methodology and preparation, implementation and follow-up, detailed timeline including assigning roles and responsibilities (for internal staff), Monitoring & Evaluation mechanisms etc. The inception report also informs about the quality control mechanisms. The Action plan which included activities[22] and tentative process of the conducting the survey, field movement, data analysis and draft assessment framework was developed. This helped in preparing the field work plan.

Outputs:

- Inception report inclusive of Action plan

1.6.2. Interactions with Stakeholders and Data Gathering

Geographical Approach

As per the assessment of current strategies and regional understanding of selected locations, the field analysis plan shortlisted the villages that reflect the needs of the project. These villages were selected based on available data, internal consultations with stakeholders as well as GIZ team. The villages selected are in the

[22] A specific field movement plan was prepared wherein each supervisor and investigator were mapped with specific number of days of travel, data collection within the various blocks of the districts. The Field Movement Plan provides a date wise and geography wise movement of the field team throughout the data collection process.

areas that face a shortage or absence of primary water sources, or in regions with contaminated ground/surface water sources. The geographical approach to the study covers 4 regions/states in India. This was finalized during Task 1 of the study.

Table 4: Samples to be collected

Sr. No	Title	Sample to be restricted to for the study
1	State/ Regions	4 (not exceeding)
2	Districts	8 (2 districts in each state)
3	Villages	32 villages (4 villages in each district)

Sampling Strategy

The assessment touches a wide range of topics for the various stakeholder groups; to create a holistic and comprehensive picture of the market assessment of the programme; sample size and distribution was decided to cover all relevant stakeholder groups to ensure the project objectives will be fulfilled. The sampling strategy across the following levels includes Household level, Community level, District/Block level authorities. This gave a comprehensive viewpoint from consumer end as well as institutional enablers such as government authorities.

Table 5: Sampling Size and Distribution

Sr. No.	Stakeholder Groups	Sample Size	Tools Administered
1.	Consumers / Village residents	800 Households in total i.e., 100 in each district	Survey Questionnaire
2.	PRIs/ Village level officials	32 (1 from each village)	Key Informant Interviews
3.	Key Market Players in service delivery[23]	8-10 in total	Focus Group Discussion
4.	State level Government Functionaries, authorities	4 (1 in each state)	Key Informant Interview
5.	District level Authorities	16 (2 in each district)	Key Informant Interview

Table 6: District and Village wise surveys to be conducted

List of Sample Districts and Villages					Sample Survey to be Conducted				
Sr. No.	State	District	Village	Taluka	Household Survey (HH)	KIIs Village Level Officials	FGDs – NGOs, Private Players	KIIs State Level Gov. Functionaries	KIIs District Level Authorities
1.	Rajasthan	Jodhpur	Basni	Osian	25	1	1	1	2
			Ranisar	Phalodi	25	1			
			Jhalamand	Jodhpur	25	1			
			Luni	Salawas	25	1			
		Jaisalmer	Deora	Fatehgarh	25	1	1		2
			Basna	Jaisalmer	25	1			
			Jajiya	Jaisalmer	25	1			
			Morani	Pokaran	25	1			
2.	Odisha	Balangir	Ambapali	Balangir	25	1	1	1	2
			Champasar	Patnagarh	25	1			
			Haldi	Titlagarh	25	1			
			Juba	Belpara	25	1			
		Sundargarh	Bargarh	Sundargarh	25	1	1		2
			Sundargarh	Sundargarh Town	25	1			
			Raurkela	Raurkela PS	25	1			
			Hatibari	Hatibari	25	1			
3.	Uttar Pradesh	Mahoba	Chandpura	Mahoba	25	1	1	1	2
			Mirtala	Mahoba	25	1			
			Bamhori	Kulpahar	25	1			
			Raheliya	Mahoba	25	1			
		Jalaun	Ethaura vavni	Jalauna	25	1	1		2
			Khutmila	Kalpi	25	1			

[23] existing organizations in the region, private players, NGOs

			Parausa	Kalpi	25	1			
			Majhwar	Kalpi	25	1			
4.	Maharashtra	Beed	Beed	Beed	25	1	1	1	2
			Mogra	Manjlegaon	25	1			
			Shirur	Shirur	25	1			
			Wadwani	Wadwani	25	1			
		Raigarh	Kurul	Alibaug	25	1	1		2
			Pen Rural	Pen	25	1			
			Amboli	Murud	25	1			
			Morbe	Panvel	25	1			
Total Samples					**800**	**32**	**8**	**4**	**16**

Preparation of Tools

The research tools were developed for the assessment in the form of Survey Questionnaires, semi-structured/structured IDIs/FGD guides and interaction checklists to collect data on Qualitative aspects, Different tools for HHs and KIIs with the key stakeholders was also developed.

Digitization of Tools

These finalized tools for qualitative assessment were digitized and adapted by Taru team on its data collection -Open Data Kit (ODK) software (CAPI based) - on Android Based Tablet PCs to collect information from various stakeholders.

Outputs:

- Research Tools for gathering information and data from Stakeholders
- Data collection and Field Work

1.6.3. Data Analysis and Report Preparation

Data Analysis

The findings and information gathered from the various sources such as literature review, quantitative and qualitative data and information gathered during the interactions with key stakeholders and field survey was collated, cleaned, analyzed, and verified. The research data is a synthesis of conclusions and insights.

Preparation of Draft Report

The team started developing the draft report using the key analyzed findings. In addition to using its sectoral experience and understanding, local wisdom, learnings, Taru team has generated insights (Both data and insights will be captured in an objective way focusing on not only data but also insights) and recommendations/next steps towards the assignment.

Final Report Presentation

The final Draft Report was finalized after incorporating the comments/feedback proposed by the GIZ and SOURCE teams.

Outputs:

- Draft report
- Final report (with comments/feedback as received from GIZ India and Source incorporated)

Chapter 2: Key Findings at State, District and Village-Level

Rural areas from four Indian States of Rajasthan, Odisha, Uttar Pradesh and Maharashtra were surveyed to study their requirement for Renewable Drinking Water Technologies. The data was analyzed at state, district and village level and key findings are listed below in tabular format as per state.

2.1. Rajasthan

Rajasthan heavily suffers from water crisis especially, the rural and remote areas. Women and girls are responsible for the collection, carrying, storage, supplying, and managing water in every home in Rajasthan's rural districts[24]. In Rajasthan, the gross household water demand is projected to be 2245.37 Mm^3/yr, 3496.50 Mm^3/yr, 4535.54 Mm^3/yr, and 5216.96 Mm^3/yr, respectively, in the years 2010, 2020, 2040, and 2060 (Mm - Million cubic metres per year and $1m^3$= 1000L)[25]. Overall, the drinking water demand in Rajasthan was about 125.1 Mm^3/yr for the year 2011 (considering a demand of 5 LPCD and 2011 census population). Men move to cities in search of employment in regions where there isn't enough water for farming, leaving women all alone to care for the elderly and young. Women have limited time for several other productive activities as majority of their time goes into collecting water. This also affects the education of the girls[26].

Figure 5: Unmaintained water supply facilities in Jodhpur

To tackle with this situation, ₹127.5 Million ($ 1.55 Million) will be invested in four districts, namely, Bikaner, Ganganagar, Jodhpur and Jaisalmer, for four escape reservoirs to avoid drinking water scarcity for upcoming 30 years. This will be beneficial for about 2.087 million households in 6,707 villages from these districts. Also, ₹813.7 Million ($ 9.87 Million) are being allotted through JJM to cover a total of 7.6 million homes in these districts[27].

2.1.1. Analysis at State and District Level

Current Status and Issues about the water supply in the district and the surveyed villages

1) Jodhpur District

Rural people mainly depend upon rain water for agriculture and animal husbandry. 30-35 villages bring water from wells through tankers since no other source is available. This water is also used for drinking purposes. The issue of water scarcity in the summer (March-July) leads to complaints from the people. Poor where there is a lack of water, and normal where water is available. Livelihood dependency is majorly on agriculture and cattle rearing. People also work as labourers under MNREGA as an alternative source of income. Average income of rural people ranges from ₹7,000-12,000 per month.

[24] https://hindi.indiawaterportal.org/content/water-crisis-rajasthan/content-type-page/53102
[25] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://www.water.rajasthan.gov.in/content/dam/water/state-water-resources-planning-department/tahaldata/Final%20Report%204.6/Volume1-%20Main%20Report/Report%204.6.%20IN-24740-R13-077_Part%20A%20and%20B.pdf
[26] https://hindi.indiawaterportal.org/content/water-crisis-rajasthan/content-type-page/53102
[27] https://timesofindia.indiatimes.com/city/jaipur/plan-to-end-drinking-water-woes-in-desert-dists-phed-official/articleshow/87857625.cms

There is a non-availability of funds for water supply. Villages near the canals get sufficient water, but farther villages suffer due to lesser availability of water. Villages have poor infrastructural facilities, and sometimes people fight with each other for water.

- **Luni village -** A tank has been installed which provides water for 4 hours for 4-5 days a week but need more water storage facility and water tankers to bring the water from the city.
- **Jhalamand village** - Each house gets water for 2-3 days a week through a pipeline from a canal 6 km away from it and is used for all purposes.
- **Basini village** – People get the water from the canal through a pipe which is then filtered. Sometimes they get a mix of tube well and canal water which is saline.
- **Ranisar village** - 4-5 tubewells act as a major water source. Each HHs buys around 100 litres of water from the tankers which goes for around 4 days. This water is either taken from the tubewells or market.

Figure 6: Type of Water Supply Facilities in Jodhpur

2 villages have to buy water from tankers for drinking purpose as per requirement and people have to travel to get the water from them. In some cases, the **tanker** brought from **market or tubewells with saline water** costs around **₹500 ($6.09)** but the **tanker brought from the canal costs around ₹1500 ($18.28)** which is suitable for drinking but not affordable to the villagers. **Water demand** varies for all villages from **25,000 – 300,000 litres daily** depending on its use. Water shortage still exists for all the 4 villages and there is a need for a system to cater to the water needs of the people. Tubewell water is saline in nature and also very deep but still people have to consume it due to water scarcity, Some villages are old, so, laying new pipelines becomes difficult.

JJM hasn't started yet in 3 of the villages. They do not have separate budget for water supply. There is no Jal Samiti or any youth association or women association or any NGO working towards this issue. The GP officials are willing to form such associations. **Navyug Scheme** has been recently launched by the PHED department but is still in progress.

2) Jaisalmer District

There is a dependency on rain water for various purposes while agriculture is dependent on rainwater. Cattle drink the water from ponds, while in some cases, separate taps are installed for them. Animal husbandry and farming is the primary source of livelihood in the district. People produce millet, moong and other seeds when there is rain. They are also involved in labour work under MNREGA, and a few are involved in industrial work to feed their family. Farming is done for 4 months; otherwise, labour work is done in some of the villages. Average income of rural people is around ₹6,000 – 10,000 per month.

There is no proper water supply arrangement for 4,112 houses from 98 villages. Water shortage is a major issue in the district. Most people rear sheep, goat animals and cows and do not stay permanently in such areas. Villages have poor infrastructural facilities.

- **Deora village** - Canal water stored in a tank is supplied for 2 hours (which is not enough) to all and is used for drinking purpose from the last 5 years.
- **Jajiya and Khabiya villages -** It has a piped water system from canal under Atal Bhujal Scheme. The water is stored in on-ground tanks.
- **Morani village –** Under JJM, every house has been provided a pipeline connection connected to a lake and water is supplied from a tank. Water is provided through tankers with a capacity of 5,000 litres, whenever needed. Water availability is still an issue.

Water Demand varies for all villages from **25,000 – 300,000 litres daily** depending on its use. Water shortage exists in all villages, so, in some cases rain water is stored by digging a pond. **Water taps are installed for animals.** Poor people have to fetch water themselves, whereas slightly wealthier people have tanks installed in their homes as part of a government programme to store water. 3 of the villages are facing saline water issues, causing illnesses among people due to poor quality, so, government has launched a scheme to install RO in all houses in Deora. Water is so saline that it cannot be consumed even by animals and cannot be used for agricultural purpose, so farming is also less. Currently GPs do not have funds to supply water and need financial and implementation support from the water supply department. There is a lack of water quality, accessibility, availability and sanitation in the villages.

Focused group discussions were conducted at the state, district and GP offices of Rajasthan. The key findings have been tabulated below:

Table 7: Key Findings for the selected districts and villages in Rajasthan

Aspects	Rajasthan State Departments
Institutional Arrangements (Departments or Authorities) involved in the provision of water supply	• PHED supplies water through tanks which gets filtered by ROs and then it is supplied to other places. • Popular technologies currently being practiced in Rajasthan is Reverse Osmosis, which can serve household capacity area (Mass Consumption). • Private places are provided RO installation facilities. They have provided RO in public places and are allowed to install the plant and recover the cost of water charges. • **4,000 plants** are installed under PPP, providing the resource and recovering the maintenance through public cost. **425 new ROs will be installed this year.**
Most hard-to-access areas, Approximate demand for water supply in these areas	• There is hardly any village that doesn't have PHED water supply. It is there in the form of hand pumps. PHED ensures that every village should have one hand pump at least. • If the water supply is once in a week, water stored through rainwater conservation is used but it is not sufficient as rural residents still have to use water carefully as per the GP officials. The water supplied by PHED is rainwater.
Any improvement in the water supply provision	• In the last 5 years, 6,800 Fluoride affected habitations have been given special attention. • Work is going on to provide water to every household, under which 20,000 villages out of 60,000 have already been covered
Further improvements to be made or Suggestions	• If the water supply is extensive and the water sources are available within short distances, say within 50m in desert areas, it will be very beneficial. • Water should be re-used. • SOURCE Global technology should be installed in the Jaisalmer area
Demand for a decentralized/ alternative water supply system in the state	• Water supply service coverage – provision of water supply connections to households in hard to access areas and remote areas • Sustainable water management • Capacity building and institutional strengthening

Challenges in provisioning of water supply in rural areas

Rajasthan is a state with many variations in terms of geography, rainfall, availability of water, and quality of water. Jaisalmer District is deprived of many facilities. Unavailability of water source is also a pressing issue in Rajasthan. Groundwater water quality is poor because of no perennial water source improvement leads to surface water challenges. Other challenges include lack of implementing resources and secondary resources obtaining water, funding and clearances, managing funds, project implementation, and a shortage of raw materials and contractors. Clearances consist of obtaining permissions from the forest department, railway department to cross the railway line, road departments to cross the road and so on, to construct such a vast

infrastructure. Some places have become dark zones due to excess use of groundwater and lesser groundwater recharge.

Challenges, barriers and willingness in the implementation of any new system or technology related to water supply

The significant challenge of installing the technology and creating infrastructure is not that big but **getting into force of that structure** and sustainability of operations is. The biggest challenges are **power supply, cost, and climatic changes such as extreme summer and extreme winter**. Sometimes **changing the mindset** of the people becomes difficult. **People want free water**; they do not care about technology since the government must provide water to them.

2.1.2. Household Level Analysis at Rural Level of the Districts

Demographic Profile of Respondents

The demographic details of the respondents from the chosen rural and remote areas of the Jodhpur and Jaisalmer districts from the state of Rajasthan have been studied to know their socio-economic background and also willingness to pay and participate for a newly provided water supply technology. These details consist of gender, age, total members in the HH and the HH income. This can be helpful to know the importance of these criteria to be considered while choosing areas where the renewable drinking water technology can be implemented.

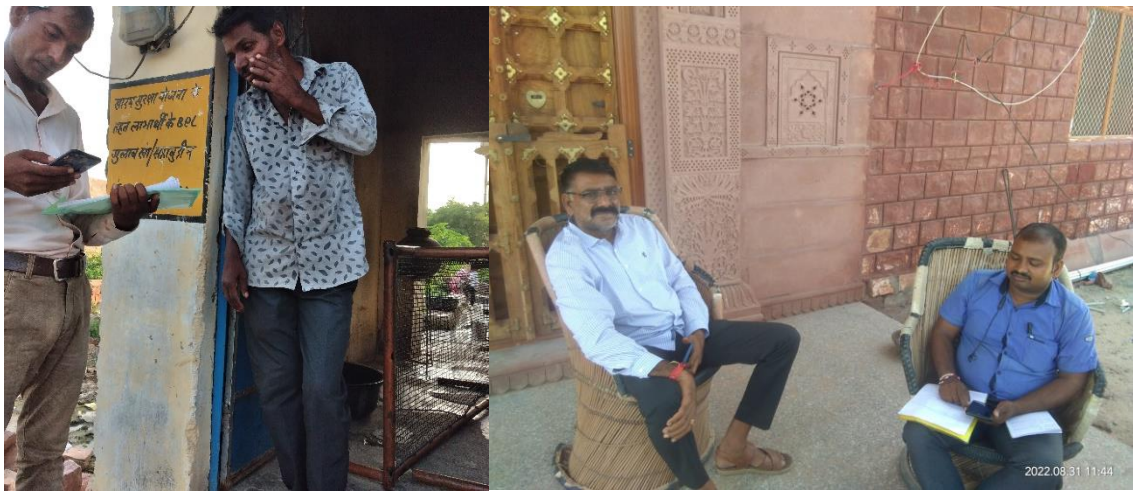


Figure 7: Surveys conducted in both the districts

Over three-fourth from Jodhpur of the respondents were males while 55% respondents from Jaisalmer were females. The average **HH size** in rural areas of **Jodhpur and Jaisalmer districts** is observed to be **6 and 5 respectively**. The respondents from the rural areas of both the districts were distributed across all the age categories as shown in the figure below. Almost 50% of the respondents from Jodhpur belong to the age group of 26-45 years while 30% belong to 46-60 years of age group and only 7% of them are above 60 years of age. Similarly, for Jaisalmer district, almost 60% of the respondents are from 26-45 years age category, 20% are from 46-60 years of age and around 12% are less than 25 years of age.

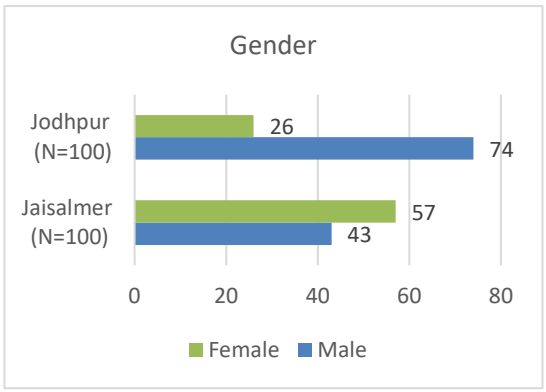


Figure 8: Gender of Respondents from Rajasthan

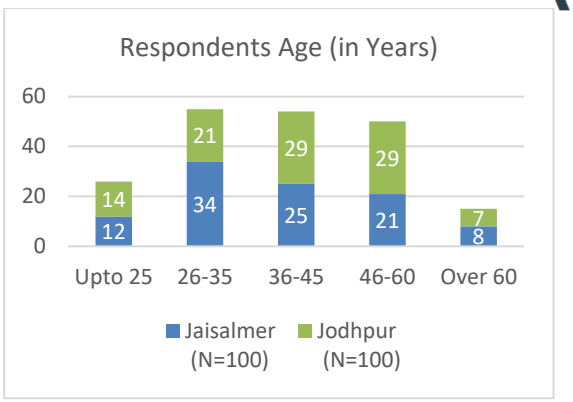


Figure 9: Age of Respondents from Rajasthan

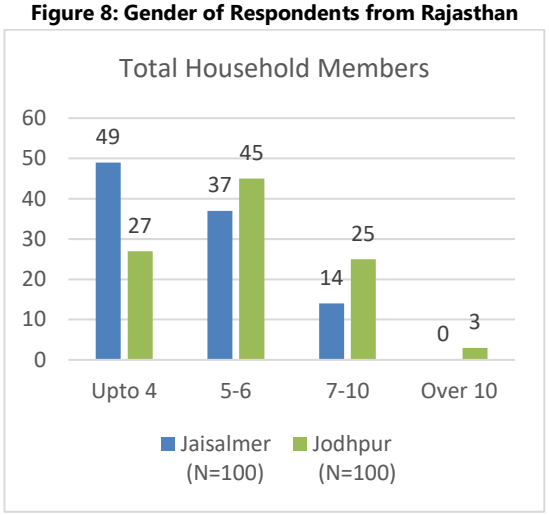


Figure 10: Total HH members in respondents' family

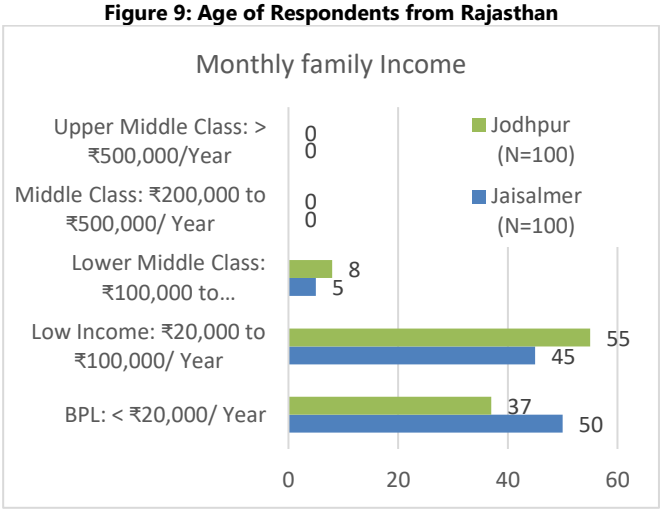


Figure 11: Total family income of respondents from Rajasthan

The average HH income of the families of **half** of the respondents from the rural areas of **Jaisalmer** district is less than **₹20,000/ year (BPL category)** ($243.74/ year)**, 45%** of them earn between 20,000-1,00,000/ year **(Lower income)** ($243.74-1,218.7/ year) and only **5%** belong to the **lower middle-class** category. As per the primary survey of HHs while as per many GP Sarpanch, **average monthly income** is observed to be **₹6,000-10,000** ($73.1-121.9/ month)**.**

About **37%** people from the rural areas of **Jodhpur** earn less than ₹20,000/ year (**BPL category**) ($243.74/ year) while **55%** earn in the range of **₹20,000-1,00,000/ year (Lower income)** ($243.74-1,218.7/ year)**.** A very few percent (**8%**) of people earn from **₹1,00,000-2,00,000/ year** (**Lower middle-income**) ($1,218.7-2437.4/ year). According to GP Sarpanch, average monthly income is **₹7,000-12,000** ($85.3-146.24/ month). Most of the people are involved in labour work under MNREGA, farming and its allied activities.

Current Dependency on drinking water supplied from different sources

As per the primary survey, major water sources in both the districts are **rainwater, ponds and tubewells**, from which water is provided through **tankers** or taken at **individual** level. Water pipeline provision to each and every HH is under progress through JJM. Around 44% of the rural HHs from **Jaisalmer** and **61%** from **Jodhpur** district require up to **200-500 litres** of water each day while **49%** and 23% from **Jaisalmer** and Jodhpur, respectively, require **less than 200 litres** quantity of water each day for different purposes. Around 7% and 14% from the respective rural areas of Jaisalmer and Jodhpur districts need 500-800 litres water.

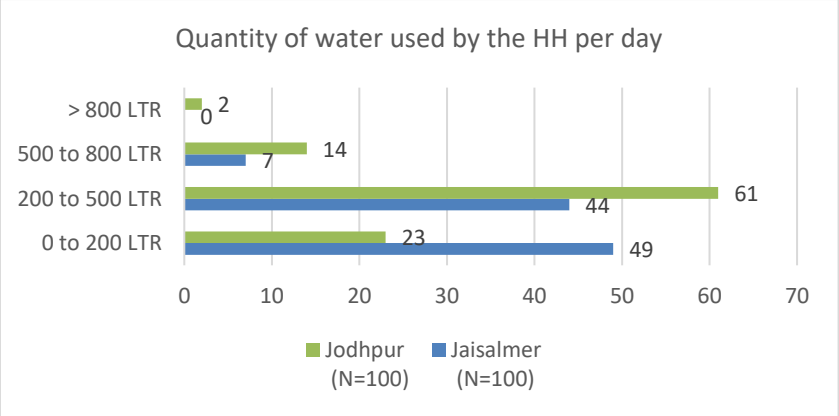


Figure 12: Daily quantity of water used by the rural HHs in the selected districts from Rajasthan

A major source of water is through tankers in the rural areas of both the districts for drinking and other purposes. For **Jaisalmer**, almost **all people** are dependent on public handpumps and while a **very few** have **hand pumps** at their **homes**. In **Jodhpur**, almost **half of the respondents** are dependent on **piped water into residence** while other half are dependent on other sources of water supply for **both drinking and other purposes**.

In 2020–2049, compared to data from 1970–1999, the average rainfall in west Rajasthan would rise by 20–35%, and in east Rajasthan, it will rise by 5%–20%[28]. Below table shows the Projected Domestic and Drinking Water Demand (in cubic Million meters per day) using projected data of rural population and HHs calculated using the above primary data obtained for water requirement per day. Drinking water projection has been calculated by assuming 5 LPCD requirement by each individual.

Table 8: Projected Domestic and Drinking Water Demand (in Mm^3/ day) in Rajasthan

State	District	Projected Rural Population		HH Size	Projected Rural HHs		Average Water Demand per HH	Projected Water Demand (in Mm^3/ day)		Projected Drinking Water Demand (in Mm^3/ day)	
		2021	2031		2021	2031		2021	2031	2021	2031
Rajasthan	Jodhpur	29,39,360	34,56,169	6	4,89,893	5,76,028	249	0.122	0.143	0.015	0.017
	Jaisalmer	7,25,883	8,70,871	5	1,45,177	1,74,174	344	0.050	0.060	0.004	0.004

Water Potability and Type of Water Treatment Done at Household Level

The quality of water obtained from the discussion with the government officials, has got an overall rating of **1 out 5** from the Sarpanch from the GPs of all the surveyed villages. The water from many areas of the district is **saline in nature**, at some places, there is a **presence of chlorine and fluoride**. Around all of the rural respondents from Jodhpur and Jaisalmer districts have reported the water to be potable except a few. The remaining 4% rural respondents from both the districts mentioned muddiness, salinity, fluoride and iron presence as the major reasons for non-potability of water. **This shows that the rural residents are not much aware about the quality of drinking water in their areas.** So, there is a need to aware them about the present water quality in their areas and the ill effects due to its consumption. To resolve the issue of non-potability of water, most people don't take any efforts to treat it at HH level, only one-fifth of the people filter or use other techniques such as boiling, chlorination and use of alum.

[28] https://www.downtoearth.org.in/news/climate-change/change-in-rainfall-patterns-is-behind-regular-floods-in-rajasthan-83980

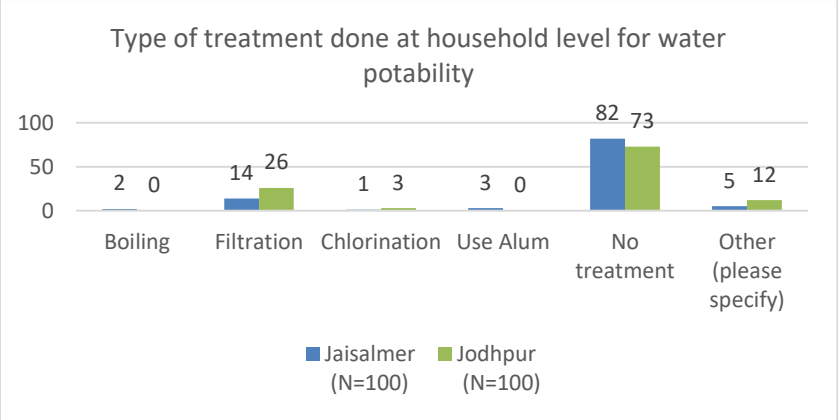


Figure 13: Type of treatment done at household level for water potability by the rural HHs in the selected districts from Rajasthan

Awareness about Renewable drinking water technology in the market

Almost one-third the respondents from the villages of Jaisalmer district and two-third respondents from Jodhpur district are aware about the renewable drinking water technologies while the remaining are unaware.

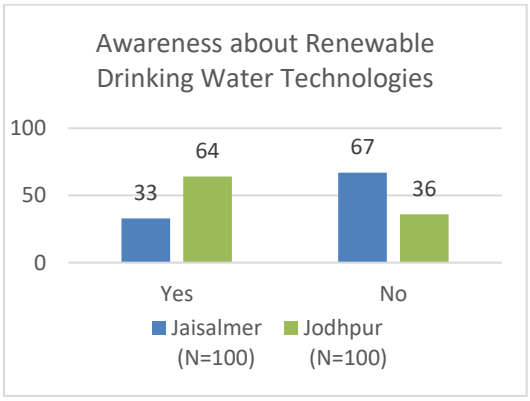


Figure 14: Awareness about Renewable Drinking Water Technologies of the rural HHs in the selected districts from Rajasthan

2.1.3. Other Aspects

Willingness to use and pay for installing and maintaining Renewable Drinking Water Technologies by the Government Officials and the Community

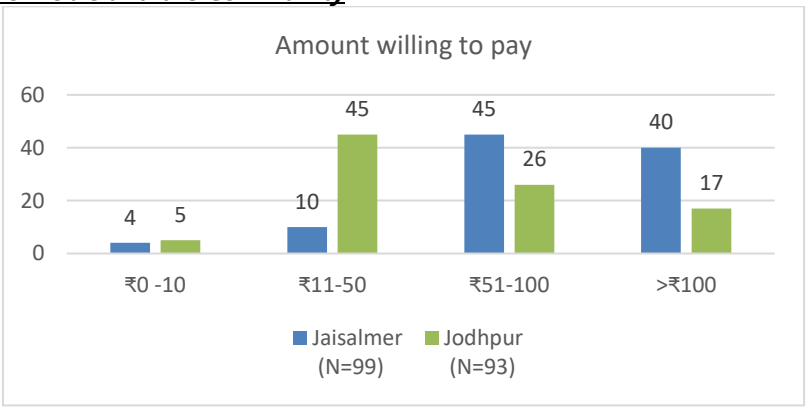


Figure 15: Amount willing to pay for such services in the rural areas of the selected districts from Rajasthan

The willingness to participate and pay for higher quality drinking water has been studied during HH survey conducted in the rural areas of different districts. Almost **all** the respondents from the **rural areas** of Jaisalmer and Jodhpur district are **willing to use and pay** for the renewable drinking water technology as there is huge

water shortage and water quality issues as stated by GP Sarpanch in Rajasthan. In rural areas of Jodhpur district, **45%** of the respondents are willing to pay upto **₹11-50/ month** ($0.13-0.6/ month) while **26%** of them are ready to pay a charge from **₹51-100/ month** ($0.62-1.22/ month) and **17%** are even ready to pay more than **₹100/month** (>$1.22/ month). In Jaisalmer district, around **15%** ready to pay upto **₹50/ month** ($0.6/ month), **45%** are willing to pay from **₹51-100/month** ($0.62-1.22/ month) and as large as **40%** of them are ready to pay above **₹100/ month** ($1.22/ month) for installation and maintenance of Renewable Drinking Water Technologies services.

As per District and GP officials, villagers will fully cooperate and contribute if any scheme or technology related to water is implemented and will also take part in the awareness programs. GP plays an active role in the implementation of new schemes but Block Office, District Office, Youth and Women's Organizations and NGOs should also participate well. More staff will be needed at all the levels to get the scheme implemented efficiently. As per the Sarpanch, rural people can also work as labourers to install the new system which will also provide employment to them. The officials were also willing to support and readily implement a new scheme announced by the state government and financial support is provided by them but also highlighted that maintenance of new systems in remote areas is difficult.

Overall Rating for rural water supply

The overall rating given by the GP officials for the water supply services in the villages are displayed in the below chart. The rating for both the districts for aspects such as **water supply service delivery, access to water and its availability is the lowest**. The reason for this is the **non-availability of a water supply system or saline nature** of water. Water quality rating is also the lowest in Jaisalmer while the GP officials in Jodhpur haven't given any rating for water quality due to poor quality.

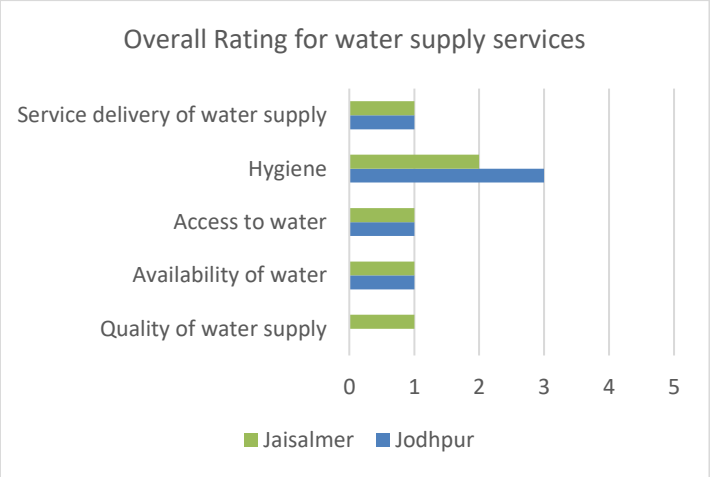


Figure 16: Overall Rating for Water Supply Services

Jodhpur district has comparatively higher rating, of 3, in terms of water supply hygiene (i.e., cleaning the water at home to make it suitable for drinking) than Jaisalmer district which is 2. It is less but there is need for government to deploy some technology to provide potable water in enough quantity.

Suggestions by the officials

Jodhpur – A plan needs to be chalked out for **proper arrangement** for water supply and a **system** needs to be installed to **fulfil the need of water**. It should be **long lasting, designed specifically for Indian climatic conditions** (like solar panels which are being implemented), **automatically controlled**, to check if the tank is fully filled or not or the solar panels are working or not. GP officials suggested to build small dams, install Ground Level Reservoir (GLR), lay pipelines to all HHs, install RO at village level to provide clean and safe drinking water to everyone, take measures to reduce water theft and wastage and ensure timely delivery of water.

Jaisalmer – There is need to install an RO plant which may provide clean water to the villagers. Government should dig more ponds so that water stays for longer periods. For people who cannot afford to install tanks in their homes, tanks should be installed in their homes or water should be supplied to them through taps. Water can be supplied through pipelines. Boosters can be built in tanks to supply water in rural areas. As per the Sarpanch in Morani, more tube wells should be provided.

2.1.4. Identified Stakeholders to be engaged in implementing new technology

The State, District and GP officials suggested and rated various key stakeholders to be engaged to implement the decentralised technologies for water supply/ treatment in their rural areas. They are mentioned in the table below.

Table 9: Critical stakeholders to be engaged

Stakeholders	Accountability for implementing/ operating	Nature of Interest	Rating for Importance	Rating for Influence
			(Scale of 1 to 5, 5 = highest)	
GP	Yes	Positive	5	5
VWSC	Yes	Positive	3	3
Block office	Yes	Positive	4	4
District office	Yes	Positive	4	4
Other corporates	No	Neutral	0	0
ASHA or anganwadi workers	Yes	Positive	3	3
Minority group representatives	No	Neutral	3	0
Youth organizations	Yes	Positive	2	2
Women's organizations	Yes	Positive	2	2
NGOs	Yes	Positive	3	3
Political party-1	No	Neutral	0	0
Community	Yes	Positive	5	5
Individual 1	No	Neutral	0	0

2.2. Odisha

Several rural parts of Odisha remain devoid of access to reliable drinking water amid the implementation of numerous initiatives like the JJM. Many rural communities struggle with water shortages nearly every year, with some women being forced to walk more than 1.5 kilometres to obtain drinking water. There is occasionally a risk of the spread of water-borne infections in the rural communities in the rainy season due to the muddy water that is utilised and consumed by both people and cattle[29]. The situation in villages without access to water is exacerbated by empty tube wells, dried rivers, and insufficient potable water supplies by the local governments during the sweltering summer. Rural areas of Balangir also face crisis-like situations such as single tubewell for a whole village so, long queues to collect the water is very common to see. This is due to drying-up of river beds[30].

Contribution of accessible water in reducing costs and vulnerabilities: Several schemes by NABARD for irrigation intend to safeguard food security and increase resilience in backward tribal regions of the state. It will have a favourable effect on regions that experience greater levels of food and water shortages and climatic distress, which are home to 5.2 million disadvantaged groups, 50% of whom are women. The GoO's Department of Water Resources would carry out the project[31]. Clean drinking water has benefited towards children's wellbeing and people have started to resettle in some parts of Odisha[32]. Water filters installed in some parts of Odisha provide enough safe drinking water to satisfy the needs of the villagers. They are accessible and economical to everyone, and are minimizing the amount of unpaid caring responsibilities performed by women[33].

2.2.1. Analysis at State and District level

Current Status and Issues about the water supply in the district and the surveyed villages

1) Sundargarh District

Agriculture and animal husbandry depends upon pond water. Water is being supplied through pipelines to every area of the district without difficulty. Major water sources are in rural and remote areas are handpumps, pipelines and borewells. There are ponds in some villages whose water reduces during summers. There are small banks in the villages which helps in irrigation. People from rural areas majorly cultivate paddy crops but also cultivate potato, wheat, kulthi, maize and groundnut and also work as daily wage skilled and agricultural labourers. Average income of people is around ₹3,000-6,000/ month ($49-61/ month)

Solar system is not yet available in all villages. Terrain of the district/block requires implementation of decentralised water supply system. Solar panel are required for a decentralised system of water supply and treatment technologies for water within the district. Currently, there are no water supply related technology providers active in the district due to lesser funding.

- **Bargarh - SFC scheme** is **successful** than **tube well water supply scheme** as water level in tube well goes very deep under the ground during summer season.
- **Hatibari –** Main source of water supply are tube wells and hand pumps. Canals and small rivers are also available for water supply in the village.
- **Japanga -** There is a little proportion of pipe-based water supply and no canals are present. Tube well hand pump is placed at a minimum distance in the area and thus there is **less of scarcity** in water. **Vasudha Project** is yet to start its operation.
- **Balkdihi –** Open Pond is available within 200 metres but is not used much**.**

[29] https://www.newindianexpress.com/states/odisha/2022/jun/20/odishas-rural-areas-in-the-vergeof-acute-water-scarcity-2467614.html
[30] https://www.newindianexpress.com/states/odisha/2022/apr/24/as-mercury-soars-water-crisis-haunts-villages-across-odisha-2445879.html
[31] https://www.nabard.org/content.aspx?id=643
[32] https://www.indiawaterportal.org/articles/bandha-bhuin-village-odisha-prospered-after-initiation-rwss
[33] https://www.oxfamindia.org/knowledgehub/oxfaminaction/community-water-filters-puri

Figure 17: Type of water supply systems in Sundargarh rural areas

There is **no water treatment facility** and **technology** present to treat ground and piped water in the district. Water from **government and private open wells and handpumps** is used for domestic and allied activities in all the villages. Ghar Ghar Jol Yojana awareness programme and survey has been done but there is need for its quick implementation as only handpumps are available currently in some villages. Ground water is available at a depth of **200-400 ft** under the ground while open well water is available under 22-25 ft. Water supply through GP and Village Committee is most successful due to proper communication between administration and the resident member of the village.

Issues - Few of the installed **handpumps do not work** properly. There are **no sufficient canals** for **irrigation.** Groundwater contains many unwanted and hazardous minerals harmful to public health so, there is a demand of clean and treated water supply. Proportion of piped water connections is very minimal. Pipes get damaged due to **iron deformation** and thus require decentralised water supply system. As per the GP officials, residents will be more receptive towards getting piped water supply system.

2) Balangir District

Allied activities such as sanitation, agriculture, cattle rearing, etc.) in the district depend more on the rain, ponds and a very few canals. Mostly, in all villages handpumps and solar systems are available while ponds are also available in the villages for agriculture and animal husbandry. Economic condition of rural people is poor. Livelihood dependency is majorly on farming and labour work. Average income of people is around ₹4,000-6,000/ month ($49-61/ month).

There is water supply problem in 6 blocks of Balangir. Turekela, Belpatla, Saitala Punjkela and others have pipe connection. They have lesser ponds and canals. There are a**dequate distribution channels with respect to canals** for the available water resources. In summer, the groundwater and pond water levels go down. Canals are also very few. **Water is not pure. Power supply, and awareness** are the major barriers in the implementation of any new system. Various communities are committed to clean water. **Funding Structure** - 50% by the central government and 50% by the state government under JJM. Due to lesser budget, maintaining and repairing the solar (if damaged) becomes difficult.

Figure 18: Poor and unhygienic condition of handpumps and taps in Balangir rural areas

- **Ambapali –** There is a need for alternative system of water supply and treatment technology as there is no such treatment facility in the village. Electric motor water supply and direct water supply have been provided. **Least** successful scheme **in Ambapali is well vision** water supply to common group of people.
- **Champasar – No water supply** related **treatment** and **technology** is provided presently. Sanitation activities using **bleaching powder** and pond water cleaning takes place in the Champasar village. Wells with lower groundwater table are present. Main sources of water for **allied activities** are **pond water, boring water** and sometimes **piped water**. **Most** successful scheme **in Champasar is PWD drinking water supply scheme** because its usage is the highest among the residents. **Least** successful scheme **in Champasar - Irrigation scheme** as there is a lack of proper monitoring from the service department and awareness from the user groups of the village. **Constraints**: There are certain block level constraints presently in the district. Many times, actions get delayed by the departments even after repeated requests.
- **Haldi – Lesser deep irrigation and well water** supply provisions. **Canal** is very **far** from the residential area nearly **3 km**. **Solar pumps** are available in nearby village. **Juba –** No canal-based distribution facility available**. Solar based water supply** is **successful** as it gets damage after very long period of 4-5 years which is also repairable. **Deep bore well** is also very **successful** due to sufficient and clean water. Ground water available at a depth of **200-400 ft** under the ground. **Issues** - Some of the installed ha**ndpumps do not work** properly. GP water supply is quite good but there are disturbances due to **irregular distribution** from the department**.** Pipeline has been **broken** at many places leading to **water leakages.** There is **block level communication gap** due to **unavailability** of the **department personnel** at the right time and their **delayed response.** In most cases, **local tender contractors** do not provide adequate services after getting contracts. **Presently pipeline connections are less**. **Solar based connections are also not connected with pipeline system.**

Focused group discussions were conducted at the state, district and GP offices of Odisha. The key findings are as follows:

Table 10: Key Findings for the selected districts and villages in Odisha

Aspects	Odisha State Departments
Institutional Arrangement (Departments or Authorities) involved in the provision of water supply	• Several agencies are working under GP and block level through tender procedure for implementation of the schemes. • All the new technologies are to be implemented through district level and in communication with gram panchayat
Most hard-to-access areas, Approximate demand for water supply in these areas	• There are no such areas which are hard to access. However, water is supplied through pipelines and tube wells in remote areas. • For hill area, over tank water supply is in demand. For non-hill-based area, bore well is reachable with 100 ft under the ground. • Inner remote districts like, Malkangiri, have water supply issues. In some areas, provisioning of tubewells is difficult as the under-groundwater is at very deep level.
Further improvements to be made	• Projects with new technologies are to be implemented from Tourism Department through District Level and in joint collaboration with District Collectors
Demand for a decentralised/ alternative water supply system in the state	• There is no demand for a separate/ decentralized/ alternative system of water supply and treatment technologies for water within the village. • Cost effective and decentralized unit is to be implemented through district level to provide drinking water in the areas that are hard to access

Challenges in provisioning of water supply in rural areas

Topography is the central issue, especially in the hilly areas where tubewells are not possible, so, deploying the schemes becomes difficult. **Formulation of water –** Surface water is not sufficient, and water is gathered through dams. No significant challenge in supplying water. It is difficult to provide tubewells in hill-based areas. In those places, overhead tank water supply is supplied. Sometime road is blocked due to damaged road conditions, and one needs to clean the roads for water to be supplied in such areas. Limited resources like manpower shortage, communication problem or accessibility to reach remote places. Also, tourism department is not available at every district. Many places lack sufficient clean water. Cost of placing tubewells machines in hill station reaches more than 20 lacs sometime.

Availability of the system – There are no adequate distribution channels like canals for the available water resources in hill-based area; Pipeline is not available in hill-based areas. **Status of groundwater -** In coastal area, under groundwater is near to the ground that of noncoastal area with deep irrigation through bore well water supply. For coastal- 100 ft under the ground, noncoastal- 500 ft under the ground. **Market demand:** There is no demand for a separate/ decentralized/ alternative system of water supply and treatment technologies for water within the village. **Other -** Many of the villagers are either doing Farming or are daily wage earner and tourism hawkers with the current average income range of the residents in the village is **Rs 50,000/ year** ($609.35/ year). In rural area, tubewell developed to get water supply as the source water supply is not good. In remote areas where tourist footfall is high, several waterpoint with shed has been constructed, however **electricity** is the major problem. **Constraint and an operational gap** is that all projects are done from Tourism Department in association with District Level and Collector.

Challenges, barriers and willingness in the implementation of any new system or technology related to water supply

There are no barriers to implementing the new technologies, which carry various advantages like availability of varied field workforce, technicians, and repairing and maintenance activity stations under GP level.

Implementing New Technology like SOURCE Global requires

- ***There is a positive response to implement it***
- *Such technology can be implemented at the* ***district level and in communication with the GP***
- *GP, Block Level, District Level Officials and NGOs support such technology and positively impact the residents.*
- *Issues lie in understanding and getting support from the minority groups, political parties and youth organisations in Odisha.*

Tourism Department has its own challenges as tubewells do not work in every area. In some hill-based areas, there are difficulties in deploying tubewells and thus they require pipe-based water supply with new aided technology. Sometimes overhead tank supply needs with excess budget for those of hard to access area to reach water supply. In hill areas, tubewells cost nearly ₹2 Million ($24,374) as compared to normal tubewells which cost around ₹0.3 Million ($3,656) in soft soil-based area.

2.2.2. Household Level Analysis at Rural Level of the Districts

Demographic Profile of Respondents

The demographic details of the respondents from the chosen rural and remote areas of Balangir and Sundargarh district from Odisha have been studied to know their socio-economic background and also willingness to pay and participate in the newly provided services. Such details include gender, age, total members in the HH and the HH income.

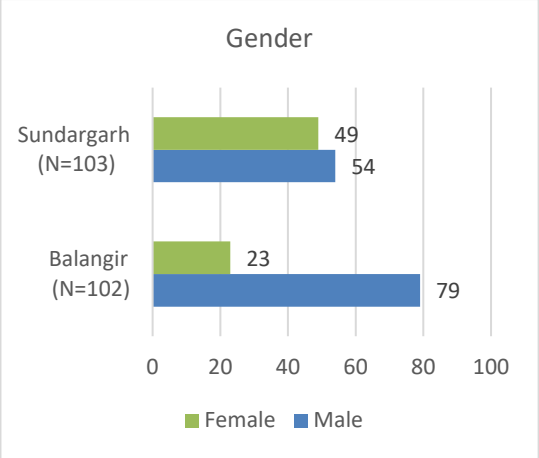


Figure 19: Gender of Respondents from Odisha

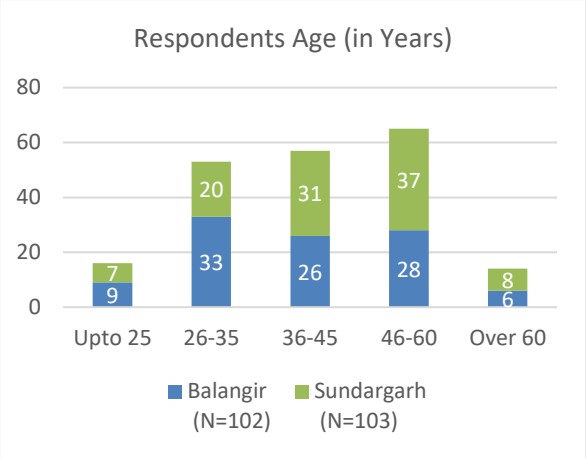


Figure 20: Age of Respondents from Odisha

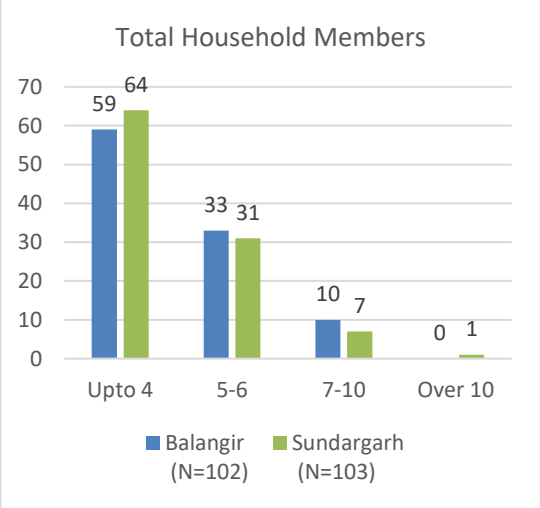


Figure 21: Total HH members in respondents' families

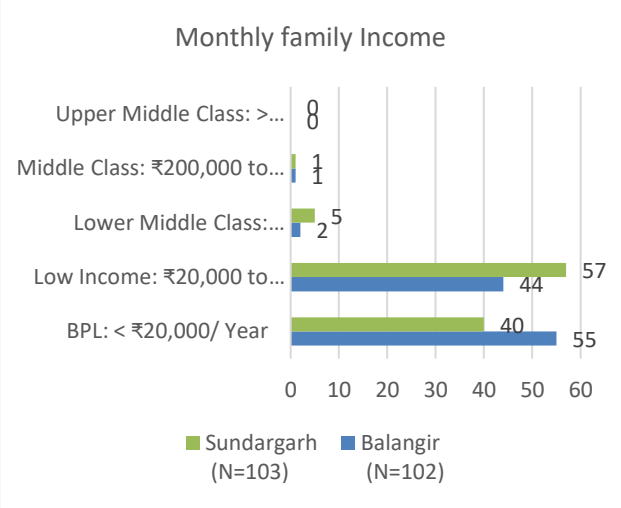


Figure 22: Total family income of respondents from Odisha

Majority of the respondents in the rural areas of Balangir were males i.e., 80% while the rest were females. Rural areas from Sundargarh district had equal number of female and male respondents. The average **HH size** in rural areas of **Sundargarh and Balangir districts** is observed to be **4**. The respondents from the rural areas of both the districts were distributed across all the age categories as shown in the above figure. Almost 50% of the respondents from Sundargarh belong to the age group of 26-45 years while 35% belong to 46-60 years of age group and only 8% of them are above 60 years of age. Similarly, for Balangir district, almost 60% of the respondents are from 26-45 years age category, 25% are from 46-60 years of age and around 9% are less than 25 years of age.

Figure 23: Surveys conducted in both the districts

As per the discussion with the GP Sarpanch, the average income was observed to be **₹4,000-6,000/ month** ($49-61/ month). As per the HH survey, the average HH income of the families of around **40**% respondents from the rural areas of **Sundargarh** district and **55**% respondents from Balangir is less **than ₹20,000/ year (BPL category**) ($243.74/ year). Around **57**% people from rural areas of Sundargarh and **44**% from Balangir earn between **₹20,000-100,000/ year (Low income)** ($243.74-1,218.7/ year). A very few percent (2-5%) of people earn from **₹100,000-200,000/ year** (**Lower middle-income group**) ($1,218.7-2437.4/ year). Most of the people are involved in farming.

Current Dependency on drinking water supplied from different sources

As per the primary survey, major water sources in both the districts are rainwater, canals, ponds and tubewells from which water is provided through pipelines and handpumps. Water pipeline provision to each and every HH is under progress through JJM. Around **60**% of the rural HHs from **Sundargarh** and **half** of the HHs from **Balangir** districts require upto **0-200 litres** of daily water each while **half** of them from **Balangir** and **42**% of them from **Sundargarh** require about **200-500 litres** quantity of water each day for **different purposes**. V**ery few** people from **Sundargarh** need **500-800 litres** of water **per day**.

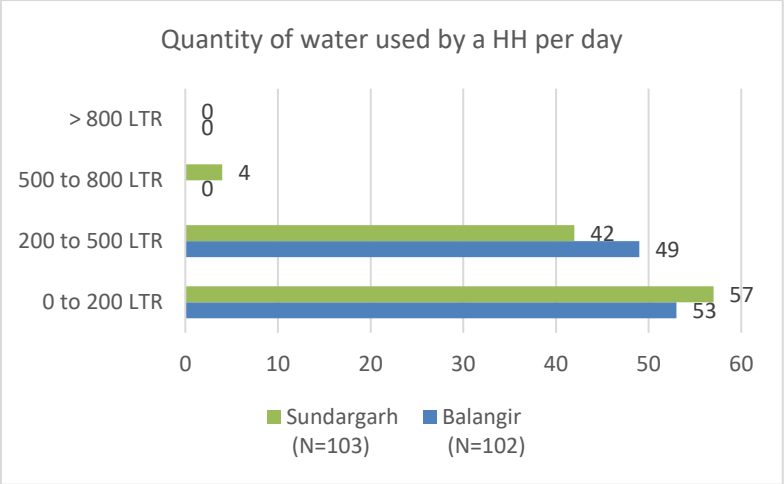


Figure 24: Daily quantity of water used by the rural HHs in the selected districts from Odisha

Major source of water is through public handpumps in the rural areas of both the districts for drinking and other purposes. For **Sundargarh**, **80**% and **65**% of the respondents are dependent on **public handpumps** for **drinking** and **other** purposes respectively. Other sources of **piped water** to residences include **handpumps, underground tanks, open well and others** for both **drinking** and **other** purposes. In **Balangir**, almost **55**% and **40**% respondents informed about dependency on **public handpumps** for drinking and other purposes, respectively. Remaining HHs have piped water to residences, public handpumps and standposts, HH handpumps, underground tanks, open wells and other sources for both drinking and other purposes.
Below table shows the Projected Domestic and Drinking Water Demand (in cubic Million meters per day) using projected data of rural population and HHs calculated using the above primary data obtained for water requirement per day.

Table 11: Projected Domestic and Drinking Water Demand (in Mm^3/ day) in Odisha

State	District	Projected Rural Population		HH Size	Projected Rural HHs		Average Water Demand per HH	Projected Water Demand (in Mm^3/ day)		Projected Drinking Water Demand (in Mm^3/ day)	
		2021	2031		2021	2031		2021	2031	2021	2031
Odisha	Sundargarh	15,08,704	16,62,068	4	3,77,176	4,15,517	230	0.087	0.096	0.008	0.008
	Balangir	14,05,673	13,59,729	4	3,51,418	3,39,932	225	0.079	0.076	0.007	0.007

Water Potability and Type of Water Treatment Done at Household Level

The quality of water obtained from different sources, as mentioned above, has got an overall rating of **2 out 5** from the Sarpanch of the GPs of all the surveyed villages. Around **60% and 50%** of the rural respondents from **Balangir and Sundargarh districts**, respectively, have reported the water to be **potable**. The remaining 40% and 50% rural respondents from Balangir and Sundargarh districts, respectively, mentioned **muddiness, salinity, bad smell/odour, contaminated water and presence of fluoride and iron** as the major reasons for non-potability of water. To resolve the issue of non-potability of water, only **30**% respondents from rural areas of **Balangir** and **20**% respondents from **Sundargarh boil the water or use chlorination techniques** to purify the water.

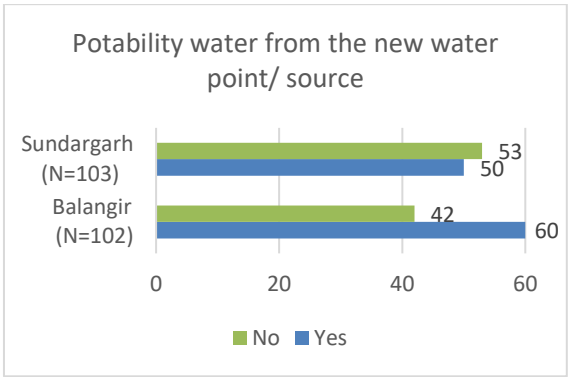


Figure 25: Potability water from the new water point/ source in the rural areas of the selected districts from Odisha

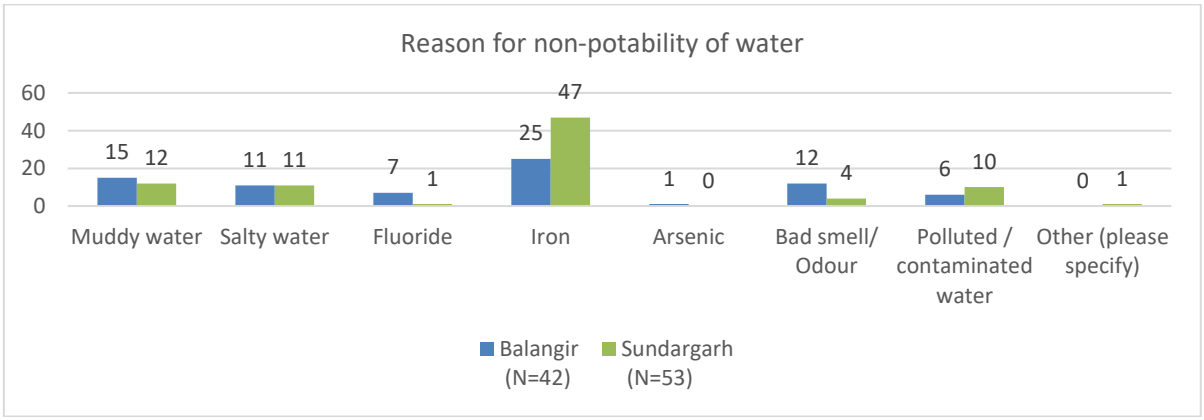


Figure 26: Reason for non-potability of water in the rural areas of the selected districts from Odisha

Awareness about Renewable drinking water technology in the market

About **43**% and **38**% of the respondents from the villages of **Balangir** and **Sundargarh** district are **aware** about the **renewable drinking water technologies** while others are unaware about any such technology.

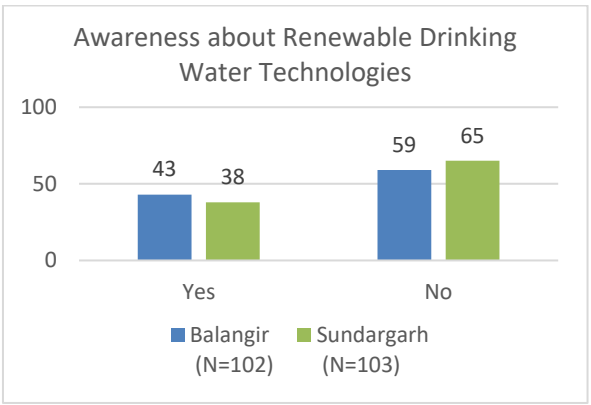


Figure 27: Awareness about Renewable Drinking Water Technologies of the rural HHs in the selected districts from Odisha

2.2.3. Other Aspects

Willingness to support, use and pay for installing and maintaining Renewable Drinking Water Technologies by the Government Officials and the Community

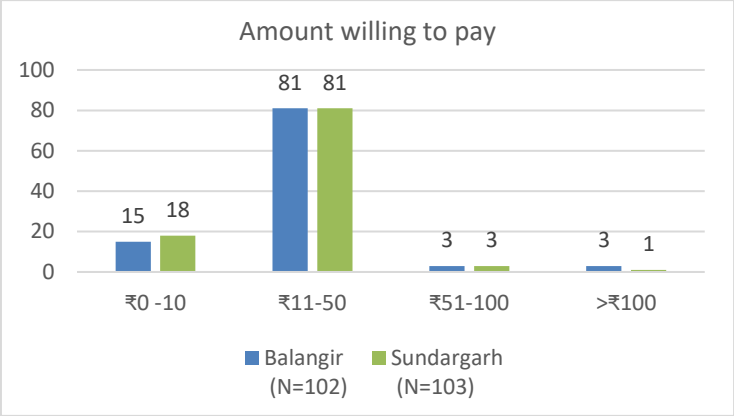


Figure 28: Amount willing to pay for such services in the rural areas of the selected districts from Odisha

Almost **all** the respondents from the rural areas of **Sundargarh and Balangir** districts are **willing to use and pay** for the renewable drinking water technology. Around **15**% of them are willing to pay upto **₹10/ month** (<$10/ month) while **80**% of them are ready to pay between **₹11-50/ month** ($0.13-0.6/ month) and a very few are ready to pay above **₹50/ month** ($0.6/ month).

Staff is less but if an NGO or an organization gives full support for a long term, then the scheme can be more efficient. As per the district official, sometimes there are problems with the land. People are not willing to give up their land for developing infrastructure which results in lesser action but JJM was fully supported by the villagers. The District officials and GPs are ready to support any organization or NGO which implements any new system or technology for drinking water. As per the respondent, villagers can pay **₹50-60/ month ($0.6-0.73/ month) for good quality water**. Solar based water supply system can be well received by the village residents because electric bill is heavily charged. **Sometimes there is a communication gap between the operational staff and the users for implementation at the village** which needs to be solved. **Solar based water supply system has been well received** by the village residents as electric bill is heavily charged. It is **cost effective and farmers are willing to receive such facility.**

Overall Rating

The overall rating given by the GP officials for the water supply services in the villages are displayed in the below chart. The rating for all the aspects for both the districts is **neither satisfactory nor dissatisfactory** except hygiene and access to water in Sundargarh and water availability in Balangir. There is a scope to improve in all the aspects.

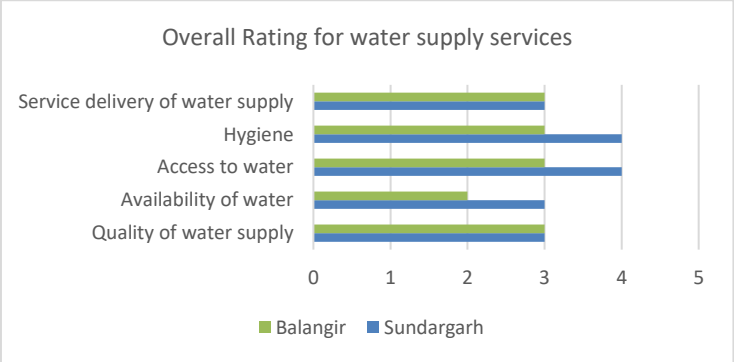


Figure 29: Overall Rating for water supply services

Suggestions by the officials

Sundargarh - full in its capacity for every household. Solar panel are needed to provide clean drinking water in the hard-to access areas. Villagers demand for advance technology to test soil, groundwater level and nature of the water in hard to access area. Such system needs to be provided. **Geographical nature** of the area should be kept in mind while **implementing any scheme** at the GP level. In the hilly areas, there is a demand for uninterrupted decentralised water supply treatment technology. NGOs in association with block level department should be given authority to handle support for water supply. Issues of water supply need to be resolved by engaging NGOs. Instead of iron made pipe PVC pipes should be used to avoid iron deformation which will also be cost effective.

Balangir - There is a need of uninterrupted water supply to every household of the villages. Any new technology if implemented by an organization, then it should make arrangements at the village level and for its maintenance. The power supply has been stopped in many places due to faulty solar panels, so technical support is also needed. **Overhead tank water supply** and **piped water connection** need to be provided to **every** individual house. **Clean water** should be provided by the water supply department, **irrigation water facility and regular pipeline water supply** to the residents. There is need of a **multiple tap system** at one water point so that more households can access at a given time. There is need of pipeline-based water supply in the hilly areas. **NGOs** in association with **Block Level Department** should be given authority to handle **support for water supply**.

2.2.4. Identified Stakeholders to be engaged in implementing new technology

The State, District and GP officials suggested and rated various key stakeholders to be engaged to implement the decentralised technologies for water supply/ treatment in their rural areas. They are mentioned in the table below.

Table 12: Critical stakeholders to be engaged

Stakeholders	Accountability for implementing/ operating	Nature of Interest	Rating for Importance	Rating for Influence
			(Scale of 1 to 5, 5 = highest)	
GP	Yes	Positive	5	5
VWSC	Yes	Positive	5	5
Block office	Yes	Positive	5	5
District office	Yes	Positive	5	5
Other corporates	No	Neutral	0	0
ASHA or anganwadi workers	Yes	Positive	4	4
Minority group representatives	Yes	Positive	3	3
Youth organizations	Yes	Positive	3	3
Women's organizations	Yes	Positive	4	5
NGOs	YES	Positive	4	4
Political party-1	Yes	Neutral	4	4
Political party-2	No	Negative	1	1
Individual 1	Yes	Positive	5	5
Other 1	Yes	Positive	5	5

2.3. Uttar Pradesh

The examination of drinking water and sanitation facilities access reveals that Uttar Pradesh has not yet accomplished its objective of providing piped water. Additionally, it demonstrates how many homes rely on their own private tubewells and pumps to fulfill their daily water requirements. In comparison to the rest of India, Uttar Pradesh has poor coverage for both residential sanitation and drainage services. Only 28% of the approximately 25.8 million in the State, according of the 2001 Census, had individual HH toilets [34]. With only 19.41% of its population connected to the tap, Uttar Pradesh has the lowest rate among states. From 26.4 million homes, 5.13 million have tap water access. The biggest tap water connections under JJM have been made in Bihar, Maharashtra, and Gujarat[35]. Focused group discussions were conducted at the state offices of Uttar Pradesh. The key findings are as follows:

2.3.1. Analysis at State and District Level

Current Status and Issues about the water supply in the district and the surveyed villages

1. **Jalaun District**

Water will be supplied through pipes at all places, there is no such area where water cannot reach. District officials usually cooperate to implement a new scheme. **Upcoming Success of JJM -** It has already been added to **574 GPs** and **853 revenue villages** are taken under the mission. Each and every home will get water due to their inclusion under the scheme. Construction work is in process and being done by contractor and agencies. Earlier water tanks are getting repaired. They have celebrated "**Jal Utsav Program" - Water Festival Program**, so that each and every village will get water.

Pond water is used for cattle rearing and there are tubewells in all farms and canals are also present. The source of water in the outskirts of the village is hand pump and tubewell. The canal water is carried through the river and the water is being given to the places where the water is saline. Pond water is also consumed. The living conditions of the people is decent as per the district official but the average income in the rural areas is only between ₹4,000-10,000/ month ($49-122/ month). Majority of the people are involved in farming and labour work while a few work in the service sector who earn decently while others' income is low.

Three surface water treatment plants at Kota, Raipura, Manipur will be installed near Jamuna River, through which every village will get water. In remote villages, domestic tap connections will be installed. There were serious problems regarding water supply but now the pipeline is being laid at many places, but tanks are not constructed yet. In total **355 water tanks have been constructed**. Groundwater testing training is being given in villages. Block office gives monitoring support to the GPs for the ongoing project and Sarpanch also participates actively. **Water demand for drinking purpose** is around **5 litres/ person** in the villages. Many houses from the villages have received connections except some but they will start only after installing taps and tanks.

- **Khutmila –** For domestic purpose, **taps, wells and handpumps** are present. Water from the taps and the wells dry up in summers and so, people have to rely upon **tankers** for the water. For **allied activities**, pond and river water is used.
- **Majhwar –** Water from handpumps is used for domestic purposes. No scheme is successful yet as there is no progress. For **allied activities**, water from ponds and wells is used.
- **Parausa –** Water from handpumps and wells is used for domestic purposes. For **allied activities**, water from ponds is used.
- **Itaura Bavni –** JJM work is still in progress and solar plants have been installed. There are only handpumps.

[34] https://www.researchgate.net/publication/289038240_Drinking_water_and_sanitation_in_Uttar_Pradesh_A_regional_analysis
[35] https://zeenews.india.com/india/jal-jeevan-mission-up-ranks-at-the-bottom-gujarat-seventh-state-to-achieve-100-per-cent-household-tap-2527161.html

Figure 30: Unhygienic conditions near handpumps in both the districts

2. Mahoba District

River water is used for cattle cleaning. Main sources of water are dams, wells, ponds and handpumps are placed at some places for domestic purpose. Wells are available for farming and animal husbandry. Majority of the rural residents of the district depend upon agriculture and labour work for livelihood generation. Labour work is also not a stable job for them. A scheme by the district offices is going on which employs at least 7-8 persons in the GP. Average income in the rural areas is observed to ₹4,000-5,000/ month ($49-61/ month). This income is not enough to educate their children.

Figure 31: Pond water used for allied activities

Functional Household Tap Connection (FHTC) provision for every rural home is in process under JJM. Even though a lot of schemes are provided, water scarcity is still an issue. **Identification of areas where water supply is difficult:** A survey is conducted in every village in the remote areas or the hamlets which is reviewed by the panchayat members to check coverage under that survey. For this a separate budget is set. Public Awareness about the Government Schemes is done through ISA to get their active participation. Block office in collaboration with district and state officials have created a portal from where different data can be obtained. Each GP has a **women's organization** or group consisting of **5 members and a YUVA organization** consisting of around **13 technicians and plumbers.**

- **Chandpura –** Water supply is through taps, tanks and handpumps. There are no piped connections but there are ditches because of which driving trucks and rickshaws becomes difficult.
- **Mirtala & Raheliya –** Water demand is **20 million litres**. There are **no arrangements for water pipe connections**, so they have to rely upon **tankers** sometimes for domestic purpose. For **allied activities**, water from **canals, handpumps and ponds** is used. **Solar plants** are being installed in the village.

Focused group discussions were conducted at the state, district and government offices of Uttar Pradesh and the outcomes are written below:

Table 13: Key Findings for the selected districts and villages in Uttar Pradesh

Aspects	Uttar Pradesh State Departments
Institutional Arrangement (Departments or Authorities) involved in the provision of water supply	• **Nagar Nigam** – does the water supply • In villages and Tourism Department – water supply is done by the local body • **Jal Nigam** – provide manpower resources to work under the scheme implementation

	• The primary means to get water supply are handpumps, tankers and tap water connections are through **JJM, State Water and Sanitation Mission and Jal Nigam**
Most hard-to-access areas, Approximate demand for water supply in these areas	• Eastern district of Uttar Pradesh is under hard to access areas. As these areas do not have groundwater recharges. • In the rural areas, villagers travel distant places to fetch water. The availability of water for the domestic purpose is mostly dependent upon tankers and handpumps. • Almost all households **get water once in 2 or 3 days** for **domestic purposes**. • Bundelkhand area persistently faces the scarcity of water. Many schemes are being run there. UP Government is planning to work with Israel Ministry of Water to launch a plan of cooperation for sustainable long-term water management for the Bundelkhand area[36].
Any improvement in the water supply provision	• JJM is being carried out with the target to supply Har Ghar Jal by 2024. But still the workability of implementation is at slower pace.
Water supply related technology providers active in the state	• No one as of now
Awareness programs conducted to conserve surface and groundwater	• JJM has conducted several training programs and workshops for water testing, conservation of surface water and reuse of grey water

Challenges in provisioning of water supply in rural areas

Agencies hired for construction are delaying the process. A lot of power issues, although Jal Nigam is supporting through the team of experts. Dependent on surface water and lack of groundwater. Community acceptance related to cost. A hand pump is an easy source for villagers. **Constraints and the operational gaps** are the difficulties in involving community and having their participation while implementing a new scheme.

2.3.2. Household Level Analysis at Rural Level of the Districts

The demographic details of the respondents from the chosen rural and remote areas of the Mahoba and Jalaun district from Uttar Pradesh have been studied to know their socio-economic background and also willingness to pay and participate in the newly provided services. Such details include gender, age, total members in the HH and the HH income.

Majority of the respondents were males - Over three-fourth from Mahoba and 55% from Jalaun while the rest were female respondents. The average **HH size** in rural areas of **Jalaun and Mahoba districts** is observed to be **5**. The respondents from the rural areas of both the districts were distributed across all the age categories as shown in the figure below. Almost **50**% of the respondents from **Jalaun** belong to the age group of **26-45 years** while **25**% belong to **46-60 years** of age group and only **10**% of them are above **60 years** of age. Similarly, for **Mahoba** district, almost **60**% of the respondents are from **26-45 years** age category, **25**% are from **46-60 years** of age and around **20**% are less than **25 years** of age.

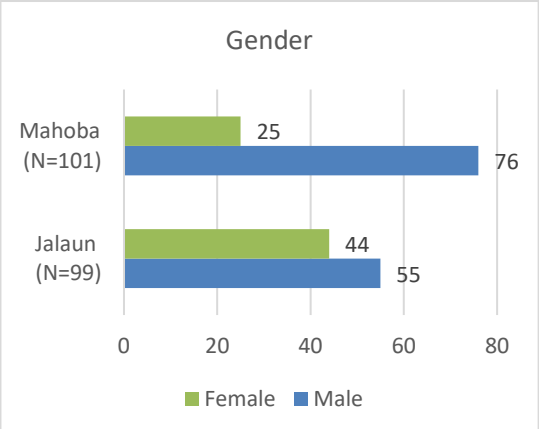


Figure 32: Gender of Respondents from Uttar Pradesh

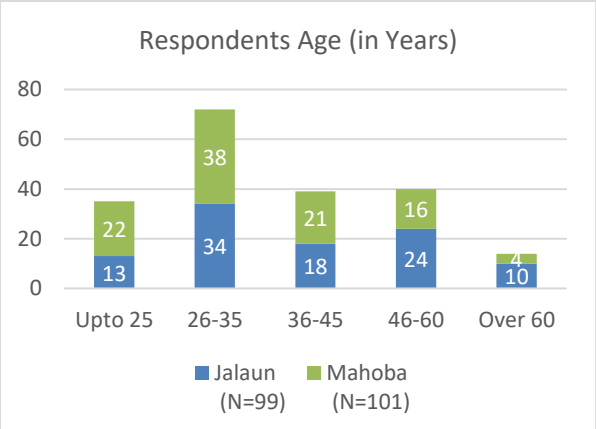


Figure 33: Age of Respondents from Uttar Pradesh

[36] https://timesofindia.indiatimes.com/city/allahabad/up-govt-israel-giving-final-shape-to-water-project-for-bundelkhand/articleshow/83217175.cms

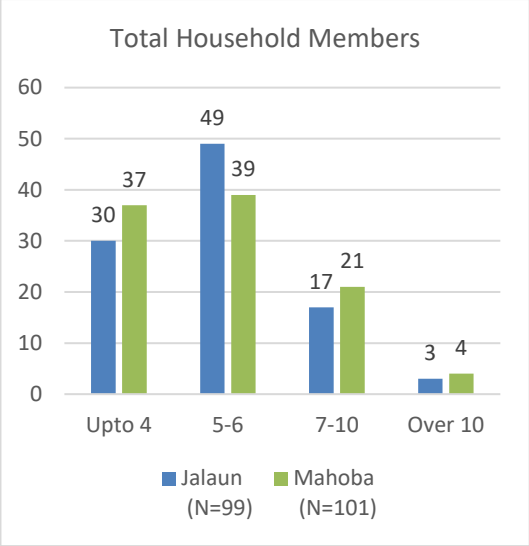


Figure 34: Total HH members in respondents' family

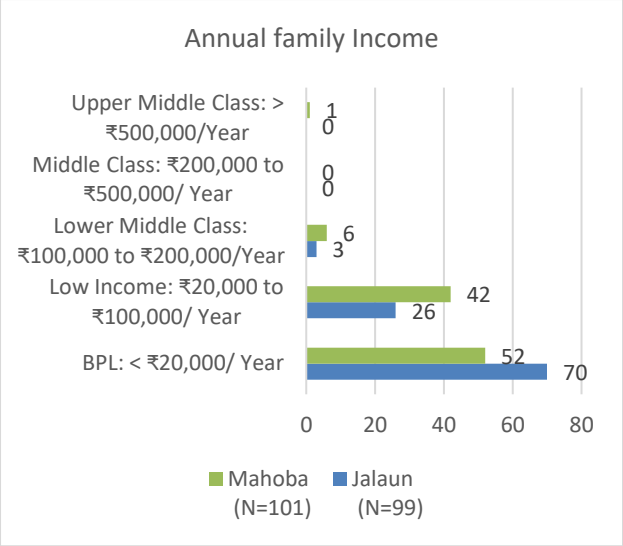


Figure 35: Total family income of respondents from Uttar Pradesh

The average HH income of the families of **70**% respondents from the rural areas of **Jalaun** district is less **than ₹20,000/ year (BPL category**) ($243.74/ year), as per the primary survey of HHs while as per GP Sarpanch, it was observed to be **₹4,000-10,000 per month (BPL category**) ($49-121.9/ month)**.** Around **25**% people from rural areas earn between **₹20,000-1,00,000/ year** ($243.74-1,218.7/ year)**. 70% p**eople from the rural areas of **Mahoba** earn less than **₹20,000/ year** (BPL category) ($243.74/ year), while 25% earn in the range of **₹20,000-1,00,000/ year** ($243.74-1,218.7/ year)**.** A very few percent (5%) of people earn from **₹1,00,000-2,00,000/ year** (**Lower middle-income group**) ($1,218.7-2437.4/ year). Most of the people are involved in farming and labour work and a few in service sector who earn more.

Current Dependency on drinking water supplied from different sources

As per the primary survey, major water sources in both the districts are rivers, canals, ponds and wells from which water is provided through pipelines, tankers and handpumps. Water pipeline provision to each and every HH is under progress through JJM. Around **60**% of the rural HHs from both **Jalaun and Mahoba districts** require upto **200-500 litres** of water each day while **30**% require **less than 200 litres** quantity of water each day for different purposes. Around **7-8**% also need **500-800 litres** water.

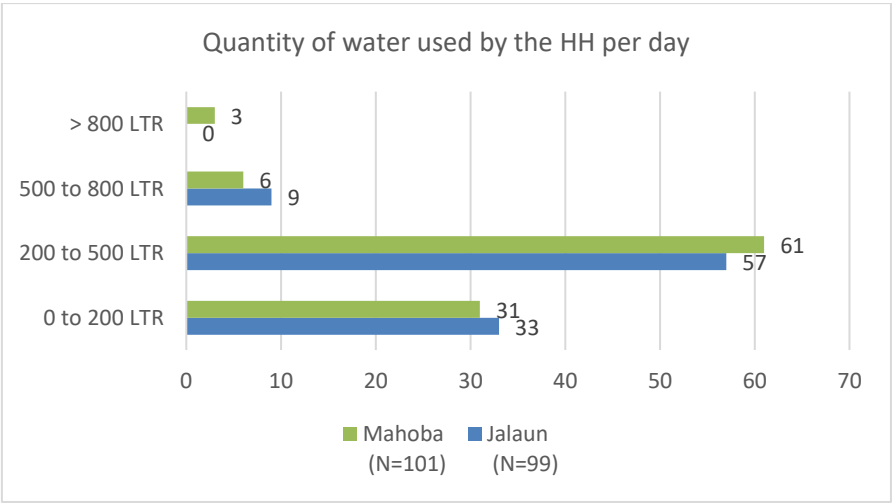


Figure 36: Daily quantity of water used by the rural HHs in the selected districts from Uttar Pradesh

Major source of water is through public handpumps in the rural areas of both the districts for drinking and other purposes. For **Jalaun**, almost **all people** are dependent on public handpumps and while a **very few** have **hand pumps** at their **homes**. In **Mahoba**, almost **65% people** are dependent on **public handpumps,**

one-fourth of the people are dependent on **public stand posts** and a few people have installed **hand pumps** at their homes. Below table shows the Projected Domestic and Drinking Water Demand (in cubic Million meters per day) using projected data of rural population and HHs calculated using the above primary data obtained for water requirement per day.

Table 14: Projected Domestic and Drinking Water Demand (in Mm^3/ day) in Uttar Pradesh

State	District	Projected Rural Population		HH Size	Projected Rural HHs		Average Water Demand per HH	Projected Water Demand (in Mm^3/ day)		Projected Drinking Water Demand (in Mm^3/ day)	
		2021	2031		2021	2031		2021	2031	2021	2031
Uttar Pradesh	Jalaun	14,31,521	15,91,968	5	2,86,304	3,18,394	291	0.083	0.093	0.007	0.008
	Mahoba	10,35,866	13,81,154	5	2,07,173	2,76,231	308	0.064	0.085	0.005	0.007

Water Potability and Type of Water Treatment Done at Household Level

The quality of water obtained from different sources, as mentioned above, has got an overall rating of **3 out 5** from the Sarpanch from the GPs of all the surveyed villages. Around **95**% of the rural respondents from **Mahoba and Jalaun districts** have reported the water to be potable. The remaining **5**% rural respondents from both the districts mentioned **muddiness, salinity, bad smell/ odour and contaminated water** as the major reasons for non-potability of water. To resolve the issue of non-potability of water, **people don't take any efforts to treat it at HH level, only 1% people filter or boil the water**.

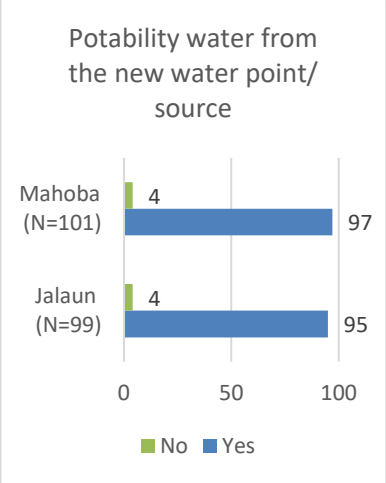


Figure 37: Potability water from the new water point/ source in the rural areas of the selected districts from Uttar Pradesh

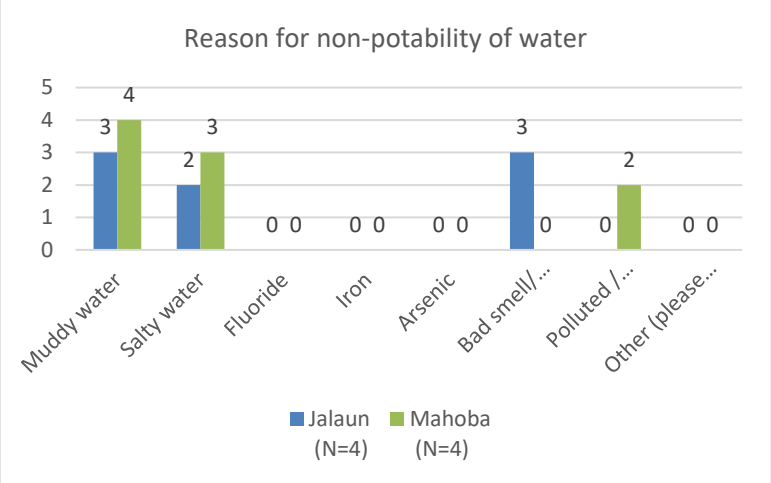


Figure 38: Reason for non-potability of water in the rural areas of the selected districts from Uttar Pradesh

Awareness about Renewable drinking water technology in the market

Almost **half of the respondents from the villages of both the districts are unaware** about the renewable drinking water technologies.

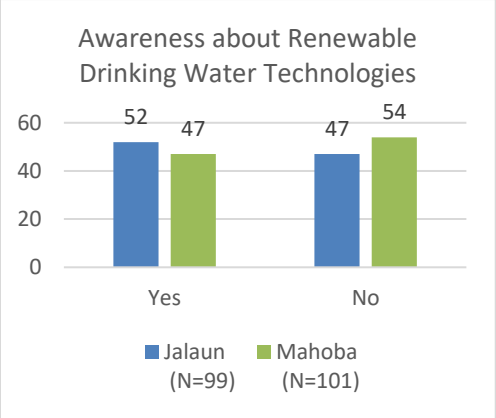


Figure 39: Awareness about Renewable Drinking Water Technologies of the rural HHs in the selected districts from Uttar Pradesh

2.3.3. Other Aspects

Willingness to support, use and pay for installing and maintaining Renewable Drinking Water Technologies by the Government Officials and the Community

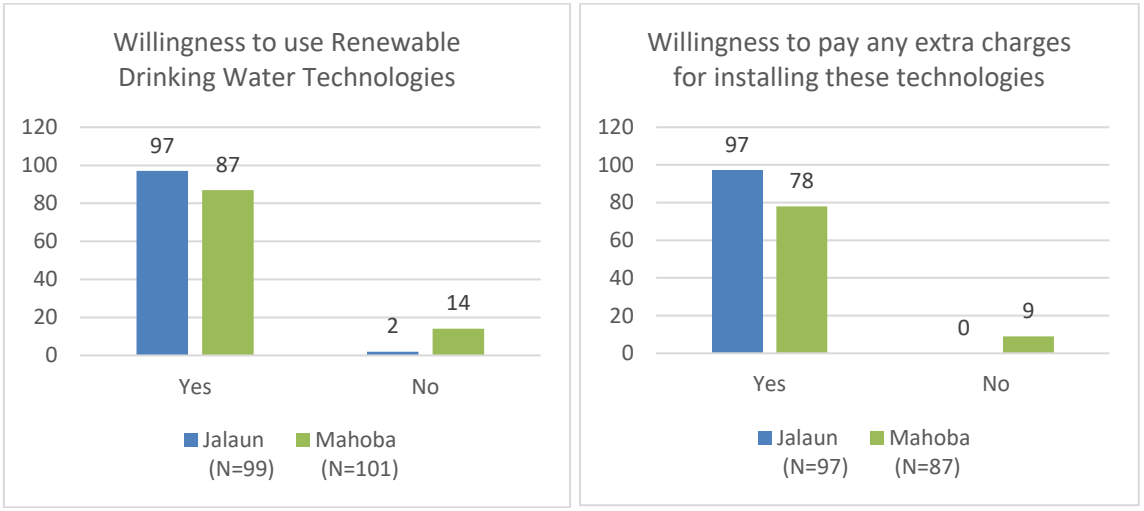


Figure 40: Willingness to use and pay extra for installing Renewable Drinking Water Technologies in the rural areas of the selected districts from Uttar Pradesh

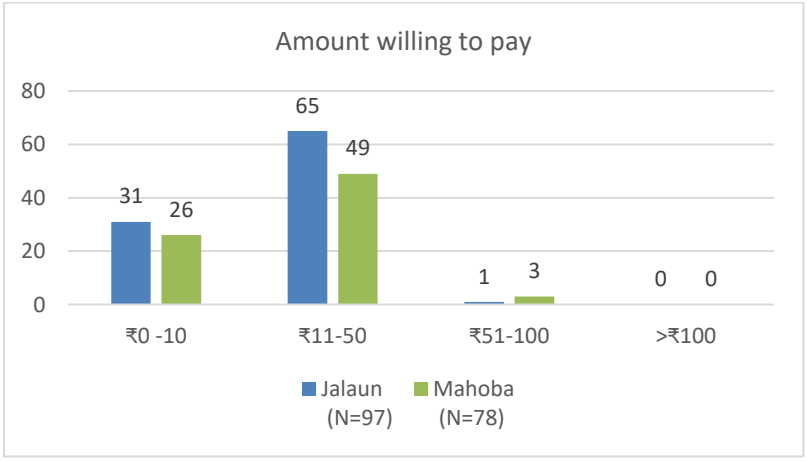


Figure 41: Amount willing to pay for such services in the rural areas of the selected districts from Uttar Pradesh

Almost all the respondents from the rural areas of **Jalaun** district are **willing to use and pay** the renewable drinking water technology even though there are water quality issues as stated by them. **31**% of them are willing to pay upto **₹10/ month** ($0.12/ month) while **65**% of them are ready to pay a charge upto **₹50 per**

month ($0.6/ month). Around **85**% of the respondents from the surveyed villages of **Mahoba** district are **willing to use** such technologies and around **80**% of them are willing to pay for such technology, One-third are ready to pay upto **₹10/ month** ($0.12/ month), **60%** are willing to pay from **₹11-50/month** ($0.13-0.6/ month) and a very **few** are ready to pay upto **₹100/ month** ($1.22/ month). Remaining are not willing to use and pay for such services.

The districts are ready to support any organization or NGO which implements any new system or technology for drinking water. Enough staff is available to implement a new technology.

Overall Rating

The overall rating given by the GP officials for the water supply services in the villages are displayed in the below chart. The water supply service delivery in Mahoba is satisfactory and all the other aspects can still be improved as per the officials. Jalaun district need a lot of improvement towards access to water, water availability and water quality which is saline while other aspects can also be looked upon.

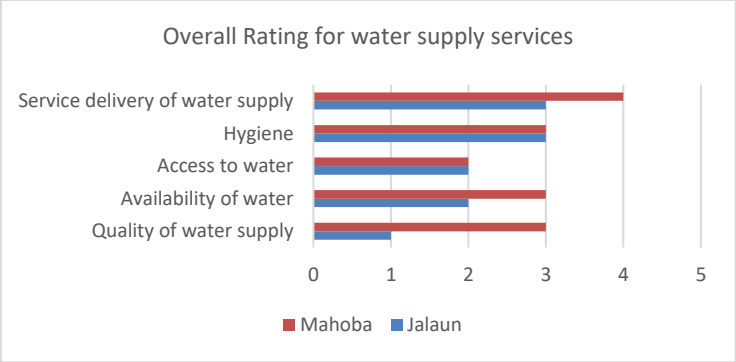


Figure 42: Overall Rating for water supply services

Suggestions by the officials

Jalaun - Officials have not given any suggestions, as many facilities are being installed for water supply as per them.
Mahoba - Officials expressed a need to create more awareness about water scarcity and conservation.

2.3.4. Identified Stakeholders to be engaged in implementing new technology

The State, District and GP officials suggested and rated various key stakeholders to be engaged to implement the decentralised technologies for water supply/ treatment in their rural areas. They are mentioned in the table below.

Table 15: Critical stakeholders to be engaged

Stakeholders	Accountability for implementing/ operating	Nature of Interest	Rating for Importance	Rating for Influence
			(Scale of 1 to 5, 5 = highest)	
GP	Yes	Positive	5	5
VWSC	Yes	Positive	5	5
Courtyard Shelter	Yes	Positive	4	4
Minority group representatives	Yes	Positive	2	4
Youth organizations	Yes	Positive	4	4
Women's organizations	Yes	Positive	4	4
NGOs	Yes	Positive	4	4
Political party-1	No	Negative	3	3

2.4. Maharashtra

Several areas experience water scarcity. An enormous water crisis is currently affecting Maharashtra. Amid drought years, river currents have slowed down, water levels in dams and reservoirs have dropped, and excessive groundwater use has expressed doubts about the water supply's long-term viability. The state dispatches the most water tankers ever to fulfill the potable water requirements of dry districts.[37] Water does not pump to the surface as a result of stratum fracture. The source well can be desilted just at moment of the field visit, therefore there is no water. In Summers, unsustainable sources dry up[38].

Contribution of accessible water in reducing costs and vulnerabilities: Drinking water supply in rural regions of Maharashtra changed from supply to a demand-driven method as per the demand of the rural residents[39]. The implementation of the water delivery programme in various districts of the State, has fully ended the struggle of women. Regardless of the sweltering 44^0Celsius summers, rural women had to trek large distances several times a day simply to obtain potable water for their family. With the advent of the metering system for bills, rural people now receive plenty of water at their homes each day[40].

2.4.1. Analysis at State and District Level

Current Status and Issues about the water supply in the district and the surveyed villages

1. Beed District

There is dependency of agriculture, animal husbandry on river and dam water for irrigation, drinking and cleanliness purpose. The domestic water sources are river, dam and wells. Water is supplied by tankers, handpumps. Farming crops like wheat, bajra, cotton and jowar is the primary occupation of the villagers in the rural areas of district while some also have their own businesses and some work as labourers. Average income ranges from ₹10,000-25,000/ month ($122-305/ month).

Under Atal Amrit Scheme, water will be easily accessible in all the villages except some villages where it is a bit difficult to provide pipelines due to natural obstacles. **The work is still in construction phase.** A tanker is provided in the rural and remote areas and also hand pumps (taps) are installed by the district officers. No tanker is provided in hard to access areas. There is a river, a dam and a filter plant from which water is supplied. There is need for adequate canal distribution channels which will be covered under the schemes. Demand for water is increasing day by day due to construction of new homes. When bathrooms are built, the demand for water increases. There are **funding issues** to deal with the situation during natural calamity like a flood. **Current Budget of Atal Amrit Yojana is about 10 to 15 crores. There are no active technology providers in the district. People set up filter plants privately who invest their own money and sell water.** JJM is yet to start or just connections have been given to the houses without tap provision in many villages of the district. Village wise observations are as follows.

- **Beed -** In the city, water is supplied through taps and pipes in sufficient amount for domestic purposes. The water is supplied through pipes in other villages. River water, wells and handpumps are used for allied activities.
- **Mogra - Godavari** River is a major source of water. Water is supplied through handpumps. Every member needs at least **6 to 7 litres** of water for drinking. Everyone drinks water from hand pumps as there is no piped water connection. The water that comes during **floods remains very dirty for 2 months**. There is a **well** for **cleaning** and **farming** purposes. The **river water** is used for **animal husbandry, agriculture, and sanitation**. The only challenge is finance, so that no scheme gets closed.
- **Shirur – Drinking** water comes from **Tagadgao dam** for domestic purposes. Water demand is around **0.5-0.7 million litres each day**. There is a need of a tap water scheme as water runs out frequently. The level of groundwater is too low and not potable. The water required for allied activities comes through the tanker.

[37] https://indianexpress.com/article/explained/simply-put-5000-dry-villages-in-maharashtra-6500-tankers-5777789/
[38] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ctara.iitb.ac.in/en/system/files/uma-unicef-iitb-irap-rws.pdf
[39] https://www.jstor.org/stable/25664046
[40] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://jalshakti-ddws.gov.in/sites/default/files/09.01.14_E_NEWSLETTER.pdf

- **Wadwani – Dam water** is supplied for all purposes. **Filter plant** is there. Per capita drinking water is around **2.5 litres/ day.** There is no problem related to water as everyone gets sufficient amount of water.

Figure 43: Issues like unhygienic conditions near water tap, water wastage and poor water quality in rural areas

2. Raigarh District

Water is supplied by pipes and somewhere by tankers to the most hard-to-access where supply is not possible. **There are some villages in the hilly area where it is very difficult to send water. Water is sent by tanker in that area but the cost is high**. There is no water connection in the rural and remote areas. A tank has been built there and then water is poured into it which is then supplied to everyone in such areas. Water is transported by tanker in hard to access rural areas where it is not possible to deliver water. Water demand has increased in the district because people are building houses, bathrooms in their villages. The domestic water sources are River, dams, ponds and wells. Water is supplied by tankers, handpumps. People are dependent on farming and labour work for their livelihood. Average income ranges from ₹5,000-20,000/ month ($61-242.5/ month).

There are **bureaucracy issues** to supply water which acts as a biggest challenge. It can be easy if the task is given to administration. The terrain of the district/block require implementation of decentralised water supply system. Villagers use more water nowadays as new houses and toilets are being built. Raigad district comes at **number 5** in terms of **cleanliness**. Currently water is supplied through MJP. The budget of JJM is around **4 million to connect 1,540 villages** but it is yet to start or just connections have been given to the houses without tap provision in many villages of the district. Village wise observations are as follows.

- **Kurul –** At present, water distribution is through **MIDC** only for **domestic** purposes. **No other scheme** is there. Water demand is **200,075 litres daily**. Water from ponds is taken for **sanitation, agriculture, and animal husbandry.**
- **Umbarde –** Water is supplied through **Pani Puravtha Scheme**. So, clean water is suppled under a scheme **every day** for **2-3 hours** and from **dams to pipelines** for **domestic purposes.** There is a scarcity of water during April-May.
- **Amboli –** People get water through a scheme, but the contractor provided dirty water. Even people and government in the village are not very supportive towards a new scheme. **Water Demand** is around **0.3 million litres/ day.** Groundwater is single source which is available in a plentiful amount and is used for all purposes.
- **Morbe –** There is a **well and a tank**. Tank gets **groundwater** using a motor and a **pipeline** is connected to the tank which provides to everyone. **Tablets** are used to **kill viruses** from water once in 15 days. But the groundwater table is much down. Other source for **drinking** water is a **river**.

Figure 44: Packaged drinking water and water purification plants in rural areas of both the districts

Focused group discussions were conducted at the state offices of Maharashtra. The state offices include Department of Environment and Climate Change Government of Maharashtra and **Water Supply and Sanitation Department**. The key findings are as follows:

Table 16: Key Findings for the selected districts and villages in Maharashtra

Aspects	Maharashtra State Departments
Institutional Arrangement (Departments or Authorities) involved in the provision of water supply	• Water Supply and Sanitation Department • Maharashtra Jeevan Pradhikaran (MJP), Mumbai • Groundwater Surveys & Development Agency (GSDA), Pune
Any improvement in the water supply provision	• There were schemes in Maharashtra but as per the guidelines before only 44 LPCD of water was supplied but now 55 LPCD is supplied. • Earlier some villages did not even have water supply schemes. • As prescribed in JJM guidelines, water quality is tested in labs with regular bases like **biological sampling and chemical sampling**. So, now purified water is supplied. • **Women are given training** on how to test water
Further improvements to be made	• Goal is to complete our mission efficiently and on time and as of now, the dashboard is 60-70% completed. • In Maharashtra, **GPs not only participate but they also launched multi schemes** for 40 villages which were very big schemes and it is the big thing for us and so, there is need to make one committee for whole people of village

Challenges in provisioning of water supply in rural areas from the State Perspective

Main intention of Jal Jeevan Scheme is to provide 55 LPCD of tap water and its facilities in every house with maintained water quality. The main challenges are to find a **reliable source to supply yearly water to the rural HHs**. **Constraints and operational gap**: It is difficult to **bridge a gap** between Irrigation Potential Created (**IPC**) and Irrigation Potential Utilized (**IPU**). There are **losses in Urban Distribution Network** and a need to **reduce the Non-Revenue Water (NRW)** and restricting domestic water use within the prescribed norms particularly in urban areas is a key issue which needs to be addressed on priority[41].

Challenges, barriers and willingness in the implementation of any new system or technology related to water supply

There is no filtration plan for rural areas. There are issues of capital maintenance charges to maintain a newly provided service. The state and district will design a scheme for any new technology which comes up and after implementation of any such technology, it should go at least for the next 30 years. If there are huge capital means then the technology can be implemented by forming and launching policies otherwise without capital, it becomes difficult to implement the schemes. People should also believe that new technology to increase its usage and this can be done by advertising that scheme. Such technologies also require the cooperation of people towards maintenance and tax payment.

According to the GSDA Official, **adopting a new technology might not work out well in rural areas** because currently people only pay ₹300 - 400/ year and ₹1000 max ($12/ month) in HUDCO designated areas

[41] https://wrd.maharashtra.gov.in/Site/Upload/PDF/State%20Water%20Policy%2005092019-pages-32-55.pdf

and **25 paisa/ 1,000 litres ($0.003/ month)** in other rural areas[42] for water. If an enhanced technology is installed, they govt. may not get any charges from the people to maintain the existing water supply system. There are around 40,000 villages from where uneven amount is obtained from each village. These initiatives should be taken by the gram panchayat itself and the scheme is adopted it means it should also be maintained properly. And also, MJP also designs some schemes and even they have their own schemes.

2.4.2. Household Level Analysis at Rural Level of the Districts

The households from the four selected villages from each district were surveyed to identify their demographic and socio-profile, dependency on different types of water sources,

Demographic Profile of Respondents

The demographic details of the respondents from the chosen rural and remote areas of the Beed and Raigarh district have been studied to know their socio-economic background and also willingness to participate in new provided services. Such details include gender, age, total members in the HH and the HH income.

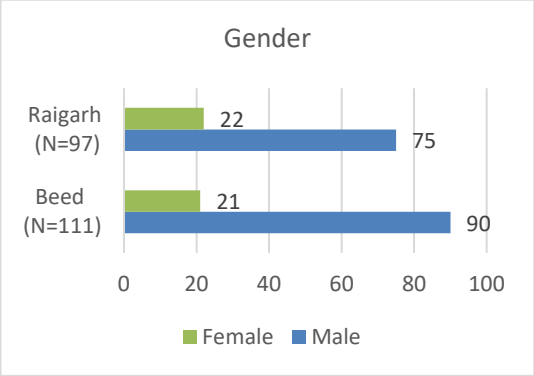


Figure 45: Gender of Respondents from Maharashtra

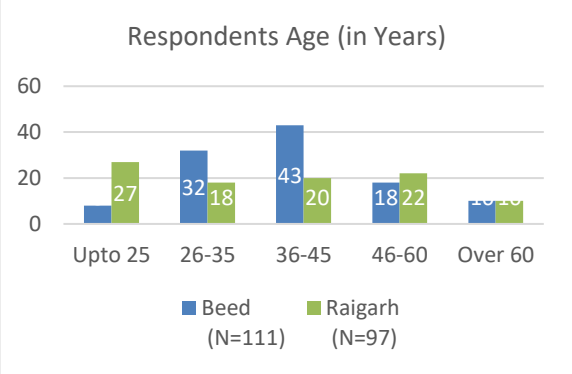


Figure 46: Age of Respondents from Maharashtra

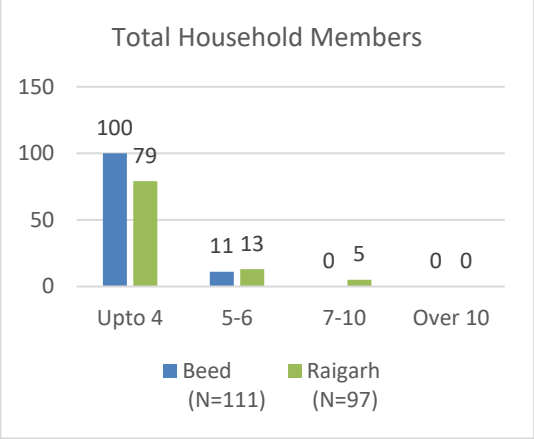


Figure 47: Total HH members in respondents' family

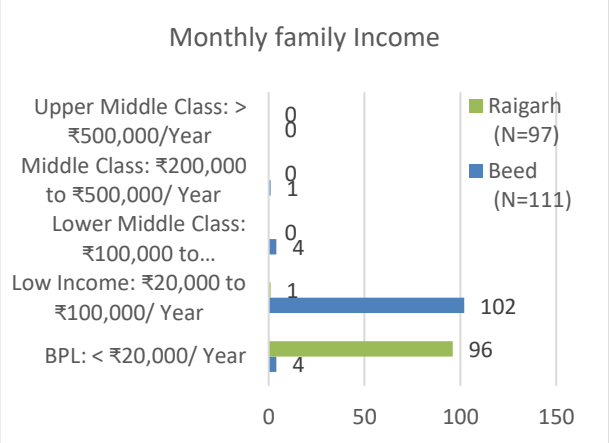


Figure 48: Total family income of respondents from Maharashtra

Majority of the respondents were males - Over three-fourth from Raigarh and four-fifth from Beed while average **HH size** in both the districts is observed to be **4**. The respondents from Raigarh were distributed across all the age categories as shown in the above figure. Almost **70**% of the respondents from **Beed** belong to the age group of **26-45 years** while **16**% belong to **46-60 years** of age group and only **9**% of them are **above 60 years** of age. Similarly, for **Raigarh** district, almost **40**% of the respondents are from **26-45 years** age category, **22**% are from **46-60 years** of age and around **27**% are less than **25 years** of age.

The average monthly HH income for rural areas of **Raigarh** district is less **than ₹20,000 per month (BPL category**) ($244/ year), as per the primary survey of HHs while it is **₹20,000-1,00,000 per month (Low**

[42] https://indianexpress.com/article/cities/mumbai/maharashtra-govt-hikes-water-tariff-for-agriculture-domestic-and-industrial-sectors-5032136/#:~:text=Water%20tariff%20for%20individual%20farmers,the%20tariff%2C%20said%20an%20official.

Income category) ($244-1,219/ year) in the **Beed** district. Majority of the people are involved in **cultivation of crops like wheat, jowar, bajra and cotton and some have their own businesses.**

Current Dependency on drinking water supplied from different sources

As per the primary survey, major water sources in both the districts are rivers, dams and wells from which water is provided through **pipelines, tankers and handpumps**. Water pipeline provision to each and every HH is under progress through JJM. Around **three-fourth HHs** from **Raigarh** require upto **200 litres** of water each day while remaining **one-fourth** require **200-500 litres** quantity of water each day. Around **half** of the people living in rural areas of **Beed** district require more than **500 litres** of water each day. **40**% people need **200-500 litres** of water each day while only **10**% need **less than 200 litres** of water per day.

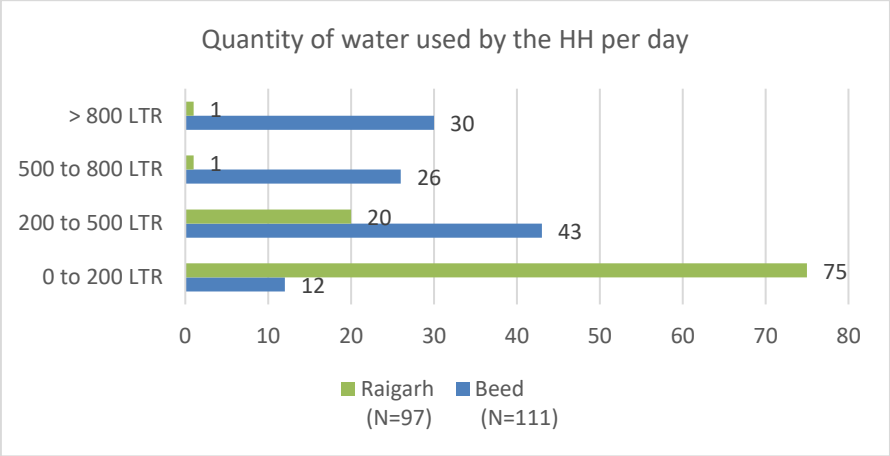


Figure 49: Daily quantity of water used by the rural HHs in the selected districts from Maharashtra

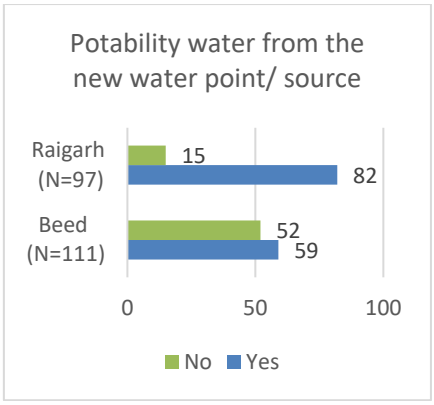
Major source of water is through **pipelines** into rural HHs of both the districts for **drinking and other purposes**. **Raigarh** also has **public stand posts and ponds** while **Beed** has **public RO water** and other source of water supply delivery systems. Water required for other purposes is through **public hand pumps**, **ponds, rivers** in rural areas of **Beed** and through pu**blic stand posts and other sources** in rural areas of **Raigarh** district. Below table shows the Projected Domestic and Drinking Water Demand (in cubic Million meters per day) using projected data of rural population and HHs calculated using the above primary data obtained for water requirement per day.

Table 17: Projected Domestic and Drinking Water Demand (in Mm3/ day) in Maharashtra

State	District	Projected Rural Population		HH Size	Projected Rural HHs		Average Water Demand per HH	Projected Water Demand (in Mm^3/ day)		Projected Drinking Water Demand (in Mm^3/ day)	
		2021	2031		2021	2031		2021	2031	2021	2031
Maharashtra	Beed	23,58,575	26,46,398	4	5,89,644	6,61,600	572	0.337	0.378	0.012	0.013
	Raigarh	17,47,920	18,31,834	4	4,36,980	4,57,959	160	0.070	0.073	0.009	0.009

Water Potability and Type of Water Treatment Done at Household Level

The quality of water obtained from different sources, as mentioned above, has got an overall rating of **4 out 5** from the Sarpanch from the GPs of all the surveyed villages. Around **85**% and **50**% of the rural respondents from **Raigarh** and **Beed** district, respectively, responded **positively regarding the potability of water**. The remaining rural respondents from **Raigarh** mentioned **muddiness, salinity and presence of iron** as the major reasons for non-potability of water while in **Beed**, the major reasons for non-potability are **muddiness, bad smell/odour and contaminated water.**



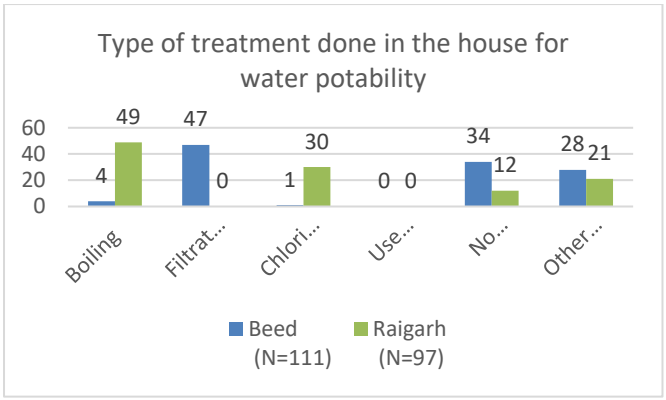


Figure 50: Potability water from the new water point/ source and type of treatment done at household level in the rural areas of the selected districts from Maharashtra

To resolve the issue of non-potability of water, people take efforts to treat it at HH level. In **Raigarh**, around **half** of the respondents prefer **boiling the water, one-fourth prefer chlorination** method while about **10**% **don't do any kind of treatment** at home. In rural areas of the **Beed** district, **40**% respondents prefer **filtration** and around **30**% **don't prefer any kind treatment** of the water.

Awareness about Renewable drinking water technology in the market

Almost **all** the respondents from the villages of **Beed** district are **aware** about the renewable drinking water technologies while for rural respondents from **Raigarh**, the figure is around **40**%.

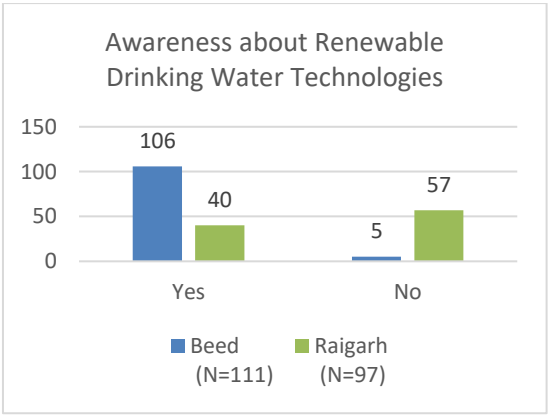


Figure 51: Awareness about Renewable Drinking Water Technologies of the rural HHs in the selected districts from Maharashtra

2.4.3. Other Aspects

Willingness to support, use and pay for installing and maintaining Renewable Drinking Water Technologies by the Government Officials and the Community

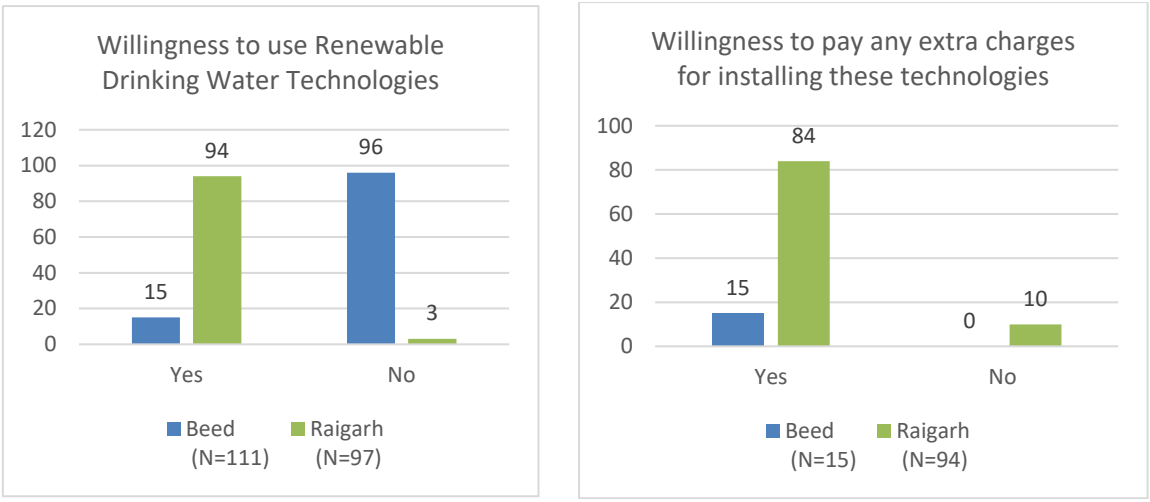


Figure 52: Willingness to use and pay extra for installing Renewable Drinking Water Technologies in the rural areas of the selected districts from Maharashtra

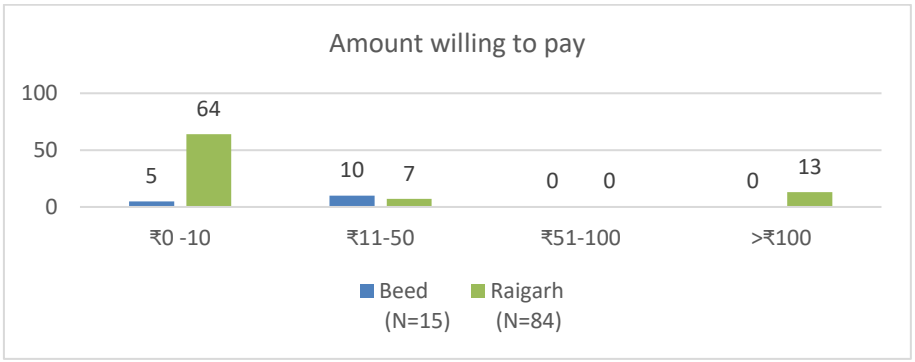


Figure 53: Amount willing to pay for such services in the rural areas of the selected districts from Maharashtra

Only **15**% of respondents from the rural areas of **Beed** district are **willing to use and pay** the renewable drinking water technology even though there are water quality issues as stated by them. They are ready to pay a charge upto **₹50/ month** ($0.6/ month). Almost **all** the residents from the surveyed villages of **Raigarh** district are **willing to use such technologies** and around **70**% of them are **willing to pay** upto **₹10/ month** ($0.12/ month), **7**% are ready to pay from **₹11-50/ month** ($0.13-0.6/ month) and **15**% are willing to pay **more than ₹100/ month** ($1.22/ month). The remaining are willing to use but do not want to pay for such services.

All the district and GP officials were asked their willingness to participate and support a new technology which can be implemented at the rural level. **Beed District** - As per the district official, there is no challenge to implement a new scheme or technology and villagers and the district officials will fully cooperate towards it. Only **issue** in **finance** and if it is provided by the government, then more people should be benefitted. **Raigarh District -** The **challenge** is the slow movement due to bureaucracy because of which people do not allow implementation of big projects in their areas otherwise they will easily cooperate with new schemes People have some expectations from Swachh Bharat Mission and JJM. District officials are also willing to implement new schemes in the villages and district.

Overall Rating

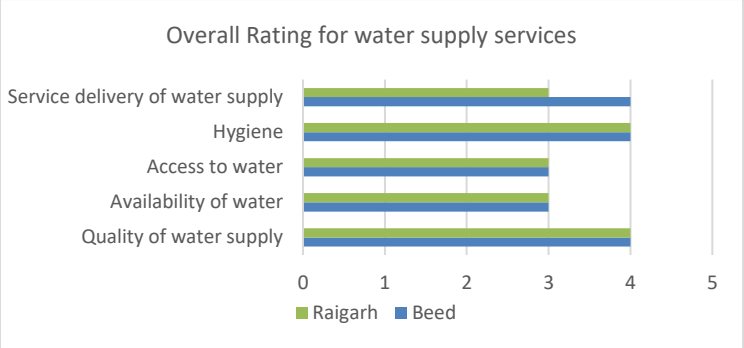


Figure 54: Overall Rating for water supply services

The overall rating given by the GP officials for the water supply services in the villages are displayed in the below chart. Beed district has comparatively higher rating in terms of service delivery of water supply than Raigarh district and it is same for other aspects.

Suggestions by the officials

Beed - Remote and inaccessible areas should be provided with clean drinking water as per their needs in the rural areas of Beed District.

Raigarh - Government should provide enough finance to implement different schemes in the rural areas of Raigarh District.

2.4.4. Identified Stakeholders to be engaged in implementing new technology

The State, District and GP officials suggested and rated various key stakeholders to be engaged to implement the decentralised technologies for water supply/ treatment in their rural areas. They are mentioned in the table below.

Table 18: Critical stakeholders to be engaged

Stakeholders	Accountability for implementing/ operating	Nature of Interest	Rating for Importance	Rating for Influence
			(Scale of 1 to 5, 5 = highest)	
GP	Yes	Positive	5	5
VWSC	No	Negative	0	0
Block office	Yes	Positive	5	5
District office	Yes	Positive	5	5
Other corporates	No	Negative	0	0
ASHA or anganwadi workers	Yes	Positive	4	4
Minority group representatives	No	Neutral	3	0
Youth organizations	Yes	Positive	4	4
Women's organizations	Yes	Positive	4	4
NGOs	No	Negative	0	0
Political party-1	No	Negative	0	0
Political party-2	No	Negative	0	0
Individual 1	No	Negative	0	0

Chapter 3: Key Findings for Renewable Drinking Water Technologies

3.1. Key details for Renewable Drinking Water Technology

Since there are very limited technologies for drinking water based on renewable sources, the below tables show the key findings for value chain of 2 such technologies which we have considered for the purpose of this study namely i.e., 1) SOURCE Global and 2) URAVU providing renewable drinking water using a sustainable water technology to extract water.

Table 19: Value Chain Details

Aspects	SOURCE Global	URAVU
Purpose of the Technology	• To develop a 100% renewable drinking water option, use hydro panels that work on solar energy, transforming the energy sectors.	• To develop a 100% renewable drinking water option using Solar Photovoltaic Technology (Solar PV), which transforms the energy sectors.
Concept	**Steam Shower Concept – as water droplets on walls.** • **Creating renewable drinking water with hydro panels that will produce water from sunlight and moisture using solar energy** • Each hydro panel has patented hydroponic material that absorbs moisture from the atmosphere and is heated inside the hydro panel. Once the moisture is heated and when the water encounters a cooler surface (walls of the panel), the water droplets are formed. • A complete stand-alone device can be placed near sunlight to get mineralized drinking water	• Using a renewable source of energy like Solar PV, which is decentralized and accessible and produces 100% renewable water from air solution to bridge the gap in drinking water • Solar PV produces water as per the Relative Humidity (RH) of an area
Workability	• The product works on **moisture absorption and humidity.** • Completely solar powered (the technology consumes more solar power energy than the energy consumed for other purposes by solar panels. • Coastal areas will be benefitted as the area can produce an 8-10% humid climate	**Water from the air in 2 ways** • **Conventional technology – air conditioning (desiccant) based, also called atmospheric water generators (AWG)** • The technology creates an icy surface and then condenses the moisture present in the air by passing the air through the cold surface. Water droplets are developed on the outer surface of the extracted cold surface. • **URAVU uses AWG desiccant-based hygroscopic material that can absorb moisture and form water with the help of a heat process rather than cooling.** • Desiccant material, in the form of gel, is being used to absorb water, known as the absorption process (suppose it weighs 3 kg and after 3 hours it is 12 kg, that means within 3 hours it has absorbed 2 litres of water from the moisture/air). • Once the absorption is done, the material is heated up to 60-700^{0}Celsius, condensing to form fresh water. • Energy used can be from solar, e-waste, electricity, and biomass. Currently, solar and electricity are being used.
Market Demand and Cost Benefits	• Market demand is as per the production capacity, which varies with moisture • It is best suited for remote areas where the government cannot lay pipelines and where water is scarce. • Several health benefits include adding minerals to the water compared to other purifying technologies like RO and DFU, which remove essential minerals from the water.	• Water production depends upon and varies as per the RH of any location at a given period. • **Depending upon the scale and usability, cost, and Will from government, CSR, community, and policy.** • There is a higher demand from the industrial and commercial sectors. • Beverage industries consume a high capacity of water (million litres of water per day)

		• Several health benefits include adding minerals to the water • Electricity consumption increases with decreased RH (For **80% RH – 330Watt/ litres; for 30% RH, the energy consumption increases fivefold**) • Benefit margins are more depending upon the quality commercials can charge extra for better water quality to get their profit margins.
Size of the Equipment	• Each panel roughly occupies around **6 sq. metre**	• Each unit roughly occupies around **4-metre x 2-metre** space
Production Capacity and types of available units in the market	• Currently, the technology is in its pilot phase, so only a single type of unit with 5-10 litres of production capacity is available in the market. • In places like the Western Ghats, the production is **6-8 LPD** • In **coastal** areas like Chennai and Mumbai, water production is **10 LPD**	• Three types of units are available in the market with varying production capacities as per the desiccant mass – 20, 200, 500 and 2,000 litres • In places like Chennai, Mumbai etc., with 80% RH, a unit having **100 litres capacity can extract 95-100 LPD of water** • In a place like Bangalore, where **RH is 60-70%, 40-50 LPD** of water is produced. • In places like Rajasthan, Uttar Pradesh, where RH is less, units with 100 litres capacity can produce 20 litres of water each. • So, the production capacity increases with the desiccant mass and the type of location to increase the water capacity (in areas with less RH, more desiccant is placed to absorb water)
Installation Cost	• **The production and installation costs around ₹0.2 Million ($2,438) per unit**	• **Cost varies by 10-20% depending upon the desiccant installed**. • **20 LPD capacity unit -** used for villa projects for a family of **4-5**, the cost will be around **₹6-7/ litre** ($0.073-0.085/ litre); Installation cost **(CAPEX – ₹0.4 Million ($4,875))** – **is the costliest** • **200 LPD capacity unit** - installed in commercial spaces, offices, hotels, and schools, the cost will be around **₹4/ litre** ($0.05/ litre); Installation cost (**CAPEX – ₹1.8 Million ($0.22 Million)**) • Capacity between **2,000-5,000 LPD** – can cater to the **beverage** industry
Operation and Maintenance Costs	• AC filter-type filters in the panel can be changed once a year. • Mineral cartridge, which adds minerals to the water – can be changed • Product life – minimum 20 years • Annual maintenance cost – **₹2500/year** ($30.5/ year)– (Similar to the solar panel)	**Operation Cost** • **Depends upon RH of an areas** – The higher the % of RH, the higher the water absorption, and the lesser the energy; lower the % of RH, the manifold the energy consumption, increasing the operation cost. • Depending upon the climate/weather conditions, the need for the desiccant varies with the technology cost. The technology is a one-time investment. The cost increases by 10-20%, depending upon the RH. • **So, an increased operation cost is required to install and operate a unit in areas like Rajasthan, Uttar Pradesh (western ghats) where RH is low.** • **The operation cost of water can vary from ₹5 to ₹15 ($0.06-0.18) depending upon the RH fluctuation.** • For community spaces with water scarcity, residents can want to buy water, for **₹2/ litre** ($0.024/ litre), made using 2,000 LPD capacity unit. **Maintenance Cost** • Minimal cost required for air filters and cartridge to be replaced, which comes to around **5 paise/ litre** ($0.0006/ litre). • URAVU provides **free maintenance for first 5 years**

Cost Recovery	• Helps in developing the ground water recharge by not utilizing the water table for longer period	• Market to the consumers highlighting that the fact that renewable water is being used to make the product (when installed for the beverage industry)
Demand Aspects	• The quantity of water per day required for drinking depends on the number of people. • Considering 5 litres of water required for drinking per person, the panel can be installed depending upon the requirement for the demand-supply of drinking water.	• Mainly for the beverage industries like the manufacturing of beer, and soft drinks, where water consumption is high. • The system is installed/can be used mostly for communal space, depending upon the per person per day water requirement for drinking and cooking
Supply Aspects	• Currently, 1 module is available – 5-10 LPD capacity	• Currently, 4 modules are available – 20, 200, 500 and 2,000 LPD capacity • If the requirement is more, the modules can multiply
	• JJM also provides 55 LPCD/person/day water for domestic purposes to every household.	
Operation and Maintenance Recovery	• Partnering with local NGOs will train the people inside the community, and appoint head trainers and operators from among themselves to collect a minimal amount for maintenance. • The amount will be collected in O&M from the person in the village to pay the annual maintenance for the technology. • VWSC group can be developed – For the water supply technology unit audit – Depending upon the willingness of the people to pay for the annual maintenance	• For the community, **₹2/ litre** ($0.024/ litre) is entirely **not cost-effective**. Hence, it can be **partnered** with strategic bodies like World Bank, WHO, or any big corporates who do CSR projects that can subsidize the operation and maintenance cost by **50-80**%. • The remaining amount will be collected in O&M from a person in the village to pay the annual maintenance for the technology. • VWSC group can be developed – For the water supply technology unit audit – Depending upon the willingness of the people to pay for the annual maintenance
Affordability	• Affordable to communities • As the product life is a minimum of 20 years. After 20 years, only the hygroscopic material needs to changed and not the entire setup.	• The installation is a onetime investment which has a product life of 15-20 years. After 20 years, only the filter needs to be changed and not the entire product. • Affordable for large scale industries (beverage) and communal spaces for large number of people. • The product can be developed and installed based on the number of users and hence the installation cost.
Benefits	• **Availability** – Do not have to depend upon groundwater recharge and its quality • **Affordability** – Getting filtered/purified water at an affordable cost • **Health Benefits** – Adding minerals to the water • **Hygiene** – no quality issues like smell, colour, dirt etc. • **Environmental benefits** – Reducing the wastage of water as compared to RO – Preventing emission material usage like the use of plastic bottles – Replacing groundwater with renewable drinking water • It can be installed anywhere • No artificial power consumption • Less maintenance	• **Availability** - **100**% output throughout the year – how much water is required for drinking can be extracted. • **Health Benefits** – Better quality water as compared to Bisleri water • **Hygiene** – no quality issues like smell, colour, dirt etc. • **Environmental benefits** – Reducing the wastage of water as compared to RO – Preventing emission material usage like the use of plastic bottles – Replacing groundwater with renewable drinking water – Preventing groundwater from depletion, especially in the beverage industries, which use 2,000-5,000 LPD of water.
Impacts	• **The impact of the product is based on the pilot installations. The product is in the process of working.**	• **Environmental Impacts -** For the 2,000 litres module, considering groundwater with RO combination, where RO is used to filter the groundwater. Comparing it with the URAVU module, RO emits 3.5 grams of CO_2 per 1 litre of water produced, which in the URAVU's case is 0 grams. However, for 2,000 litres, in case of RO needs 1 million litres of water to be withdrawn from the ground. Hence, **saving thousands of**

		litres of water wastage and 100s of carbon emissions. • **Social Impacts –** In the case of rural areas, saving time travel to consume water on a per-day basis. • **Sustainability Impact (SDG-3) –** Improving access to water and preventing the spread of water-related diseases.

3.2. Technology Analysis

We have developed a typical Cost Benefits Analysis basis the available information and data obtained from primary surveys including literature review. The details are provided below:

Table 20: Drinking water cost per litre for the identified markets based on a 'True-cost' approach, including parameters

Parameters	Description	Rajasthan	Odisha	Uttar Pradesh	Maharashtra
Current cost of drinking water alternatives	Safe drinking water at the household level	**₹2/ 1000 litres** ($0.024/ kilolitres) for RO purified water **₹800-1000** ($9.75-12) for tanker water from canals or tubewells	**37.5 paise/ 1000 litres** ($0.0046/ kilolitres)[43]	**20-30 paisa/ 1000 litres** ($0.0024-0.0036/ kilolitres)	HUDCO Designated rural areas: **₹1000/ year** ($12/ year) but some **hardly pay ₹300-400/ year** ($3.66-4.9/ year) Other rural areas: **13.5 paisa/ 1000 litres** ($0.0016/ kilolitres)[44]
Wholistic **value of impacts** to communities	**Health Benefits:** Cost saved on health check-ups due to water borne diseases (INR/ailment)[45,46]:	*Non-hospitalised treatment: 842	Non-hospitalised treatment: 550	Non-hospitalised treatment: 762	Non- hospitalised treatment: 528
		**Hospitalised treatment: 16,268	Hospitalised treatment: 11,159	Hospitalised treatment: 23,144	Hospitalised treatment: 19,383
	Better Hygiene Benefits: No smell and odour of drinking water	Cannot be quantified			
Opportunity cost of water	**Time savings**: Women walking several hours to get water for all the purposes for the family vs. Income that could've been earned from working in those hours	Cannot be quantified: Not so significant because women will still have to travel those distances to fetch water for other purposes, or they will have to rely upon and spend money to buy tanker water	-	Cannot be quantified: Not so significant because people still will have to fetch water from handpumps and tubewells for other purposes	Cannot be quantified: Not so significant because people still will have to rely upon handpumps, tubewells and sometimes spend money to buy tanker water for other purposes
	Increased Productivity of women: Women investing their time in education and other hobbies				
	Livelihood opportunity for women: Women engaging themselves in local jobs				
Direct environmental cost of current solutions	Plastics, RO reject water, Brine from desalination plants	• RO reject water can impact the soil quality if disposed of improperly.[47] • Desalinated water costs around **₹3500/ 1000 litres** in India which is quite high[48]. • One of the studies show 1.5 times more brine than the desalinated water is formed at the plant which amounts to 51.8 billion cubic meters/ year[49].			

* **Non-hospitalised treatment**: Average medical expenditure per spell of ailment for non-hospitalised treatment during a 15-day period
** **Hospitalised treatment**: Average medical expenditure incurred for treatment during stay at hospital per case of hospitalization

[43] https://www.newindianexpress.com/states/odisha/2021/apr/11/water-to-cost-10-per-cent-more-in-odisha-from-this-month-2288623.html#:~:text=As%20per%20the%20notification%20issued,is%20five%20cusec%20or%20more
[44] https://indianexpress.com/article/cities/mumbai/maharashtra-govt-hikes-water-tariff-for-agriculture-domestic-and-industrial-sectors-5032136/#:~:text=Water%20tariff%20for%20individual%20farmers,paise%20and%2013.50%20paise%2C%20respectively.
[45] http://164.100.161.63/sites/default/files/publication_reports/KI_Health_75th_Final.pdf
[46] http://www.indiaenvironmentportal.org.in/files/file/national%20health%20profile%20india%202021.pdf
[47] https://www.researchgate.net/publication/355339219_INFLUENCE_OF_REVERSE_OSMOSIS_REJECT_WATER_ON_SOIL_QUALITY_IN_DISPOSAL_SITES_OF_VAVUNIYA_SRILANKA
[48] https://swachenv.com/current_news/desalination-big-money-game/
[49] https://www.nationalgeographic.com/environment/article/desalination-plants-produce-twice-as-much-waste-brine-as-thought

Using the information as above, certain assumptions have been made to assess both SOURCE Global Technology and URAVU. Assumptions and calculations are done for similar type of units of both the technologies, i.e., with a production capacity of 6-8 LPD. So, the calculations are done for single HH instead at community level.

Cost-benefit Analysis for SOURCE Global

Assumptions:

- Calculation for **one HH** provided with the technology having a production capacity of 6-8 LPD
- **Project Cost** - To install SOURCE Global technology - **₹200,000** ($2,437)
    - **Let's assume there is a 10% community contribution towards the project implementation – ₹20,000 ($244)**
    - **Let's assume 90% of the contribution to funded from different partner agencies, government schemes and donor organizations.**
- **Operation and Maintenance Cost** - Yearly maintenance costs are to be paid by the HH
- **Cost Savings –** Cost saved on buying water due to the use of this technology for drinking purposes. People will still have to buy water for other purposes as the technology only provides drinking water, so these savings are insignificant in this case.
- **Wholistic Benefits to communities**
    - **Heath benefits –** Cost saved on health check-ups due to improved health
    - **Health well-being – Better Hygiene Benefits**
    - For calculations, it is assumed that water-borne disease related cases are detected in the HH.
    - Annual expenditure per ailment for a non-hospitalized treatment and annual expenditure per ailment for a hospitalized treatment by a HH in rural areas has been considered under 'Wholistic Benefits to communities' for water-borne diseases for each state and the nos. are taken accordingly.
    - Annual expenditure per ailment for a non-hospitalized treatment and a hospitalized treatment for rural areas grows at an average rate of 5% per year as calculated from a study done by ADB[50].
- **Socio-economic benefits - Opportunity cost** due to time savings leading to upgradation in education, and livelihood due to better drinking water technology especially among women. Here, the parameters under the opportunity cost considered only for drinking water supply are not quantifiable, so the rows are blank in all the cases, but for other services, they might be quantified and can be used for cost-benefit analysis. Also, these benefits are almost insignificant as the community will have to invest their time and money in buying water for other domestic purposes.
    - **Time savings:** Women walking several hours to get water for all the purposes for the family vs. Income that could've been earned from working in those hours
    - **Increased Productivity of women:** Women investing their time in education and other hobbies
    - **Livelihood opportunity for women:** Women engaging themselves in local jobs
- Let other benefits be 1% of the total HH income
- Income increases at a rate of 2% per annum

Table 21: Cost-benefit analysis of SOURCE Global Technology from the perspective of a HH

Cost Benefit Analysis - SOURCE Global Technology						
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**TOTAL**
Costs (in ₹)						
Project Cost	20,000					**20,000**
Operation and Maintenance Cost		2,500	2,500	2,500	2,500	**10,000**
						0
TOTAL	**20,000**	**2,500**	**2,500**	**2,500**	**2,500**	**30,000**

[50] https://www.adb.org/sites/default/files/publication/783876/sawp-091-assessment-maharashtra-state-health-system.pdf

Cumulative	20,000	22,500	25,000	27,500	30,000	
Benefits (Rajasthan)						
Cost Savings	-	-	-	-	-	**0**
Wholistic Benefits to communities	17,110	17,966	18,864	19,807	20,797	**94,544**
Socio-economic benefits (Opportunity cost)	-	-	-	-	-	**0**
Other benefits	90	92	94	96	97	**468**
TOTAL	**17,200**	**18,057**	**18,957**	**19,902**	**20,895**	**95,012**
Cumulative	17,200	35,257	54,215	74,117	95,012	
NET BENEFIT OR COST	-2,800	14,700	14,700	14,700	14,700	65,012
Benefits (Odisha)						
Cost Savings	-	-	-	-	-	**0**
Wholistic Benefits to communities	11,709	12,294	12,909	13,555	14,232	**64,700**
Socio-economic benefits (Opportunity cost)	-	-	-	-	-	**0**
Other benefits	50	51	52	53	54	**260**
TOTAL	**11,759**	**12,345**	**12,961**	**13,608**	**14,286**	**64,960**
Cumulative	11,759	24,104	37,066	50,673	64,960	
NET BENEFIT OR COST	-8,241	9,845	10,461	11,108	11,786	-52
Benefits (Uttar Pradesh)						
Cost Savings	-	-	-	-	-	**0**
Wholistic Benefits to communities	23,906	25,101	26,356	27,674	29,058	**1,32,096**
Socio-economic benefits (Opportunity cost)	-	-	-	-	-	**0**
Other benefits	75	77	78	80	81	**390**
TOTAL	**23,981**	**25,178**	**26,434**	**27,754**	**29,139**	**1,32,486**
Cumulative	23,981	49,159	75,593	1,03,347	1,32,486	
NET BENEFIT OR COST	3,981	14,136	13,520	12,873	12,195	1,32,538
Benefits (Maharashtra)						
Cost Savings	-	-	-	-	-	**0**
Wholistic Benefits to communities	19,911	20,907	21,952	23,049	24,202	**1,10,021**
Socio-economic benefits (Opportunity cost)	-	-	-	-	-	**0**
Other benefits	175	179	182	186	189	**911**
TOTAL	**20,086**	**21,085**	**22,134**	**23,235**	**24,391**	**1,10,932**
Cumulative	20,086	41,171	63,305	86,540	1,10,932	
NET BENEFIT OR COST	16,105	5,950	6,566	7,213	7,891	-21,607

Table 22: Overall Cost to Benefit Ratio for SOURCE Global Technology: for each rural HH in the state

Overall Cost to Benefit Ratio: for each rural HH in the state	
Rajasthan	1to3.16
Odisha	1to2.16
Uttar Pradesh	1to4.41
Maharashtra	1to3.69

Above table shows the cost to benefit ratios calculated for each rural HH in each state. Some values are taken from primary survey while some values are taken from literature review. The ratio is higher in the state of

Uttar Pradesh where the medical expenditure for a non-hospitalised treatment and a hospitalised treatment is higher while it is lowest in Odisha where the overall per HH medical expenditure is comparatively less. Below graph shows the overall cost spent and benefits obtained by a rural HH in each state after opting for SOURCE Global Technology. **Highest benefits are observed in Uttar Pradesh while the lowest benefits are observed in Odisha**. The reason being maximum medical expenditure on health check-ups due to water-borne diseases in Uttar Pradesh, so this technology will save the cost of rural communities in the state on medical expenditure. For Odisha, since the cost of medical expenditure on such diseases is very less, so their benefits will be lesser. **The cost benefits in Maharashtra and Rajasthan will be comparatively lower than Uttar Pradesh with not much difference. Overall, the cost benefits in all the states will be significantly higher for each HH if compared with the annual income of each HH.**

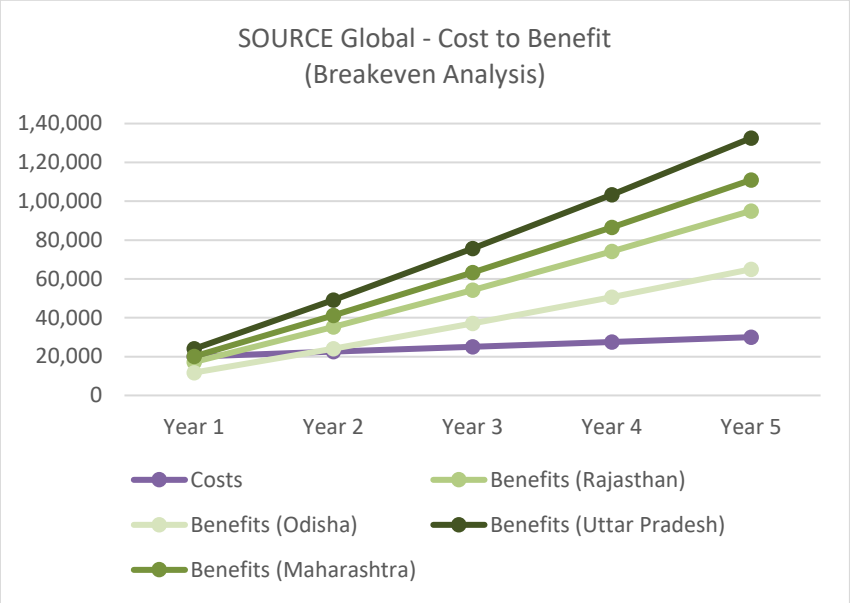


Figure 55: Cost-to-benefit graph for SOURCE Global Technology Implementation

Cost-benefit Analysis for URAVU

Assumptions:

- Calculation for **one HH** provided with the technology having a production capacity of 6-8 LPD
- **Project Cost** - To install SOURCE Global technology - **₹400,000** ($4,959)
    - **Let's assume there is a 10% community contribution towards the project implementation – ₹40,000 ($496)**
    - **Let's assume 90% of the contribution to funded from different partner agencies, government schemes and donor organizations.**
- **Operation and Maintenance Cost** - Yearly maintenance costs are to be paid by the HH; URAVU provides free maintenance for first 5 years but after that the users will have to pay 5 paisa/ litre ($0.0006/ litre) operation and maintenance cost
- **Cost Savings –**
- Cost saved on buying water due to the use of this technology for drinking purposes. People will still have to buy water for other purposes as the technology only provides drinking water, so these savings are insignificant in this case.
- **Wholistic Benefits to communities**
    - **Heath benefits –** Cost saved on health check-ups due to improved health
    - **Health well-being – Better Hygiene Benefits**
    - For calculations, it is assumed that water-borne disease related cases are detected in the HH.
    - Annual expenditure per ailment for a non-hospitalized treatment and annual expenditure per ailment for a hospitalized treatment by a HH in rural areas has been considered under 'Wholistic Benefits to communities' for water-borne diseases for each state and the nos. are taken accordingly.

  - Annual expenditure per ailment for a non-hospitalized treatment and a hospitalized treatment for rural areas grows at an average rate of 5% per year as calculated from a study done by ADB[51].
- **Socio-economic benefits - Opportunity cost** due to time savings leading to upgradation in education, and livelihood due to better drinking water technology especially among women. Here, the parameters under the opportunity cost considered only for drinking water supply are not quantifiable, so the rows are blank in all the cases, but for other services, they might be quantified and can be used for cost-benefit analysis. Also, these benefits are almost insignificant as the community will have to invest their time and money in buying water for other domestic purposes.
  - **Time savings:** Women walking several hours to get water for all the purposes for the family vs. Income that could've been earned from working in those hours
  - **Increased Productivity of women:** Women investing their time in education and other hobbies
  - **Livelihood opportunity for women:** Women engaging themselves in local jobs
- Let other benefits be 1% of the total HH income
- Income increases at a rate of 2% per annum
- For URAVU - This analysis has been done for a unit with 5-20 litres/ day of production capacity at individual level.

Table 23: Cost-benefit analysis of URAVU from the perspective of a HH

Cost Benefit Analysis - URAVU						
	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
Costs						
Socio-economic benefits (Opportunity cost)	40,000					**40,000**
Operation and Maintenance Cost		0	0	0	0	**0**
						0
TOTAL	**40,000**	**0**	**0**	**0**	**0**	**40,000**
Cumulative	40,000	40,000	40,000	40,000	40,000	
Benefits (Rajasthan)						
Cost Savings	-	-	-	-	-	**0**
Wholistic Benefits to communities	17,110	17,966	18,864	19,807	20,797	**94,544**
Socio-economic benefits (Opportunity cost)	-	-	-	-	-	**0**
Other benefits	90	92	94	96	97	**468**
TOTAL	**17,200**	**18,057**	**18,957**	**19,902**	**20,895**	**95,012**
Cumulative	17,200	35,257	54,215	74,117	95,012	
NET BENEFIT OR COST	-22,800	17,200	17,200	17,200	17,200	55,012
Benefits (Odisha)						
Cost Savings	-	-	-	-	-	**0**
Wholistic Benefits to communities	11,709	12,294	12,909	13,555	14,232	**64,700**
Socio-economic benefits (Opportunity cost)	-	-	-	-	-	**0**
Other benefits	50	51	52	53	54	**260**
TOTAL	**11,759**	**12,345**	**12,961**	**13,608**	**14,286**	**64,960**
Cumulative	11,759	24,104	37,066	50,673	64,960	
NET BENEFIT OR COST	-28,241	12,345	12,961	13,608	14,286	9,948
Benefits (Uttar Pradesh)						
Cost Savings	-	-	-	-	-	**0**
Wholistic Benefits to communities	23,906	25,101	26,356	27,674	29,058	**1,32,096**
Socio-economic benefits (Opportunity cost)	-	-	-	-	-	**0**
Other benefits	75	77	78	80	81	**390**
TOTAL	**23,981**	**25,178**	**26,434**	**27,754**	**29,139**	**1,32,486**
Cumulative	23,981	49,159	75,593	1,03,347	1,32,486	

[51] https://www.adb.org/sites/default/files/publication/783876/sawp-091-assessment-maharashtra-state-health-system.pdf

NET BENEFIT OR COST	-16,019	11,636	11,020	10,373	9,695	1,22,538
Benefits (Maharashtra)						
Cost Savings	-	-	-	-	-	**0**
Wholistic Benefits to communities	19,911	20,907	21,952	23,049	24,202	**1,10,021**
Socio-economic benefits (Opportunity cost)	-	-	-	-	-	**0**
Other benefits	175	179	182	186	189	**911**
TOTAL	**20,086**	**21,085**	**22,134**	**23,235**	**24,391**	**1,10,932**
Cumulative	20,086	41,171	63,305	86,540	1,10,932	
NET BENEFIT OR COST	36,105	8,450	9,066	9,713	10,391	-11,607

Table 24: Overall Cost to Benefit Ratio for URAVU: for each rural HH in the state

Overall Cost to Benefit Ratio: for each rural HH in the state	
Rajasthan	1to2.37
Odisha	1to1.62
Uttar Pradesh	1to3.31
Maharashtra	1to2.77

URAVU provides free maintenance for first 5 years but after that the users will have to pay 5 paisa/ litre ($0.0006/ litre) so, the cost for the first 5 years is ₹ 40,000 ($487.6) as the installation cost. This analysis has been done for a unit with 5-20 litres/ day of production capacity at individual level. But for community level units of URAVU, having a production capacity of about **2000-5000 litres/ day**, the **operation cost is around ₹2/ litre ($0.024/ litre) which is quite high** while the maintenance cost remains the same. Above table shows the cost to benefit ratios calculated for each rural HH in each state. Some values are taken from primary survey while some values are taken from literature review. The states of **Uttar Pradesh and Odisha have the highest and lowest levels of benefits**, respectively. This is due to the high cost of medical expenditure on non-hospitalised treatment and a hospitalised treatment caused by water-borne diseases in Uttar Pradesh. This technology would reduce medical costs for rural people in the state. Since such diseases have extremely low treatment costs in Odisha, the advantages they provide would be limited. **Maharashtra and Rajasthan will have costs benefits that are somewhat less favourable than those in Uttar Pradesh. Highest benefits are observed in Uttar Pradesh while the lowest benefits are observed in Odisha, similarly like SOURCE Global. When compared to each HH's annual income, the cost benefits in all the states will be noticeably larger for each HH.**

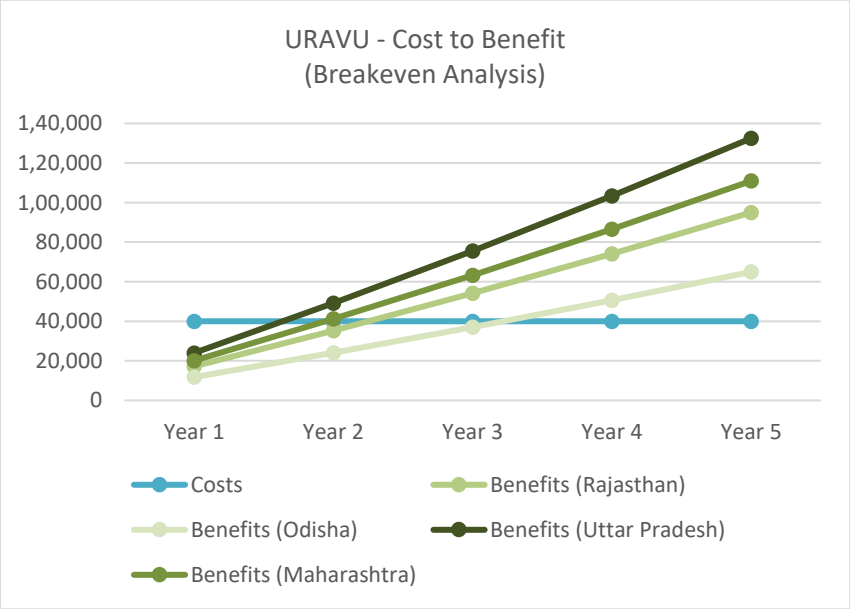


Figure 56: Cost-to-benefit graph for URAVU Implementation

Chapter 4: Conclusion & Recommendations

4.1. Summary & Conclusion

The table below shows the key criteria that could be considered while selecting the target market(s) for the implementation of the renewable drinking water technologies. The summary of state-wise findings is also showcased and the states are rated on a scale of 1 to 5 (1 being the lowest, 5 being the highest) on each criterion. The priority order of the target states is provided as the key takeaway in this section.

Limitations

It is to be noted that one of the key limitations around the implementation of these technologies in the focus geographies is that the whilst the criteria and information in the 4 states is quite specific, URVAU has worked only for the industries till now and Source Global has is still in its pilot phase. Hence, a detailed technology feasibility study needs to be undertaken as the next step.

Table 25: Summary for Key Criteria and Findings in each State

Sr. No.	Criteria for identifying and analysing target markets	Reason for choosing the criteria	Rajasthan		Odisha		Uttar Pradesh		Maharashtra	
			Jodhpur	Jaisalmer	Sundargarh	Balangir	Jalaun	Mahoba	Beed	Raigarh
1	**Gender and Age distribution of the population from the selected areas**	To know the socio-economic background of the people	50% of the respondents belong to the age group of 26-45 years while 30% belong to 46-60 years of age group, only 7% of them are above 60 years of age and 14% from below 25 years category	Almost 60% of the respondents are from 26-45 years age category, 20% are from 46-60 years of age, 8% are above 60 years age and around 12% are less than 25 years of age	Almost 50% of the respondents from Sundargarh belong to the age group of 26-45 years while 35% belong to 46-60 years of age group and only 8% of them are above 60 years of age	Almost 60% of the respondents are from 26-45 years age category, 25% are from 46-60 years of age and around 9% are less than 25 years of age	Almost 50% of the respondents belong to the age group of 26-45 years while 25% belong to 46-60 years of age group and only 10% of them are above 60 years of age.	Almost 60% of the respondents are from 26-45 years age category, 25% are from 46-60 years of age and around 20% are less than 25 years of age.	Almost 70% of the respondents belong to the age group of 26-45 years while 16% belong to 46-60 years of age group and only 9% of them are above 60 years of age.	Almost 40% of the respondents are from 26-45 years age category, 22% are from 46-60 years of age and around 27% are less than 25 years of age.
2	**Household size of each of the families**	To identify the water demand of each HH	6	5	4	4	5	5	4	4
3	**Rural Population of the selected areas**	To study the demographic details of the regions to calculate the overall water demand of the region	2,422,551	580,894	1,355,340	1,451,616	1,271,074	690,577	2,070,751	1,664,005
	Number of HHs of the selected areas		414,223	100,427	312,497	369,273	216,570	124,678	435,588	381,204
4	**Livelihood dependency**	To know the socio-economic background of the people	Majorly on agriculture, animal husbandry and cattle rearing and people also work as labourers under MNREGA		Economic condition of rural people is poor. Livelihood dependency is majorly on farming and labour work		Majority of the rural residents of the district depend upon agriculture and labour work for livelihood generation, Labour work is also not a stable job for them; Some people are involved in service sector who earn decently while others' income is low		People are dependent on farming and labour work for their livelihood while some have their own businesses. Overall, the living condition is fair.	
5	**Nature of employment**	To identify if the job is stable throughout the year or seasonal	Farming is done for 4 months; otherwise, labour work is done in some of the villages.		Some are seasonal while some are throughout the year		Labour work is seasonal while some are throughout the year		Some are seasonal while some are throughout the year	
6	**Average income levels of the HHs**	To know the socio-economic background of the people and identify paying capacity	**₹7,000-12,000/ month**	**₹6,000 – 10,000/ month** ($61-122/ month)	**₹3,000-6,000/ month** ($49-61/ month)	**₹4,000-6,000/ month** ($49-61/ month)	**₹4,000-10,000/ month** ($49-122/ month)	**₹4,000-5,000/ month** ($49-61/ month)	**₹10,000-25,000/ month** ($122-305/ month)	**₹5,000-20,000/ month** ($61-242.5/ month)

7	**Climatic and topographical conditions of the selected areas**	To study the environmental factors of the selected region	Dry and arid region; desert land	Tropical climate with high temperature and humidity, medium to high rainfall and short and mild winters; topography changes throughout the state[52]	The state has a climate of extremes with cyclical droughts, floods, hot summers, cold winters and either very wet or very dry rainy seasons; topography changes throughout the state[53]	Tropical monsoon climate in some areas while the weather is dry in some parts; topography is varying throughout the state[54]
8	**Groundwater level in the selected areas**	To know the existing details of the groundwater table	Varies from 600-1,000 ft	In coastal area - **100** ft; non-coastal area - **500** ft for few areas	**330** ft below the ground level	Groundwater depth **depends upon the geographical area**
9	**Water Quality**	To know whether the water is potable or not and, if not, the reasons for its non-potability	• Groundwater is **saline** in many parts and even **fluoride** is present in some places. • Canal water (rainwater) - not saline	There is a demand for pure drinking water. The water available is not clean. Even many handpumps release dirty water.	Water is **saline** at some places; As per the Water Quality Index of Mahoba District, **overall water quality** is **fairly good** in the district with some patches with poor index values[55]	Water gets dirty during excessive rains, floods and pipeline breakage; Groundwater is **saline** at many places
10	**Current sources of water**	To identify different water sources in the states	• **Domestic purpose** - Canal system, Groundwater, Surface water, Rivers, hand pumps, and tube wells in rural areas • **Tourist spots -** Rainwater harvesting, tubewells, and PHED connections • **Allied activities and animal and cattle planning -** 30 LPCD allowed in 7-9 districts in desert areas	• **Domestic purpose -** Pipelines and tube wells • **Water supply**: The **pipeline** covers **26**% of the total district area. However, the **tube well** has reached **100%**. **Hilly areas**- Pipeline and overhead tanks but in hill-based areas • **Allied activities like sanitation, cattle rearing, and animal husbandry –** Groundwater, open ponds and rivers	• **Drinking purpose** - Wells, Hand Pumps and Tap Water Connection (JJM) for • Areas with scarcity of water still depend upon handpumps and tankers • **Allied activities and animal rearing** - Tube wells, handpumps	• **Groundwater, river water, seasonal dams** for drinking and other purpose • **Energy supply:** Electricity and solar power
11	**Nature of the sources**	To know whether the sources are seasonal or not to identify water availability	Most of them are seasonal.	Most of them are seasonal.	Some of them are seasonal.	Some of them are seasonal.
12	**Current Status of water supply schemes or services provided**	To know how much area will be covered by them, at least in the next two years; JJM is on-going in rural India and is expected deadline to be completed till 2024	JJM, Chambal Bhilwara Urban Water Supply Scheme[56]; JJM is ongoing but yet to start in some of the villages	Vasudha Scheme, JJM Yojana, OMBADC Scheme, Tube well scheme, 5 years scheme of Tourism Department, Over tank water supply for hill based hard to access area, RWLL Scheme – presently active, Other schemes (solar based); JJM is ongoing but yet to start in some of the villages	Namami Gange Project, Swajal Bharat Scheme, Water and Sanitation Mission, JJM; JJM is ongoing but yet to start in some of the villages	Amrit Sarovar, Jalyukta Shivar Scheme, JJM, Majhi Vasundhara under convergent like Sarovar scheme; JJM is ongoing but yet to start in some of the villages
13		To know current status drinking water	Under JJM, provision of tap water connections is in progress and is yet to start at some places to provide 55 LPCD water to every rural HH by the year 2024. It also plans to include water quality testing to provide clean drinking water.			

[52] http://orienvis.nic.in/index1.aspx?lid=24&mid=1&langid=1&linkid=22#:~:text=The%20State%20has%20tropical%20climate,tropical%20Savannah%20type%20of%20climate.
[53] https://byjus.com/free-ias-prep/uppsc-geography-of-uttar-pradesh/
[54] https://www.maharashtratourism.net/geography.html#:~:text=The%20state%20has%20tropical%20monsoon,Sahyadri%20regions%20of%20the%20state.
[55] https://www.researchgate.net/publication/349291951_Groundwater_quality_assessment_using_water_quality_index_WQI_under_GIS_framework
[56] https://urban.rajasthan.gov.in/content/dam/raj/udh/organizations/ruidp/MISC/Rajasthan_Urban_Water_Supply_Policy_2018_final.pdf

	Measures taken for providing drinking water	provision, how water is supplied to the people or houses (e.g., Pipelines, tankers, handpumps, etc.) and the governance structure of water supply	• Tanker water from well is used for drinking purposes at many places • Canal water stored in tanks and piped connection in few villages; No facility and electricity in remote villages in Jaisalmer. • Provision of RO and DFU at many private and public places to serve households • 4,000 plants are installed under PPP and 425 new ROs will be installed this year. • State is doing all kinds of work, providing supplies, engaging tendering contracts to create infrastructure and then O&M the substituent 10-year prototype.		• Several agencies are working under GP and block level through tender procedure for implementation of the schemes. • All the new technologies are to be implemented through district level and in communication with GP		• **Nagar Nigam** – does the water supply • In villages and Tourism Department – water supply is done by the local body • **Jal Nigam** – provide manpower resources to work under the scheme implementation • The primary means to get water supply are handpumps, tankers and tap water connections are through **JJM, State Water and Sanitation Mission and Jal Nigam** • Currently 14-15 District Implementation Partners (DIPs) are working together under Atal Bhujal Scheme		• Dams are built for water supply and chlorine chemical is used to clean the water • **Village Water Sanitation Committee** consisting of local people and GP Sarpanch submits village level plans to the central government by identifying requirements. Women are hired for water testing under this committee. • After approval, a committee formed under the chairmanship of Guardians Minister. • Villagers contact Local GP or BOD department if there are any water quality issues	
14	**Current charges paid by the residents to avail of such systems (Paying capacity)**	To know the current paying capacity of the people	• RO purified water: **₹2/ 1000 litres** ($0.024/ kilolitres) • Tanker water from canals or tubewells: **₹800-1000** ($9.75-12)		**37.5 paise/ 1000 litres** ($0.0046/ kilolitres)[57]		**20-30 paisa/ 1000 litres** ($0.0024-0.0036/ kilolitres)		• HUDCO Designated rural areas: **₹1000/ year** ($12/ year) but some **hardly pay ₹300-400/ year** ($3.66-4.9/ year) • Other rural areas: **13.5 paisa/ 1000 litres** ($0.0016/ kilolitres)[58]	
15	**Water Treatment facilities or practices at GP and HH level**	To know if the people or GPs are treating non-potable water at their end for consumption	• **RO technique** is used in rural areas and **DFU** installed in Udaipur and Jodhpur wherever there is fluoride content. • Around 80% HHs don't treat water at HH level		Surface water is maintained with proper cleaning through bleaching powder and other pest control systems.		Using chemicals like chlorine and water testing kit as trained under JJM		• Use of **chlorine chemical** to clean the water • Villager contact Local GP or BOD department to address water quality issues	
16	**Overall water demand of each HH and the whole area for drinking purposes**	To know the current water demand for drinking purposes (Generally, drinking water demand 5 LPCD)	30 LPD/HH (considering the HH size as 6)	25 LPD/HH (considering the HH size as 5)	20 LPD/HH (considering the HH size as 4)	20 LPD/HH (considering the HH size as 4)	25 LPD/HH (considering the HH size as 6)	25 LPD/HH (considering the HH size as 5)	20 LPD/HH (considering the HH size as 4)	20 LPD/HH (considering the HH size as 4)
17	**Demand for a decentralised/ alternative water supply system**	To know if new technology is needed or not	**Water supply service coverage** in hard to access areas and remote areas; Sustainable water management; Capacity building and institutional strengthening		There is no demand for an alternative system of water supply and treatment technologies for water within the village. Cost effective and decentralized unit is to be implemented through district level to provide drinking water in the areas that are hard to access		Cost effective and decentralized unit can be deployed in Eastern Districts of the state which are remote.		Cost effective and decentralized unit can be deployed in hard-to-access areas of the state which are remote.	

[57] https://www.newindianexpress.com/states/odisha/2021/apr/11/water-to-cost-10-per-cent-more-in-odisha-from-this-month-2288623.html#:~:text=As%20per%20the%20notification%20issued,is%20five%20cusec%20or%20more

[58] https://indianexpress.com/article/cities/mumbai/maharashtra-govt-hikes-water-tariff-for-agriculture-domestic-and-industrial-sectors-5032136/#:~:text=Water%20tariff%20for%20individual%20farmers,paise%20and%2013.50%20paise%2C%20respectively.

18	**Most hard-to-access areas**	To identify market areas	There is hardly any village that doesn't have PHED water supply. Rainwater conservation is done in areas where water supply is once in a week. But as per GP officials, villages on Pakistan Border do not have any facilities	There are no such areas which are hard to access. Water is supplied through pipelines and tube wells in remote areas. Hill areas have overhead tank water and non-hill-based areas have tubewells reachable within 100 ft under the ground. Inner remote districts like, Malkangiri, have water supply issues.	Eastern districts are under hard to access areas as they do not have groundwater recharges. Villagers travel distant places to fetch water for domestic purpose as they get water once in 2-3 days who also depend upon tankers and handpumps	Eastern districts come under most hard to access areas. Some rural areas from Marathwada region, and Nandurbar district also have lesser accessibility and acute water shortages. Lower Konkan region also have some remote villages.
19	**Incidences of natural risks or disasters in the areas**	To study the environmental factors of the selected region	Famine and drought-like conditions due to lesser rainfall and water scarcity	Flood, cyclones and drought occur from July to December[59]; Lesser rainfall in the district and there are consequences of climate change as well.	One of the surveyed villages mentioned the problems like **floods, famine and hailstorms** in their areas which leads to many losses	No risk but sometimes there are flood-like conditions in the villages situated on river banks; water scarcity in a few areas due to shortage of rain
20	**Awareness of people about water-borne diseases**	To know if the people are aware of the ill effects of consuming poor-quality of water	Not much aware about the quality of groundwater which they consume and its side effects	Around half of the respondents reported water to be non-potable and were aware about the ill-effects due to its consumption	Around all of the respondents reported water to be potable, but as literature review there are incidences of water-borne diseases. This shows there is somewhat lack of awareness about such diseases among the villagers.	Around 85% from Raigarh and half of the respondents from Beed reported water to be potable and some of them were aware about the ill-effects due to consumption of non-potable water
21	**Incidences of any water-contamination related disease in the region**	To identify the range of effects on people due to poor quality of water	Yes, there are incidences of cholera and dysentery due to water contamination[60]	Yes, there are incidences of cholera, typhoid, infantile diarrhea, dysentery, infectious hepatitis, polio, ziardiasis, jaundice, etc. due to industrial, mining and man-made water contamination[61]	Yes, there are incidences of diseases linked to kidneys, liver, gallbladder, uterus, other organs and cancer are common in some village due to arsenic content in water[62]	Yes, there are incidences of diseases such as cholera, typhoid, leptospirosis[63]
22	**Annual medical expenses on water-borne diseases**	Tentative current medical expenses on such diseases (INR/ailment)	*Non- hospitalised treatment: 842 **Hospitalised treatment: 16,268	Non- hospitalised treatment: 550 Hospitalised treatment: 11,159	Non- hospitalised treatment: 762 Hospitalised treatment: 23,144	Non- hospitalised treatment: 528 Hospitalised treatment: 19,383
23	**Right stakeholders/ institutional partners to be involved in the implementation and can play a role in long term sustainability and scaling up**	To identify critical stakeholders to collaborate with to implement such technologies	• PHED, PPP • ISA named, Gramin Vikas • Some NGOs working in the region – Piramal, Prerna, Jal Bhagirathi organization by Jodhpur Maharaja • Community and GP • CSRs, Corporates, • Investors, HNIs, UHNIs • Local NGOs • National and International Donor agencies	• Block and District level officials and several agencies working under GP like VWSC • Community and GP • ASHA/ Anganwadi workers • Minority group representatives • Youth and Women's organizations/SHGs • NGOs (Local and International) • CSRs, Corporates, Investors, HNIs, UHNIs • National and International Donor agencies	• Nagar Nigam, Jal Nigam, State Water and Sanitation Mission • Community, GP and VWSC • ASHA/ Anganwadi workers • Minority group representatives • Youth and Women's organizations/ SHGs; NGOs and Courtyard Shelters • CSRs, Corporates, Investors, HNIs, UHNIs • National and International Donor agencies	• Water Supply and Sanitation Department, MJP • District and Block officials • Community and GP • ASHA/ Anganwadi workers • Youth and Women's organizations/ SHGs • CSRs, Corporates, Investors, HNIs, UHNIs • Local NGOs • National and International Donor agencies

[59] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://cdn.s3waas.gov.in/s3289dff07669d7a23de0ef88d2f7129e7/uploads/2018/05/2018051623.pdf
[60] https://timesofindia.indiatimes.com/city/jaipur/rural-areas-in-rajasthan-most-affected-by-contaminated-drinking-water/articleshow/23274968.cms
[61] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://magazines.odisha.gov.in/Orissareview/jan2006/engpdf/Water_Pollution.pdf
[62] https://www.newslaundry.com/2022/01/24/arsenic-in-water-brings-death-and-disease-in-up-bihar
[63] https://timesofindia.indiatimes.com/city/mumbai/maharashtra-water-borne-diseases-dive-44-in-2020-2021/articleshow/90179195.cms

24	**Awareness programs conducted to conserve all forms of water**	To know if any programs are being conducted at the rural, district or state level to create awareness	• Rural Water Supply Program • Jal Abhiyan • Rajiv Gandhi Water Management Mission[64]		• Rainwater Harvesting Structures[65] • NGO/ private agencies are working for water supply development and Mission Shakti Water Project is also working along with RWLL		• JJM has conducted several training programs and workshops for water testing, conservation of surface water and reuse of grey water		• Water-related campaigning is done through other schemes such as Jal Jeevan mission, **Jal Yukta Shivar and by Jal Shakti Ministry.** • Central and State Government conducts awareness about rainwater collection.	
25	**Awareness of residents about renewable drinking water technologies**	To know if the people are aware of any such technologies	Almost one-third the respondents from the villages of Jaisalmer district and two-third respondents from Jodhpur district are aware about the renewable drinking water technologies while the remaining are unaware.		About **43**% and **38**% of the respondents from the villages of **Balangir** and **Sundargarh** district are **aware** about the **renewable drinking water technologies** while others are unaware about any such technology.		Almost **half of the respondents from the villages of both the districts are unaware** about the renewable drinking water technologies.		Almost **all** the respondents from the villages of **Beed** district are **aware** about the renewable drinking water technologies while for rural respondents from **Raigarh**, the figure is around **40**%.	
26	**Willingness to pay and use such technologies**	To know paying capacity of HHs and their willingness to use such technologies	40% HH are willing to pay above ₹100, 45% can pay ₹51-100, 10% can pay ₹11-50 and remaining can pay below ₹10	17% HH are willing to pay above ₹100, 26% can pay ₹51-100, 45% can pay ₹11-50 and remaining can pay below ₹10	Only 6% HH are willing to pay above ₹100 and between ₹51-100, 81% can pay ₹11-50 and remaining can pay below ₹10	Only 4% HH are willing to pay above ₹100 and between ₹51-100, 81% can pay ₹11-50 and remaining can pay below ₹10	2% HH are not willing to while 3% can pay ₹51-100, 65% can pay ₹11-50 and remaining 31% can pay below ₹10	14% not willing to pay while remaining 3% can pay ₹51-100, 49% can pay ₹11-50 and remaining 26% can pay below ₹10	Almost 86% not willing to pay while remaining 9% can pay ₹11-50 and 4% can pay below ₹10	Around 4% not willing to pay while remaining 15% can pay above ₹100, 8% can pay ₹11-50 and remaining 76% can pay below ₹10
			As per District and GP officials, villagers will fully cooperate and contribute if any scheme or technology related to water is implemented and will also take part in the awareness programs. GP plays an active role in the implementation of new schemes but Block Office, District Office, Youth and Women's Organizations and NGOs should also participate well. But needs offices need to more staff to support such schemes.							
27	**Challenges to implementing any new scheme**	To know the obstacles that one might need to overcome to implement such technology	• Obtaining water, funding and clearances, managing funds, project implementation, and a shortage of raw materials and contractors. • Sustainability of operations, **changing the mindset** of the people • Other challenges are **power supply, cost, and climatic changes such as extreme summer and extreme winter**		Any project is done from Tourism Department in association with District Level and Collector; **Implementing New Technology needs** • Receptive response to implement it at the district level and in communication with the GP • GP, Block and District Level Officials and NGOs support such technology and this positively impacts the residents • Issues in getting support from various groups and organisations		• Delay in the process • Community participation and involvement		• Bridging the gap between Irrigation Potential Created and Utilized • Losses in Distribution Network	
28	**Availability of funds with local government officials**	To identify the spending capacity of the GPs or district offices	Obtained through various State and Central Schemes		Obtained through various State and Central Schemes		Obtained through various State and Central Schemes		Obtained through various State and Central Schemes	

* **Non-hospitalised treatment**: Average medical expenditure per spell of ailment for non-hospitalised treatment during a 15-day period
** **Hospitalised treatment**: Average medical expenditure incurred for treatment during stay at hospital per case of hospitalization

[64] https://water.rajasthan.gov.in/content/water/en/swrpdepartment/aboutus.html
[65] http://www.dowrodisha.gov.in/SWP2007/SWP%202007.pdf

Table 26: Ratings to identify priority order of Target Markets

Sr. No.	Criteria for identifying and analyzing target markets	Rajasthan	Odisha	Uttar Pradesh	Maharashtra
1	Gender and Age distribution of the population from the selected areas	-	-	-	-
2	Household size of each of the families	-	-	-	-
3	Rural Population of the selected areas	-	-	-	-
	Number of HHs of the selected areas	-	-	-	-
4	Livelihood dependency	2	2	2.5	3
5	Nature of employment	2	2	2.5	3
6	Average income levels of the HHs	2	2	2.5	3
7	Climatic and topographical conditions of the selected areas	2	2.5	2.5	2.5
8	Groundwater level in the selected areas	1	2	2.5	2.5
9	Water Quality	1	1	3	2.5
10	Current sources of water	1	2.5	3.5	3.5
11	Nature of the sources	1	2	3	3
12	Current Status of water supply schemes or services provided	1.5	2.5	3.5	3.5
13	Measures taken for providing drinking water	1.5	2	3	3
14	Current charges paid by the residents to avail of such systems (Paying capacity)	3	3	3	3
15	Water Treatment facilities or practices at GP and HH level	2	3	3	3
16	Overall water demand of each HH and the whole area for drinking purposes	-	-	-	-
17	Demand for a decentralised/ alternative water supply system	4	3	1.5	1.5
18	Most hard-to-access areas	4	3	2	2
19	Incidences of natural risks or disasters in the areas	4	4	3	1.5
20	Awareness of people about water-borne diseases	1	2	2.5	3
21	Incidences of any water-contamination related disease in the region	4	4	3	2
22	Medical expenses on such diseases	2	3	2	2
23	Right stakeholders/ institutional partners to be involved in the implementation and can play a role in long term sustainability and scaling up	3.5	3.5	3.5	3.5
24	Awareness programs conducted to conserve all forms of water	3	3	3.5	3.5
25	Awareness of residents about renewable drinking water technologies	2	3	3	4
26	Willingness to pay and use such technologies	4	2.5	2.5	1.5
27	Challenges to implementing any new scheme	2	2	3	3
28	Availability of funds with local government officials	2.5	2.5	2.5	3
	Overall Rating	**2.33**	**2.58**	**2.77**	**2.75**

Key Takeaway: -

The rating done is based on the primary analysis and is relative for all the states. Based on the the above information and keeping in mind the various parameters and their identified ratings, **Rajasthan and Odisha** are the most feasible states to commence the implementation followed by Maharashtra and Uttar Pradesh respectively. **Rajasthan and Odisha are chosen because of their lower rating in all the parameters which shows their higher scope of improvement in all of those parameters.**

4.2. Potential Business Models for Implementation of Renewable Water Technology

Business models contain essential finance, delivery, and monitoring aspects and outline how financial investments can be planned, executed, and overseen. The most suitable business model for a particular project will be determined by the regional circumstances, the economic and legal climate, as well as the institutional mechanisms and support systems in existence. Along with the target audience, the scope and goal of the project or service must be clearly stated. Business models are not predefined frameworks; instead, they must each be customised to the specific local conditions and risk levels of the chosen enterprise. Factors influencing the selection of a suitable business model are the concerns for a product or service, project scope, the client, the public, and the legal framework[66]. Some business model options designed for renewable drinking water supply have been identified from which the most suitable one for the focused areas will be selected. They are explained in the further sections.

4.2.1. Ownership Business Model

The major focus of ownership business model is upon financing and risk mitigation aspects. The technical and fiscal difficulties of renewable drinking water projects are addressed via such models. A public-private partnership (PPP), executed as a kind of build-own-operate-transfer (BOOT) or multiparty ownership, is often the most suitable model. Leasing or hiring buy, as well as dealer credit sale methods, are widely used in smaller projects.

Public-Private Partnership (PPP)

A public and private sector authorities enter into a PPP contract. A sizeable portion of the operational, technological, and fiscal needs are assumed by the private party. Its basic goal is to distribute the responsibilities and risks to the individuals who can better manage them, particularly the private players. The cost of using the renewable drinking water supply service may be covered completely by private parties or by the government, depending on how the PPP contract is set up. The BOOT, BOO, and BOT PPP models are typical.

The formation of a special-purpose corporation (SPC) or special-purpose vehicle (SPV) is usually required to plan, construct, maintain, and run the (renewable drinking water project at a community level) asset for the agreed-upon duration. To develop the facility and to run and maintain it, the SPC or SPV engages into an agreement with the government also with subcontractors. In general, BO(O)T PPP models are preferred for significant infrastructure projects. **Projects including both conventional and renewable water sources might use this business model.** One advantage is that it makes it possible to allocate certain risks to parties who are best prepared to manage them. The drawbacks include the potential for great complexity, significant transaction costs, and potential financial consequences to the public in the event that risks are improperly allocated.

Lease or Hire purchase model

Users are able to buy devices or units using this strategy and pay over time. The end user leases the unit from a leasing business (the lessor) or a unit provider in exchange for recurrent instalments over a predetermined time frame. As the contract period concludes, unit ownership may either remain with the leaseholder or transfer to the lessee, as per the terms of the agreement. Leasing agreements prohibit leased unit from assimilating into a structure, business establishment, or water plant. So, the **model cannot be used for some renewable water supply projects** because of this clause.

Dealer Credit Business Model

The system provider gives the preliminary credits for the system under this model. Distributors recommend on, advertise, sell, assemble, and uphold installations; instruct users; and oversee respective microloans to users to fund the unit, which include collecting the down payment and month - to - month repayments from users and starting to recover systems and capital in the event of default. These are some of the model's key features. At the conclusion of the loan repayment, the user becomes the system's owner.

The advantages include the ability for donor-funded micro - credit and customer control over the process. The drawback is that the dealership then must take over the supply chain or potentially lose the capital if the renewable water technology business does not provide the requisite service or item assurances required for loan repayment.

4.2.2. Service Business Model

The major focus of service business model is on delivering certain services and direct attention to various operating and maintenance procedures. Offering a good or service to the customer is the main goal of this model. A renewable water production company—which could be a cooperative, NGO, commercial

[66] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.adb.org/sites/default/files/publication/161889/business-models-renewable-energy-gms.pdf

company, or public utility—offers the service. A cost depending on water usage is paid by the user. Users pay a price for the water they use from the installed unit under the typical utility service contract. A user cooperative business model could be used for rural renewable water supply units.

User Cooperative with Service Fees

This concept entails launching a local nonprofit community group. It offers a method for local projects utilising renewable water technology to be supported by governments or NGOs. The growth of public infrastructure in emerging economies is a good fit for user cooperatives. In industrialized nations, they have also been effectively put into practice.

A non-profit community group whose members control both the technical and financial aspects. Usually, volunteers chosen from amongst members operate it. Donations from members are used to fund projects, regardless of using additional private or public funding. Deployment, maintenance, operational stability, fiscal administration, and payments between users, contractors, and technicians, as well as the cooperative, are all ensured and supervised by the cooperative. One of the advantages of startup financing is that it might include funding from donors or the government. The disadvantages include the possibility of low management competencies and skills because responsibilities are carried out by supervisors chosen from the group of members. Since managers' participation is entirely optional, it is occasionally problematic when they are not fully committed[67].

Water as a Service Model

A business concept known as "water-as-a-service" (WaaS) allows clients to pay for a water supply without making an initial financial commitment. WaaS models often consist of managing water usage to provide the desired service or subscribing for water units controlled by a service provider. Water is used for a variety of purposes in both residential and commercial structures, including the production of water. Renewable technologies must establish themselves and entice users to adopt them in order to prevent drinking contaminated water, as well as the worst effects of climate change and water scarcity.

Some case studies for innovative service business models for renewable drinking water have been studied as below:

Swajal Business Model

It began in 2011 as a survey project to assess water quality in two villages near Noida and Ghaziabad. It developed plans for commercial system based on solar powered reverse osmosis (RO) water purifier which generates clean water at an affordable price through vending machines. Its aim was to establish 5 pilot water purification centres, to set up central monitoring system supporting the business and to test its potential for upscaling. The budget was about ₹ 15,248,793 ($186,729) including co-funding from UNDP- ACE/MNRE and Saurya EnerTech and the implementing agency was Saurya EnerTech. The Business Model targeted a population of 1000 families.

Workability

- **Stage 1: Through Surveys -** Identified best locations and most effective design for the pilot system.
- **Stage 2: Promotions -** Through workshops and other interactions with local stakeholders such as schools, hospitals and municipalities and covered in both print and digital media.
- **Stage 3: Campaigns -** Health surveys and educational campaigns were held in schools and door-to-door to teach people about the connection between their health, medical expenses, and quality of drinking water

Challenges, Opportunities and Threats

- With success and effective marketing, Swajal has created a lot of interest for its system with government bodies, NGOs, and private enterprises. With the completion of project, few orders have come up for installations in various parts of India.
- There is a lack of supportive policy framework for water pricing as water in India is traditionally free or highly subsidized. To survive for long term, company needs some sort of subsidy or continuing grant support.

Impact

- It created 4 new jobs and health care expenditure decreased after people started drinking water from Swajal units.

- **Purification of Rural Drinking Water Supply Based on Renewable Energy**

  It was a prototype and demonstration project of MIT for Calamul Campeche Municipality, Mexico. Their aim was to **access clean and affordable drinking water**, which is a great challenge in many rural areas of developing countries. The financial support by **W.K. Kellogg Foundation** have helped to set up a 1,000 litres

[67] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.adb.org/sites/default/files/publication/161889/business-models-renewable-energy-gms.pdf

per day prototype solar photovoltaic-powered reverse osmosis (PVRO) water purification station. The System uses solar panels to charge batteries, which then power pumps that push brackish well water and collected rainwater through filtration membranes. The batteries also supply the ultraviolet sterilization bulbs with electricity. The **Business Model** is specifically for the **location where water resources are scarce or contaminated**.

Workability

- **Stage 1: Technology Feasibility in the lab and in the field -** Training for operation and Maintenance, villagers are paying the community operators for their drinking water at a price they can afford, and one that makes the system self-sustainable. Non-expert communities were properly trained so that they can independently operate high-tech systems.
- **Stage 2: Designing and Installation Technology -** Began with designing and installing the technology, known as a photovoltaic powered reverse osmosis (PVRO); Training the community residents to operate and maintain the system. A local aid organization identified a potential site for the system, that receives ample amounts of sunshine — an ideal environment for a solar-powered system. It identifies the resourceful helpers who were willing to help in installation of the system.

Challenges faced

- Training the villagers was difficult due to language barrier – Local aid worker would translate to the local indigenous dialect.

Impacts

- **Economic Benefit -** The water purification station has created a viable business opportunity for the village. The locally produced clean water is sold for 5 pesos per 20-liter bottle, which is 1/10th of the cost of bottled water that would otherwise need to be bought from another village about an hour away.
- **Health Benefit -** Village have been trained to operate and maintain the PVRO system which gently improves their lives.
- The community has appointed a committee to manage the incoming funds, setting aside some money for maintenance and repair of the system, and investing the rest back into the community.
- Residents took the ownership of the technology to develop business by selling water to the tourists.

- **Shujola Project (2019-2021)**
  The aim of the project was to build and operate water kiosks with clean and affordable water in suburban areas.

Workability

- **Community water Kiosk Model-**
  - Assistance is provided to a local SME so it can open a water kiosk.
  - An affordable subscription for residents to access clean drinking water.
  - Customers share ownership of the water kiosk.
  - For administrative and business issues - As members of kiosk management boards, their representatives participate in decision-making in educating the neighbourhood.
- **School water Kiosk Model-**
  - The school provides the land, access to water, and power necessary for the establishment of a water kiosk.
  - The school directors serve as the committee's representatives and oversee the management and direction of the water kiosk's operations.
- **Functioning of Kiosk**
  - The kiosk offers water in bottles and canisters to locals (at reduced pricing), as well as to local businesses and shops (at higher prices).
  - The kiosk has 2 windows - one facing a playground for schoolchildren and teachers, and the other facing the road. The kiosk provides free daily water rations to all students and instructors through the window facing the schoolyard.
- **Partners in the project and Project Objectives**
  - Include businesses that deal with water technology, SMEs, school boards and community leaders, microfinance organisations, and manufacturers of consumer products
  - Project Objectives A total of 400 low-income families with around 1,750 residents and 300 students and teachers are served by two successful water kiosks, respectively.
  - Testing is done on solidarity methods to see if they can also give the poorest of the poor access. Experiences are recorded to make it easier to replicate the effective water kiosk concepts elsewhere.
  - Partners in financing are Lokales Wasser 37 AG and Max Ditting AG.
  - It is a component of the Swiss Contact Development Programme, which is co-financed by the Federal Department of Foreign Affairs FDFA and the Swiss Agency for Development and Cooperation (SDC)

Challenges faced

- None as of now as the project is still in its pilot phase.

Impact

- A water kiosk with an innovative business model is run by two local SMEs, one in a rural area and the other at a school. Safe drinking water is made available to 1,750 people in a rural hamlet, including 300 kids.
- The themes of clean water, health, and cleanliness are brought to the attention of more than 2,000 potential customers of the water kiosks.

4.3. Proposed Business Model

The use of renewable technology can be encouraged by policy that takes into account the environmental costs of water use. Successful application is hampered by high upfront equipment costs, user capital limits, and operational unpredictability. To increase the market's acceptance of renewable energy, additional steps might be required. Hence, keeping the learnings in mind, the model of providing ***Water-as-a-Service*** is one potential remedy.

Important Outcomes from all the analyses:

- Range of current paying capacity of the people from rural areas: Less than **₹5/1000 litre**
- Willing to use new technology: Overall, around **87% are willing** to use.
- Willing to pay for a new technology: Overall, around **97% people are willing** to pay and 3/4th of them are willing to pay in the range of **₹0-50/ month**.
- Current operating cost of SOURCE Global (For unit with 6-8 LPD capacity): **₹2500/year** ($30.5/ year) – (Similar to the solar panel), Around **₹0.98/ litre**
- Current operating cost of URAVU (For unit with 6-8 LPD capacity): **₹0.05/ litre** ($0.0006/ litre).
- Implementation Support by the Government at State, District and Village Level: Most of them are willing to support such new technology in its implementation and operation phase.
- Right stakeholders/ institutional partners to be involved in the implementation: Present almost in all the states.
- Benefits: Health, Better Hygiene
- Opportunity Cost: Time Savings, Increased Productivity, Livelihood opportunity for women
- Direct environmental cost of current solutions: Plastics, RO reject water, Brine from desalination plants

What is Water-as-a-Service?

By considering all the above points, new service at a community level will be the most efficient one where the rural community along with different stakeholders will maintain and operate the service. Also, the reach of the technology will be maximum in such case. A wide range of historically commodity-based businesses have seen an increase in the acceptance of service-based business models in recent decades. Without making a direct investment in the commodity or having control over how it is used, the consumer can nevertheless benefit from it. WaaS can increase access to improved technology, which benefits consumers, service providers, renewable water technology, and perhaps society as a whole. Water-as-a-service (WaaS) is a word that can be used to refer to a variety of business models in the water supply industry, including subscription-based water usage patterns. Customers and society have benefited from WaaS in the past, and it may be useful for extending the usage of new technologies in the future[68].

Below is the selected model found to be suitable for providing renewable drinking water service to the community.

Expanding Access to Renewable Water Technology in rural remote and hard to access areas using Water-as-a-Service Model

Renewable water technology can provide residents with safe potable water with limited cost, if financial help is provided from other sources. They can also provide health benefits to the customers. Company can install and maintain a renewable water technology unit at community level with higher production capacity. It can retain the ownership of the system and charge the customer for the service. Because its revenue depends on system performance, the provider can have an incentive to design and install the best possible system for the type of customer. The company can collaborate with various partners like GPs, government departments, private companies, NGOs, etc. regarding implementation, capacity building and financial support.

WaaS is the selected model. Under this model, ownership of the unit is be retained by the service provider i.e., SOURCE Global Technology, after installation of the unit at the community level in rural areas. A greater production capacity renewable water technology unit can be installed and maintained at the community level by SOURCE Global since performance affects its revenue. It may keep ownership of the system while billing the client for the service. The revenue obtained after levying some minimal charges to the users can go the account of SOURCE Global, extra maintenance charges can be obtained from the partners.

It can collaborate with different partner agencies, organizations to set up unit at an affordable cost and also for the operation and maintenance of such units. If funding is available from other sources, renewable water technology can offer residents clean drinkable water at a low cost and with added health benefits. The business is open to working with a variety of partners, including GP, government agencies, private businesses, NGOs, CSRs, women and youth associations, VWSC, etc., on implementation, capacity building, and financial support. The company can train the locals to operate and maintain the technology unit at the local level. This will also generate employment for a few locals from the rural areas.

The WaaS paradigm could be used to more effectively match consumer incentives with overall unit operating restrictions. It might support capacity planning, aid in the integration of renewable water technologies, and promote solar-powered renewable water production.

4.3.1. Analysis of the Business Model

We want to understand the building blocks of the business model, value proposition of the offering, its infrastructure, market and finances etc. The objective of the analysis is to assist GIZ to align their activities accordingly. The basic analysis of the business model and its components is described below:

Table 27: Key Elements of a Business Model

Value proposition of the business	Value proposition refers to the product or service the firm intends to offer to its customers to meet their needs. It is unique to an organisation as it sets it apart from its competitors.
Key Activities	The key activities that generate the value proposition

[68] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://media.rff.org/documents/IB_19-09_EaaS.pdf

Key Resources	The key resources it used to create value for its customers
Key Partners	Its alliances or key partner networks and the things that motivate them to be part of the business model
Cost Structure	The cost structure section outlines all the monetary costs the business incurs while operating under the model.
Customer Segments	Customer segments break the total market down to help identify and describe its target customers more specifically.
Channels	Channels of delivery connect a customer segment to the value proposition. For example, an organisation can deliver value to its clients using its own channels, major distributors or both. Perhaps customers access it online, maybe they visit a store.
Customer Relationships	The type of relationship between the business and its customers. For example, transactional, long-term, self-service, co-creation, etc.
Revenue Streams	It describes how the company makes money from its target market.

Key Partners

- **All the below authorities can be partnered with the rural community to deliver a Value Proposition**
  - PHED, ISA, Nagar Nigam, Jal Nigam, State Water Supply and Sanitation Department
  - Rural Communities and GPs
  - Block and District level officials and several agencies working under GP like VWSC
  - ASHA/Anganwadi workers
  - Minority group representatives
  - Youth and Women's organizations/SHGs
  - NGOs (Local and International)
  - Courtyard Shelters
  - CSRs, Corporates, Investors, HNIs, UHNIs
  - National and International Donor agencies
- Partners can provide Implementation, Financial and Capacity Building Support to deliver the technology at the grassroots level

Key Activities

- **Provision of Drinking Water as a service to the key beneficiaries**
- Other value propositions can be delivered by involving various partners toward various activities within time
- SOURCE Global in partnership with its partners can undertake surveys, promotions and campaigns to increase the reach of the initiatives.
- Partners can provide support to the villages to adopt a new initiative in the villages within the oversight of the State and District Government.

Key Resources

- Key Resources include financial resources for the implementation of the technology at the community level such as installation cost of the SOURCE Global (₹ 0.2 Million ($2,459.4)) – which is really high as compared to the annual income of the villagers. Community can pay a service or user fee (pay-as-you-use) service model which can cater towards operations and maintenance of the units and capital expenditure to be taken up by govt stakeholders, donor agencies, CSRs, community funds, grants, other philanthropy etc.
- Other resources include technical expertise, community mobilization, BCC/IEC, O&M etc. in the form of Human Resources

Value Proposition

- Customers will be delivered a product **to create renewable drinking water with hydro panels that will produce potable water from sunlight and moisture using solar energy i.e., safe drinking water using renewable sources of energy -** best suited for **remote areas** where the government cannot lay pipelines and where water is scarce.

Customer Relationships

- SOURCE Global to look at effective BCC and IEC campaigns towards impact of safe drinking water and longer-term impact
- SOURCE Global and partners can look at providing CAPEX support towards infrastructure installation.
- Freemium model can be explored wherein drinking water can be provided at no/low cost initially to develop customer relationships and to retain them.
- Moreover, they can provide **technical support in collaboration with different GPs, NGOs or any other groups** to train the community on how to use it at individual and at community level.
- **Effective marketing** campaigns can also help in creating more customers

Channels

- SOURCE Global along with its Partner Organization → State Water Supply and Sanitation Department → District Level Officials → Gram Panchayat → User (Villagers/ Community)

Customer Segments

Rural Communities

- from remote and inaccessible settlements which do not have access to clean drinking water, are dependent on tanker and saline and contaminated ground water or who have to travel long distances to fetch drinking water
- living in areas suffering from drought-like conditions, have water scarcity, power supply issues, or living in hilly areas
- where current govt. schemes or CSRs do not have reach

Cost Structure

- Costs towards capital expenditure are prohibitive and may restrict uptake of individual HH level uptake or installation – business model to look at co-financing models with other partners and rural communities
- Some part of CAPEX can be borne by SOURCE Global/development partners/CSRs etc. Local GP and Community funds can be explored as well.
- The business model requires cost structure to be such that it is more affordable
- Focus on activities like surveys, promotions and campaigns

Revenue Streams

- User fees/service fees from communities - the customers are willing to monthly charge ranging from ₹ 0-100/ month ($1.23) for the water obtained from the technology. Currently people from different states pay from ₹ 0.135-2/1000 litres ($0.0017-0.025/1000 litres).
- Alternate revenue streams from different funding sources to be explored

Figure 57: Key Elements of the Business Model

4.3.2. Financing the interventions

While exploring the financing options and designing the revenue generation models for Drinking Water Management, there are three important components to be considered:

a. **Hardware components:** The funds allocated for the hardware components are used to facilitate the development, streamlining the value chain processes and installation of SOURCE Global Technology. These funds are used towards the capital expenditure for the establishment of this physical infrastructure of the technology at the individual or community level.
b. **Software Component:** This component includes the awareness generation campaigns, capacity building activities, etc. and the funds required to conduct these activities. These funds are used for the development of training manuals and conducting/ organizing the awareness and training sessions for the rural community to use the SOURCE Global Technology and its benefits, operation etc.
c. **Operation and Maintenance Component:** These funds are allocated to be used towards the operations and maintenance of the technology unit.

Typical cost estimation for incorporating a Water Supply System at Community Level
Calculating the Capex and Opex cost for developing a Renewable water technology system is a crucial aspect in the decision-making and fund allocation process. Based on the literature and evidence-based research, the proposed framework for the norms to calculate these costs is:

60% of the total cost – Infrastructure development/ Hardware component cost
20% of the total cost – Capacity Building, IEC/ Software component cost
20% of the total cost – Operation and Maintenance

4.3.3. Revenue generation models

It is known that implementing agencies and government authorities find it difficult to create and manage water management projects with limited finance. Moreover, the infrastructure created is not properly utilized and the Return on Investment (ROI) is often ignored, hence, leading to failure. Moreover, there are challenges around access to market based/debt finance for projects. Under **Water-as-a-Service (WaaS) Model**, ownership of the unit will be retained by the service provider i.e., SOURCE Global Technology. They can collaborate with different partner agencies and organizations to set up technology unit and its infrastructure and provision of safe drinking water at an affordable cost to consumers/beneficiaries.

There is an urgent requirement to look at innovative financing and revenue Mechanisms towards mobilisation of water management initiatives focusing on both Capital Expenditure (CapEX) (both software[69] and hardware[70] components) and Operation Expenditure (OpEX) (operations & maintenance[71] component) focusing on potential of self-sustainability i.e., generating revenue through the provision of water services to rural communities. Some of the options are provided below:

Table 28: Recommended Revenue Generation Model

Type of Expenditure	Type of Financing Mechanism	Rural
Capital Expenditure (CapEX) Development of services is required for • Hardware, infrastructure components such as initial investment in Renewable Water Technology Unit Infrastructure and facilities, provision of space for setting up the unit	Central and State Government Assistance i.e., Government Grants and Schemes – for provision of space for setting up the unit at the community level – for implementation and capacity building support – partially for O&M, so that the water charges are affordable to the rural community	Yes, Funds available with various development programmes of the Ministry of Rural Development, Jal Jeevan Mission (JJM), State Water & Sanitation Mission - Uttar Pradesh, Member of Parliament Local Area Development scheme (MPLADS), Member of Legislative Assembly Local Area Development scheme (MLALADS) funds, funds under Ministry of Health & Family Welfare, Ministry of Women and Child development, CSR, etc.
	Finance Commission[72] Funds and Grants	Yes, areas needing water management

[69] Software Component: Funding for the software component is needed to support activities such as communication for demand creation and behaviour change, capacity building of key stakeholders, monitoring, and so on;
[70] Hardware Component: Funding for the hardware component mainly includes capital expenditure, that is, the funds required to construct the infrastructure for the management of the drinking water infrastructure;
[71] O&M Component: Funding for the O&M component is needed to sustain the usability of the facilities constructed in terms of repairs, consumables, and so on. In comparison to hardware funding that may be larger but a onetime cost, the funds for O&M, although small, would be required in perpetuity
[72] Funds available under central and state finance commission grants to the PRIs may also be utilized for this purpose

• Software components such as planning, community participation processes and how to use the renewable water unit services, programme costs for activities such as operational training, institutional development	Private Sector Participation (PSP) - Corporate Social Responsibility contribution, locally active private sector partnerships	Yes
	Own Financing (i.e., GPs own funds[73] or ULBs own funds)	Yes
	Bank Loans Financing/External Funding	Yes, but with inbuilt viable business model – this needs to be showcased under a tangible financial model showing good Return on Investment taken up during preparation of Detailed Project Report (DPR)
	Donor/Grant Making Agencies[74]	Yes
	Municipal bonds[75] and debentures	No
	Other Fiscal Incentives[76]	No
Operating Expenditure (OpEX) Recurring costs required for operation and maintenance of the facilities and operational costs of public service provision, also looking at major repairs and eventual replacement of hardware	User Charges[77]	Yes, the willingness to pay in rural areas of the states shows that the people are willing to pay in the range of ₹ 0-100/ month ($0.12/ month).
	Local Taxes for water management	Yes
	Land Leveraging	Yes
	Subsidies from GPs and/or government funds	Yes

4.4. Implementation Strategy

The recommendations for drinking water management are based on the challenges observed from the focus districts and GPs. The implementation strategy typically includes details on how the village will monitor progress in order to measure achievements in reaching the stated goals. Before defining the implementation strategy at GP levels, the proposed activities towards implementation arrangements at the **district level** are as follows:

- To facilitate this system, the district level authorities including District Planning Committee can provide support to SOURCE Global Company through a mechanism of MOU between RD, PRI, PHED and/or between JJM programmes which may involve paying for services, technical support and coordination, etc.
- District team (District Planning Committee) will have to augment its capacity to facilitate the coordination between district and rural level activities with the GP which will include - technical support planning and implementation, funding the services, communication support and monitoring.
- The district team should look at policy and programmes jointly funded by JJM/ Finance Commission Grants, CSR funds, Donor grants and other revenue sources for better impact, scale, and sustainability of the renewable water supply system.
- District team should create an eco-system to promote innovative technologies, solutions by engaging with start-ups, innovators, producers/ manufacturers, service providers and other stakeholders providing drinking water services.

[73] taxes, rental from shops, lease of lands etc.
[74] Asian Development Bank (ADB), Japan Bank for International Cooperation (JBIC), German Development Bank (KfW) and the World Bank. GIZ etc.
[75] Tax-free municipal bonds can be issued for raising finances from the market for infrastructure development. Such bonds can be issued by ULBs having good financial health and good credit rating to attract investors to invest in municipal bonds. The amount invested is redeemable after a specific period with a definite rate of interest.
[76] Tax Exemption of Certain Bonds Issued by Local Authorities; Tax Holiday for the Project Entity for Drinking Water Provision; Tax Exemption for Income of Infrastructure Capital Funds/Companies; Inclusion as Eligible Investments of Charitable Funds; share from stamp duty on transfers of property, share from entertainment tax, share from education tax in the form of a grant from the provincial or national government
[77] Customers such as Households/community: residential homeowners pay for drinking water provision

The implementation strategy for the **GP level** is proposed to be classified into two types – **Primary Model and Cluster Model**. Where, the Primary Model will be applied for the large GPs with a population of 2000 persons and above and the Cluster Model will be applied to a group/cluster of various small GPs consisting of a population size of below 2000.

Table 29: Recommendations at GP Level Implementation

Areas	Primary Model (Large GPs of 2000 & above population)	Cluster Model (Group of small GPs of below 2000 population)
Detailed Water Audit	• Detailed Drinking Water audits to be conducted to identify the water quality, frequency of water supply, service affordability, willingness to pay, hygiene and maintenance, etc., for every village through customized tools and implementing their own efforts for improved planning.	• Detailed Drinking Water audits to be conducted to identify the water quality, frequency of water supply, service affordability, willingness to pay, hygiene and maintenance, etc., by the group of small GPs/ cluster through customized tools and implementing their own efforts for improved planning.
Institutional Clarity	• Institutional arrangements to be refined by engaging existing Village Water and Sanitation Committee (VWSC) comprising of GP President, selected ward members and representatives of other committees with the service provider. • If there is no such committee in the GP, it should be formed wherever the service is being provided. • The committee can help in implementation and capacity building for the renewable water technology units • As the ownership is retained by the service provider, the O&M charges and partial from different schemes will be deposited into their account.	• Institutional arrangements to be refined by engaging existing Village Water and Sanitation Committee (VWSC) at the Cluster level comprising of Elected Cluster Head, GP Presidents, selected members and representatives of other committees. • If there is no such committee in the GP, it should be formed wherever the service is being provided. • The committee can help in the implementation and capacity building for the renewable water technology unit • As the ownership is retained by the service provider, the O&M charges and partial from different schemes will be deposited into their account.
Planning solutions - DPR/Financial Models/Norms/Standards	• GP specific participatory and inclusive DPRs should be prepared considering the context and infrastructure availability and requirements in future, community behavior, and environmental conditions along with the estimated budgets for the Capex and Opex costs. Based on these DPRs, the Operational Plans including the detailed financial models with 10 years projections on revenue and return on investment can be prepared.	• Cluster specific participatory and inclusive DPRs should be prepared considering the context and infrastructure availability and requirements in future, community behavior, and environmental conditions along with the estimated budgets for the Capex and Opex costs. Based on these DPRs, the Operational Plans including the detailed financial models with 10 years projections on revenue and return on investment can be prepared.
Financing the implementation	• Mobilization of funds for the Capex and Opex of the DPRs from the Government schemes, GP funds, CSR activities, user charges and other sources to be explored. • These funds should be planned as per the Operational Plans prepared in the DPRs at the beginning of the financial year to ensure accurate mobilization of resources towards water management using such technology.	
Collaboration of Service Providers with different organizations and agencies	• Services providers can collaborate with Micro Enterprises/NGOs/SHGs for the implementation of services through proper service contracts which will solely be based on performance and sustainability of revenue and provision of services • These contracts can be issued and managed by VWSC at the GP and Cluster levels.	
Communication Campaigns	• Awareness and Training programmes should be designed and launched in all targeted GPs where the technology is being implemented • They include creating awareness on operating and maintaining the technology, service charges, collection systems, behavioral practices, participation of the community in increasing the reach of renewable drinking water technology as a sustainable option	
Capacity Building	• Training of all the VWSC Members, service providers, should be conducted towards the awareness programmes to be conducted, Service Management, Contract Management, Efficient service delivery, Monitoring systems, etc.	
Infrastructure services development	• Build/ establish infrastructural facilities for renewable drinking water technology units at community level as the costs at individual level are quite prohibitive • Service to be properly designed for meeting the safe drinking water needs of the community at the affordable rate	

Operation Management	• This section defines the launch of renewable drinking water technology services at the GP or Cluster level. • Nominal charges can be taken from the community towards O&M and the service provider can opt for other finances from its partner organizations and through government schemes.
Monitoring and Grievance Redressal System	• Concurrent monitoring of the entire system to be ensured by the VWSC. • Water audit, audit of services and user satisfaction to be carried out regularly by the GPs and clusters. • A system for addressing complaints, maintaining database, compliance and redressal can be developed for efficient functioning of the system.

4.5. Next Steps and Way Forward

A typical process of Drinking Water Supply Project Implementation can follow the steps below.

Table 30: Next Steps and Way Forward

Actions	Status	Timeline
Initial Situation Analysis/Market Assessment of Geographies - in priority geography areas focusing on Issues and Gaps in water supply	Completed through this assignment	NA
Detailed Technical Feasibility of Renewable Drinking Water Technologies - Identification and Prioritisation of Action	Upcoming	Immediate (within 3-4 months)
Detailed Financial Feasibility i.e., development of detailed Financial Models - determination of Financial Sources (project revenues & capital funds), Project Costs (capital & revenues expenditures) i.e., Overall Cost Assessment (Full Cost Assessment), Project Viability and Financial Support Requirement, Identification of sources of finance and deficit management		Short term (Within 6-8 months)
Undertake ***Project Scoping and structuring – Preparation of Detailed Project Reports (DPR)*** - Project Scoping, Risk Identification and Allocation and Project Structuring and Project Documentation		Medium term (Within 8-15 months)
Setting up of partnerships/Signing of MoUs		
Kick off Drinking Water Service Provision Model		

Annexures

Annexure 1: Key Findings at State, District and Rural Level

Rural areas from four Indian States of Rajasthan, Odisha, Uttar Pradesh and Maharashtra were surveyed to study their requirement for Renewable Drinking Water Technologies. The data was analyzed at state, district and village level and key findings are listed below in tabular format as per state.

2.5. Rajasthan

Rajasthan heavily suffers from water crisis especially, the rural and remote areas. Women and girls are responsible for the collection, carrying, storage, supplying, and managing water in every home in Rajasthan's rural districts[78]. In Rajasthan, the gross household water demand is projected to be 2245.37 Mm^3/yr, 3496.50 Mm^3/yr, 4535.54 Mm^3/yr, and 5216.96 Mm^3/yr, respectively, in the years 2010, 2020, 2040, and 2060 (Mm - Million cubic metres per year and $1m^3$= 1000L)[79]. Overall, the drinking water demand in Rajasthan was about 125.1 Mm^3/yr for the year 2011 (considering a demand of 5 LPCD and 2011 census population). Men move to cities in search of employment in regions where there isn't enough water for farming, leaving women all alone to care for the elderly and young. Women have limited time for several other productive activities as majority of their time goes into collecting water. This also affects the education of the girls[80].

Unmaintained water supply facilities in Jodhpur

To tackle with this situation, ₹127.5 Million ($ 1.55 Million) will be invested in four districts, namely, Bikaner, Ganganagar, Jodhpur and Jaisalmer, for four escape reservoirs to avoid drinking water scarcity for upcoming 30 years. This will be beneficial for about 2.087 million households in 6,707 villages from these districts. Also, ₹813.7 Million ($ 9.87 Million) are being allotted through JJM to cover a total of 7.6 million homes in these districts[81]. The districts chosen from rural areas of Rajasthan are Jodhpur and Jaisalmer. Their details are as follows:

Details of selected districts from Rajasthan[82]

District	**Jodhpur**	**Jaisalmer**
Total District Population	3,687,165	669,919
Total number of inhabited villages	1,836	756
Rural Population	2,422,551	580,894
No. of Rural Households	414,223	100,427
Selected Rural areas for the study	Basni	Deora
	Ranisar	Basna`
	Jhalamand	Jajiya
	Luni	Morani

[78] https://hindi.indiawaterportal.org/content/water-crisis-rajasthan/content-type-page/53102
[79] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://www.water.rajasthan.gov.in/content/dam/water/state-water-resources-planning-department/tahaldata/Final%20Report%204.6/Volume1-%20Main%20Report/Report%204.6.%20IN-24740-R13-077_Part%20A%20and%20B.pdf
[80] https://hindi.indiawaterportal.org/content/water-crisis-rajasthan/content-type-page/53102
[81] https://timesofindia.indiatimes.com/city/jaipur/plan-to-end-drinking-water-woes-in-desert-dists-phed-official/articleshow/87857625.cms
[82] Census of India, 2011

Total number of HH surveys conducted	100	100

2.5.1. Analysis at State level

Focused group discussions were conducted at the state offices of Rajasthan. The key findings have been tabulated below:

Key Findings for the selected districts and villages in Rajasthan

Aspects	Rajasthan State Departments
Surveyed State Departments	• Tourism Department Jaipur • CMI Public Health Engineering Department (PHED) Jaipur • Rajasthan Tourism Development Corporation (RTDC) Jaipur • IAS Environmental Department Jaipur • Water and Sanitation Support Organization (WSSO) Director Jaipur
List of Schemes	• JJM • Chambal Bhilwara Urban Water Supply Scheme[83]
Institutional Arrangements (Departments or Authorities) involved in the provision of water supply	• PHED supplies water through tanks which gets filtered by ROs and then it is supplied to other places. • Popular technologies currently being practiced in Rajasthan is Reverse Osmosis, which can serve household capacity area (Mass Consumption). • The state is doing all kinds of work, providing all the supplies, and is engaged in tendering contracts to create infrastructure and then operate and maintain the substituent 10-year prototype. • Private places are provided RO installation facilities. They have provided RO in public places and are allowed to install the plant and recover the cost of water charges which is **₹20/100 litres** ($0.24/ 100 litres) in urban areas while **20 paise/ 100 litres ($0.0024/ 100 litres) in rural areas.** • They put all the money they were supposed to invest and then recover that cost + profit through this water system. **4,000 plants** are installed under PPP, providing the resource and recovering the maintenance through public cost. **425 new ROs will be installed this year.**
Most hard-to-access areas, Approximate demand for water supply in these areas	• There is hardly any village that doesn't have PHED water supply. It is there in the form of hand pumps. PHED ensures that every village should have one hand pump at least. • If the water supply is once in a week, water stored through rainwater conservation is used but it is not sufficient as rural residents still have to use water carefully as per the GP officials. The water supplied by PHED is rainwater.
Source of water supply	• A lot of areas have been covered by the **canal system** in Rajasthan. • **Groundwater, hand pumps, and tube wells** are sources of water in **rural areas** • Groundwater (cheapest way of achieving); Surface water (water bodies or small bodies); Rivers • **PHED Connections** for Hotels, hospitals, parks, 15-20 RTDC hotels (Jaisalmer, Jodhpur, Udaipur, Jaipur) and other areas in the cities • **Every tourist spot** gets water from rainwater harvesting, tubewells, and PHED connections.
Water Quality testing	• Groundwater is **saline** in many parts of Rajasthan; even **fluoride** is present in some places. • **Reverse osmosis (RO) technique** is used in rural areas which is a short-term measure to treat water extracted from tube wells. • ROs, filters and purified waters are installed at tourist places to provide good quality water. • De-Fluoridation Unit **(DFU)** is installed at Udaipur, Jodhpur wherever there is fluoride content.
Water Supply charges	• Cost of **RO water** installed at public places is – ₹20/ 100 litres ($0.24/ 100 litres) in urban areas – **20 paise/ 100 litres ($0.0024/ 100 litres) in rural areas** • Water provided through **DFU is free**
Access to FHTC	• Under JJM, the water supply is designed per the water requirement of 55 LPCD and is being provided for domestic purposes. • Out of 11.2 million HHs, 2.9 million HHs (**26% HHs**) are now served with **Functional Household Tap Connection (FHTC)** and have achieved sanctions for 9 million HHs under JJM. • Rajasthan is on its path to achieve 100% water connections to each and every household in every area under JJM

[83] https://urban.rajasthan.gov.in/content/dam/raj/udh/organizations/ruidp/MISC/Rajasthan_Urban_Water_Supply_Policy_2018_final.pdf

Role of each department in overcoming the drinking water related challenges	**Public Health Engineering Department (PHED) Jaipur** • PHED is responsible for all the water supply systems and supplies water to the overhead tanks • Responsible for checking and maintaining the quality of supplied water through the installation of ROs and DFUs • Provision of water supply to every district, city, village and tourist spot • PHED water supply system is the primary source of drinking water in Rajasthan. • Surface water is also a source of drinking water. • PHED and ERPC provide safe drinking water to 13 districts of Rajasthan. **Water Resource Department** • Builds dams, and canals for water supply and irrigation **Department of Tourism, Jaipur** • Ensures that facilities like water, bathrooms or toilets are available in hotels **Rajasthan Tourism Development Corporation (RTDC)** • Purifies and distributes the water (supplied by PHED to the overhead tanks connected to the individual ROs) to the households. • These ROs are being installed under a corporation with private funding. • RTDC has also invested in the installation of ROs.
Funding	• The implementation cost is more than ₹2000 Billion ($24.37 Billion) in terms of infrastructure and resources. • **Rural schemes** have some of their cost paid by the **State and centre (50:50).** • **Private players** under the corporation fund the **installation of ROs.**
Source of water supply for the other allied activities (Sanitation, agriculture, cattle rearing, etc.)	• Particular 7-9 districts have allowed 30 LPCD in desert areas for animal and cattle planning. • Under JJM, the Government of India has taken special provisions to provide technical support for harvesting in desert areas. • Groundwater or surface water is suitable for domestic use.
Any improvement in the water supply provision	• In the last 5 years, 6,800 Fluoride affected habitations have been given special attention. • Work is going on to provide water to every household, under which 20,000 villages out of 60,000 have already been covered
Further improvements to be made or Suggestions	• If the water supply is extensive and the water sources are available within short distances, say within 50m in desert areas, it will be very beneficial. • Water should be re-used. • SOURCE Global technology should be installed in the Jaisalmer area
Demand for a decentralised/ alternative water supply system in the state	• Water supply service coverage – provision of water supply connections to households in hard to access areas and remote areas • Sustainable water management • Capacity building and institutional strengthening
Water supply-related technology providers active in the state	• RO – Reverse Osmosis • DFU – De-fluorinated Unit • URAVU – Renewable Drinking Water Source
Awareness programs conducted to conserve surface and groundwater	• Rural Water Supply Program • Jal Abhiyan • Rajiv Gandhi Water Management Mission[84]

Challenges in provisioning of water supply in rural areas

Rajasthan is a state with many variations in terms of geography, rainfall, availability of water, and quality of water. Jaisalmer District is deprived of many facilities. Unavailability of water source is also a pressing issue in Rajasthan. Groundwater water quality is poor because of no perennial water source improvement leads to surface water challenges. Other challenges include lack of implementing resources and secondary resources obtaining water, funding and clearances, managing funds, project implementation, and a shortage of raw materials and contractors. Clearances consist of obtaining permissions from the forest department, railway department to cross the railway line, road departments to cross the road and so on, to construct such a vast infrastructure. Some places have become dark zones due to excess use of groundwater and lesser groundwater recharge.

Challenges, barriers and willingness in the implementation of any new system or technology related to water supply

[84] https://water.rajasthan.gov.in/content/water/en/swrpdepartment/aboutus.html

The significant challenge of installing the technology and creating infrastructure is not that big but **getting into force of that structure** and sustainability of operations is. The biggest challenges are **power supply, cost, and climatic changes such as extreme summer and extreme winter**. Sometimes **changing the mindset** of the people becomes difficult. **People want free water**; they do not care about technology since the government must provide water to them.

2.5.2. Analysis at District and Rural Level

Analysis has been done at each state and its respective district level to identify their suitability towards investing in such renewable drinking technologies in their rural areas to provide potable drinking water to the households. The table below shows the water supply status analysis and key findings in the rural areas of the Jodhpur and Jaisalmer districts of Rajasthan, as discussed with the district level and gram panchayat level officials.

Key Findings for the selected districts and villages in Rajasthan

Aspects	Jodhpur	Jaisalmer
Departments surveyed	• Public Health Engineering Department (PHED) • GP offices of Luni, Osiya (Basini Village), Pariyal (Ranisar village) and Jhalamand	• Public Health Engineering Department (PHED) • GP offices of Deora, Morani, Jajiya and Khabiya
Current Water Supply Scheme	• JJM (JJM) • ISA (International Solar Alliance) • Gramin Vikas	• JJM • Atal Bhujal Scheme
NGOs or organisations working towards water provision	• One **ISA**, named **Gramin Vikas**, is working in the whole district to create awareness among mass and is actively working in JJM. • It identifies the needs and demands of the rural people through Gram Sabha • Currently, no NGO is working towards water supply.	• **Piramal NGO -** Works for water treatment and has installed an RO system in the schools. • **Prerna** • Jodhpur Maharaja is running one organization named "**Jal Bhagirathi**". He registered many villages under it and made water available, which proved beneficial. Also, a pond was dug where water stays for around six months.
Works done till now	• PHED is the responsible authority for water supply in the district • Tube wells have been provided in 20-22 villages where it isn't easy to take water through a pipeline. • RO machines are being installed in the villages.	• PHED is the responsible authority for water supply in the district • Solar equipment are made available at some places to extract water.
Water Dependency and Source of water	• Rural people mainly depend upon rain water for agriculture and animal husbandry • 30-35 villages bring water from wells through tankers since no other source is available • This water is also used for drinking purposes.	• Dependency on rain water for various purposes • Agriculture is dependent on rainwater • Cattle drink the water from ponds, while in some cases, separate taps are installed for them.
Cost to buy a tanker	• ₹800-1,000 ($9.75-12.19) each with a capacity of around 5000L	• ₹800-1,000 ($9.75-12.19) each with a capacity of 5000L
Availability of canal or river	• No canal or river is available in the vicinity of many villages • 1 of 4 villages get their water from a canal	• Non-availability of **canal** and **electricity** in the villages near the Pakistan border
Groundwater level	• 800-1,000 ft	• 600-1,100 ft
Cost to dig a tubewell	• ₹3.5-4 Million ($0.043-0.049 Million)	• ₹3-3.5 Million ($0.037-0.043 Million)
Water Quality	• Groundwater and the water brought from the tanker are Saline in nature which also causes illnesses • Water from canals is not saline as it is rainwater • One of the Sarpanch informed that the water stored for 2-3 days in tanks becomes sticky and not suitable for drinking (Deora village, Jaisalmer) • Presence of chlorine in Basini, fluoride in Jajiya and Khabiya (three of the surveyed villages)	
Socio-economic condition of people from rural and remote areas	• Poor where there is a lack of water, and normal where water is available • Livelihood dependency is majorly on agriculture and cattle rearing	• Animal husbandry and farming is the primary source of livelihood in the district. People produce millet, moong and other seeds when there is rain.

	• People also work as labourers under MNREGA as an alternative source of income • Average income of rural people ranges from **₹7,000-12,000 per month**	• They are also involved in labour work under MNREGA, and a few are involved in industrial work to feed their family. • Farming is done for 4 months; otherwise, labour work is done in some of the villages. • Average income of rural people is around **₹6,000 – 10,000 per month**
Incidence of any disaster due to climate change	• Famine and drought-like conditions due to lesser rainfall and water scarcity	• Famine is prevalent in Deora village

Current Status and Issues about the water supply in the district and the surveyed villages

3) Jodhpur District

The issue of water scarcity in the summer (March-July) leads to complaints from the people. There is a non-availability of funds for water supply. Villages near the canals get sufficient water, but farther villages suffer due to lesser availability of water. Villages have poor infrastructural facilities, and sometimes people fight with each other for water.

- **Luni village -** A tank has been installed which provides water for 4 hours for 4-5 days a week but need more water storage facility and water tankers to bring the water from the city.
- **Jhalamand village** - Each house gets water for 2-3 days a week through a pipeline from a canal 6 km away from it and is used for all purposes.
- **Basini village** – People get the water from the canal through a pipe which is then filtered. Sometimes they get a mix of tube well and canal water which is saline.
- **Ranisar village** - 4-5 tubewells act as a major water source. Each HHs buys around 100 litres of water from the tankers which goes for around 4 days. This water is either taken from the tubewells or market.

Type of Water Supply Facilities in Jodhpur

2 villages have to buy water from tankers for drinking purpose as per requirement and people have to travel to get the water from them. In some cases, the **tanker** brought from **market or tubewells with saline water** costs around **₹500 ($6.09)** but the **tanker brought from the canal costs around ₹1500 ($18.28)** which is suitable for drinking but not affordable to the villagers. **Water demand** varies for all villages from **25,000 – 300,000 litres daily** depending on its use. Water shortage still exists for all the 4 villages and there is a need for a system to cater to the water needs of the people. Tubewell water is saline in nature and also very deep but still people have to consume it due to water scarcity, Some villages are old, so, laying new pipelines becomes difficult.

JJM hasn't started yet in 3 of the villages. They do not have separate budget for water supply. There is no Jal Samiti or any youth association or women association or any NGO working towards this issue. The GP officials

are willing to form such associations. **Navyug Scheme** has been recently launched by the PHED department but is still in progress.

4) Jaisalmer District

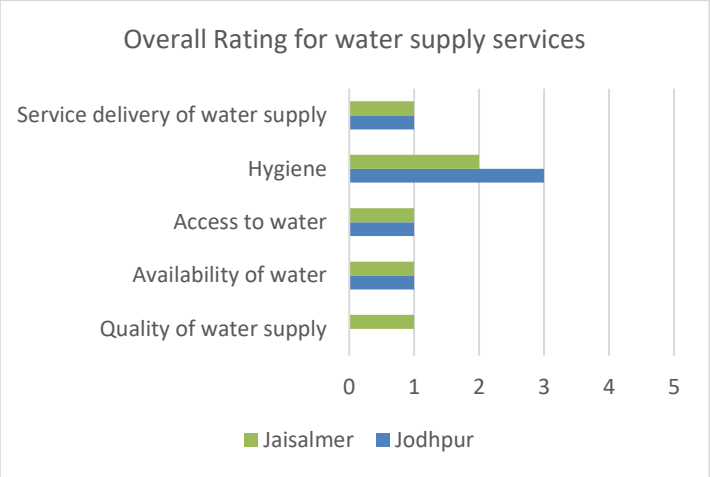
There is no proper water supply arrangement for 4,112 houses from 98 villages. Water shortage is a major issue in the district. Most people rear sheep, goat animals and cows and do not stay permanently in such areas. Villages have poor infrastructural facilities.

- **Deora village** - Canal water stored in a tank is supplied for 2 hours (which is not enough) to all and is used for drinking purpose from the last 5 years.
- **Jajiya and Khabiya villages -** It has a piped water system from canal under Atal Bhujal Scheme. The water is stored in on-ground tanks.
- **Morani village –** Under JJM, every house has been provided a pipeline connection connected to a lake and water is supplied from a tank. Water is provided through tankers with a capacity of 5,000 litres, whenever needed. Water availability is still an issue.

Water Demand varies for all villages from **25,000 – 300,000 litres daily** depending on its use. Water shortage exists in all villages, so, in some cases rain water is stored by digging a pond. **Water taps are installed for animals.** Poor people have to fetch water themselves, whereas slightly wealthier people have tanks installed in their homes as part of a government programme to store water. 3 of the villages are facing saline water issues, causing illnesses among people due to poor quality, so, government has launched a scheme to install RO in all houses in Deora. Water is so saline that it cannot be consumed even by animals and cannot be used for agricultural purpose, so farming is also less. Currently GPs do not have funds to supply water and need financial and implementation support from the water supply department. There is a lack of water quality, accessibility, availability and sanitation in the villages.

Overall Rating for rural water supply

The overall rating given by the GP officials for the water supply services in the villages are displayed in the below chart. The rating for both the districts for aspects such as **water supply service delivery, access to water and its availability is the lowest**. The reason for this is the **non-availability of a water supply system or saline nature** of water. Water quality rating is also the lowest in Jaisalmer while the GP officials in Jodhpur haven't given any rating for water quality due to poor quality.



Overall Rating for Water Supply Services

Jodhpur district has comparatively higher rating, of 3, in terms of water supply hygiene (i.e., cleaning the water at home to make it suitable for drinking) than Jaisalmer district which is 2. It is less but there is need for government to deploy some technology to provide potable water in enough quantity.

Willingness to support for a new technology to be implemented

As per District and GP officials, villagers will fully cooperate and contribute if any scheme or technology related to water is implemented and will also take part in the awareness programs. GP plays an active role in the implementation of new schemes but Block Office, District Office, Youth and Women's Organizations and NGOs should also participate well. More staff will be needed at all the levels to get the scheme implemented efficiently. As per the Sarpanch, rural people can also work as labourers to install the new system which will also provide employment to them. The officials were also willing to support and readily implement a new scheme announced by the state government and financial support is provided by them but also highlighted that maintenance of new systems in remote areas is difficult.

Suggestions by the officials

Jodhpur - A plan needs to be chalked out for **proper arrangement** for water supply and a **system** needs to be installed to **fulfil the need of water**. It should be **long lasting, designed specifically for Indian climatic conditions** (like solar panels which are being implemented), **automatically controlled**, to check if the tank is fully filled or not or the solar panels are working or not. GP officials suggested to build small dams, install Ground Level Reservoir (GLR), lay pipelines to all HHs, install RO at village level to provide clean and safe drinking water to everyone, take measures to reduce water theft and wastage and ensure timely delivery of water.

Jaisalmer – There is need to install an RO plant which may provide clean water to the villagers. Government should dig more ponds so that water stays for longer periods. For people who cannot afford to install tanks in their homes, tanks should be installed in their homes or water should be supplied to them through taps. Water can be supplied through pipelines. Boosters can be built in tanks to supply water in rural areas. As per the Sarpanch in Morani, more tube wells should be provided.

2.5.3. Identified Stakeholders to be engaged in implementing new technology

The State, District and GP officials suggested and rated various key stakeholders to be engaged to implement the decentralised technologies for water supply/ treatment in their rural areas. They are mentioned in the table below.

Critical stakeholders to be engaged

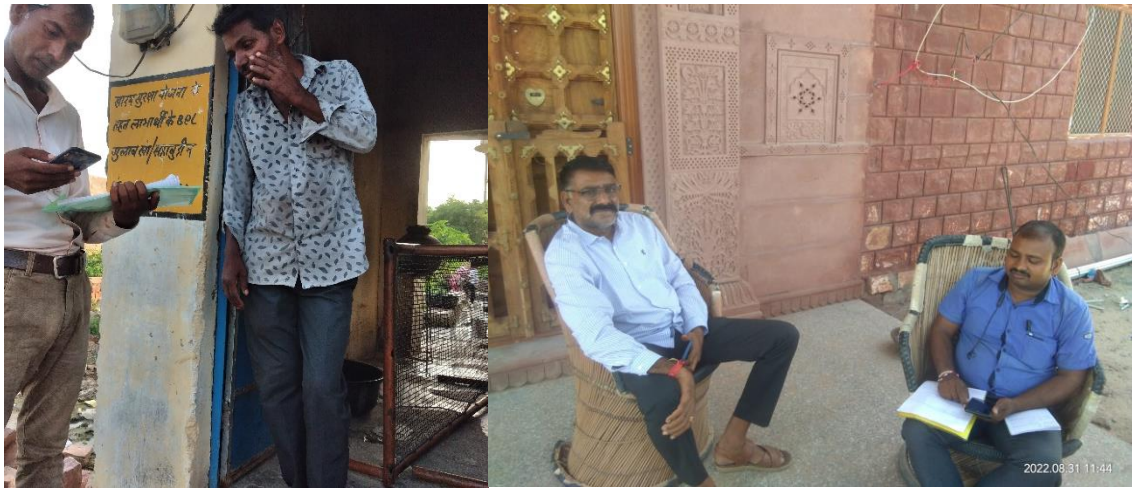
Stakeholders	Accountability for implementing/ operating	Nature of Interest	Rating for Importance	Rating for Influence
			(Scale of 1 to 5, 5 = highest)	
GP	Yes	Positive	5	5
VWSC	Yes	Positive	3	3
Block office	Yes	Positive	4	4
District office	Yes	Positive	4	4
Other corporates	No	Neutral	0	0
ASHA or anganwadi workers	Yes	Positive	3	3
Minority group representatives	No	Neutral	3	0
Youth organizations	Yes	Positive	2	2
Women's organizations	Yes	Positive	2	2
NGOs	Yes	Positive	3	3
Political party-1	No	Neutral	0	0
Community	Yes	Positive	5	5
Individual 1	No	Neutral	0	0

2.5.4. Household Level Analysis at Rural Level of the Districts

Demographic Profile of Respondents

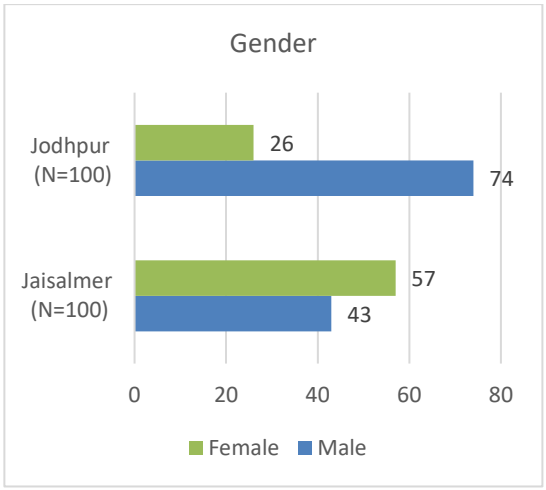
The demographic details of the respondents from the chosen rural and remote areas of the Jodhpur and Jaisalmer districts from the state of Rajasthan have been studied to know their socio-economic background and also willingness to pay and participate for a newly provided water supply technology. These details consist of gender, age, total members in the HH and the HH income. This can be helpful to know the

importance of these criteria to be considered while choosing areas where the renewable drinking water technology can be implemented.

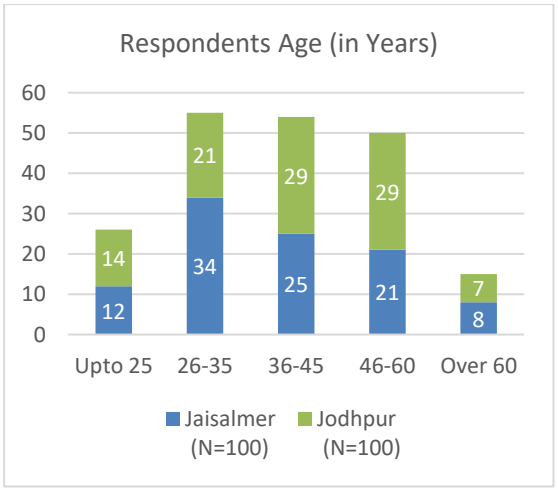


Surveys conducted in both the districts

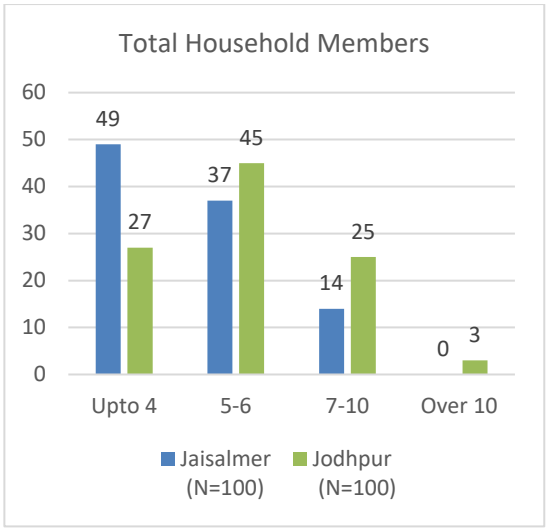
Over three-fourth from Jodhpur of the respondents were males while 55% respondents from Jaisalmer were females. The average **HH size** in rural areas of **Jodhpur and Jaisalmer districts** is observed to be **6 and 5 respectively**. The respondents from the rural areas of both the districts were distributed across all the age categories as shown in the figure below. Almost 50% of the respondents from Jodhpur belong to the age group of 26-45 years while 30% belong to 46-60 years of age group and only 7% of them are above 60 years of age. Similarly, for Jaisalmer district, almost 60% of the respondents are from 26-45 years age category, 20% are from 46-60 years of age and around 12% are less than 25 years of age.



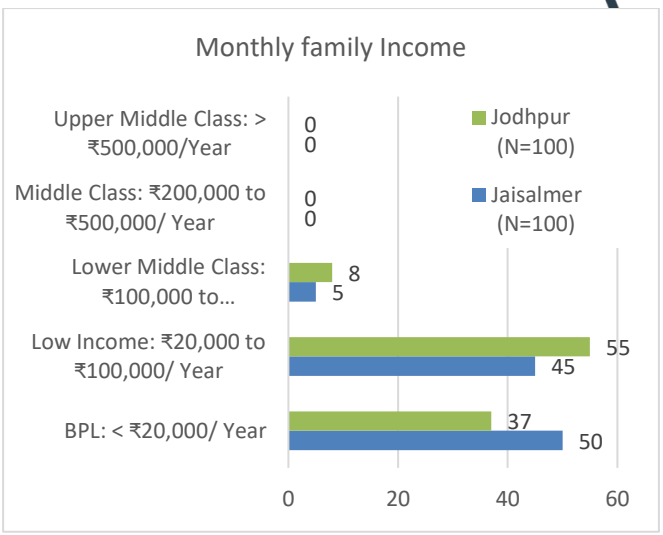
Gender of Respondents from Rajasthan



Age of Respondents from Rajasthan



Total HH members in respondents' family



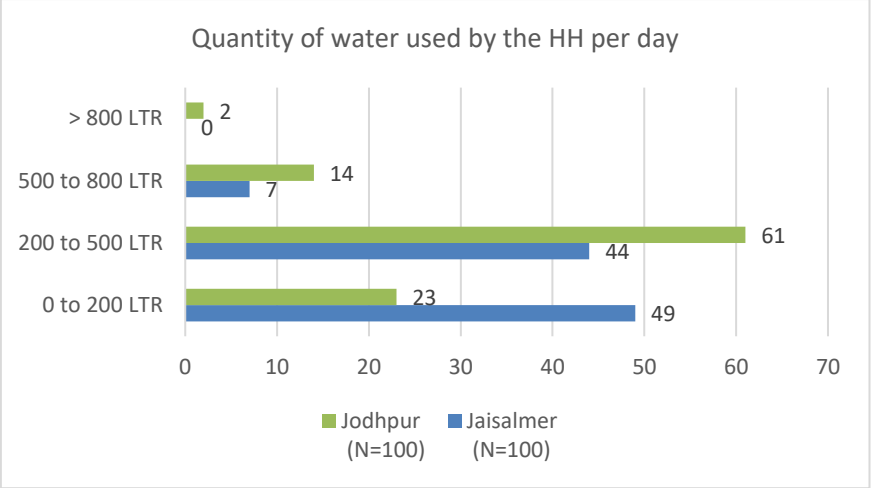
Total family income of respondents from Rajasthan

The average HH income of the families of **half** of the respondents from the rural areas of **Jaisalmer** district is less than **₹20,000/ year (BPL category)** ($243.74/ year)**, 45%** of them earn between 20,000-1,00,000/ year **(Lower income)** ($243.74-1,218.7/ year) and only **5%** belong to the **lower middle-class** category. As per the primary survey of HHs while as per many GP Sarpanch, **average monthly income** is observed to be **₹6,000-10,000** ($73.1-121.9/ month)**.**

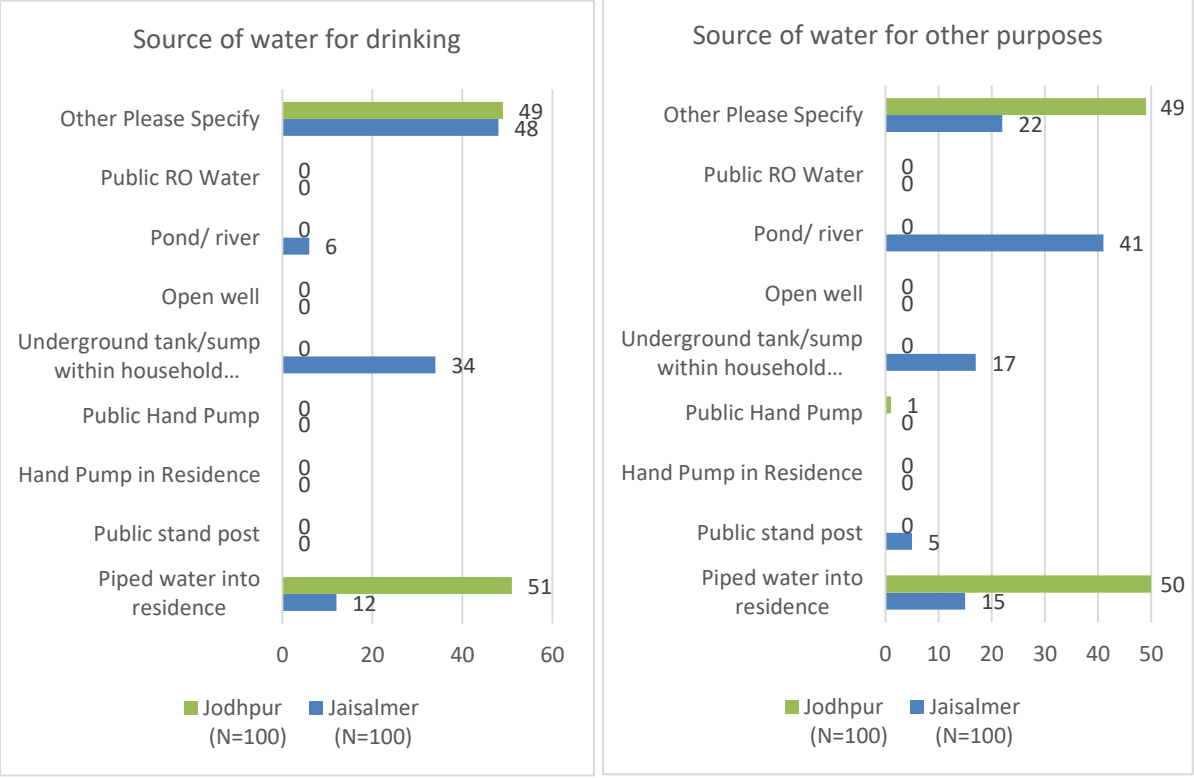
About **37%** people from the rural areas of **Jodhpur** earn less than ₹20,000/ year (**BPL category**) ($243.74/ year) while **55%** earn in the range of **₹20,000-1,00,000/ year (Lower income)** ($243.74-1,218.7/ year)**.** A very few percent (**8%**) of people earn from **₹1,00,000-2,00,000/ year** (**Lower middle-income**) ($1,218.7-2437.4/ year). According to GP Sarpanch, average monthly income is **₹7,000-12,000** ($85.3-146.24/ month). Most of the people are involved in labour work under MNREGA, farming and its allied activities.

Current Dependency on drinking water supplied from different sources

As per the primary survey, major water sources in both the districts are **rainwater, ponds and tubewells**, from which water is provided through **tankers** or taken at **individual** level. Water pipeline provision to each and every HH is under progress through JJM. Around 44% of the rural HHs from **Jaisalmer** and **61%** from **Jodhpur** district require upto **200-500 litres** of water each day while **49%** and 23% from **Jaisalmer** and Jodhpur, respectively, require **less than 200 litres** quantity of water each day for different purposes. Around 7% and 14% from the respective rural areas of Jaisalmer and Jodhpur districts need 500-800 litres water.



Daily quantity of water used by the rural HHs in the selected districts from Rajasthan



Source of water for drinking and other purposes for the rural HHs in the selected districts from Rajasthan

A major source of water is through tankers in the rural areas of both the districts for drinking and other purposes. For **Jaisalmer**, almost **all people** are dependent on public handpumps and while a **very few** have **hand pumps** at their **homes**. In **Jodhpur**, almost **half of the respondents** are dependent on **piped water into residence** while other half are dependent on other sources of water supply for **both drinking and other purposes**.

In 2020–2049, compared to data from 1970–1999, the average rainfall in west Rajasthan would rise by 20–35%, and in east Rajasthan, it will rise by 5%–20%[85]. Below table shows the Projected Domestic and Drinking Water Demand (in cubic Million meters per day) using projected data of rural population and HHs calculated using the above primary data obtained for water requirement per day.

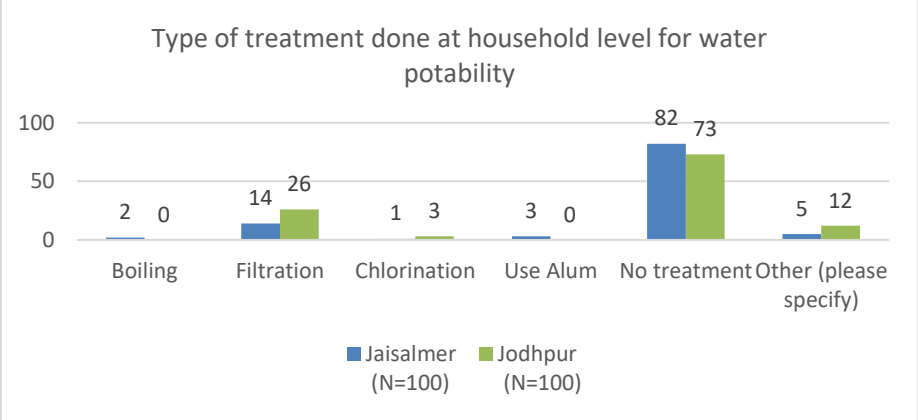
[85] https://www.downtoearth.org.in/news/climate-change/change-in-rainfall-patterns-is-behind-regular-floods-in-rajasthan-83980

Projected Domestic and Drinking Water Demand (in Mm^3/ day) in Rajasthan

State	District	Projected Rural Population		HH Size	Projected Rural HHs		Average Water Demand per HH	Projected Water Demand (in Mm^3/ day)		Projected Drinking Water Demand (in Mm^3/ day)	
		2021	2031		2021	2031		2021	2031	2021	2031
Rajasthan	Jodhpur	29,39,360	34,56,169	6	4,89,893	5,76,028	249	0.122	0.143	0.015	0.017
	Jaisalmer	7,25,883	8,70,871	5	1,45,177	1,74,174	344	0.050	0.060	0.004	0.004

Water Potability and Type of Water Treatment Done at Household Level

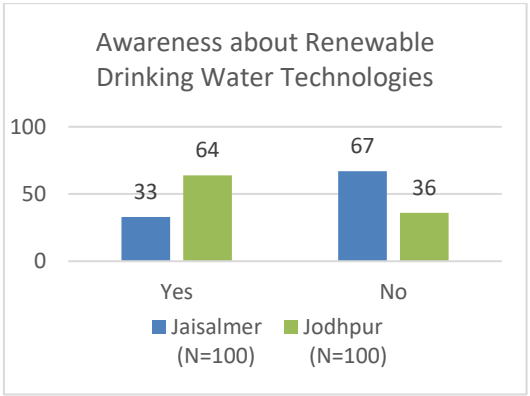
The quality of water obtained from the discussion with the government officials, has got an overall rating of **1 out 5** from the Sarpanch from the GPs of all the surveyed villages. The water from many areas of the district is **saline in nature**, at some places, there is a **presence of chlorine and fluoride**. Around all of the rural respondents from Jodhpur and Jaisalmer districts have reported the water to be potable except a few. The remaining 4% rural respondents from both the districts mentioned muddiness, salinity, fluoride and iron presence as the major reasons for non-potability of water. **This shows that the rural residents are not much aware about the quality of drinking water in their areas.** So, there is a need to aware them about the present water quality in their areas and the ill effects due to its consumption. To resolve the issue of non-potability of water, most people don't take any efforts to treat it at HH level, only one-fifth of the people filter or use other techniques such as boiling, chlorination and use of alum.



Type of treatment done at household level for water potability by the rural HHs in the selected districts from Rajasthan

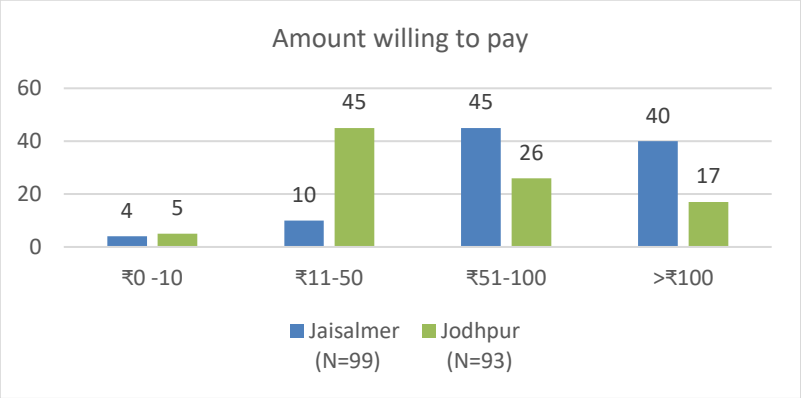
Awareness about Renewable drinking water technology in the market

Almost one-third the respondents from the villages of Jaisalmer district and two-third respondents from Jodhpur district are aware about the renewable drinking water technologies while the remaining are unaware.



Awareness about Renewable Drinking Water Technologies of the rural HHs in the selected districts from Rajasthan

Willingness to use and pay for installing and maintaining Renewable Drinking Water Technologies



Amount willing to pay for such services in the rural areas of the selected districts from Rajasthan

The willingness to participate and pay for higher quality drinking water has been studied during HH survey conducted in the rural areas of different districts. Almost **all** the respondents from the **rural areas** of Jaisalmer and Jodhpur district are **willing to use and pay** for the renewable drinking water technology as there is huge water shortage and water quality issues as stated by GP Sarpanch in Rajasthan. In rural areas of Jodhpur district, **45%** of the respondents are willing to pay upto **₹11-50/ month** ($0.13-0.6/ month) while **26%** of them are ready to pay a charge from **₹51-100/ month** ($0.62-1.22/ month) and **17%** are even ready to pay more than **₹100/month** (>$1.22/ month). In Jaisalmer district, around **15%** ready to pay upto **₹50/ month** ($0.6/ month), **45%** are willing to pay from **₹51-100/month** ($0.62-1.22/ month) and as large as **40%** of them are ready to pay above **₹100/ month** ($1.22/ month) for installation and maintenance of Renewable Drinking Water Technologies services.

2.6. Odisha

Several rural parts of Odisha remain devoid of access to reliable drinking water amid the implementation of numerous initiatives like the JJM. Many rural communities struggle with water shortages nearly every year, with some women being forced to walk more than 1.5 kilometres to obtain drinking water. There is occasionally a risk of the spread of water-borne infections in the rural communities in the rainy season due to the muddy water that is utilised and consumed by both people and cattle[86]. The situation in villages without access to water is exacerbated by empty tube wells, dried rivers, and insufficient potable water supplies by the local governments during the sweltering summer. Rural areas of Balangir also face crisis-like situations such as single tubewell for a whole village so, long queues to collect the water is very common to see. This is due to drying-up of river beds[87].

Contribution of accessible water in reducing costs and vulnerabilities: Several schemes by NABARD for irrigation intend to safeguard food security and increase resilience in backward tribal regions of the state. It will have a favourable effect on regions that experience greater levels of food and water shortages and climatic distress, which are home to 5.2 million disadvantaged groups, 50% of whom are women. The GoO's Department of Water Resources would carry out the project[88]. Clean drinking water has benefited towards children's wellbeing and people have started to resettle in some parts of Odisha[89]. Water filters installed in some parts of Odisha provide enough safe drinking water to satisfy the needs of the villagers. They are accessible and economical to everyone, and are minimizing the amount of unpaid caring responsibilities performed by women[90]. Below table shows the demographic details of the surveyed villages.

Details of selected districts from Odisha[91]

District	**Sundargarh**	**Balangir**
Total District Population	2,093,437	1,648,997
Total number of inhabited villages	1,713	1,751
Rural Population	1,355,340	1,451,616
No. of Rural Households	312,497	369,273
Selected Rural areas for the study	Bargarh	Ambapali
	Sundargarh	Champasar
	Raurkela	Haldi
	Hatibari	Juba
Total number of surveys conducted	103	102

2.2.5. Analysis at State level

Focused group discussions were conducted at the state offices of Odisha. The key findings are as follows:

Key Findings for the selected districts and villages in Odisha

Aspects	Odisha State Departments
Surveyed State Departments	• Public Health Engineering Department (PHED) Bhuvneshwar • Tourism Department Odisha • State Level Rural Water Supply and Sanitation (RWSS) • Gram Pradhan, Village Water & Sanitation Committee (VWSC)
List of Schemes	• **Vasudha Scheme** – State government-sponsored scheme mainly for irrigation water supply, but its funding has stopped due to other central government schemes. This scheme is presently operational in Puri and Ganjam districts. • **JJM Yojana** – is a centralised scheme catering to village residents. It is executed for the Gramin water recharge project. The Rooftop Harvesting scheme and water filling and recharge schemes are executed under the Jal Jeevan Yojana Scheme. • **OMBADC Scheme** – PHED runs a mega pipeline water supply scheme with the aim of "Har Ghar Jal" using surface water to provide tap water for every household. Currently, Odisha works for nine blocks on a circulation mode, supplying water to every household under this scheme. State Government has a budget for water supply, rooftop rainwater harvesting, and water recharge programmes.

[86] https://www.newindianexpress.com/states/odisha/2022/jun/20/odishas-rural-areas-in-the-vergeof-acute-water-scarcity-2467614.html
[87] https://www.newindianexpress.com/states/odisha/2022/apr/24/as-mercury-soars-water-crisis-haunts-villages-across-odisha-2445879.html
[88] https://www.nabard.org/content.aspx?id=643
[89] https://www.indiawaterportal.org/articles/bandha-bhuin-village-odisha-prospered-after-initiation-rwss
[90] https://www.oxfamindia.org/knowledgehub/oxfaminaction/community-water-filters-puri
[91] Census of India, 2011

	• **Other schemes (solar based)** – Nearly 950 solar-based pumps are installed under nine blocks for water supply. • **Tube well –** Implemented under Tourism department • **5years scheme of Tourism Department** – Tourism Department (both rural and urban) development has been good as per the respondent. • **Over tank water supply for hill based hard to access area** • **RWLL Scheme –** presently active
Institutional Arrangement (Departments or Authorities) involved in the provision of water supply	• Several agencies are working under GP and block level through tender procedure for implementation of the schemes. • All the new technologies are to be implemented through district level and in communication with gram panchayat
Targeted Beneficiary	• Tourism Department (Both rural and urban areas) • Hill based residential members
Successful Schemes	• Under Vasudha scheme, state govt has stopped sending funds as the other central govt scheme is running through. • Under OMBADC, state govt has its budget for water supply, roof top rainwater harvesting and water recharge programme, and Har Ghar Jal yojana through tap placing for every household, we are running through. Vasudha project is running in another district but is presently ineffective. • For hill-based area, tubewells are not receptive and therefore, overhead tank and pipeline water supply is suggested. • For non-hill-based area, pipeline will be the most successful.
Most hard-to-access areas, Approximate demand for water supply in these areas	• There are no such areas which are hard to access. However, water is supplied through pipelines and tube wells in remote areas. • For hill area, over tank water supply is in demand. For non-hill-based area, bore well is reachable with 100 ft under the ground. • Inner remote districts like, Malkangiri, have water supply issues. In some areas, provisioning of tubewells is difficult as the under-groundwater is at very deep level.
Source of water supply	• **Major** sources of water supply in Odisha are **pipelines and tube wells** for domestic purpose • **Water supply**: The **pipeline** covers **26**% of the total district area. However, the **tube well** has reached **100%**. 100% pipeline is expected to be covered after completing the mega project. • In few of the hill-based areas, water is supplied through **pipeline and overhead tanks** but in hill-based areas, it is very difficult to get tubewells under the soil as the nature of the soil is very hard and require very high costs. In normal soil, tubewells cost nearly ₹0.3 million ($3656) but in hill-based area, sometimes it requires ₹2 million ($24,374) for machine to dig the soil.
Groundwater level	• In coastal area, water is available at 100 ft • In non-coastal area, in few places, water is available 500 ft below the ground. • Residents harvest rooftop water stored in the pit, dug under the ground and placed beside the house, which helps in groundwater recharge. Presently, there are no issues in supplying water; however, groundwater level used to be an issue.
Water Quality testing	• There are no other alternative plans to fulfil the overall water requirement. • However, surface water is maintained with proper cleaning through bleaching powder and other Pest control systems.
Access to FHTC	• Under JJM, the **pipeline** covers **26**% of the total districts area. 100% pipeline is expected to be covered after completing the mega project
Role of each department in overcoming the drinking water related challenges	**District Level** • If any proposal comes from collectors or any other representative for any of our tourist places, we ask for DPR and act accordingly. For remote area, water is treated, and supply technology is implemented under district level. **Collector Level** • For any new small project to be implemented in any place, it has to be passed by collector. • He/she decides who is the right agency suitable to get the project done. • Collector or Tourism Department directly deal with high value projects **Tourism Department** • Tourism department has got its budget for water supply issue both for urban and rural and in last 5 years, development has been done with support of required amenities for water supply **Majorly district level government authorities are involved for in the major activities of drinking water** **GP**

	• Varied field manpower resources are available under GP. To avoid remote are access barriers, repairing and maintenance activity under GP level. • New water supply technologies are implemented through district level and in communication with GP. • Open ponds, rivers for allied activities like sanitation, cattle rearing
Source of water supply for the other allied activities (Sanitation, agriculture, cattle rearing, etc.)	• Groundwater • Open ponds and rivers are the sources for allied activities like sanitation, cattle rearing, and animal husbandry. Natural water is unavailable during summer as the ponds and rivers get dried up. • Water supply is not so good across all allied places, but in tourist places have water supply but not up to the mark as required
Further improvements to be made	• Projects with new technologies are to be implemented from Tourism Department through District Level and in joint collaboration with District Collectors
Demand for a decentralised/ alternative water supply system in the state	• There is no demand for a separate/ decentralized/ alternative system of water supply and treatment technologies for water within the village. • Cost effective and decentralized unit is to be implemented through district level to provide drinking water in the areas that are hard to access
Water supply related technology providers active in the state	• Technological development is done through state level technology providers with local government body, but no private agency is working on that
Awareness programs conducted to conserve surface and groundwater	• Rainwater Harvesting Structures[92]
Awareness of industries/ companies/ NGOs working on renewable water supply technologies related projects	• NGO/ private agencies working for water supply development for Tourism Department as per the respondent. Mission Shakti Water Project working along with RWLL

Challenges in provisioning of water supply in rural areas

Topography is the central issue, especially in the hilly areas where tubewells are not possible, so, deploying the schemes becomes difficult. **Formulation of water –** Surface water is not sufficient, and water is gathered through dams. No significant challenge in supplying water. It is difficult to provide tubewells in hill-based areas. In those places, overhead tank water supply is supplied. Sometime road is blocked due to damaged road conditions, and one needs to clean the roads for water to be supplied in such areas. Limited resources like manpower shortage, communication problem or accessibility to reach remote places. Also, tourism department is not available at every district. Many places lack sufficient clean water. Cost of placing tubewells machines in hill station reaches more than 20 lacs sometime.

Availability of the system – There are no adequate distribution channels like canals for the available water resources in hill-based area; Pipeline is not available in hill-based areas. **Status of groundwater -** In coastal area, under groundwater is near to the ground that of noncoastal area with deep irrigation through bore well water supply. For coastal- 100 ft under the ground, noncoastal- 500 ft under the ground. **Market demand:** There is no demand for a separate/ decentralized/ alternative system of water supply and treatment technologies for water within the village. **Other -** Many of the villagers are either doing Farming or are daily wage earner and tourism hawkers with the current average income range of the residents in the village is **Rs 50,000/ year** ($609.35/ year). In rural area, tubewell developed to get water supply as the source water supply is not good. In remote areas where tourist footfall is high, several waterpoint with shed has been constructed, however **electricity** is the major problem. **Constraint and an operational gap** is that all projects are done from Tourism Department in association with District Level and Collector.

Challenges, barriers and willingness in the implementation of any new system or technology related to water supply

There are no barriers to implementing the new technologies, which carry various advantages like availability of varied field workforce, technicians, and repairing and maintenance activity stations under GP level.

[92] http://www.dowrodisha.gov.in/SWP2007/SWP%202007.pdf

Implementing New Technology like SOURCE Global requires

- ***There is a positive response to implement it***
- *Such technology can be implemented at the* ***district level and in communication with the GP***
- *GP, Block Level, District Level Officials and NGOs support such technology and positively impact the residents.*
- *Issues lie in understanding and getting support from the minority groups, political parties and youth organisations in Odisha.*

Tourism Department has its own challenges as tubewells do not work in every area. In some hill-based areas, there are difficulties in deploying tubewells and thus they require pipe-based water supply with new aided technology. Sometimes overhead tank supply needs with excess budget for those of hard to access area to reach water supply. In hill areas, tubewells cost nearly ₹2 Million ($24,374) as compared to normal tubewells which cost around ₹0.3 Million ($3,656) in soft soil-based area.

2.2.6. Analysis at District and Rural Level

Below table shows the key findings on water supply status in the rural areas of Sundargarh and Balangir districts of Odisha, as discussed with the district level and gram panchayat level officials.

Key Findings for the selected districts and villages in Odisha

Aspects	Sundargarh	Balangir
Departments or Officials surveyed	• Assistant Executive Engineer	• Additional District Magistrate - PA & Climatic Change • Rural Water Supply Board • GP offices - Jarmunda Ampalli and Champasur Patnagar Bharatbahal
Current Water Supply Scheme	• **Vasudha** (Rural) - Closed • **JJM** (Rural) - Ongoing • **OMBADC** (Odisha Government) – Ongoing • **State Government SFC Scheme** - Common group of villagers • **Block Tube Well Water Supply** - Common group of villagers	• **JJM** (For water supply to rural people) to be completed by 2024 • **Vasudha** (For providing drinking water to every citizen of Gram Sabha) – Closed • **Well vision** - Benefits directly given to the common people of the village residents • **Regular water supply scheme** – For residents and farmers of the village • **Bore-water supply to dry area** - Pipeline water supply to those of dry area residents and farmers • **Water supply through soil dug drainage** - Mainly for the farmers • **Open well Pipe line water supply for those of less underground water area with 15-ft-deep** – For resident members of the villagers • **Boring water supply for those of less underground water with 200-250-ft-deep tubewell** - Directly to the common group of people and the farmers those of residents located over the less ground water available more than that of 300- 500 ft below the ground water level • **Pond water development scheme** - For Pond land owner and nearby residents • **PWD village drinking water supply scheme** - For farmers and village residents of the district • **Public health water supply** - Residents of the village
NGOs or organisations working towards water provision	• **Mission Shakti Water** Project working along with RWLL - **Water supply only for agriculture** •	• **Switeed Foundation** that works for solar maintenance • **Lok Drishti Company** that creates awareness for clean water • **Sankalp** - It only provides awareness. • **Choto Jol Prokolpo -** Water supply to the villagers.

Works done till now	• **26**% coverage of **piped water connection** is **yet to be done** with the district rest is done	• At present, **80-85**% of the borewells have the provision of drinking water by laying pipelines. • JJM is going on for complete supply of pure drinking water.
Water Dependency	• Agriculture and animal husbandry depends upon pond water	• Allied activities such as sanitation, agriculture, cattle rearing, etc.) in the district depend more on the rain, ponds and a very few canals.
Source of water	• Water is being supplied through **pipelines to every area of the district** • There is no difficulty • Rural and remote areas – **Handpumps, Pipelines, Borewells** • There are ponds in some villages whose water reduces during summers • There are small banks in the villages which helps in irrigation.	• Mostly, in all villages handpumps and solar systems are available. • Ponds are also available in the villages for agriculture and animal husbandry.
Availability of canal or river	• Canals and ponds are there	• Canals and ponds are there
Groundwater level	• **40-50 ft**	• **80-120 ft** • Varies from location to location
Water Quality	• There is a demand for pure drinking water. The water available is not clean. Even many handpumps release dirty water.	
Socio-economic condition of people from rural and remote areas	• People from rural areas majorly cultivate paddy crops but also cultivate potato, wheat, kulthi, maize and groundnut and also work as daily wage skilled and agricultural labourers[93] • Average income of people is around **₹3,000-6,000/ month** ($49-61/ month)	• Economic condition of rural people is poor. • Livelihood dependency is majorly on farming and labour work • Average income of people is around **₹4,000-6,000/ month** ($49-61/ month)
Incidence of any disaster due to climate change	• Flood, cyclones and drought occur from July to December[94]	• Lesser rainfall in the district and there are consequences of climate change as well.

Current Status and Issues about the water supply in the district and the surveyed villages

3) Sundargarh District

Solar system is not yet available in all villages. Terrain of the district/block requires implementation of decentralised water supply system. Solar panel are required for a decentralised system of water supply and treatment technologies for water within the district. Currently, there are no water supply related technology providers active in the district due to lesser funding.

- **Bargarh - SFC scheme** is **successful** than **tube well water supply scheme** as water level in tube well goes very deep under the ground during summer season.
- **Hatibari –** Main source of water supply are tube wells and hand pumps. Canals and small rivers are also available for water supply in the village.
- **Japanga -** There is a little proportion of pipe-based water supply and no canals are present. Tube well hand pump is placed at a minimum distance in the area and thus there is **less of scarcity** in water. **Vasudha Project** is yet to start its operation.
- **Balkdihi –** Open Pond is available within 200 metres but is not used much**.**

[93] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://www.desOdisha.nic.in/pdf/2011-dshb-sundargarh.pdf
[94] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://cdn.s3waas.gov.in/s3289dff07669d7a23de0ef88d2f7129e7/uploads/2018/05/2018051623.pdf

Type of water supply systems in Sundargarh rural areas

There is **no water treatment facility** and **technology** present to treat ground and piped water in the district. Water from **government and private open wells and handpumps** is used for domestic and allied activities in all the villages. Ghar Ghar Jol Yojana awareness programme and survey has been done but there is need for its quick implementation as only handpumps are available currently in some villages. Ground water is available at a depth of **200-400 ft** under the ground while open well water is available under 22-25 ft. Water supply through GP and Village Committee is most successful due to proper communication between administration and the resident member of the village.

Issues - Few of the installed **handpumps do not work** properly. There are **no sufficient canals** for **irrigation.** Groundwater contains many unwanted and hazardous minerals harmful to public health so, there is a demand of clean and treated water supply. Proportion of piped water connections is very minimal. Pipes get damaged due to **iron deformation** and thus require decentralised water supply system. As per the GP officials, residents will be more receptive towards getting piped water supply system.

4) Balangir District

There is water supply problem in 6 blocks of Balangir. Turekela, Belpatla, Saitala Punjkela and others have pipe connection. They have lesser ponds and canals. There are a**dequate distribution channels with respect to canals** for the available water resources. In summer, the groundwater and pond water levels go down. Canals are also very few. **Water is not pure. Power supply, and awareness** are the major barriers in the implementation of any new system. Various communities are committed to clean water. **Funding Structure** - 50% by the central government and 50% by the state government under JJM. Due to lesser budget, maintaining and repairing the solar (if damaged) becomes difficult.

Poor and unhygienic condition of handpumps and taps in Balangir rural areas

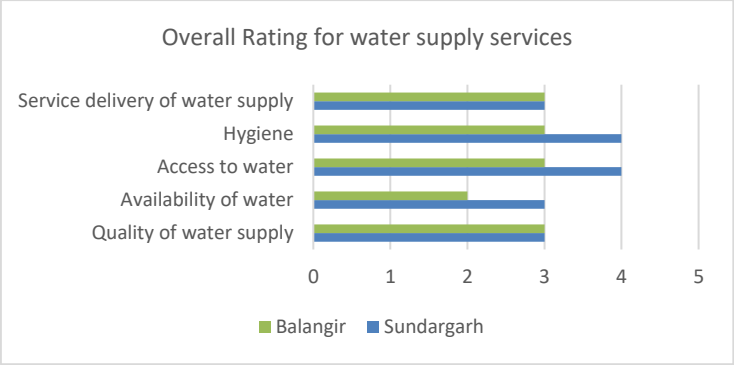
- **Ambapali –** There is a need for alternative system of water supply and treatment technology as there is no such treatment facility in the village. Electric motor water supply and direct water supply have been provided. **Least** successful scheme **in Ambapali is well vision** water supply to common group of people.
- **Champasar – No water supply** related **treatment** and **technology** is provided presently. Sanitation activities using **bleaching powder** and pond water cleaning takes place in the Champasar village. Wells with lower groundwater table are present. Main sources of water for **allied activities** are **pond**

water, boring water and sometimes **piped water**. **Most** successful scheme **in Champasar is PWD drinking water supply scheme** because its usage is the highest among the residents. **Least** successful scheme **in Champasar - Irrigation scheme** as there is a lack of proper monitoring from the service department and awareness from the user groups of the village. **Constraints**: There are certain block level constraints presently in the district. Many times, actions get delayed by the departments even after repeated requests.

- **Haldi – Lesser deep irrigation and well water** supply provisions. **Canal** is very **far** from the residential area nearly **3 km**. **Solar pumps** are available in nearby village. **Juba –** No canal-based distribution facility available**. Solar based water supply** is **successful** as it gets damage after very long period of 4-5 years which is also repairable. **Deep bore well** is also very **successful** due to sufficient and clean water. Ground water available at a depth of **200-400 ft** under the ground. **Issues** - Some of the installed ha**ndpumps do not work** properly. GP water supply is quite good but there are disturbances due to **irregular distribution** from the department**.** Pipeline has been **broken** at many places leading to **water leakages.** There is **block level communication gap** due to **unavailability** of the **department personnel** at the right time and their **delayed response.** In most cases, **local tender contractors** do not provide adequate services after getting contracts. **Presently pipeline connections are less**. **Solar based connections are also not connected with pipeline system.**

Overall Rating

The overall rating given by the GP officials for the water supply services in the villages are displayed in the below chart. The rating for all the aspects for both the districts is **neither satisfactory nor dissatisfactory** except hygiene and access to water in Sundargarh and water availability in Balangir. There is a scope to improve in all the aspects.



Overall Rating for water supply services

Willingness to support for a new technology to be implemented

Staff is less but if an NGO or an organization gives full support for a long term, then the scheme can be more efficient. As per the district official, sometimes there are problems with the land. People are not willing to give up their land for developing infrastructure which results in lesser action but JJM was fully supported by the villagers. The District officials and GPs are ready to support any organization or NGO which implements any new system or technology for drinking water. As per the respondent, villagers can pay **₹50-60/ month ($0.6-0.73/ month) for good quality water**. Solar based water supply system can be well received by the village residents because electric bill is heavily charged. **Sometimes there is a communication gap between the operational staff and the users for implementation at the village** which needs to be solved. **Solar based water supply system has been well received** by the village residents as electric bill is heavily charged. It is **cost effective and farmers are willing to receive such facility.**

Suggestions by the officials

Sundargarh - full in its capacity for every household. Solar panel are needed to provide clean drinking water in the hard-to access areas. Villagers demand for advance technology to test soil, groundwater level and nature of the water in hard to access area. Such system needs to be provided. **Geographical nature** of the area should be kept in mind while **implementing any scheme** at the GP level. In the hilly areas, there is a demand for uninterrupted decentralised water supply treatment technology. NGOs in association with block

level department should be given authority to handle support for water supply. Issues of water supply need to be resolved by engaging NGOs. Instead of iron made pipe PVC pipes should be used to avoid iron deformation which will also be cost effective.

Balangir - There is a need of uninterrupted water supply to every household of the villages. Any new technology if implemented by an organization, then it should make arrangements at the village level and for its maintenance. The power supply has been stopped in many places due to faulty solar panels, so technical support is also needed. **Overhead tank water supply** and **piped water connection** need to be provided to **every** individual house. **Clean water** should be provided by the water supply department, **irrigation water facility and regular pipeline water supply** to the residents. There is need of a **multiple tap system** at one water point so that more households can access at a given time. There is need of pipeline-based water supply in the hilly areas. **NGOs** in association with **Block Level Department** should be given authority to handle **support for water supply**.

2.2.7. Identified Stakeholders to be engaged in implementing new technology

The State, District and GP officials suggested and rated various key stakeholders to be engaged to implement the decentralised technologies for water supply/ treatment in their rural areas. They are mentioned in the table below.

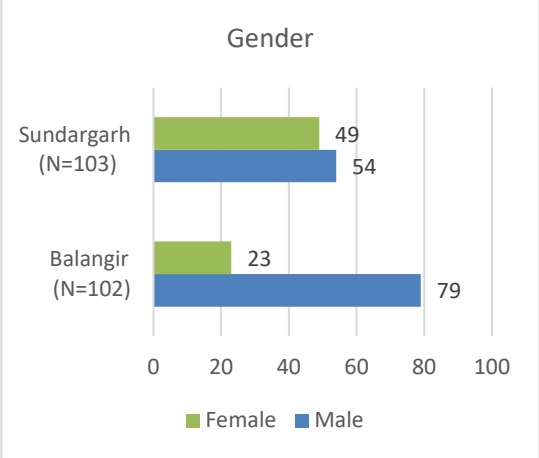
Critical stakeholders to be engaged

Stakeholders	Accountability for implementing/ operating	Nature of Interest	Rating for Importance	Rating for Influence
			(Scale of 1 to 5, 5 = highest)	
GP	Yes	Positive	5	5
VWSC	Yes	Positive	5	5
Block office	Yes	Positive	5	5
District office	Yes	Positive	5	5
Other corporates	No	Neutral	0	0
ASHA or anganwadi workers	Yes	Positive	4	4
Minority group representatives	Yes	Positive	3	3
Youth organizations	Yes	Positive	3	3
Women's organizations	Yes	Positive	4	5
NGOs	YES	Positive	4	4
Political party-1	Yes	Neutral	4	4
Political party-2	No	Negative	1	1
Individual 1	Yes	Positive	5	5
Other 1	Yes	Positive	5	5

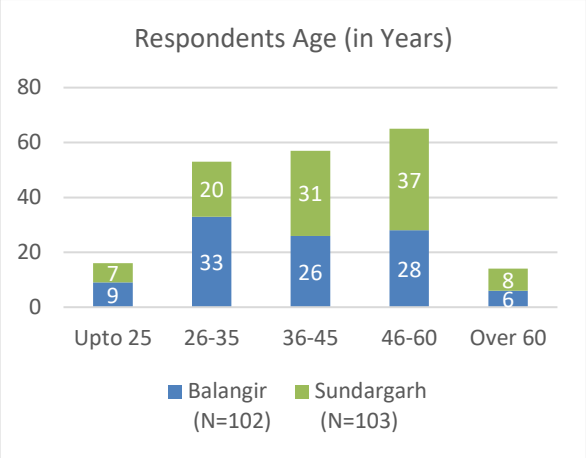
2.2.8. Household Level Analysis at Rural Level of the Districts

Demographic Profile of Respondents

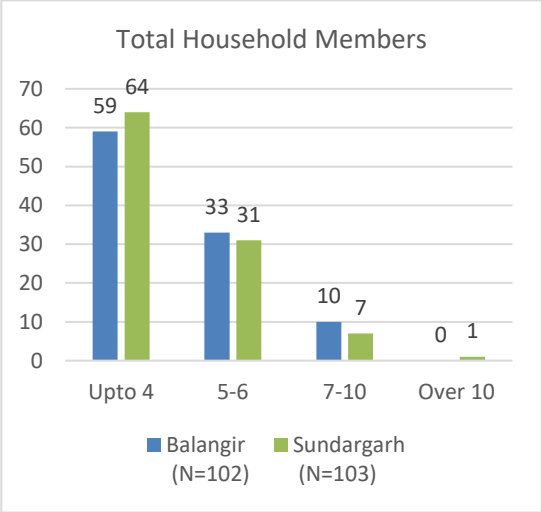
The demographic details of the respondents from the chosen rural and remote areas of Balangir and Sundargarh district from Odisha have been studied to know their socio-economic background and also willingness to pay and participate in the newly provided services. Such details include gender, age, total members in the HH and the HH income.



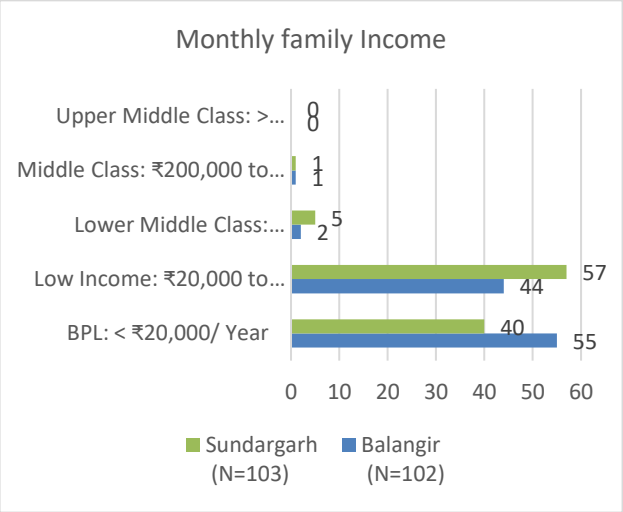
Gender of Respondents from Odisha



Age of Respondents from Odisha



Total HH members in respondents' families



Total family income of respondents from Odisha

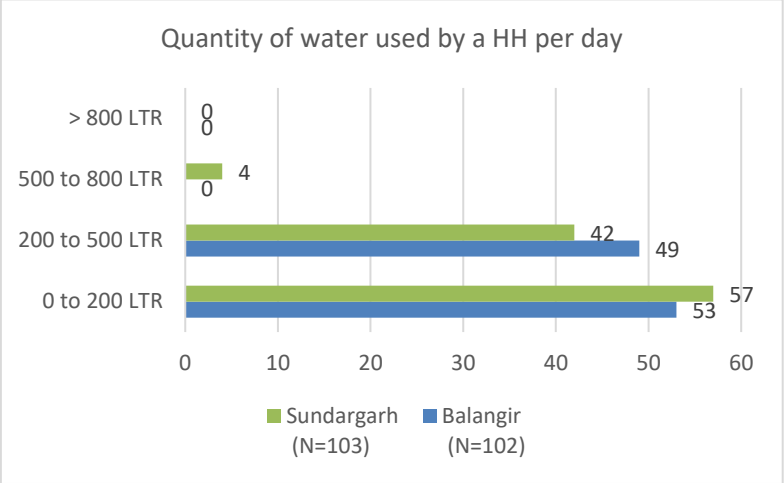
Majority of the respondents in the rural areas of Balangir were males i.e., 80% while the rest were females. Rural areas from Sundargarh district had equal number of female and male respondents. The average **HH size** in rural areas of **Sundargarh and Balangir districts** is observed to be **4**. The respondents from the rural areas of both the districts were distributed across all the age categories as shown in the above figure. Almost 50% of the respondents from Sundargarh belong to the age group of 26-45 years while 35% belong to 46-60 years of age group and only 8% of them are above 60 years of age. Similarly, for Balangir district, almost 60% of the respondents are from 26-45 years age category, 25% are from 46-60 years of age and around 9% are less than 25 years of age.

Surveys conducted in both the districts

As per the discussion with the GP Sarpanch, the average income was observed to be **₹4,000-6,000/ month** ($49-61/ month). As per the HH survey, the average HH income of the families of around **40**% respondents from the rural areas of **Sundargarh** district and **55**% respondents from Balangir is less **than ₹20,000/ year (BPL category**) ($243.74/ year). Around **57**% people from rural areas of Sundargarh and **44**% from Balangir earn between **₹20,000-100,000/ year (Low income)** ($243.74-1,218.7/ year). A very few percent (2-5%) of people earn from **₹100,000-200,000/ year** (**Lower middle-income group**) ($1,218.7-2437.4/ year). Most of the people are involved in farming.

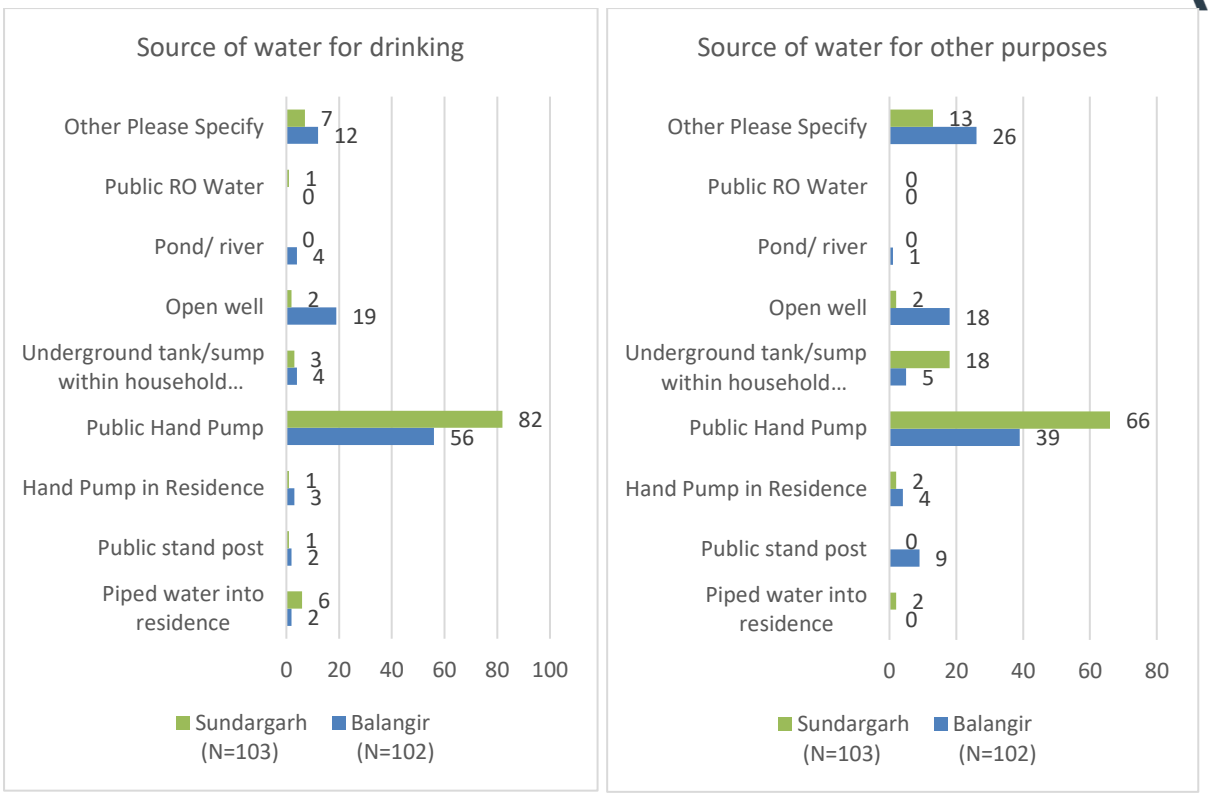
Current Dependency on drinking water supplied from different sources

As per the primary survey, major water sources in both the districts are rainwater, canals, ponds and tubewells from which water is provided through pipelines and handpumps. Water pipeline provision to each and every HH is under progress through JJM. Around **60**% of the rural HHs from **Sundargarh** and **half** of the HHs from **Balangir** districts require upto **0-200 litres** of daily water each while **half** of them from **Balangir** and **42**% of them from **Sundargarh** require about **200-500 litres** quantity of water each day for **different purposes**. V**ery few** people from **Sundargarh** need **500-800 litres** of water **per day**.



Daily quantity of water used by the rural HHs in the selected districts from Odisha

Major source of water is through public handpumps in the rural areas of both the districts for drinking and other purposes. For **Sundargarh**, **80**% and **65**% of the respondents are dependent on **public handpumps** for **drinking** and **other** purposes respectively. Other sources of **piped water** to residences include **handpumps, underground tanks, open well and others** for both **drinking** and **other** purposes. In **Balangir**, almost **55**% and **40**% respondents informed about dependency on **public handpumps** for drinking and other purposes, respectively. Remaining HHs have piped water to residences, public handpumps and standposts, HH handpumps, underground tanks, open wells and other sources for both drinking and other purposes.



Source of water for drinking and other purposes for the rural HHs in the selected districts from Odisha

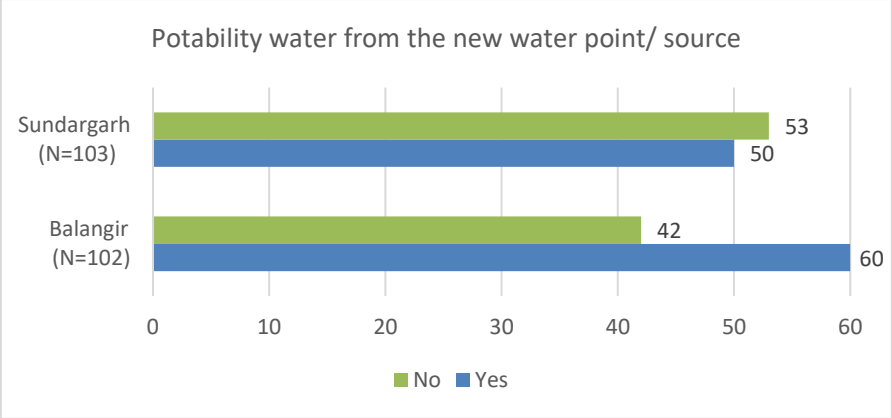
Below table shows the Projected Domestic and Drinking Water Demand (in cubic Million meters per day) using projected data of rural population and HHs calculated using the above primary data obtained for water requirement per day.

Projected Domestic and Drinking Water Demand (in Mm^3/ day) in Odisha

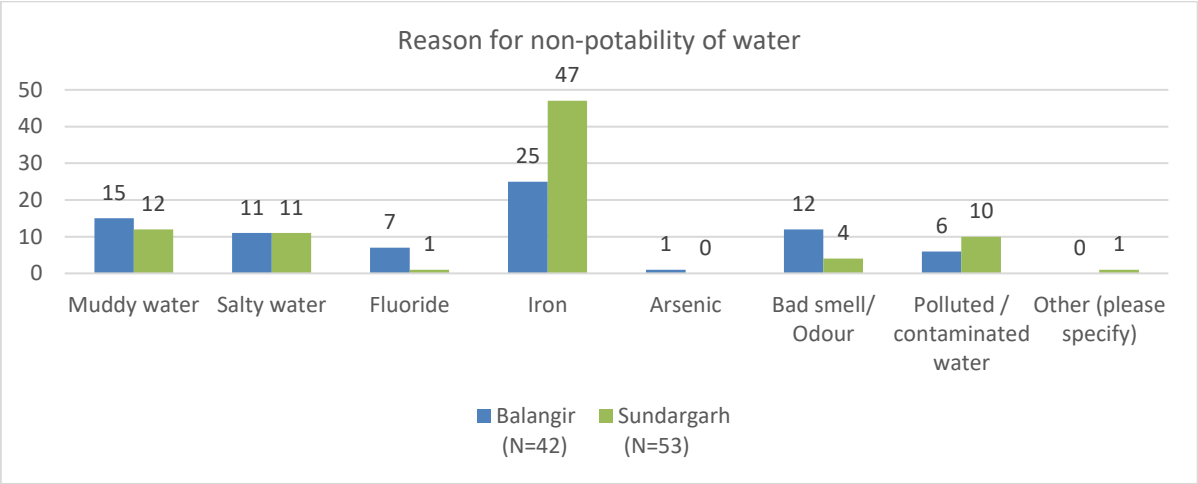
State	District	Projected Rural Population		HH Size	Projected Rural HHs		Average Water Demand per HH	Projected Water Demand (in Mm^3/ day)		Projected Drinking Water Demand (in Mm^3/ day)	
		2021	2031		2021	2031		2021	2031	2021	2031
Odisha	Sundargarh	15,08,704	16,62,068	4	3,77,176	4,15,517	230	0.087	0.096	0.008	0.008
	Balangir	14,05,673	13,59,729	4	3,51,418	3,39,932	225	0.079	0.076	0.007	0.007

Water Potability and Type of Water Treatment Done at Household Level

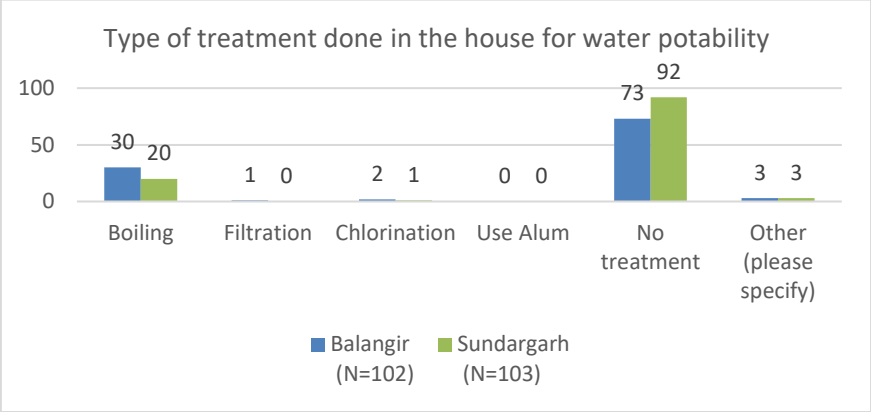
The quality of water obtained from different sources, as mentioned above, has got an overall rating of **2 out 5** from the Sarpanch of the GPs of all the surveyed villages. Around **60% and 50%** of the rural respondents from **Balangir and Sundargarh districts**, respectively, have reported the water to be **potable**. The remaining 40% and 50% rural respondents from Balangir and Sundargarh districts, respectively, mentioned **muddiness, salinity, bad smell/odour, contaminated water and presence of fluoride and iron** as the major reasons for non-potability of water. To resolve the issue of non-potability of water, only **30**% respondents from rural areas of **Balangir** and **20**% respondents from **Sundargarh boil the water or use chlorination techniques** to purify the water.



Potability water from the new water point/ source in the rural areas of the selected districts from Odisha



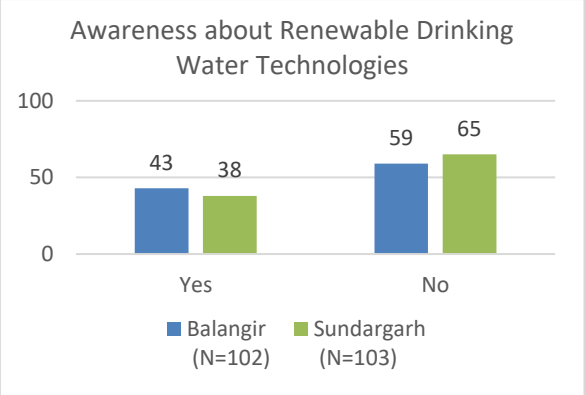
Reason for non-potability of water in the rural areas of the selected districts from Odisha



Type of treatment done at household level for water potability by the rural HHs in the selected districts from Odisha

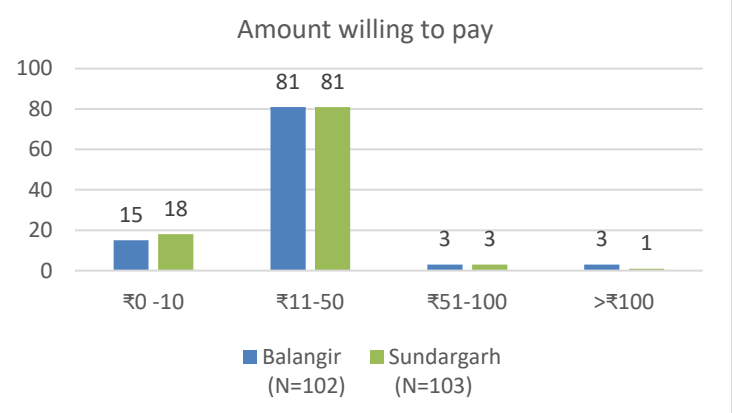
Awareness about Renewable drinking water technology in the market

About **43**% and **38**% of the respondents from the villages of **Balangir** and **Sundargarh** district are **aware** about the **renewable drinking water technologies** while others are unaware about any such technology.



Awareness about Renewable Drinking Water Technologies of the rural HHs in the selected districts from Odisha

Willingness to use and pay for installing and maintaining Renewable Drinking Water Technologies



Amount willing to pay for such services in the rural areas of the selected districts from Odisha

Almost **all** the respondents from the rural areas of **Sundargarh and Balangir** districts are **willing to use and pay** for the renewable drinking water technology. Around **15**% of them are willing to pay upto **₹10/ month** (<$10/ month) while **80**% of them are ready to pay between **₹11-50/ month** ($0.13-0.6/ month) and a very few are ready to pay above **₹50/ month** ($0.6/ month).

2.7. Uttar Pradesh

The examination of drinking water and sanitation facilities access reveals that Uttar Pradesh has not yet accomplished its objective of providing piped water. Additionally, it demonstrates how many homes rely on their own private tubewells and pumps to fulfill their daily water requirements. In comparison to the rest of India, Uttar Pradesh has poor coverage for both residential sanitation and drainage services. Only 28% of the approximately 25.8 million in the State, according of the 2001 Census, had individual HH toilets [95]. With only 19.41% of its population connected to the tap, Uttar Pradesh has the lowest rate among states. From 26.4 million homes, 5.13 million have tap water access. The biggest tap water connections under JJM have been made in Bihar, Maharashtra, and Gujarat[96]. Below table shows the demographic details of the surveyed villages.

Details of selected districts from Uttar Pradesh[97]

District	**Jalaun**	**Mahoba**
Total District Population	1,689,974	875,958
Total number of inhabited villages	942	435
Rural Population	1,271,074	690,577
No. of Rural Households	216,570	124,678
Selected Rural areas for the study	Ethaura vavni	Chandpura
	Khutmila	Mirtala
	Parausa	Bamhori
	Majhwar	Raheliya
Total number of surveys conducted	99	101

Focused group discussions were conducted at the state offices of Uttar Pradesh. The key findings are as follows:

2.3.5. Analysis at State level

Key Findings for the selected districts and villages in Uttar Pradesh

Aspects	Uttar Pradesh State Departments
Surveyed State Departments	• Tourism Department, Uttar Pradesh • Water Supply and Sanitation Directorate, Lucknow • Environment Department
List of Schemes	• **Water supply schemes are being implemented through Jal Nigam and Nigam Rural Mission working together** • Namami Gange Project • Swajal Bharat Scheme • Water and Sanitation Mission • JJM
Institutional Arrangement (Departments or Authorities) involved in the provision of water supply	• **Nagar Nigam** – does the water supply • In villages and Tourism Department – water supply is done by the local body • **Jal Nigam** – provide manpower resources to work under the scheme implementation • The primary means to get water supply are handpumps, tankers and tap water connections are through **JJM, State Water and Sanitation Mission and Jal Nigam**
Targeted Beneficiary	• Both rural and urban areas, remote and hard to access areas
Successful Schemes	• **Swajal Bharat Scheme** implemented for drinking water by Work Bank
Difficulties in Running schemes	• Lack of Manpower resources • Lack of construction resources
Most hard-to-access areas, Approximate demand for water supply in these areas	• Eastern district of Uttar Pradesh is under hard to access areas. As these areas do not have groundwater recharges. • In the rural areas, villagers travel distant places to fetch water. The availability of water for the domestic purpose is mostly dependent upon tankers and handpumps. • Almost all households **get water once in 2 or 3 days** for **domestic purposes**. • Bundelkhand area persistently faces the scarcity of water. Many schemes are being run there. UP Government is planning to work with Israel Ministry of Water to launch a plan of cooperation for sustainable long-term water management for the Bundelkhand area[98].

[95] https://www.researchgate.net/publication/289038240_Drinking_water_and_sanitation_in_Uttar_Pradesh_A_regional_analysis
[96] https://zeenews.india.com/india/jal-jeevan-mission-up-ranks-at-the-bottom-gujarat-seventh-state-to-achieve-100-per-cent-household-tap-2527161.html
[97] Census of India, 2011
[98] https://timesofindia.indiatimes.com/city/allahabad/up-govt-israel-giving-final-shape-to-water-project-for-bundelkhand/articleshow/83217175.cms

Source of water supply	• Wells, Hand Pumps and Tap Water Connection • JJM facilitates water supply • Areas with scarcity of water still depend upon handpumps and tankers
Groundwater level	• **330 ft** below the ground level
Water Quality testing	• Using chemicals like chlorine and water testing kit as trained under JJM
Access to FHTC	• JJM is working in provisioning water supply in the rural areas – Har Ghar Jal Mission.
Role of each department in overcoming the drinking water related challenges	**Jal Nigam** • Supply water to every household. Also provides manpower resources and other resources for the implementation of water supply schemes. • Through JJM (JJM) Operation and Maintenance will be taken care of – **₹50-100/ HH** ($0.61-1.22/ HH) taken by Village Water and Sanitation Committee **(VWSC).** • **Monitoring Contribution by JJM** - during development of overhead tanks will be - **10% community contribution** through any assurances to involve community • **30% Operation and Maintenance** by the community, VWSC will decide the amount through an open meeting **NGOs** • Several NGOs are working for the scarcity of water issues, especially in the Bundelkhand region **Environment Department** • Deals with the conditions of sewerage like putting up of STP or ETP
Source of water supply for the other allied activities (Sanitation, agriculture, cattle rearing, etc.)	• Depends of the Tube wells and handpumps to cater water to the other allied activities and animal rearing
Any improvement in the water supply provision	• JJM is being carried out with the target to supply Har Ghar Jal by 2024. But still the workability of implementation is at slower pace.
Water supply related technology providers active in the state	• No one as of now
Awareness programs conducted to conserve surface and groundwater	• JJM has conducted several training programs and workshops for water testing, conservation of surface water and reuse of grey water

Challenges in provisioning of water supply in rural areas

Agencies hired for construction are delaying the process. A lot of power issues, although Jal Nigam is supporting through the team of experts. Dependent on surface water and lack of groundwater. Community acceptance related to cost. A hand pump is an easy source for villagers. **Constraints and the operational gaps** are the difficulties in involving community and having their participation while implementing a new scheme.

2.3.6. Analysis at District and Rural Level

Below table shows the analysis of water supply status in the rural areas of Jalaun and Mahoba districts of Uttar Pradesh, as discussed with the district level and gram panchayat level officials.

Key Findings for the selected districts and villages in Uttar Pradesh

Aspects	Jalaun	Mahoba
Departments or Officials surveyed	• Jal Nigam Jalaun • GP offices - Etaura Vavni, Khutmili, Majhwar and Parausa	• Additional District Magistrate – Namami Gange • GP offices – Chandpura and Mitla
Current Water Supply Scheme	• **JJM (JJM)** – Plan to provide 55 LPCD of water to all the rural population • There are **32 water supply schemes** through which water is supplied to all villages	• **JJM** • **Atal Bhujal Scheme Gamin -** Successful due to availability of resources, quick agreement processes and collaboration with private sector to build infrastructure • **Namami Gange** • As per the district official, JJM is involved in the overall water supply to rural areas but Gramin Bhujal Scheme lists and provides water supply to every house in the rural areas. Under this scheme, department is working upon 5 sub-schemes – **GOV (Group of Village)**

		– **Shivar Scheme - Lehchura Kashipura** – **Salaiya Nathupura Scheme** – **Arjun Dam** – **Dharva Sirwaha (Guv)**
NGOs or organisations working towards water provision	• PWD, Jal Nigam, PMC (an agency to look after project management), TPI agency (quality and quantity of project), UNOPS • Some big companies - Public farewell council, Rajasthan Human Care Foundation, Communication Service Society, Nirman Agency (responsible for construction work), Gopal Construction Company, and GVPR. • Jan Kalyan Parishad • Rajasthan Human Care Foundation • Sanchar Sewa Society • Samay • Devendra Gandhi NGO • 4 ISA – Consisting of Public Welfare Committee, Public Welfare, Rajasthan Human Care Foundation and Sanchar to create awareness among people; UNOPS is working in creating model and awareness in 10 revenue villages • Water Monitoring Committees consisting of 5 elected women candidates from the villages have been formed for all the villages	• Currently 14-15 District Implementation Partners (DIPs) are working together under Atal Bhujal Scheme • Bhartiya Kalyan Sanstha • ISA - Chetna Srivastava, Baba Sri Guru Bachchan Society are working towards social research and the social development • NK Gupta and KV Gupta through L&T company to provide water to each and every HH • **UNOPS** - Arranges meetings regarding water quality and gives training under JJM • Currently no NGO is working in the district towards water supply
Water Dependency	• Pond water is used for cattle rearing • There are tubewells in all farms and canals are also present.	• For cattle cleaning, river water is used
Source of water	• The source of water in the outskirts of the village is **hand pump and tubewell**. • The canal water is carried through the river and the water is being given to the places where the water is saline. • **Pond water** is also consumed	• Main sources of water are **dams, wells, ponds and handpumps** are placed at some places for domestic purpose • **Wells** are available for **farming** and **animal husbandry**
Availability of canal or river	• River is present and some villages don't have canals	• **Canal is present** and its water is used for allied activities
Groundwater level	• Varies with geographical features and ranges from 5**0-350 ft**	• Ranges from **50-150 ft**
Water Quality	• Water is **saline** at some places like Mandora, Somayi and Girman in the district	• As per the Water Quality Index of Mahoba District (ranging from 0-50 which is excellent to good), **overall water quality** is **fairly good** in the district with some patches with poor index values (ranging from 50 and above)[99].
Socio-economic condition of people from rural and remote areas	• The living conditions of the people is decent as per the district official but the **average income** in the rural areas is only between **₹4,000-10,000/ month** ($49-122/ month) • Majority of the people are involved in farming and labour work while a few work in the service sector who earn decently while others' income is low	• Majority of the rural residents of the district depend upon agriculture and labour work for livelihood generation • Labour work is also not a stable job for them • A scheme by the district offices is going on which employs at least 7-8 persons in the GP • **Average income** in the rural areas is observed to **₹4,000-5,000/ month** ($49-61/ month) • This income is not enough to educate their children
Incidence of any disaster due to climate change	• One of the surveyed villages mentioned the problems like **floods, famine and hailstorms** in their areas which leads to many losses	• An app called" **DAMINI**" has been developed for people to inform using mobile phones, whenever there is a power cut during any risk or disaster like condition

[99] https://www.researchgate.net/publication/349291951_Groundwater_quality_assessment_using_water_quality_index_WQI_under_GIS_framework

	• Summers are tough in some of the villages leading to water shortages	

Pond water used for allied activities

Current Status and Issues about the water supply in the district and the surveyed villages

3. Jalaun District

Water will be supplied through pipes at all places, there is no such area where water cannot reach. District officials usually cooperate to implement a new scheme. **Upcoming Success of JJM -** It has already been added to **574 GPs** and **853 revenue villages** are taken under the mission. Each and every home will get water due to their inclusion under the scheme. Construction work is in process and being done by contractor and agencies. Earlier water tanks are getting repaired. They have celebrated "**Jal Utsav Program" - Water Festival Program**, so that each and every village will get water.

Three surface water treatment plants at Kota, Raipura, Manipur will be installed near Jamuna River, through which every village will get water. In remote villages, domestic tap connections will be installed. There were serious problems regarding water supply but now the pipeline is being laid at many places, but tanks are not constructed yet. In total **355 water tanks have been constructed**. Groundwater testing training is being given in villages. Block office gives monitoring support to the GPs for the ongoing project and Sarpanch also participates actively. **Water demand for drinking purpose** is around **5 litres/ person** in the villages. Many houses from the villages have received connections except some but they will start only after installing taps and tanks.

- **Khutmila –** For domestic purpose, **taps, wells and handpumps** are present. Water from the taps and the wells dry up in summers and so, people have to rely upon **tankers** for the water. For **allied activities**, pond and river water is used.
- **Majhwar –** Water from handpumps is used for domestic purposes. No scheme is successful yet as there is no progress. For **allied activities**, water from ponds and wells is used.
- **Parausa –** Water from handpumps and wells is used for domestic purposes. For **allied activities**, water from ponds is used.
- **Itaura Bavni –** JJM work is still in progress and solar plants have been installed. There are only handpumps.

Unhygienic conditions near handpumps in both the districts

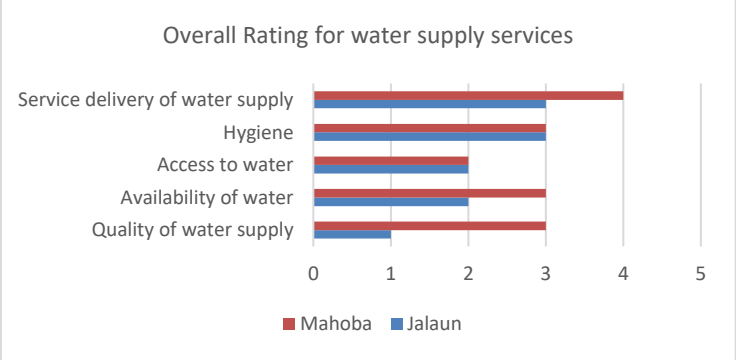
4. **Mahoba District**

Functional Household Tap Connection (FHTC) provision for every rural home is in process under JJM. Even though a lot of schemes are provided, water scarcity is still an issue. **Identification of areas where water supply is difficult:** A survey is conducted in every village in the remote areas or the hamlets which is reviewed by the panchayat members to check coverage under that survey. For this a separate budget is set. Public Awareness about the Government Schemes is done through ISA to get their active participation. Block office in collaboration with district and state officials have created a portal from where different data can be obtained. Each GP has a **women's organization** or group consisting of **5 members and a YUVA organization** consisting of around **13 technicians and plumbers.**

- **Chandpura –** Water supply is through taps, tanks and handpumps. There are no piped connections but there are ditches because of which driving trucks and rickshaws becomes difficult.
- **Mirtala & Raheliya –** Water demand is **20 million litres**. There are **no arrangements for water pipe connections**, so they have to rely upon **tankers** sometimes for domestic purpose. For **allied activities**, water from **canals, handpumps and ponds** is used. **Solar plants** are being installed in the village.

Overall Rating

The overall rating given by the GP officials for the water supply services in the villages are displayed in the below chart. The water supply service delivery in Mahoba is satisfactory and all the other aspects can still be improved as per the officials. Jalaun district need a lot of improvement towards access to water, water availability and water quality which is saline while other aspects can also be looked upon.



Overall Rating for water supply services

Willingness to support for a new technology to be implemented

The districts are ready to support any organization or NGO which implements any new system or technology for drinking water. Enough staff is available to implement a new technology.

Suggestions by the officials

Jalaun - Officials have not given any suggestions, as many facilities are being installed for water supply as per them.
Mahoba - Officials expressed a need to create more awareness about water scarcity and conservation.

2.3.7. Identified Stakeholders to be engaged in implementing new technology

The State, District and GP officials suggested and rated various key stakeholders to be engaged to implement the decentralised technologies for water supply/ treatment in their rural areas. They are mentioned in the table below.

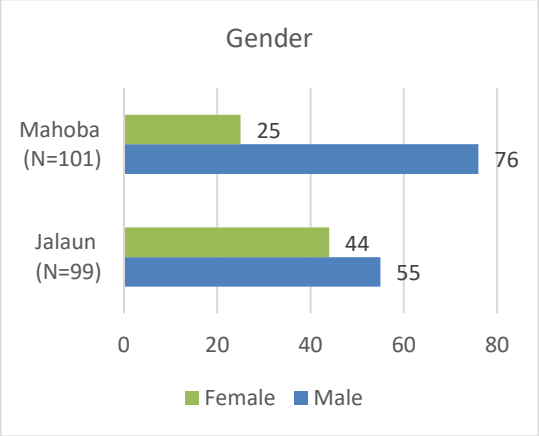
Critical stakeholders to be engaged

Stakeholders	Accountability for implementing/ operating	Nature of Interest	Rating for Importance	Rating for Influence
			(Scale of 1 to 5, 5 = highest)	
GP	Yes	Positive	5	5
VWSC	Yes	Positive	5	5
Courtyard Shelter	Yes	Positive	4	4
Minority group representatives	Yes	Positive	2	4
Youth organizations	Yes	Positive	4	4
Women's organizations	Yes	Positive	4	4
NGOs	Yes	Positive	4	4
Political party-1	No	Negative	3	3

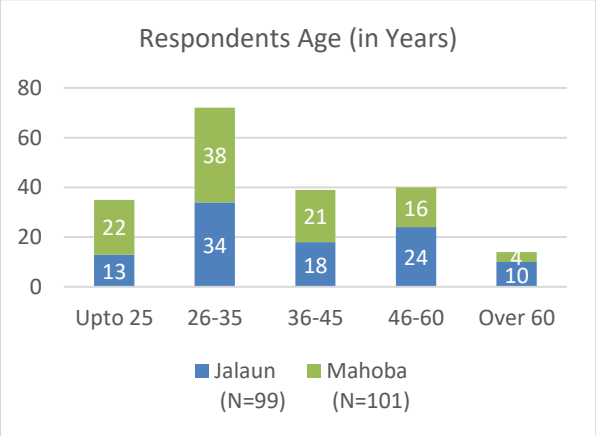
2.3.8. Household Level Analysis at Rural Level of the Districts

The demographic details of the respondents from the chosen rural and remote areas of the Mahoba and Jalaun district from Uttar Pradesh have been studied to know their socio-economic background and also willingness to pay and participate in the newly provided services. Such details include gender, age, total members in the HH and the HH income.

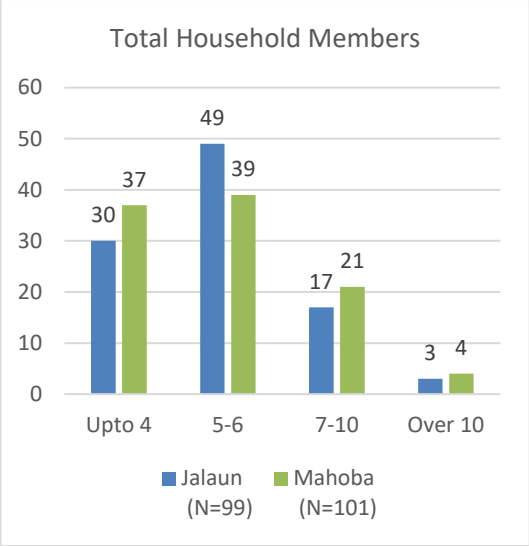
Majority of the respondents were males - Over three-fourth from Mahoba and 55% from Jalaun while the rest were female respondents. The average **HH size** in rural areas of **Jalaun and Mahoba districts** is observed to be **5**. The respondents from the rural areas of both the districts were distributed across all the age categories as shown in the figure below. Almost **50**% of the respondents from **Jalaun** belong to the age group of **26-45 years** while **25**% belong to **46-60 years** of age group and only **10**% of them are above **60 years** of age. Similarly, for **Mahoba** district, almost **60**% of the respondents are from **26-45 years** age category, **25**% are from **46-60 years** of age and around **20**% are less than **25 years** of age.



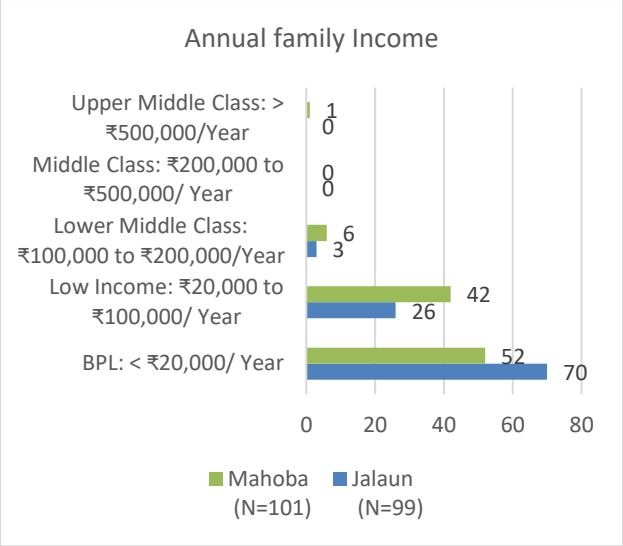
Gender of Respondents from Uttar Pradesh



Age of Respondents from Uttar Pradesh



Total HH members in respondents' family

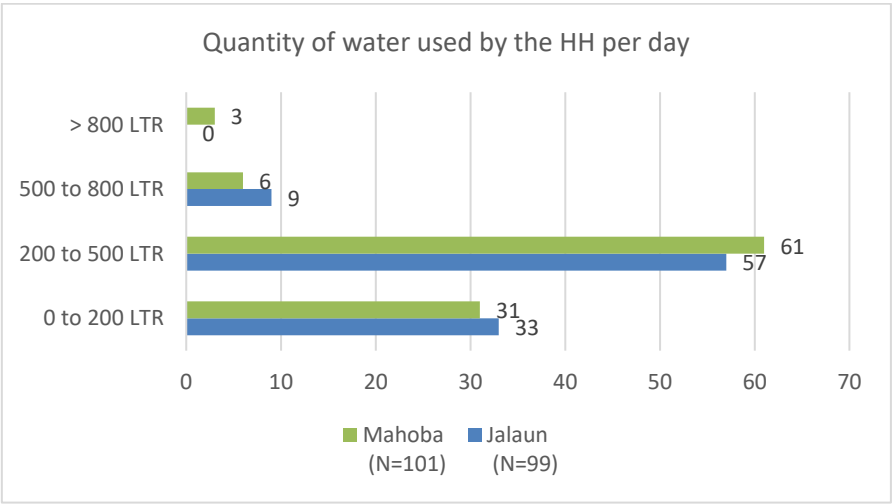


Total family income of respondents from Uttar Pradesh

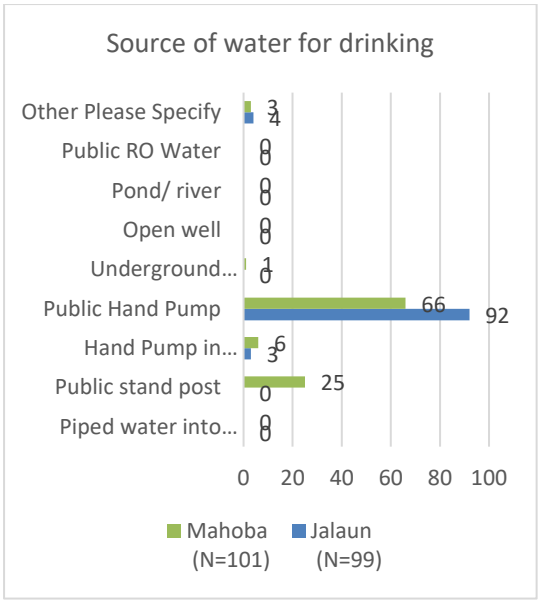
The average HH income of the families of **70**% respondents from the rural areas of **Jalaun** district is less **than ₹20,000/ year (BPL category**) ($243.74/ year), as per the primary survey of HHs while as per GP Sarpanch, it was observed to be **₹4,000-10,000 per month (BPL category**) ($49-121.9/ month)**.** Around **25**% people from rural areas earn between **₹20,000-1,00,000/ year** ($243.74-1,218.7/ year)**. 70% p**eople from the rural areas of **Mahoba** earn less than **₹20,000/ year** (BPL category) ($243.74/ year), while 25% earn in the range of **₹20,000-1,00,000/ year** ($243.74-1,218.7/ year)**.** A very few percent (5%) of people earn from **₹1,00,000-2,00,000/ year** (**Lower middle-income group**) ($1,218.7-2437.4/ year). Most of the people are involved in farming and labour work and a few in service sector who earn more.

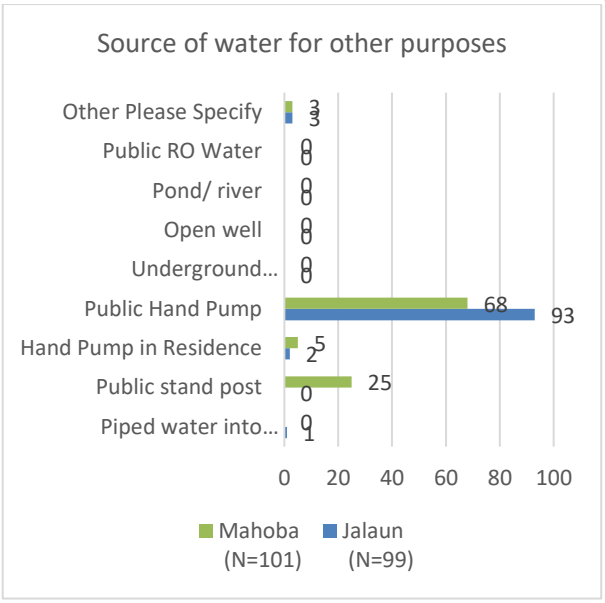
Current Dependency on drinking water supplied from different sources

As per the primary survey, major water sources in both the districts are rivers, canals, ponds and wells from which water is provided through pipelines, tankers and handpumps. Water pipeline provision to each and every HH is under progress through JJM. Around **60**% of the rural HHs from both **Jalaun and Mahoba districts** require upto **200-500 litres** of water each day while **30**% require **less than 200 litres** quantity of water each day for different purposes. Around **7-8**% also need **500-800 litres** water.



Daily quantity of water used by the rural HHs in the selected districts from Uttar Pradesh





Source of water for drinking and other purposes for the rural HHs in the selected districts from Uttar Pradesh

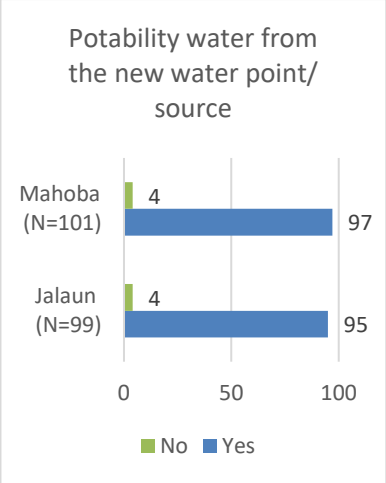
Major source of water is through public handpumps in the rural areas of both the districts for drinking and other purposes. For **Jalaun**, almost **all people** are dependent on public handpumps and while a **very few** have **hand pumps** at their **homes**. In **Mahoba**, almost **65% people** are dependent on **public handpumps, one-fourth** of the people are dependent on **public stand posts** and a few people have installed **hand pumps** at their homes. Below table shows the Projected Domestic and Drinking Water Demand (in cubic Million meters per day) using projected data of rural population and HHs calculated using the above primary data obtained for water requirement per day.

Projected Domestic and Drinking Water Demand (in Mm^3/ day) in Uttar Pradesh

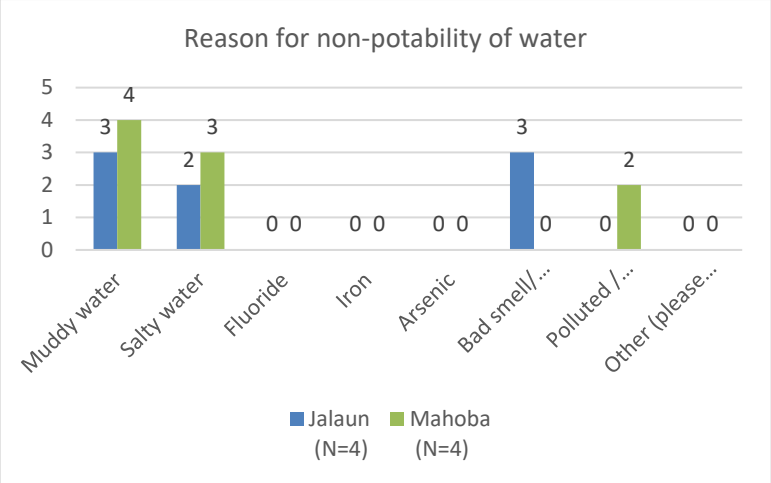
State	District	Projected Rural Population		HH Size	Projected Rural HHs		Average Water Demand per HH	Projected Water Demand (in Mm^3/ day)		Projected Drinking Water Demand (in Mm^3/ day)	
		2021	2031		2021	2031		2021	2031	2021	2031
Uttar Pradesh	Jalaun	14,31,521	15,91,968	5	2,86,304	3,18,394	291	0.083	0.093	0.007	0.008
	Mahoba	10,35,866	13,81,154	5	2,07,173	2,76,231	308	0.064	0.085	0.005	0.007

Water Potability and Type of Water Treatment Done at Household Level

The quality of water obtained from different sources, as mentioned above, has got an overall rating of **3 out 5** from the Sarpanch from the GPs of all the surveyed villages. Around **95**% of the rural respondents from **Mahoba and Jalaun districts** have reported the water to be potable. The remaining **5**% rural respondents from both the districts mentioned **muddiness, salinity, bad smell/ odour and contaminated water** as the major reasons for non-potability of water. To resolve the issue of non-potability of water, **people don't take any efforts to treat it at HH level, only 1% people filter or boil the water**.



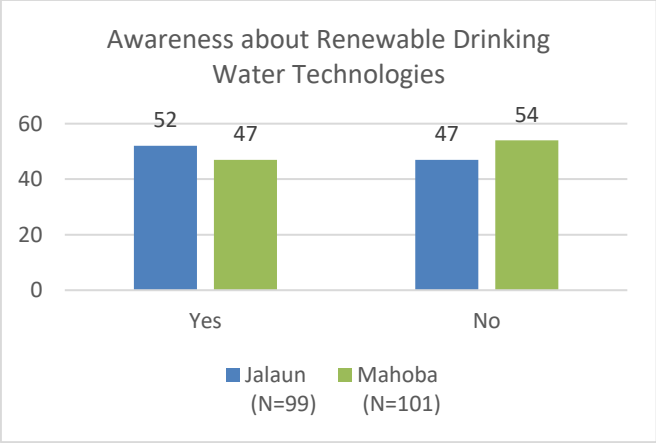
Potability water from the new water point/ source in the rural areas of the selected districts from Uttar Pradesh



Reason for non-potability of water in the rural areas of the selected districts from Uttar Pradesh

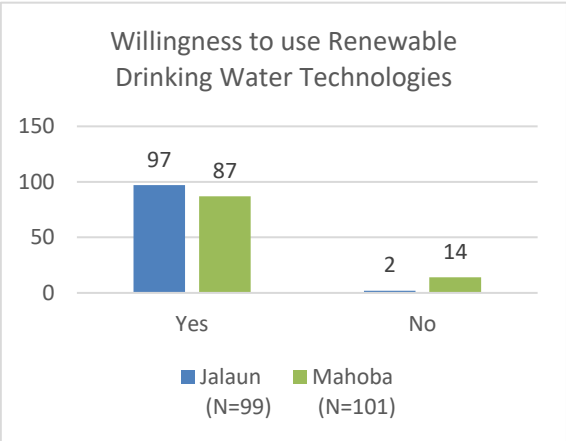
Awareness about Renewable drinking water technology in the market

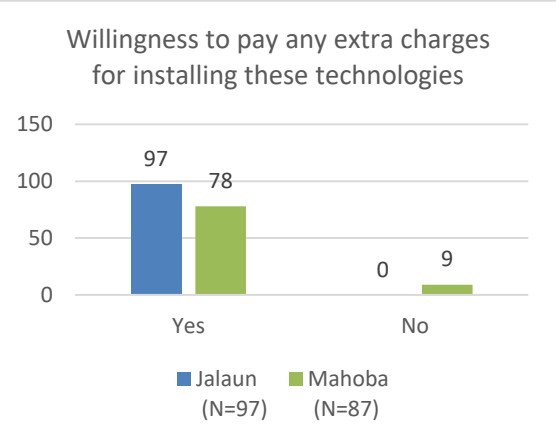
Almost **half of the respondents from the villages of both the districts are unaware** about the renewable drinking water technologies.



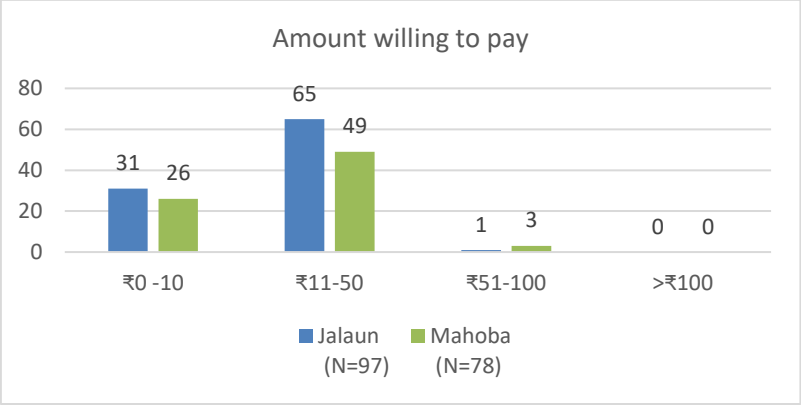
Awareness about Renewable Drinking Water Technologies of the rural HHs in the selected districts from Uttar Pradesh

Willingness to use and pay for installing and maintaining Renewable Drinking Water Technologies





Willingness to use and pay extra for installing Renewable Drinking Water Technologies in the rural areas of the selected districts from Uttar Pradesh



Amount willing to pay for such services in the rural areas of the selected districts from Uttar Pradesh

Almost all the respondents from the rural areas of **Jalaun** district are **willing to use and pay** the renewable drinking water technology even though there are water quality issues as stated by them. **31**% of them are willing to pay upto **₹10/ month** ($0.12/ month) while **65**% of them are ready to pay a charge upto **₹50 per month** ($0.6/ month). Around **85**% of the respondents from the surveyed villages of **Mahoba** district are **willing to use** such technologies and around **80**% of them are willing to pay for such technology, One-third are ready to pay upto **₹10/ month** ($0.12/ month), **60%** are willing to pay from **₹11-50/month** ($0.13-0.6/ month) and a very **few** are ready to pay upto **₹100/ month** ($1.22/ month). Remaining are not willing to use and pay for such services.

2.8. Maharashtra

Several areas experience water scarcity. An enormous water crisis is currently affecting Maharashtra. Amid drought years, river currents have slowed down, water levels in dams and reservoirs have dropped, and excessive groundwater use has expressed doubts about the water supply's long-term viability. The state dispatches the most water tankers ever to fulfill the potable water requirements of dry districts.[100] Water does not pump to the surface as a result of stratum fracture. The source well can be desilted just at moment of the field visit, therefore there is no water. In Summers, unsustainable sources dry up[101].

Contribution of accessible water in reducing costs and vulnerabilities: Drinking water supply in rural regions of Maharashtra changed from supply to a demand-driven method as per the demand of the rural residents[102]. The implementation of the water delivery programme in various districts of the State, has fully ended the struggle of women. Regardless of the sweltering 44^0Celsius summers, rural women had to trek large distances several times a day simply to obtain potable water for their family. With the advent of the metering system for bills, rural people now receive plenty of water at their homes each day[103]. Below table shows the demographic details of the surveyed villages.

Details of selected districts from Maharashtra[104]

District	**Beed**	**Raigarh**
Total District Population	2,585,049	2,634,200
Total number of inhabited villages	1,357	1,860
Rural Population	2,070,751	1,664,005
No. of Rural Households	435,588	381,204
Selected Rural areas for the study	Beed	Kurul
	Mogra	Pen Rural
	Shirur	Amboli
	Wadwani	Morbe
Total number of surveys conducted	111	97

2.4.5. Analysis at State level

Focused group discussions were conducted at the state offices of Maharashtra. The state offices include Department of Environment and Climate Change Government of Maharashtra and **Water Supply and Sanitation Department**. The key findings are as follows:

Key Findings for the selected districts and villages in Maharashtra

Aspects	Maharashtra State Departments
Surveyed State Departments	• Department of Environment and Climate Change Government of Maharashtra • Water Supply and Sanitation Department
List of Schemes	• **Amrit Sarovar** • **Jalyukta Shivar Scheme** - to take conservation measures in the drought prone rural areas of the state • **JJM** – to provide 55 LPCD of water to each rural HH by the year 2024 • **Majhi Vasundhara** under convergent like **Sarovar scheme** if for making new water bodies, state government cooperates with the district team who then make their separate water bodies used for drinking
	• There will be a **convergence** of **National schemes to State Departments**. JJM is through State Water and Sanitation Mission under State Water Committee for which a machine director's office is setup at Belapur. • More than **40,000 schemes** (implementation) are on-going all over Maharashtra. These are undertaken by **Maharashtra Limited Jeewan Karyakarta** and small schemes under ₹50 Million ($0.6 Million) budget is handled by district level.
Institutional Arrangement (Departments or Authorities) involved in the provision of water supply	• Water Supply and Sanitation Department • Maharashtra Jeevan Pradhikaran (MJP), Mumbai • Groundwater Surveys & Development Agency (GSDA), Pune
Targeted Beneficiaries	• Both rural and urban areas

[100] https://indianexpress.com/article/explained/simply-put-5000-dry-villages-in-maharashtra-6500-tankers-5777789/
[101] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ctara.iitb.ac.in/en/system/files/uma-unicef-iitb-irap-rws.pdf
[102] https://www.jstor.org/stable/25664046
[103] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://jalshakti-ddws.gov.in/sites/default/files/09.01.14_E_NEWSLETTER.pdf
[104] Census of India, 2011

Successful Schemes	• **JJM** has a **dashboard** through which one will be able to get all the names of villages, taluka as well as districts in Maharashtra and can get all the information regarding works and schemes from all areas and villages. • **Swachh Bharat Mission**
Source of water supply	• **Groundwater, river. Seasonal dams** • There is perennial river in Maharashtra. Majority of people rely on groundwater. • **Energy supply:** Electricity and solar power (rural areas with less population and lesser power supply e.g., Gadchiroli)
Groundwater level	• Groundwater depth **depends upon the geographical area** like the Konkan region has higher groundwater level and the hilly region within the western ghats have lesser groundwater level. • There is a **groundwater act** in place, which mentions some of the labels for groundwater extraction. • Under Groundwater Act and Rule, **GSDA** officers regularly take **observations** of water depth and level throughout the state and district level
Water Quality testing	• Use of **chlorine chemical** to clean the water • Villager contact Local gram panchayat or BOD department if there are any water quality issues, otherwise they should go with other ideas
Water Supply charges	• In HUDCO designated areas, ₹1000/ year ($12/ year) for rural areas in Raigarh District but some areas hardly pay ₹300-400/ year ($3.6-5/ year). There charges are laid by HUDCO which inly looks after the water supply in Raigarh District. • Rural areas from other districts get their water from other schemes which charge **13.5 paisa/ 1000 litres** ($0.0016/ 1000 litres)[105]
Role of each department in overcoming the drinking water related challenges	**Department of Environment and Climate Change** • The department began a natural restoration and conservation activity campaign in both rural and urban areas. • Water conservation measures are being taken to protect the groundwater and natural resources, to maintain the groundwater extraction for drinking and crops and the groundwater is increasing due to the plantation of trees. • It also gives suggestions to create a rainwater water harvesting system, peculation pits (especially in the Konkan Region), wells preservation also to restore old well structures and ecosystem preservation. • It also talks about water resources regermination under which suggestions related to increasing the capacity of the water structures like rivers, lakes through sanitation and deep-sea city structures are given. **Village Water Sanitation Committee** • Village level plans to be submitted to the central government as per the guidelines issued in December 2009. • Requirements are identified and a village plan to is prepared which includes **Village Pani Samiti** consisting of local people and GP Sarpanch. % Women are hired for water testing under this committee. • After approval of the prepared plan for the Village Water Sanitation Committee by the district level, a committee formed under the chairmanship of Guardians Minister reviews it. **Water Supply and Sanitation Department** • At the State Level, the whole plan of the State is approved by the Honourable Minister of Water Supply and Sanitation and arrangements are made as per the guidelines and every plan is approved by the State level itself. **GP** • After successful implementation of JJM, water supply and cleanliness responsibility will be handover to the Gram panchayat for one year and then to the community for its maintenance.
Source of water supply for the other allied activities (Sanitation, agriculture, cattle rearing, etc.)	• Groundwater, ponds, rivers
Any improvement in the water supply provision	• There were schemes in Maharashtra but as per the guidelines before only 44 LPCD of water was supplied but now 55 LPCD is supplied. • Earlier some villages did not even have water supply schemes. • As prescribed in JJM guidelines, water quality is tested in labs with regular bases like **biological sampling and chemical sampling**. So, now purified water is supplied. • **Women are given training** on how to test water

[105] https://indianexpress.com/article/cities/mumbai/maharashtra-govt-hikes-water-tariff-for-agriculture-domestic-and-industrial-sectors-5032136/#:~:text=Water%20tariff%20for%20individual%20farmers,paise%20and%2013.50%20paise%2C%20respectively.

Further improvements to be made	• Goal is to complete our mission efficiently and on time and as of now, the dashboard is 60-70% completed. • In Maharashtra, **GPs not only participate but they also launched multi schemes** for 40 villages which were very big schemes and it is the big thing for us and so, there is need to make one committee for whole people of village
Water supply related technology providers active in the state	• ISA works for rural areas • CSR Activities and Funding • Community contributes to the schemes and also it depends on their religion and background • Even labours are big contributors • The cash collected from villagers is kept in a separate bank account which is further utilised for maintenance after the completion of the scheme • More than two agencies in Maharashtra work together to implement one scheme and we get facilities from government like engineers and all but we can get limited of workers so just for this reason • Projects are also out-sourced to consultancies or other private sector companies • For water supply, capital is obtained from Jal Jeewan scheme fund.
Awareness programs conducted to conserve surface and groundwater	• Water-related campaigning is done through other schemes such as Jal Jeevan mission**, Jal Yukta Shivar**. Awareness about rainwater collection is done through Central and State Government. The ministry of Jal Shakti does lots of campaigning.

Challenges in provisioning of water supply in rural areas from the State Perspective

Main intention of Jal Jeevan Scheme is to provide 55 LPCD of tap water and its facilities in every house with maintained water quality. The main challenges are to find a **reliable source to supply yearly water to the rural HHs**. **Constraints and operational gap**: It is difficult to **bridge a gap** between Irrigation Potential Created (**IPC**) and Irrigation Potential Utilized (**IPU**). There are **losses in Urban Distribution Network** and a need to **reduce the Non-Revenue Water (NRW)** and restricting domestic water use within the prescribed norms particularly in urban areas is a key issue which needs to be addressed on priority[106].

Challenges, barriers and willingness in the implementation of any new system or technology related to water supply

There is no filtration plan for rural areas. There are issues of capital maintenance charges to maintain a newly provided service. The state and district will design a scheme for any new technology which comes up and after implementation of any such technology, it should go at least for the next 30 years. If there are huge capital means then the technology can be implemented by forming and launching policies otherwise without capital, it becomes difficult to implement the schemes. People should also believe that new technology to increase its usage and this can be done by advertising that scheme. Such technologies also require the cooperation of people towards maintenance and tax payment.

According to the GSDA Official, **adopting a new technology might not work out well in rural areas** because currently people only pay ₹300 - 400/ year and ₹1000 max ($12/ month) in HUDCO designated areas and **25 paisa/ 1,000 litres ($0.003/ month)** in other rural areas[107] for water. If an enhanced technology is installed, they govt. may not get any charges from the people to maintain the existing water supply system. There are around 40,000 villages from where uneven amount is obtained from each village. These initiatives should be taken by the gram panchayat itself and the scheme is adopted it means it should also be maintained properly. And also, MJP also designs some schemes and even they have their own schemes.

2.4.6. Analysis at District and Rural Level

Below table shows the key findings of water supply status in the rural areas of Beed and Raigarh districts of Maharashtra, as discussed with the district level and gram panchayat level officials.

Key Findings for the selected districts in Maharashtra

Aspects	Beed	Raigarh
Departments or Officials surveyed	• **District Senior Officer** • **Engineer** • GP offices - Beed City, Wadhwani, Mogara (Mangle Gaon) and Shirur	• Junior Engineer (RWSS) • District Level Officer • GP offices – Amboli, Morbe, Umbarde and Kurul

[106] https://wrd.maharashtra.gov.in/Site/Upload/PDF/State%20Water%20Policy%2005092019-pages-32-55.pdf
[107] https://indianexpress.com/article/cities/mumbai/maharashtra-govt-hikes-water-tariff-for-agriculture-domestic-and-industrial-sectors-5032136/#:~:text=Water%20tariff%20for%20individual%20farmers,the%20tariff%2C%20said%20an%20official.

Current Water Supply Scheme	• Atal Amrit Yojana (Beneficial to the people from rural areas) - work is in progress • Paani Puravtha Yojana • Both the schemes are pretty successful as they are extended to both rural and urban areas	• JJM (For rural people) – work is in progress; 1,540 villages have been supplied water till now and the deadline it 2024 • National Water Supply Scheme – has worked well • National Rural Drinking Water Scheme (1,450 villages covered in this scheme) • Bharat Nirman Yojana - No benefit till now with a sum of 1-30 Crore.
NGOs or organisations working towards water provision	• Currently no companies or NGOs are working in the district	• RCF Co. • J.S.W • Swadesh foundation
Water Dependency	• Dependency of agriculture, animal husbandry on river and dam water for irrigation, drinking and cleanliness purpose	• Water demand has increased in the district because people are building houses, bathrooms in their villages
Source of water	• River, dam and wells • Water is supplied by tankers, handpumps	• River, dams, ponds and wells • Water is supplied by tankers, handpumps
Availability of canal or river	• There is no canal but there is a major river, i.e., Godavari	• There is a river present in the district.
Water Quality	• Water gets dirty during excessive rains, floods and pipeline breakage	
Socio-economic condition of people from rural and remote areas	• Farming crops like wheat, bajra, cotton and jowar is the primary occupation of the villagers in the rural areas of district while some also have their own businesses and some work as labourers. • Average income ranges from **₹10,000-25,000/ month** ($122-305/ month)	• People are dependent on farming and labour work for their livelihood • Average income ranges from **₹5,000-20,000/ month** ($61-242.5/ month)
Incidence of any disaster due to climate change	• No risk but sometimes there are flood like conditions in the villages situated on the bank of rivers causing a lot of damage.	• There has been no incident of risk or calamity till now. • There are incidents of water scarcity in a few areas due to shortage of rain

Current Status and Issues about the water supply in the district and the surveyed villages

3. Beed District

Under Atal Amrit Scheme, water will be easily accessible in all the villages except some villages where it is a bit difficult to provide pipelines due to natural obstacles. **The work is still in construction phase.** A tanker is provided in the rural and remote areas and also hand pumps (taps) are installed by the district officers. No tanker is provided in hard to access areas. There is a river, a dam and a filter plant from which water is supplied. There is need for adequate canal distribution channels which will be covered under the schemes. Demand for water is increasing day by day due to construction of new homes. When bathrooms are built, the demand for water increases. There are **funding issues** to deal with the situation during natural calamity like a flood. **Current Budget of Atal Amrit Yojana is about 10 to 15 crores. There are no active technology providers in the district. People set up filter plants privately who invest their own money and sell water.** JJM is yet to start or just connections have been given to the houses without tap provision in many villages of the district. Village wise observations are as follows.

- **Beed -** In the city, water is supplied through taps and pipes in sufficient amount for domestic purposes. The water is supplied through pipes in other villages. River water, wells and handpumps are used for allied activities.
- **Mogra - Godavari** River is a major source of water. Water is supplied through handpumps. Every member needs at least **6 to 7 litres** of water for drinking. Everyone drinks water from hand pumps as there is no piped water connection. The water that comes during **floods remains very dirty for 2 months**. There is a **well** for **cleaning** and **farming** purposes. The **river water** is used for **animal husbandry, agriculture, and sanitation**. The only challenge is finance, so that no scheme gets closed.
- **Shirur – Drinking** water comes from **Tagadgao dam** for domestic purposes. Water demand is around **0.5-0.7 million litres each day**. There is a need of a tap water scheme as water runs out

frequently. The level of groundwater is too low and not potable. The water required for allied activities comes through the tanker.

- **Wadwani – Dam water** is supplied for all purposes. **Filter plant** is there. Per capita drinking water is around **2.5 litres/ day.** There is no problem related to water as everyone gets sufficient amount of water.

Issues like unhygienic conditions near water tap, water wastage and poor water quality in rural areas

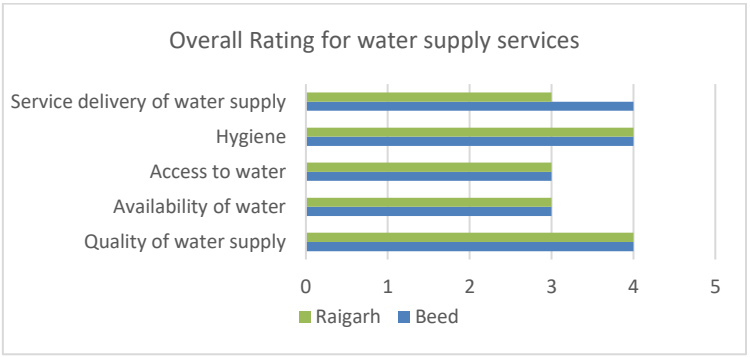
4. Raigarh District

Water is supplied by pipes and somewhere by tankers to the most hard-to-access where supply is not possible. **There are some villages in the hilly area where it is very difficult to send water. Water is sent by tanker in that area but the cost is high**. There is no water connection in the rural and remote areas. A tank has been built there and then water is poured into it which is then supplied to everyone in such areas. Water is transported by tanker in hard to access rural areas where it is not possible to deliver water. There are **bureaucracy issues** to supply water which acts as a biggest challenge. It can be easy if the task is given to administration. The terrain of the district/block require implementation of decentralised water supply system. Villagers use more water nowadays as new houses and toilets are being built. Raigad district comes at **number 5** in terms of **cleanliness**. Currently water is supplied through MJP. The budget of JJM is around **4 million to connect 1,540 villages** but it is yet to start or just connections have been given to the houses without tap provision in many villages of the district. Village wise observations are as follows.

- **Kurul –** At present, water distribution is through **MIDC** only for **domestic** purposes. **No other scheme** is there. Water demand is **200,075 litres daily**. Water from ponds is taken for **sanitation, agriculture, and animal husbandry.**
- **Umbarde –** Water is supplied through **Pani Puravtha Scheme**. So, clean water is suppled under a scheme **every day** for **2-3 hours** and from **dams to pipelines** for **domestic purposes.** There is a scarcity of water during April-May.
- **Amboli –** People get water through a scheme, but the contractor provided dirty water. Even people and government in the village are not very supportive towards a new scheme. **Water Demand** is around **0.3 million litres/ day.** Groundwater is single source which is available in a plentiful amount and is used for all purposes.
- **Morbe –** There is a **well and a tank**. Tank gets **groundwater** using a motor and a **pipeline** is connected to the tank which provides to everyone. **Tablets** are used to **kill viruses** from water once in 15 days. But the groundwater table is much down. Other source for **drinking** water is a **river**.

Packaged drinking water and water purification plants in rural areas of both the districts

Overall Rating



Overall Rating for water supply services

The overall rating given by the GP officials for the water supply services in the villages are displayed in the below chart. Beed district has comparatively higher rating in terms of service delivery of water supply than Raigarh district and it is same for other aspects.

Willingness to support for a new technology to be implemented

All the district and GP officials were asked their willingness to participate and support a new technology which can be implemented at the rural level. **Beed District** - As per the district official, there is no challenge to implement a new scheme or technology and villagers and the district officials will fully cooperate towards it. Only **issue** in **finance** and if it is provided by the government, then more people should be benefitted. **Raigarh District -** The **challenge** is the slow movement due to bureaucracy because of which people do not allow implementation of big projects in their areas otherwise they will easily cooperate with new schemes People have some expectations from Swachh Bharat Mission and JJM. District officials are also willing to implement new schemes in the villages and district.

Suggestions by the officials

Beed - Remote and inaccessible areas should be provided with clean drinking water as per their needs in the rural areas of Beed District.

Raigarh - Government should provide enough finance to implement different schemes in the rural areas of Raigarh District.

2.4.7. Identified Stakeholders to be engaged in implementing new technology

The State, District and GP officials suggested and rated various key stakeholders to be engaged to implement the decentralised technologies for water supply/ treatment in their rural areas. They are mentioned in the table below.

Critical stakeholders to be engaged

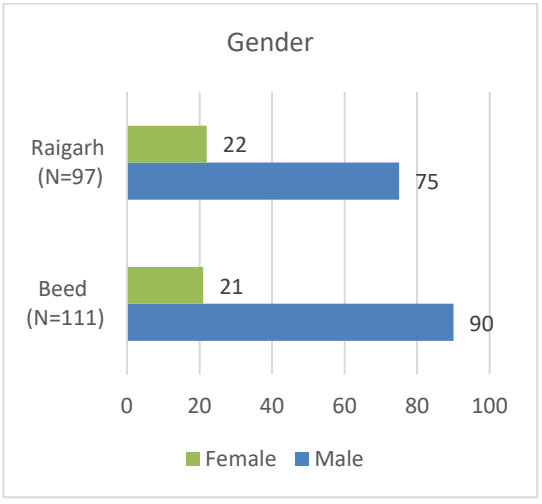
Stakeholders	Accountability for implementing/ operating	Nature of Interest	Rating for Importance	Rating for Influence
			(Scale of 1 to 5, 5 = highest)	
GP	Yes	Positive	5	5
VWSC	No	Negative	0	0
Block office	Yes	Positive	5	5
District office	Yes	Positive	5	5
Other corporates	No	Negative	0	0
ASHA or anganwadi workers	Yes	Positive	4	4
Minority group representatives	No	Neutral	3	0
Youth organizations	Yes	Positive	4	4
Women's organizations	Yes	Positive	4	4
NGOs	No	Negative	0	0
Political party-1	No	Negative	0	0
Political party-2	No	Negative	0	0
Individual 1	No	Negative	0	0

2.4.8. Household Level Analysis at Rural Level of the Districts

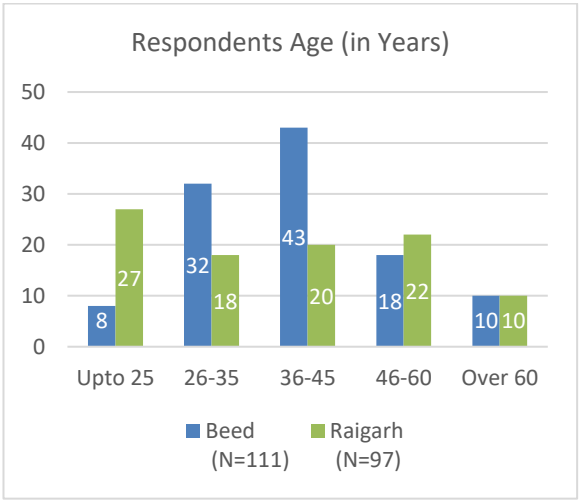
The households from the four selected villages from each district were surveyed to identify their demographic and socio-profile, dependency on different types of water sources,

Demographic Profile of Respondents

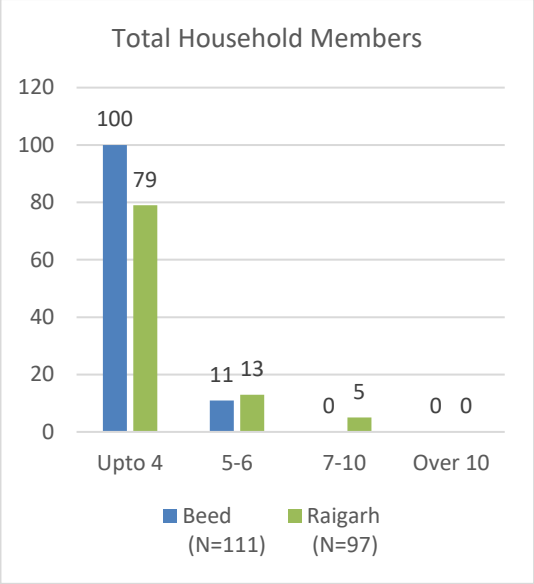
The demographic details of the respondents from the chosen rural and remote areas of the Beed and Raigarh district have been studied to know their socio-economic background and also willingness to participate in new provided services. Such details include gender, age, total members in the HH and the HH income.



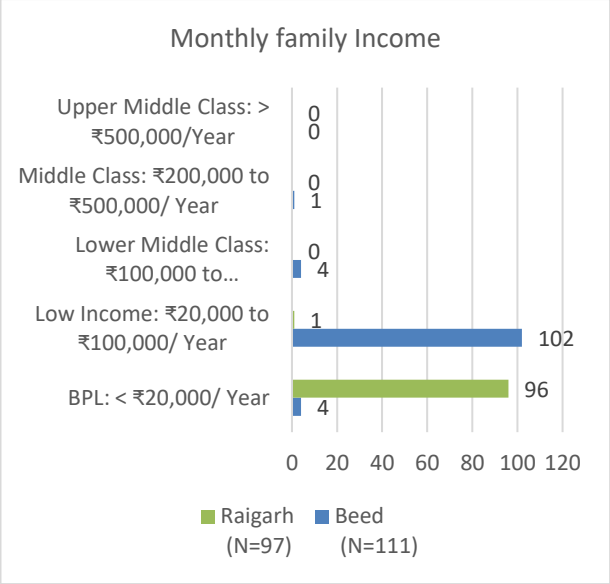
Gender of Respondents from Maharashtra



Age of Respondents from Maharashtra



Total HH members in respondents' family



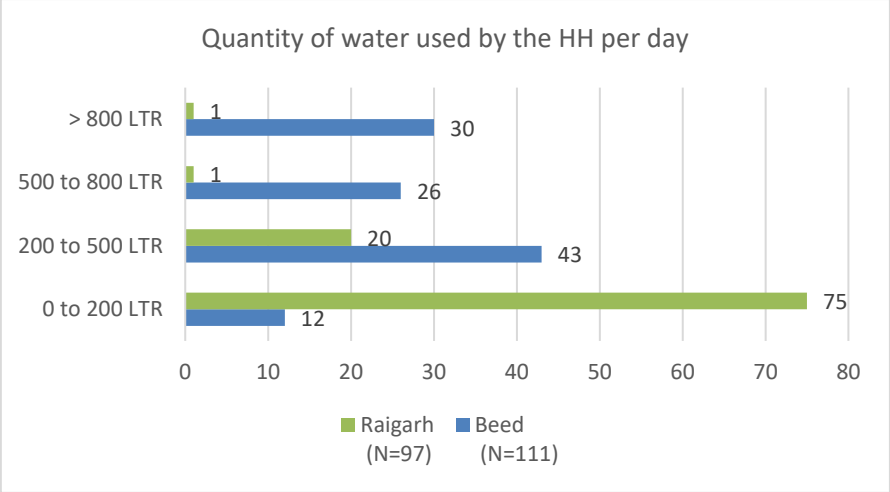
Total family income of respondents from Maharashtra

Majority of the respondents were males - Over three-fourth from Raigarh and four-fifth from Beed while average **HH size** in both the districts is observed to be **4**. The respondents from Raigarh were distributed across all the age categories as shown in the above figure. Almost **70**% of the respondents from **Beed** belong to the age group of **26-45 years** while **16**% belong to **46-60 years** of age group and only **9**% of them are **above 60 years** of age. Similarly, for **Raigarh** district, almost **40**% of the respondents are from **26-45 years** age category, **22**% are from **46-60 years** of age and around **27**% are less than **25 years** of age.

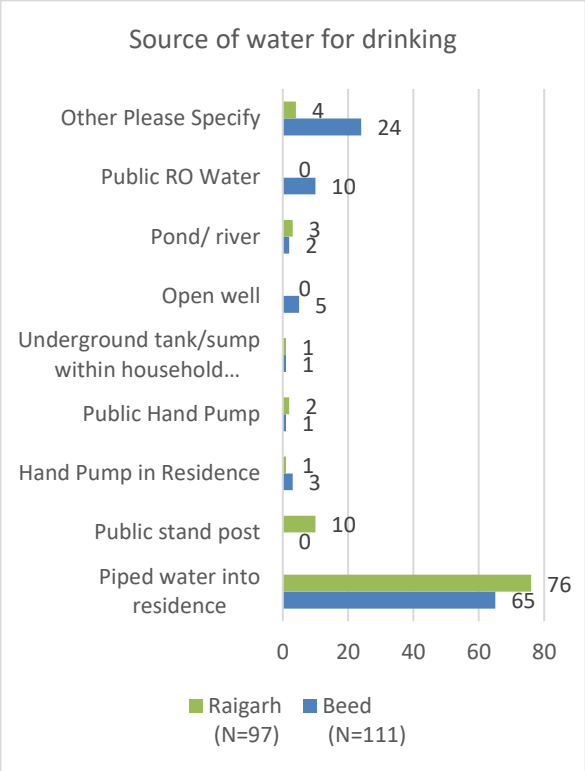
The average monthly HH income for rural areas of **Raigarh** district is less **than ₹20,000 per month (BPL category**) ($244/ year), as per the primary survey of HHs while it is **₹20,000-1,00,000 per month (Low Income category)** ($244-1,219/ year) in the **Beed** district. Majority of the people are involved in **cultivation of crops like wheat, jowar, bajra and cotton and some have their own businesses.**

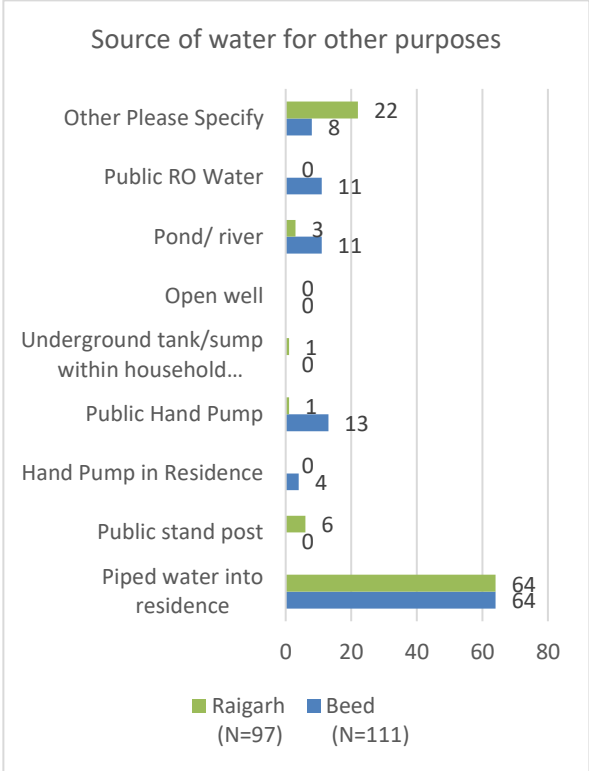
Current Dependency on drinking water supplied from different sources

As per the primary survey, major water sources in both the districts are rivers, dams and wells from which water is provided through **pipelines, tankers and handpumps**. Water pipeline provision to each and every HH is under progress through JJM. Around **three-fourth HHs** from **Raigarh** require upto **200 litres** of water each day while remaining **one-fourth** require **200-500 litres** quantity of water each day. Around **half** of the people living in rural areas of **Beed** district require more than **500 litres** of water each day. **40**% people need **200-500 litres** of water each day while only **10**% need **less than 200 litres** of water per day.



Daily quantity of water used by the rural HHs in the selected districts from Maharashtra





Source of water for drinking and other purposes for the rural HHs in the selected districts from Maharashtra

Major source of water is through **pipelines** into rural HHs of both the districts for **drinking and other purposes**. **Raigarh** also has **public stand posts and ponds** while **Beed** has **public RO water** and other source of water supply delivery systems. Water required for other purposes is through **public hand pumps**, **ponds, rivers** in rural areas of **Beed** and through pu**blic stand posts and other sources** in rural areas of **Raigarh** district. Below table shows the Projected Domestic and Drinking Water Demand (in cubic Million meters per day) using projected data of rural population and HHs calculated using the above primary data obtained for water requirement per day.

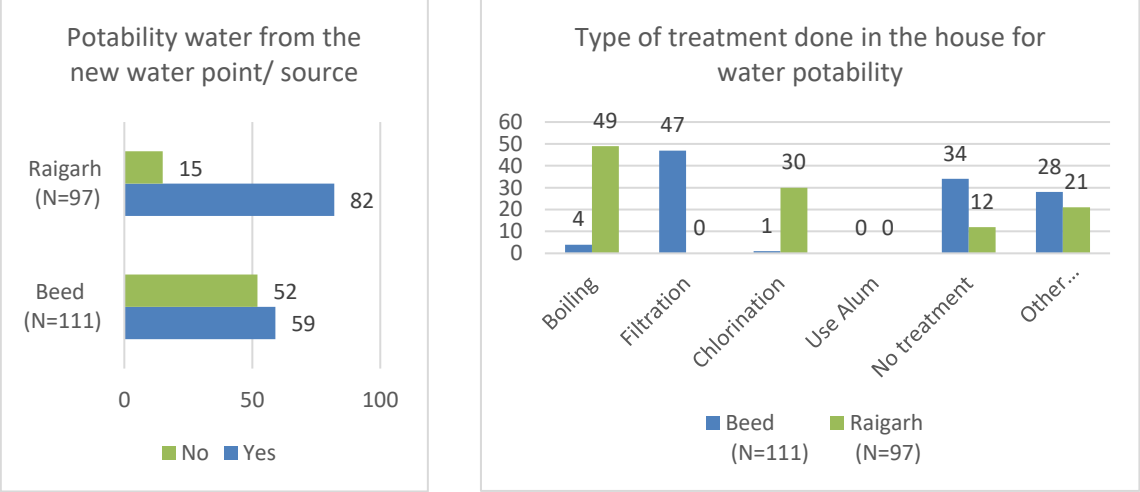
Projected Domestic and Drinking Water Demand (in Mm3/ day) in Maharashtra

State	District	Projected Rural Population	HH Size	Projected Rural HHs	Average Water Demand per HH	Projected Water Demand (in Mm^3/ day)	Projected Drinking Water Demand (in Mm^3/ day)

		2021	2031		2021	2031		2021	2031	2021	2031
Maharashtra	**Beed**	23,58,575	26,46,398	4	5,89,644	6,61,600	572	0.337	0.378	0.012	0.013
	Raigarh	17,47,920	18,31,834	4	4,36,980	4,57,959	160	0.070	0.073	0.009	0.009

Water Potability and Type of Water Treatment Done at Household Level

The quality of water obtained from different sources, as mentioned above, has got an overall rating of **4 out 5** from the Sarpanch from the GPs of all the surveyed villages. Around **85**% and **50**% of the rural respondents from **Raigarh** and **Beed** district, respectively, responded **positively regarding the potability of water**. The remaining rural respondents from **Raigarh** mentioned **muddiness, salinity and presence of iron** as the major reasons for non-potability of water while in **Beed**, the major reasons for non-potability are **muddiness, bad smell/odour and contaminated water.**

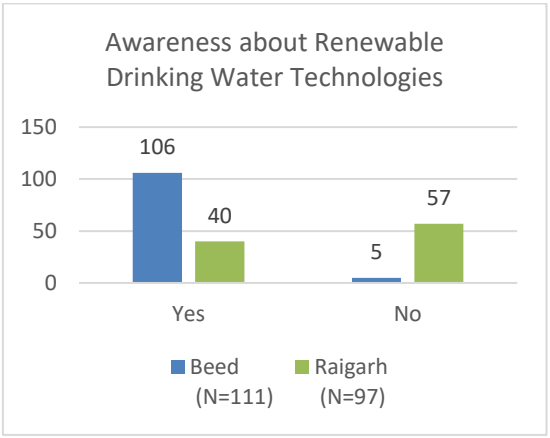


Potability water from the new water point/ source and type of treatment done at household level in the rural areas of the selected districts from Maharashtra

To resolve the issue of non-potability of water, people take efforts to treat it at HH level. In **Raigarh**, around **half** of the respondents prefer **boiling the water, one-fourth prefer chlorination** method while about **10**% **don't do any kind of treatment** at home. In rural areas of the **Beed** district, **40**% respondents prefer **filtration** and around **30**% **don't prefer any kind treatment** of the water.

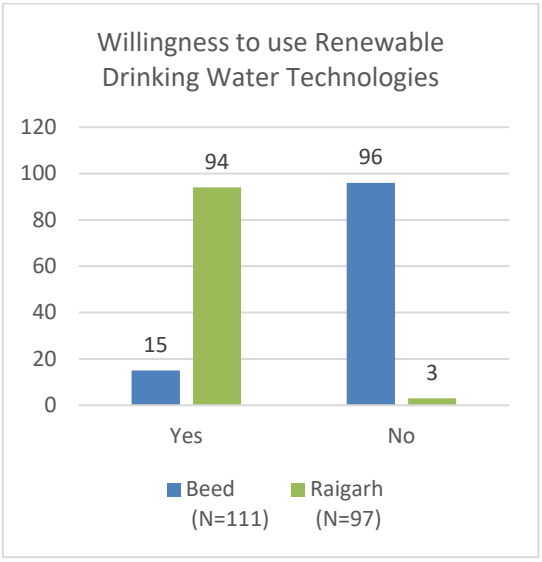
Awareness about Renewable drinking water technology in the market

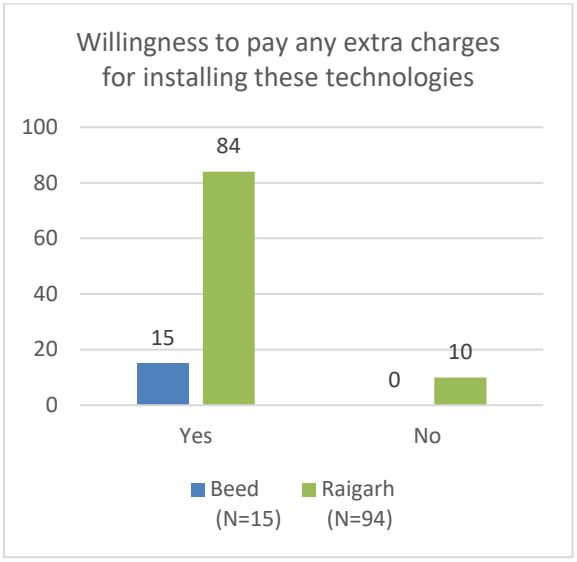
Almost **all** the respondents from the villages of **Beed** district are **aware** about the renewable drinking water technologies while for rural respondents from **Raigarh**, the figure is around **40**%.



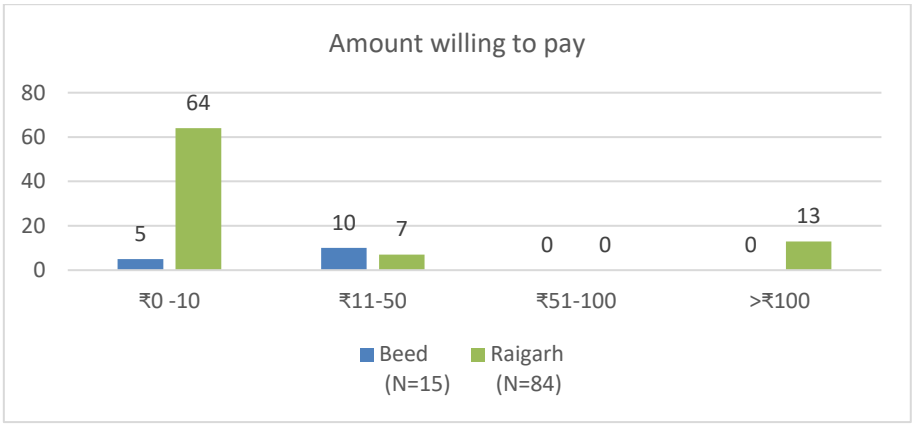
Awareness about Renewable Drinking Water Technologies of the rural HHs in the selected districts from Maharashtra

Willingness to use and pay for installing and maintaining Renewable Drinking Water Technologies





Willingness to use and pay extra for installing Renewable Drinking Water Technologies in the rural areas of the selected districts from Maharashtra



Amount willing to pay for such services in the rural areas of the selected districts from Maharashtra

Only **15**% of respondents from the rural areas of **Beed** district are **willing to use and pay** the renewable drinking water technology even though there are water quality issues as stated by them. They are ready to pay a charge upto **₹50/ month** ($0.6/ month). Almost **all** the residents from the surveyed villages of **Raigarh** district are **willing to use such technologies** and around **70**% of them are **willing to pay** upto **₹10/ month** ($0.12/ month), **7**% are ready to pay from **₹11-50/ month** ($0.13-0.6/ month) and **15**% are willing to pay **more than ₹100/ month** ($1.22/ month). The remaining are willing to use but do not want to pay for such services.

Annexure 2: List of potential criteria to identify target markets for implementing renewable drinking water technology

The rating done is based on the primary analysis and is relative for all the states. The criterion for shortlisting is aligned with the overall strategy:

- Inclusive and participatory;
- Contextual; and
- Demand for the Renewable Drinking Water Technology

Sr. No.	Criteria for identifying and analyzing target markets	Reason for choosing the criteria	Unit of Measurement	Scoring Range	Evaluation Criteria
1	**Gender and Age distribution of the population from the selected areas**	To know the socio-economic background of the people	-	Cannot be rated	-
2	**Household size of each of the families**	To identify the water demand of each HH	-	Cannot be rated but is used to measure parameters like water demand	-
3	**Population and number of HHs of the selected areas**	To study the demographic details of the regions to calculate the overall water demand of the region	-	Cannot be rated but is used to measure parameters like water demand	-
4	**Livelihood dependency**	To know the socio-economic background of the people	Number of employment options available to the rural community	0-5	Higher the value, the better the parameter
5	**Nature of employment**	To identify if the job is stable throughout the year or seasonal	Number of months the local community is employed	0-5	Higher the value, the better the parameter
6	**Average income levels of the HHs**	To know the socio-economic background of the people and identify paying capacity	Income range per HH (INR/HH)	0-5	Higher the value, the better the parameter
7	**Climatic and topographical conditions of the selected areas**	To study the environmental factors of the selected region; Stability of climatic factors in the region and whether they are supportive to the technology or not	No unit	0-5	Higher the value, the better the parameter
8	**The groundwater level in the selected areas**	To know the existing details of the groundwater table	Depth of groundwater level in feet	0-5	Here, higher rating is given to lower value of groundwater level which is better in terms of water supply and conservation and vice versa, so, higher the value, the better the parameter

9	**Water Quality**	To know whether the water is potable or not and, if not, the reasons for its non-potability	Rating given by GP officials and community	0-5	Higher the value, the better the parameter
10	**Current sources of water**	To identify different water sources in the region and water availability in them	Number of sources but linked to the next parameter	0-5	Higher the value, the better the parameter
11	**Nature of the sources**	To know whether the sources are seasonal or not to identify water availability	Number of months with water availability	0-5	Higher the value, the better the parameter
12	**Current Status of water supply schemes or services provided**	To know if new technology is needed or not To know how much area will be covered by them, at least in the next two years	Number of rural HHs covered under the current schemes	0-5	Higher the value, the better the parameter
13	**Measures taken for providing drinking water**	To know how water is supplied to the people or houses (e.g., Pipelines, tankers, handpumps, etc.)	Rating (Efficiency of local officials to take new measures for water provision)	0-5	Higher the value, the better the parameter
14	**Current charges paid by the residents to avail of such systems (Paying capacity)**	To know the current paying capacity of the people	INR	0-5	Lower the value, the better the parameter
15	**Water Treatment facilities or practices at GP and HH level**	To know if the people or GPs are treating non-potable water at their end for consumption	Available or not; Number of types	0-5	Higher the value, the better the parameter
16	**Overall water demand of each HH and the whole area for drinking purposes**	To know the current water demand for drinking purposes	LPD (litres per day)	Cannot be rated	-
17	**Demand for a decentralized/ alternative water supply system**	To know if there is any demand for any new system or technology	Rating	0-5	Lower the value, the better the parameter
18	**Most hard-to-access areas**	To know if there are any hard-to-access areas in the state	Number	0-5	Lower the value, the better the parameter
19	**Incidences of natural risks or disasters in the areas**	To study the environmental factors of the selected region	Number and intensity	0-5	Lower the value, the better the parameter
20	**Awareness of people about water-borne diseases**	To know if the people are aware of the ill effects of consuming poor-quality of water	Rating	0-5	Higher the value, the better the parameter
21	**Incidences of any water-contamination related disease in the region**	To identify the range of effects on people due to poor quality of water	Number	0-5	Lower the value, the better the parameter
22	**Medical expenses on such diseases**	To know the medical expenses of people on health check-ups for water-borne diseases	INR	0-5	Higher the value, the lower the cost of medical expenses and the better the parameter

23	**Right stakeholders/ institutional partners to be involved in the implementation and can play a role in long term sustainability and scaling up**	To identify critical stakeholders to collaborate with to implement such technologies	Number and their rating of influence	0-5	Higher the value, the better the parameter
24	**Awareness programs conducted to conserve all forms of water**	To know the current programs to generate awareness among the rural community about water use, treatment and conservation	Rating	0-5	Higher the value, the better the parameter
25	**Awareness of residents about renewable drinking water technologies**	To know if the people are aware of any such technologies	Rating	0-5	Higher the value, the better the parameter
26	**Willingness to pay and use such technologies**	To know paying capacity of people and their willingness to use such technologies	Likert Scale	0-5	Higher the value, the better the parameter
27	**Challenges to implementing any new scheme**	To know the obstacles that one might need to overcome to implement such technology	Rating	0-5	Higher the value, the better the parameter
28	**Availability of funds with local government officials**	To identify the spending capacity of the GPs or district offices	Number of schemes and funds available	0-5	Higher the value, the better the parameter
	Overall Rating		-	0-5	Higher the value, the better the existing situation and the lower the need of the technology

Annexure 3: List of potential criteria to conduct 'True-cost Analysis'

Drinking water cost per litre for the identified markets based on a 'True-cost' approach, including parameters as shown below.

Sr. No.	Parameters	Description
1	**Current cost of drinking water alternatives**	Safe drinking water at the household level
2	Wholistic **value of impacts** to communities	**Health**: Health and hygiene savings by communities due to better water quality and thus, saving money spent on water-borne diseases by them.
		Better Hygiene: No smell and odour of drinking water
3	**Opportunity cost of water**	**Time savings**: Women walking several hours to get water for all the purposes for the family vs. Income that could've been earned from working in those hours
		Increased Productivity of women: Women investing their time in education and other hobbies
		Opportunity for employment of women: Women engaging themselves in local jobs
4	**Direct environmental cost of current solutions**	Plastics, RO reject water, Brine from desalination plants

Annexure 4: Survey Tools

1. Central Ground Water Board (KIIs)

Details of the official

Name	
Designation	
Phone number	

1. What type of sources of water are available in the focus states (UP, Odisha, Rajasthan and Maharashtra)?
2. Are there any challenges faced to supply water (from ground water sources) to these states and villages? If yes, what are they?
3. What is the institutional structure and hierarchy for providing water supply in the above states?
4. Are you aware of Renewable Water Technologies for providing drinking water in such hard-to-access areas? If yes, what do you know about it?
5. Is this renewable source water drinking technology being installed/incorporated anywhere in India? If yes, are there any schemes/programmes that can provide/ fund these technologies?
6. If any such technology is proposed for a renewable source of water for drinking, will you be willing to initiate their implementation? If yes, under which schemes/programmes can such technology be implemented? How much grant can be allocated to implement such technology?
7. What, according to you, can be the opportunities for this Renewable Technologies for Drinking water supply? If not, what other alternatives would you like to suggest for supply water to such hard-to-access areas?
8. Are you connected with any market Manufacturer/supplier who are working for renewable source water technology? If yes, who are they (get contact details)? Are they a part of any of your ongoing schemes/programs?

2. Water Supply and Sewerage Management Board/ Rural Water Supply Board

Details of the official

Name	
Designation	
Phone number	
State/ District	

1. What type of water source is available in the state/ district?
2. Does every village and remote area in your state/ district have access to piped water supply? If not, what is the source of water supply to such areas? Is this water suitable for drinking as per the existing source?
3. What are the challenges faced by the state/ district for supplying water to especially the hard-to-access areas?
4. What is the per capita demand for the villages in your state/ district (especially the focus villages)? Is the demand completely fulfilled, how much quantity is deficit? What are the upcoming projects planned to meet this demand?
5. What is the institutional structure and hierarchy for providing water supply in the state?
6. Are you aware of renewable, cost effective and decentralized technologies to provide drinking water in the areas that are hard-to access?
   - If yes, what are they? If no, would you be willing to implement them in your state/ district?
   - Are there any manufactures/ producers of such technologies associated with you? Can you share their details?
   - Through which schemes/ programs are these technologies implemented? How much grant/ funding can be provided through these programs?
   - What is the tentative budget allocated for implementing these technologies?
   - If not, what alternative would you like to suggest?
7. Are there any external agencies/ partners involved in the supply of water in your state/ district? If yes, is it possible to provide their details– NGOs/Private Players/Government Stakeholders?

3. Public Health Engineering Department

Details of the official

Name	
Designation	
Phone number	
State	

1. How are the water supply projects implemented in the state, especially in the hard-to-access remote areas? What are the challenges observed for the same?
2. Is every village and remote area planned for piped water supply in your state?
3. What is the tentative current and projected budget allocated for the water supply within the state?
4. Is the water collected through these sources' drinkable? Are there any difficulties /issues related to quality and quantity of water from the current sources?
5. Are you aware of renewable, cost effective and decentralized technologies to provide drinking water in the areas that are hard-to access?
    - If yes, what are they? If no, would you be willing to implement them in your state/ district?
    - Are there any manufactures/ producers of such technologies associated with you? Can you share their details?
    - Through which schemes/ programs are these technologies implemented?
    - What is the tentative budget allocated for implementing these technologies?

4. Tourism Department

Details of the official

Name	
Designation	
Phone number	
State	

1. What is the source of water at the tourist places/ resorts within the state?
2. How is the tourism department ensuring the supply of drinking water to the hard-to-access areas? Through which programs/ schemes is this water supplied?
3. What is the total demand for water supply to these areas? Is the demand completely fulfilled? If not, what is the deficit quantity of water required?
4. Are you aware of renewable, cost effective and decentralized technologies to provide drinking water in the areas that are hard-to access?
    - If yes, what are they? If no, would you be willing to implement them in your state/ district?
    - Are there any manufactures/ producers of such technologies associated with you? Can you share their details?
    - Through which schemes/ programs are these technologies implemented?
    - What is the tentative budget allocated (current and projected) for the supply of drinking water?
5. Are there any external agencies/ partners involved in the implementation of water supply system in these tourist places?

5. District Level Officials (Additional District Magistrate)

Details of the official

Name	
Designation	
Phone number	
State	
District	

1. What type of water source available in the districts? Does the villages and remote areas have access to water sources/ provided with Functional Household Tap Connection (FHTC) under JJM?
2. If no, what are the challenges in provisioning the FHTC in the rural areas in the district?
3. Are there any difficulties /issues related to quality and quantity of water from these water sources?
4. Are you aware of renewable, cost effective and decentralized technologies to provide drinking water in the areas that are hard-to access?
    - If yes, what are they? If no, would you be willing to implement them in your state/ district?
    - Are there any manufactures/ producers of such technologies associated with you? Can you share their details?
    - Through which schemes/ programs are these technologies implemented? If no, what alternative would you like to suggest?
    - What is the tentative budget allocated (current and projected) for the supply of drinking water?

6. Forest, Environment and Climate Change Department

Details of the official

Name	
Designation	
Phone number	
State	

1. What are the methods used to conserve natural water resources within your state?
2. Are there any areas/ sectors where renewable technologies are being implemented in your state? If yes, which are they? Through which schemes/ programs/ projects are these technologies being implemented?
3. What is the status of natural water resources in your state? Are they adequate to provide water to all the rural and remote areas within the state?
4. What are the upcoming projects/ plans for the conservation of water resources and ensuring water supply in the state?
5. What is the current and projected budget towards water resource conservation/ management for the state?
6. Are you aware of renewable, cost effective and decentralized technologies to provide drinking water in the areas that are hard-to access?
    - If yes, what are they? If no, would you be willing to implement them in your state/ district?
    - Are there any manufactures/ producers of such technologies associated with you? Can you share their details?
    - Through which schemes/ programs are these technologies implemented? If no, what alternative would you like to suggest?

7. Gram Panchayat

Details of the official

Name			
Designation			
Phone number			
State			
District			
Block		Village	

1. What type of sources of water are available in the village? Are there any major challenges faced by the villagers to get water from the source? If yes, what are they?
2. Is the water from this source drinkable? If no, what are the solutions (treatments) opted for the same?
3. What is the quantity of water required to be supplied to the village per day? Is this demand being met? If yes, till what extent (percentage/ quantity)?
4. Are there any other agencies (other than Gram Panchayat) involved in the supply/ treatment/ testing of water in your village? If yes, please share their details (name, contact numbers).
5. How is the Village Water and Sanitation Committee involved in the water supply system? What are their contributions and responsibilities?
6. What is the total budget allocated for the water supply system in your village? Under which schemes/ programs are these funds allocated?
7. Are you aware of renewable, cost effective and decentralized technologies to provide drinking water in the areas that are hard-to access?
    - If yes, what are they? If no, would you be willing to implement them in your state/ district?
    - Are there any manufactures/ producers of such technologies associated with you?
    - What is the tentative budget that can be allocated for the implementation of these technologies?
    - Who will be responsible for the implementation, operation and maintenance of these technologies?
    - Please share alternative solutions, if any.

8. NGOs/ Private Sector Organizations (Manufacturers of these technologies)

Details of the official

Name	
Organization	
Phone number	
State	

1. What is the role of your organisation related to water supply systems? Do you implement these systems in any of the focus states (UP, Maharashtra, Odisha and Rajasthan)?
2. Do you manufacture any renewable drinking water technology solutions? Please share the details of its mechanism, implementation, operation and maintenance.
3. What are the preliminary skills required to operate these technologies? Are there any demonstrations provided by your team?
4. What is the total cost of installing this technology in a village? What is the estimated cost of operations and maintenance per cycle? What is the frequency of maintenance required for the same?
5. What are the criteria for the land/ topography, services (electricity, ground water level), population density, demand/ quantity of water required, etc. required to install these technologies? What were the major challenges faced in installing this technology?
6. Where is this technology installed in India? Through which scheme/ program was it installed?
7. Is this technology functioning/serving well in the rural and remote areas of the state?
8. What is the major difference observed in the water supply, before and after the installation?
9. In your opinion, how can it bring more opportunities/impact on the livelihood of the rural and remote areas?
10. What is the role/ involvement of the government stakeholders required for these technologies to perform positively? What are your observations from the areas where it is already installed?
11. Any recommendation/suggestion regarding the installation/implementation of such technology?

9. Household Survey

My name is <interviewer's name>. I am representing Taru Leading Edge. We are conducting a survey about the "Renewable drinking water in <State, District>". We want to understand your views on the impact Various market opportunities of Renewable drinking water. Your household happens to be one of those selected for the survey. I would appreciate it if you could please share your honest views and provide suggestions to improve on activities in future. All the answers you give will be confidential and will not be shared with anyone other than members of our survey team. However, all responses from the interview would be aggregated for reporting purposes. Your participation in the survey is voluntary. If I ask you any question you don't want to answer, just let me know and I will go on to the next question or you can stop the interview at any time. The interview would take approximately 20 minutes.

If you have any questions about this survey, you may ask me. **ANSWER ANY QUESTIONS POSED BY THE RESPONDENT AND ADDRESS RESPONDENT'S CONCERNS**

Do you agree to participate in this survey? Yes/No

NAME OF INTERVIEWER _____
DATE _____

District			
Block			
Gram Panchayat			
Village			
Respondents Name			
Respondents Gender	Male Female Other Do not want to disclose		
Respondents age			
Total Household Members & age	<u>Gender</u> Male Female Girls Boys	<u>Number</u>	<u>Age</u>
Working member in the family	Male Female		
Monthly family Income	BPL: < 20,000/ Year Low Income: 20,000 to 1,00,000/ Year Lower Middle Class: 1,00,000 to 2,00,000/Year Middle Class: 2,00,000 to 5,00,000/ Year Upper Middle Class: > 5,00,000/Year		
Quantity of water used by the HH per day	01 0 to 200 LTR 02 200 to 500 LTR 03 500 to 800 LTR 04 Above 800 LTR		
What is the source of water for drinking?	01 Piped water into residence 02 Public stand post		

	03 Hand Pump in Residence 04 Public Hand Pump 05 Underground tank/sump within household premises 06 Open well 07 Pond/ river 08 Public RO Water 09 Other Please Specify (_____)
What is the source of water for other purposes?	01 Piped water into residence 02 Public stand post 03 Hand Pump in Residence 04 Public Hand Pump 05 Underground tank/sump within household premises 06 Open well 07 Pond/ river 08 Public RO Water 09 Other Please Specify (_____)
Is the water from the new water point/ source potable?	01 Yes 02 No
If 'NO' then enquire about the reasons for non-potability of water? *Multiple Responses Possible*	01 Muddy water 02 Salty water 03 Fluoride 04 Iron 05 Arsenic 06 Bad smell/ Odour 07 Polluted / contaminated water 08 Other (please specify) _____
What type of treatment is done to make the water potable within the HH? *Multiple Responses Possible*	01 Boiling 02 Filtration 03 Chlorination 04 Use Alum 05 No treatment 06 Other (please specify) _____
Were there any recurring incidences of water borne/infectious diseases in the household in the last three months? (since the beginning of program in June 2021) *Record number of incidences; None=0*	
Are you aware of renewable, cost effective and decentralized technologies to provide drinking water in the areas that are hard-to access?	01 Yes 02 No
If these technologies are implemented in your village, would you be willing to use the same?	01 Yes 02 No

If yes, will you be willing to pay any extra charges for installing these technologies?	01 Yes 02 No
If yes, how much amount will you be willing to pay?	0 to 10 Rs. 11 to 50 Rs. 51 to 100 Rs. More than 100 Rs.

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