Evaluation of Safe Drinking Water Project in Odisha

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Commissioned by

Livpure

FOUNDATION

Acronyms

Acronym	Definition
AAY	Antyodaya Anna Yojana (AAY)
APL	Above Poverty Line
ASHA	Accredited Social Health Activist
AWW	Anganwadi Worker
BIS	The Bureau of Indian Standards
BPL	Below Poverty Line
CAPI	Computer-Assisted Personal Interviewing
FGD	Focus Group Discussion
HH	Household
IMMT	Institute of Minerals and Materials Technology
IRP	Iron Removal Plants
KII	Key Informant Interviews
MIS	Management Information System
NFHS	National Family Health Survey
NGO	Non-governmental Organization
OBC	Other Backward Class
PRI	Panchayati Raj Institutions
SHG	Self-help Groups
SROI	Social Returns on Investment
VWC	Village Water Committee
WASH	Water, Sanitation, and Hygiene

Executive Summary

Background

The Safe Drinking Water Project by the Livpure Foundation has established Iron Removal Plants (IRPs) utilizing simple and affordable technology to ensure ongoing access to iron-free, safe water in selected districts of Odisha. Climate-resilient water infrastructure also enhances the villages' ability to withstand natural disasters. Additionally, the project fosters ownership, effective management, and sustainability of the filtration systems by creating and empowering local Village Water Committees (VWCs). Community engagement plays a crucial role in the long-term maintenance of these systems, providing a replicable model for similar regions.

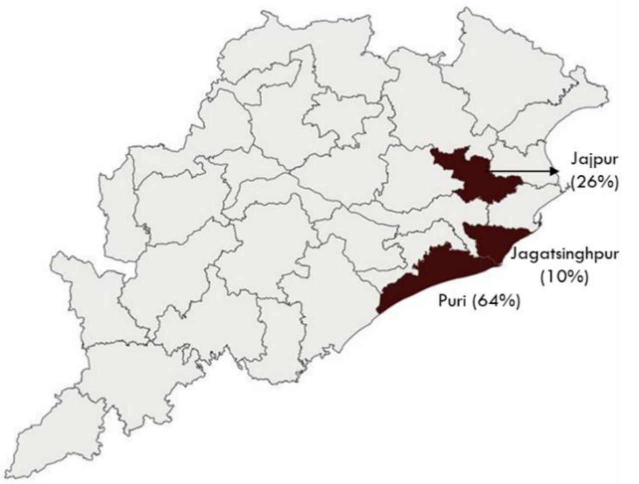
Between 2017 and 2023, more than 5900 households across four districts of Odisha – Puri, Jagatsinghpur, Jajpur and Balasore, were able to access clean iron-free water through the IRPs under the Safe Drinking Water Project. This report provides results of an evaluation of the project in three of these districts, i.e., Puri, Jagatsinghpur and Jajpur.

Methodology

The objective of the study was to assess the effectiveness of the Iron Removal Plants (IRPs) across three districts in Odisha – Puri, Jagatsinghpur and Jajpur. We used a mixed methods approach, combining quantitative inferences with qualitative findings. We have used thematic analysis of qualitative data to answer how and why questions.

By engaging a third-party survey agency (Avance Field and Brand Solutions LLP), we surveyed 260 households and conducted KIIs/FGDs across the three districts (see Figure 1), to gather information on their water consumption, sources of water, time spent on water collection and purification, and the changes in their lives and communities before and after the installation of the plants. We also conducted interviews with village leaders, held focus group discussions with village water committee members, and listened to stories from households to gather insights. Lastly, we undertook observations of IRPs in the sampled villages. The data helped us assess how the intervention changed levels of access to and satisfaction with water used for drinking and cooking purposes. With statistical analysis, we provide a picture of transformation across three districts.

Figure 1: Sample distribution of beneficiary households covered in the study

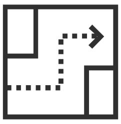


Note: This map is for representational purposes only. It is not to scale and does not necessarily reflect accurate political boundaries.

Key Findings

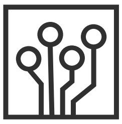
- **Improvement in Access to Safe Drinking Water:** Before the IRPs, only 55% of households had access to safe drinking water. Many relied on rivers or iron-heavy water sources for drinking and cooking purpose.

- **Increase in Reliability of Water Availability:** Before the IRPs, the availability of water was seasonal, especially impacted during summers. Post-IRP installation, 88.9% of households report a steady availability year-round. Approximately 88% of respondents also say they are satisfied with the amount of water available for cooking and drinking purposes, up from 67% who were satisfied with the available quantity before the IRPs.
- **Reduction in Time Spent Fetching Water:** The families spent 137.9 minutes on collecting water before IRP, due to heavy loads and long paths. After the IRPs, that time fell to 65.5 minutes, saving 72.5 minutes each day. In Jagatsinghpur, the saving is even more, at 94.7 minutes.



- **Reduction in burden of water collection:** Before IRP, 83.5% responsibility for water collection was exclusively on women. Post-installation, it has become a shared responsibility promoting equality and collaboration.

- **Satisfaction with Quality of Water:** A notable improvement was seen in the quality of the water (in terms of colour, odour and taste) available through IRPs. The share of respondents who were satisfied with the quality of drinking water before IRPs was 27%. This increased to 82% for water available through the IRPs.
- **Effective Community Ownership and Scalability:** The IRP programme's success is deeply rooted in its community ownership model. Community members have embraced the responsibility of managing their water systems, with 64% of households contributing to maintenance. "We take care of it because it's ours," a committee member from Jagatsinghpur capturing the sentiment succinctly.



Challenges and Suggestions

While access to safe water has increased, and on average, more than 70% of the water for cooking and drinking purposes is from IRPs, there is some limited reliance on unsafe secondary sources persisting. The maintenance of the IRPs, while overall is satisfactory, requires more attention in some places. Grid connectivity of the IRPs (already seen in many of the plants) can ensure water availability round the clock, even post sundown. Refresher training and standard modules for VWCs could also be additionally helpful in ensuring better maintenance of the plants.

Overall IRP program has significantly improved living conditions by providing safer water for 4,892 households. With a strong social return on investment (SROI) of 36:1 (including health it is 58:1), each rupee invested yields substantial benefits time savings, and community well-being. To maintain and expand these gains, the program may focus on setting up more plants, enhancing training for local committees, and prioritizing maintenance efforts. The community-driven model could be successfully implemented both in Odisha and beyond, offering sustainable improvements.

Key highlights of the study

Access to (Safe) drinking/cooking water

Access to (safe) drinking water increased from 55% to 100%, ensuring all households now have reliable, clean water

'Very Satisfied' with Quality (Taste, odour, and color) of Water

Percentage of respondents reporting satisfaction with water quality increased from 27% to 82%, reflecting a major improvement in taste, odour, and appearance.

Average Time Spent on Collecting Water (in Minutes)

Time spent collecting water dropped from 138 minutes to 65 minutes, freeing up time for other activities.

Responsibility of Women and Girls for Water Collection (%)

The burden of water collection on women and girls decreased from 83% to 49%, indicating a shift toward shared responsibility.

Perception on effectiveness of community handling IRP maintenance

94.6% of respondents perceive the community's ability to handle IRP maintenance and address issues as "Very Effective".

(Safe) Drinking water available within 300 meters

The percentage of households with safe water sources within 300 meters rose from 72% to 96%, making water more convenient to collect.

Average Time Spent on Treating Water (In Minutes)

The time spent treating water decreased from 15 minutes to 3 minutes, showing a significant reduction in household effort due to improved water quality. Cloth filtration and boiling are common methods used by households for treating water.

Time Saved After Installation of IRPs

95% of the households reported that they saved time from water collection activities after the installation of IRP.

Financial Contribution for Maintenance of IRPs

On average households make a monthly contribution of less than 30 rupees for operation and maintenance of the IRPs. 92% of respondents find their household contributions to the IRP "Very Affordable".

Participation in Village Water Committee Meetings

71.8% of households that are a part of the VWC attend meetings regularly.

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Introduction

1. Introduction

1.1. Iron contamination in groundwater sources

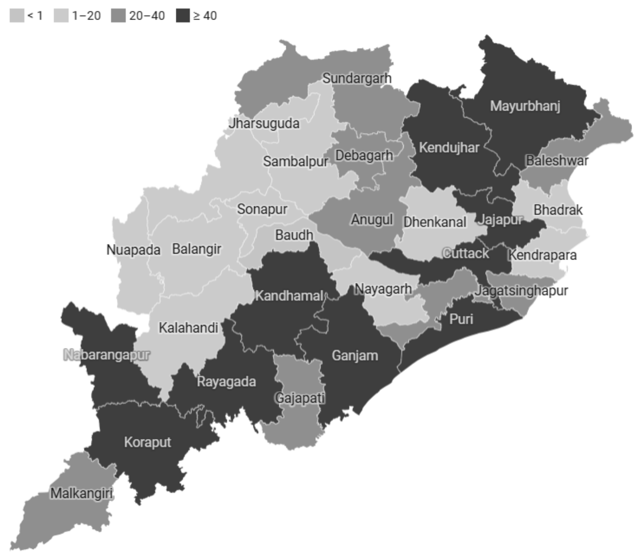
Access to safe drinking water is a fundamental need and a basic human right. United Nations defines the access to drinking water as the right to have sufficient, safe, acceptable, physically accessible, and affordable water for personal as well as domestic use. It also defines safely managed drinking water as the water that is obtained from an improved source[1], accessible on premises when required and free from fecal and chemical contamination.

Access to safe drinking water was recognized as a human right by the UN General Assembly and the Human Rights Council in 2010. It entitles everyone to have access to sufficient, safe and affordable water. UN's SDG 6.1 aims to ensure that all households have access to safe, high-quality, and sufficient quantities of water by 2030.

Globally, 2.2 billion individuals lacked access to safely managed drinking water in 2022. Additionally, over 2 billion people live in water stressed regions. This is expected to further increase on account of climate change and rising human population.[2]

India is one of the world's most water stressed regions with only 4% of global water resources and 16% of the world's population. The country excessively relies on groundwater to meet its water needs. Groundwater contributes to about 62% of irrigation, 85% of rural water supply and 50% of the urban water supply.[3] However, despite its critical importance, groundwater in India is becoming increasingly polluted due to various natural and man-made activities.

Figure 2: Number of villages with iron contamination of water- District wise



Source: Jal Shakti Dashboard (data accessed on 06.06.2025)

Note: This map is for representational purposes only. It is not to scale and does not necessarily reflect accurate political boundaries.

Studies indicate the presence of contaminants such as iron beyond the permissible limits for human consumption in close to 13.2% of the ground water samples.[4] Iron in drinking water is essential as it helps transport oxygen in the blood. The Bureau of Indian Standards (BIS) recommends 1 mg of iron in every liter of drinking water as the acceptable limit. However, high levels of iron contamination in

[1] Improved sources of water include piped water, boreholes or tubewells, protected dug wells, protected springs, rainwater, and packaged or delivered water.
[2] World Health Organization (2023) [Link]
[3] EAC-PM Working Paper Series (2024). Addressing Groundwater Depletion Crisis in India: Institutionalizing Rights and Technological Innovations [Link]
[4] Central Ground Water Board (2024). Annual Ground Water Quality Report, 2024. [Link]

water may affect taste while harbouring impurities and microbes.[5]

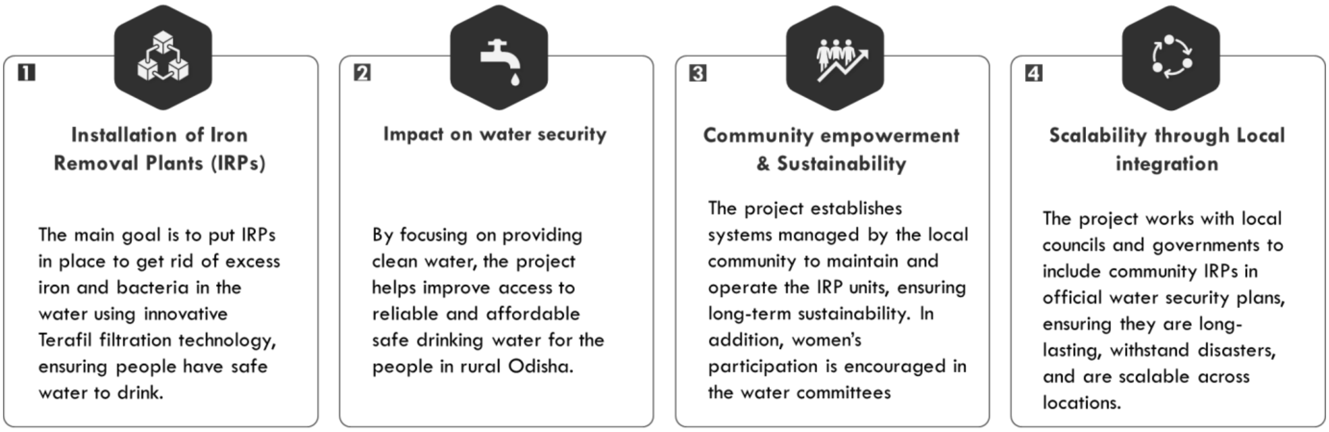
Odisha has widespread iron contamination of water. As per the Ministry of Jal Shakti Dashboard, samples from as many as 1104 villages in the state were found to be contaminated with iron. As per the latest testing data, except for Baudh, all other districts face the problem of iron contamination (Figure 2).

1.2. Safe Drinking Water Project by Livpure Foundation

Livpure Foundation in association with various NGOs is implementing a Safe Drinking Water Project in Puri, Balasore, Jajpur and Jagatsinghpur districts of Odisha to provide access to clean iron contamination free water to villages in flood prone river basins. These areas face severe water quality challenges due to iron, fluoride, nitrates, and bacterial contamination, worsened by frequent cyclones and floods.

Iron Removal Plants (IRPs) set up through the project use simple, affordable terafil technology to improve water quality and disaster resilience. Further, the project promotes community ownership, effective management, and sustainability of the filtration systems by creating and empowering local Village Water Committees (VWCs) to oversee the implementation. The villagers pay a nominal user fee to the committee every month for the maintenance and operation of the IRPs. This community engagement is key to ensuring the long-term maintenance of these systems, creating a replicable model for other regions facing similar issues. The key objectives of the project are given in Figure 3.

Figure 3: Key objectives of the Safe Drinking Water Project



1.2.1. Timeline and Progress

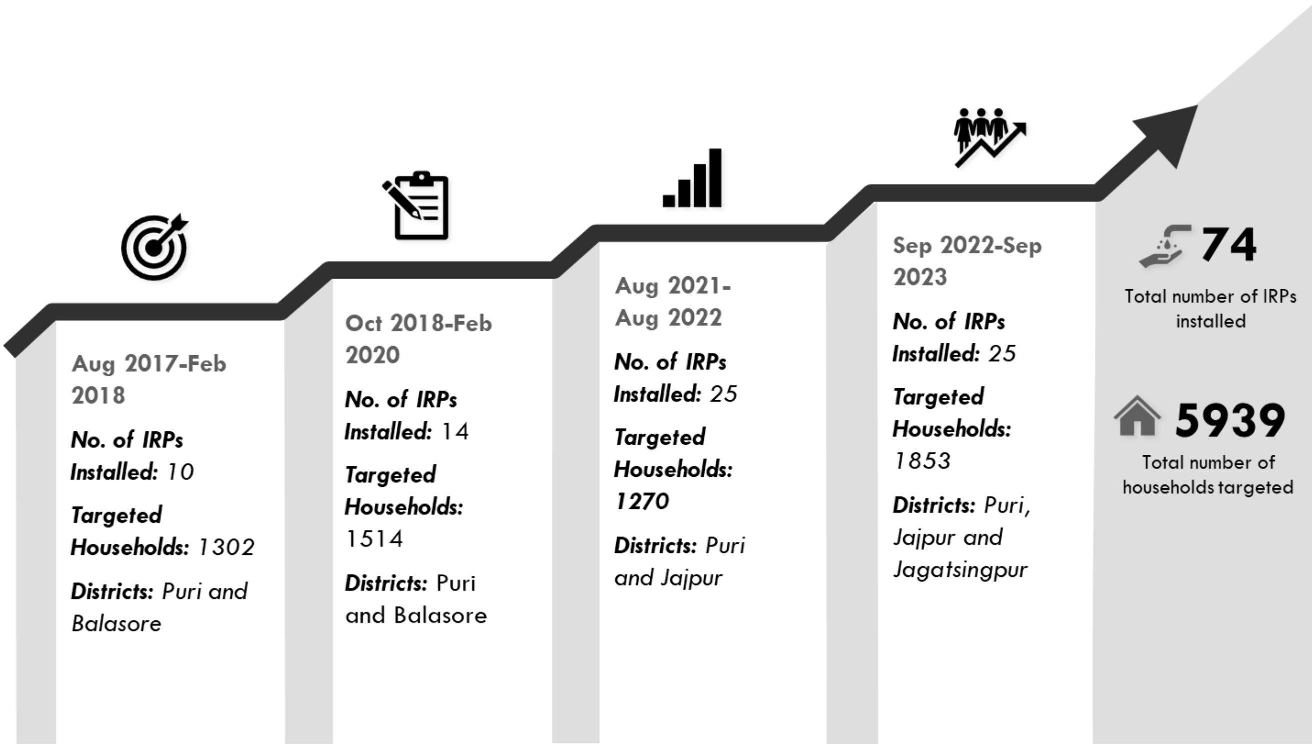
The project was initiated in 2017 in select villages of the Puri and Balasore districts in Odisha. These districts are prone to natural disasters and their groundwater is heavily infiltrated with iron content. Livpure Foundation team visited close to 10-20 villages to check the water quality and noticed that people were using surface water for drinking and cooking purposes and the water from tubewells was being used for washing clothes and utensils. Recognizing the need to support the people, the installation of IRP plants was taken up by Livpure Foundation in association with various NGOs in 10 villages of Puri and Balasore districts in 2017. The intervention involved the upgradation of existing government tubewell drinking water sources by integrating a simple technology known as 'Terafil' filtration. This enhancement

[5] Concept Note on Geogenic Contamination of Ground Water in India [Link]

effectively reduces iron contamination, thereby improving the quality of drinking water available to the communities.

With time, the coverage and scope of the initiative improved (Figure 4). During the period between August 2017 and February 2020, the project focused on building local capacities to effectively manage the water resources and formation of a user and maintenance group near every filtration unit. But since August 2021, it has also began focusing on engagement with Panchayats and government administration for integration of community IRPs into mainstream programmes for water security. It is pertinent to note that since 2017 Livpure Foundation has supported the installation of 74 IRPs directly benefitting a total of 5,939 households in Puri, Balasore, Jajpur and Jagatsinghpur districts of Odisha. As part of this study, we focus on the IRPs in the Puri, Jajpur, and Jagatsinghpur districts, which directly benefit 4,892 households.

Figure 4: Progress under various time periods



1.2.2. Development of IRP Technology

The devastating super cyclone of 1999 in Odisha, inspired scientists at the Institute of Minerals and Materials Technology (IMMT) to develop a low-cost terafil filtration system to provide clean drinking water by removing iron and other contaminants. Initially, it was designed for use in households. During 2006-2007, collaboration with Central Institute of Plastics Engineering & Technology (CIPET), Bhubaneswar led to the creation of food-grade plastic containers to house the filters. This enabled filtration of 50 liters of water per day. It was later elevated using Reinforced Cement and Concrete (RCC) structures with the help of funding organizations such as Livpure Foundation and was named Iron Removal Plant (IRP).

Terafil filter consists of a porous sintered red clay disc made from red clay, river sand, and wood sawdust, ensuring durable filtration through ultra-fine capillary openings. Chemicals or heavy metals are not used in its preparation. It is designed to be sustainable and functional even during disasters as the filter functions based on gravity filtration and does not require electricity. This technology handles turbidity up to 500 NTU and iron up to 15 ppm, effectively removing sediment, microorganisms, color, and bad odor while improving taste.

The filter is cost effective and requires low maintenance. It has a lifespan of 1-1.5 years and requires manual cleaning only twice a month for efficient functioning. Costs vary by state due to raw materials and availability of labor. In Odisha, filters are priced at INR 250-260.

Odisha has eight licensed vendors producing and marketing these filters, while a total of 127 vendors operates across India. This solution effectively upgrades government tube-well sources, removing excess iron and 99.9% of bacteria, presenting a cost-effective solution for enabling access to safe drinking water among rural communities.

1.2.3. Community Ownership Model: Village Water Committees (VWC)

A key component of the initiative is the formation of Village Water Committees (VWCs) to look after the operation and maintenance of the filtration units. The VWCs play pivotal role in engaging local communities and ensuring long-term viability of water projects. As per Livpure Foundation guidelines, the committee should comprise of 50% female members who are responsible for managing the water structures. This helps improve the social agency of women along with efficient water management. Women are entrusted with various responsibilities including the operation and maintenance of IRPs, training and capacity building and fund management. They also take up the responsibility of enforcing user rules and standards for participatory operation and management. In addition to the resource management duties, they play a key role in creating awareness about water conservation, importance of sanitation, and the health implications of clean water access.

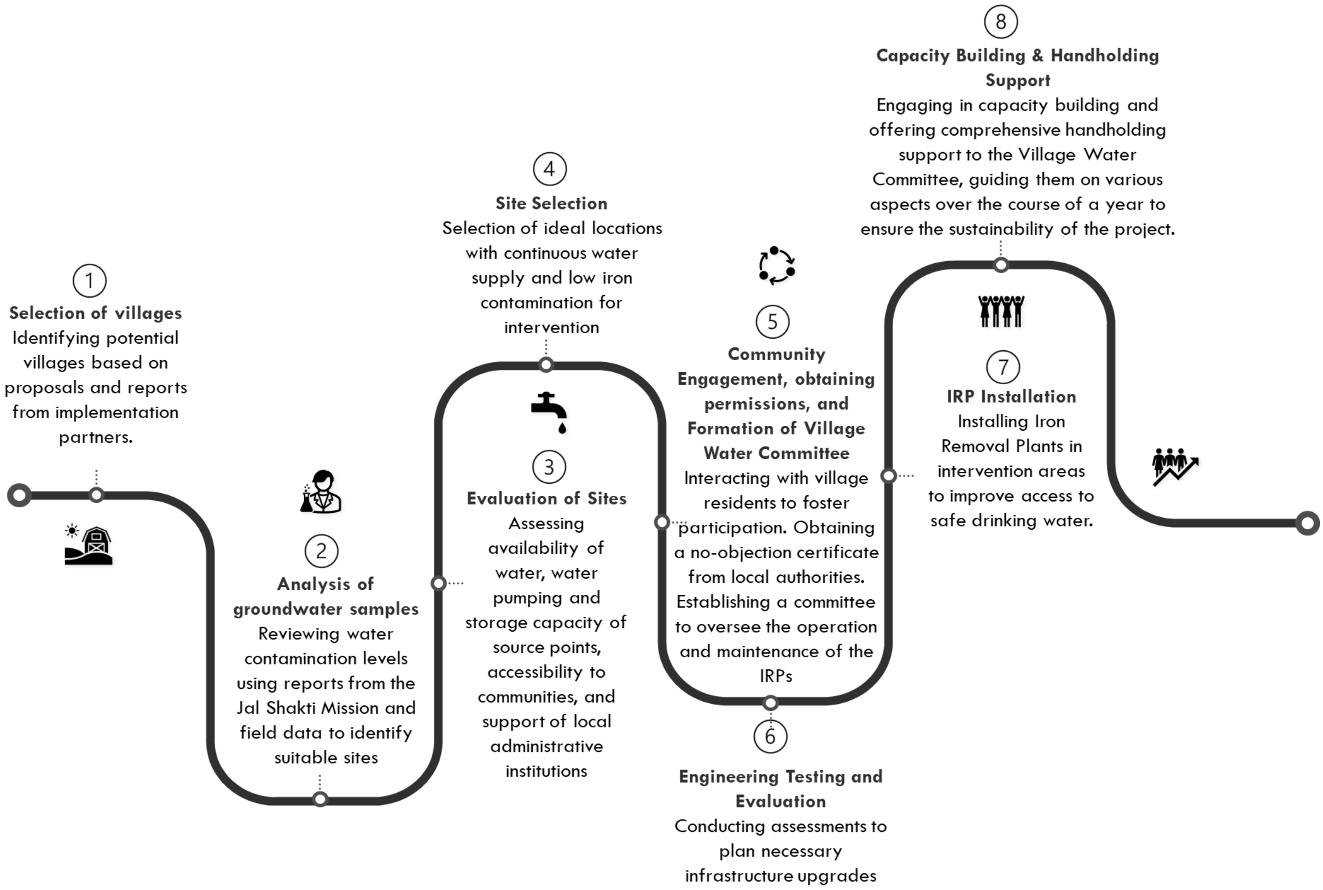
The project staff and funding partners offer handholding support to these members for one year. During this period, they transfer ownership of the structure to these committees, impart knowledge on the operation and maintenance of IRP, assist in opening of bank accounts and support them in creating a resolution for household contribution. In addition, key documents such as water quality test reports, insurance papers of solar panels, submersible motor and a warranty card are also provided. Along with this, toolkits required for operation and maintenance of the terafil filter and solar panels are also handed over to the committee members to ensure smooth functioning.

1.2.4. Selection of Sites for IRPs

A variety of factors are considered when selecting the sites for IRP installation. Initial village identification and site selection are based on proposals and reports from implementation partners. The site selection is based on ground water contamination reports from Jal Shakti Mission, Government of India and these are verified with field reports and water quality reports submitted by the implementing partners. Along with this, other factors like availability of water, water pumping and storage capacity of source points, accessibility to communities, and support of local administrative institutions are also considered. Once a village is finalized for the intervention, the team begins the site selection process by evaluating 3-4 potential sites within the village. The primary considerations include continuous water availability and the level of iron contamination in the tube wells. Among the sites evaluated, the team prioritizes ones with maximum water availability and minimal iron contamination. This site is then verified by civil engineers to ensure structural soundness and overall feasibility. Upon approval by the engineers, the site is chosen for the installation of the IRP.

Once the sites are selected, interactions with the village communities are held and a no objection certificate from the local administration is obtained. After this, testing is carried out by engineers and IRPs are installed. Later, VWCs are formed to undertake their operation and maintenance.

Figure 5: List of activities carried out pre and post IRP installation



IRP installation has emerged successful in improving the access to quality drinking water. Communities experienced consistent water flow and year-round availability post IRP installation. Along with improving the water quality, the plants also help in improving their disaster resilience as the design incorporates removable solar panels, allowing for secure storage during cyclones. The elevated height of IRP tanks ensured that taps remain above tubewell levels, providing protection during floods when tubewells are submerged.

2

Methodology

2. Methodology

2.1. Objective and scope of the study

The overall objective of the study is to assess the effectiveness of the Iron Removal Plants (IRPs) across three districts of Odisha. The scope of the assignment is given in Figure 6.

Figure 6: Overall scope of the assignment

Phase-1: Inception

- Review programme documents, theory of change, and previous assessment and annual reports
- **Finalisation of methodology in discussion with Livpure Foundation** – evaluation framework, stakeholders, sampling design and timeline
- **Designing of study tools** – questionnaire for Household survey, KII and FGD discussion guides
- **Finalisation of study analysis plan**
- **Pre-survey field visit to validate the outcome indicators**
- **Deliverable 1:** Inception report

Phase-2: Data Collection

- Field mobilisation plan
- Translation of the study tools
- CAPI scripting of the study tools
- Training of enumerators
- **Field visits and data collection in Puri, Jajpur and Jagatsingpur** – household survey and stakeholder consultations
- Field supervision and quality assurance of primary data
- Transcription of qualitative interviews
- **Deliverable 2:** Interim progress report on bi-weekly basis

Phase-3: Analysis and Reporting

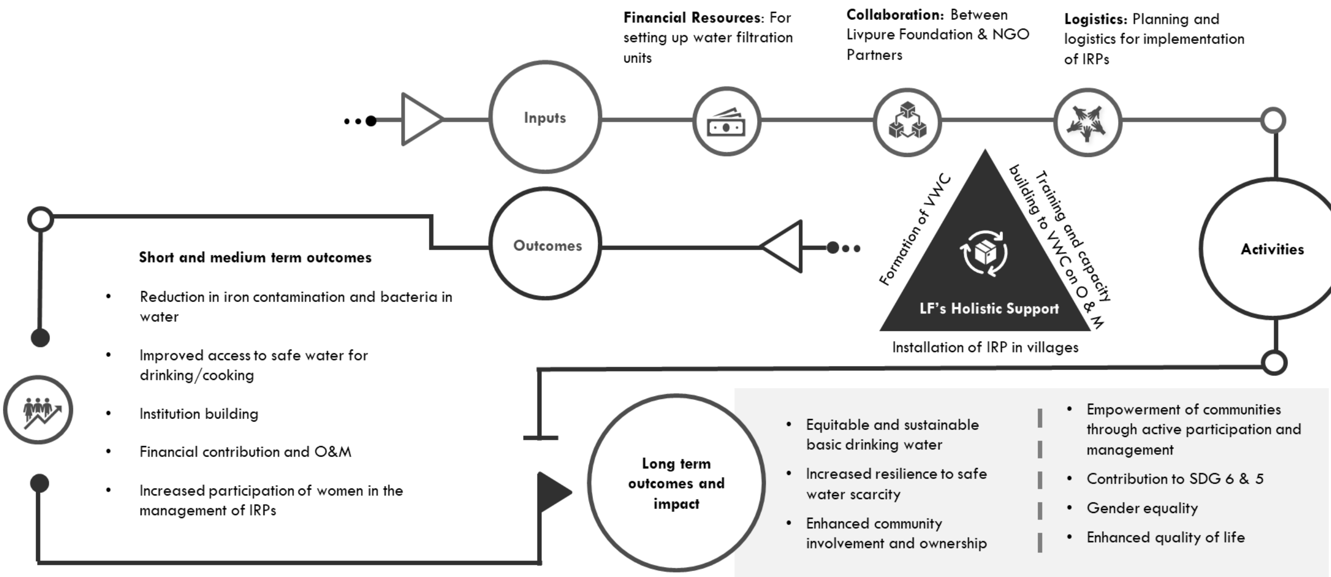
- Cleaning of quantitative and qualitative data
- Quantitative and qualitative analysis
- **Deliverable 3:** PowerPoint Presentation of key findings
- **Deliverable 4:** Submission of draft final report
- **Deliverable 5:** Final Evaluation report
- Participation in an online dissemination workshop with key stakeholders
- Submission of raw data

2.2. Theory of Change

In Figure 7, we have provided the Theory of Change (ToC) of the Safe Drinking Water Project by Livpure Foundation. The ToC is inferred from the Livpure Foundation's mission to enable access to adequate, affordable, and safe water for drinking, cooking, and domestic needs on a sustainable basis. Communities, particularly in rural Odisha, lack access to safe drinking water due to high prevalence of iron contamination and other impurities and significant time spent on water collection, especially by women. This aligns with the foundation's focus on addressing water contamination, as seen in their initiatives like the Students Ambassadors Program (SAP) to raise awareness about safe drinking water.[6]

[6] Students Ambassadors Program (SAP) *[Link: https://www.sar-group.com/livpurefoundation.org/whatwedo.php as accessed on 8th July 2025]*

Figure 7: Theory of change of Iron Removal Plants (IRP) programme by Livpure Foundation

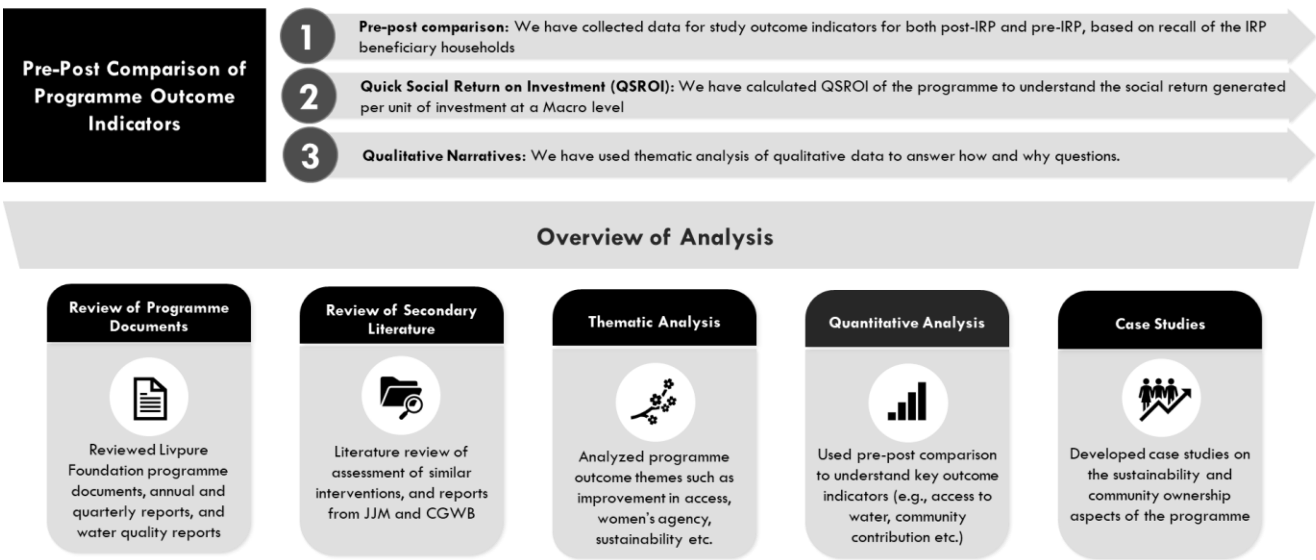


2.3. Overall approach

In this assignment, we have used a mixed methods approach, combining insights from both quantitative and qualitative data. We have collected primary data from 12 villages across Puri, Jagatsinghpur, and Jajpur districts. This quantitative data collected from the beneficiary households helped us understand the change in access to safe drinking water before and after the installation of Iron Removal Plants (IRPs). The pre-plant information was collected as recalled by IRP beneficiary households. We gathered qualitative data on community engagement, water governance, and sustainability through focus group discussions with Village Water Committee (VWC) members, as well as interviews with community members and project staff.

For the secondary study, the annual reports and project documents provided by the Livpure Foundation were reviewed to understand the scope, scale, and coverage of the program. Figure 8 depicts our overall approach to this assignment.

Figure 8: Overview of our approach for the evaluation study



2.4. Primary Data Collected

We engaged a third-party survey agency (Avance Field and Brand Solutions LLP) to collect quantitative data from the IRP beneficiaries, and qualitative data was gathered from the project and community level stakeholders. We also carried out plant observation to assess maintenance and sustainability aspects of the IRPs. In the subsequent section, we have provided the details of primary data collected for this assignment.

2.4.1. Quantitative Data Collected

In this study, 260 IRP beneficiary households were covered by the field team across 12 villages. In addition, 12 IRP sites were observed. Table 1 depicts the district wise IRP beneficiary households covered in the study.

Table 1: District wise summary of quantitative data collection

S.No.	District	Villages Covered	Sample Size (Households)	Households Covered	IRP sites observed
1	Puri	7	160	167	7
2	Jagatsinghpur	2	26	27	2
3	Jajpur	3	64	67	3
	Total	**12**	**250**	**260**	**12**

2.4.2. Qualitative Data collected

Qualitative data was collected from the key programme stakeholders to understand the sustainability of the community ownership model, project scalability, and narratives behind the quantitative inferences. Table 2 depicts the qualitative data collected in the study.

Table 2: District wise summary of qualitative data collection

S.No.	Stakeholders	Sample Size	Puri	Jagatsinghpur	Jajpur	Overall Programme Level	Total
1	FGDs with VWC members	6	4	1	1	-	6
2	KIIs with ASHA/AWW workers	6	3	1	2	-	6
3	KIIs with village heads	6	3	2	1	-	6
4	KIIs with PRI members	6	3	1	2	-	6
5	KIIs with Project staff	6	3	2	2	2	9
6	KII with IMMT official	-				1	1
	Total	**24 KIIs and 6 FGDs**					**28 KIIs and 6 FGDs**

3

Findings

3. Findings

This chapter details the findings of the evaluation. We report the results in four sections. The first section reports findings for households. The second section focuses on the impacts on women empowerment and agency. The third section talks of community ownership, and financial, technical and operational sustainability. The fourth section reports the results of a "quick" Social Return on Investment (SROI) analysis based on combining primary and secondary data.

3.1. Impact of IRPs at household level

In this section, we discuss the impact of the IRP at the household level, including its effect on access, availability, time spent fetching water, and the satisfaction of beneficiary households.

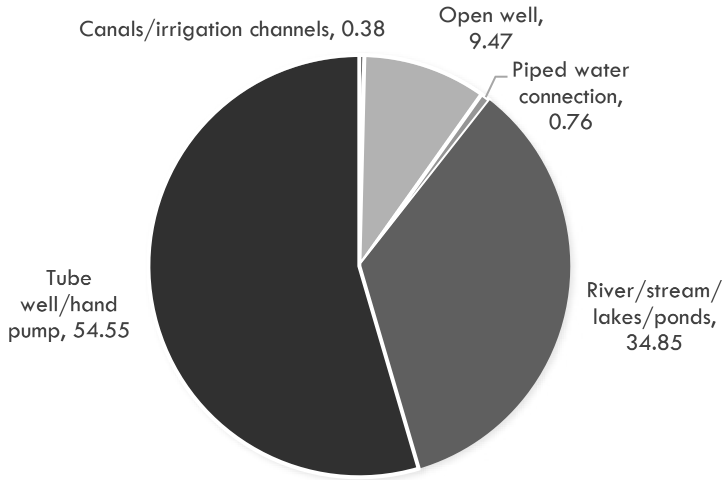
Summary of findings

- The primary data suggests the Iron Removal Plants (IRPs) in Odisha have **significantly improved access to safe drinking water, addressing long-standing issues of iron contamination**.
- It seems likely that the programme has **reduced the time burden of collecting water**, particularly for women and children, fostering community well-being.
- The evidence leans toward a **sustainable, community-driven model** that could inspire similar initiatives in other regions.

3.1.1. Improvement in access to safe drinking water

The districts of Puri, Jajpur, and Jagatsinghpur in Odisha have long faced challenges in access to safe drinking/cooking water due to iron contamination. Before the IRP programme, only 55% of households had access to safe drinking and cooking water, as defined by the WHO/UNICEF Joint Monitoring Programme (JMP) safe drinking water ladder. which classifies surface water sources - rivers, streams, lakes, ponds, open wells, and canals - as unsafe due to contamination risks.[7]

Figure 9: Primary source of water before IRP (%)



3.1.2. Increase in availability of water after IRP

Figure 10 shows a substantial enhancement in reported reliability of water availability following the introduction of the IRP programme. The proportion of households that reported reliable water available round the year, post the introduction of IRP, was higher by 19 percentage points. Before the IRP, 67% of the respondents found continuous availability to

[7] Source: The JMP service ladder for drinking water *[Link as accessed on 8th July 2025]*

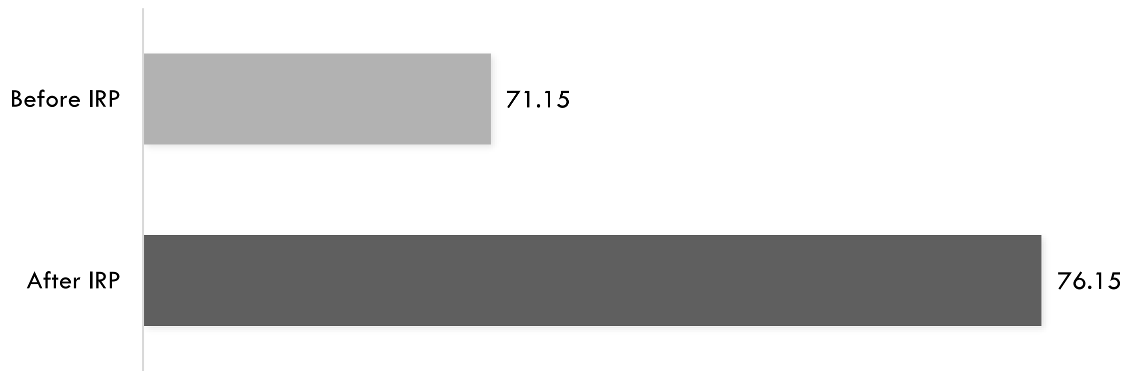
be a problem during summer. This dropped to 7% post the IRP. This could be because of dependence on backwaters in the absence of the IRP that run dry during the summer season. Additionally, from the qualitative discussions, it was revealed that the solar panels of the IRP were removable during cyclones and floods, which made the structure disaster resilient, and allowed for resumption of water supply post the disaster.

Figure 10: Availability of (safe) drinking and cooking water round the year

3.1.3. Increase in consumption of water for drinking and cooking purposes

The increase from 71% to 76 % in households consuming more than 30 litres of water daily for drinking and cooking indicates a positive impact of the IRP programme (Figure 11). This rise suggests that households may have greater confidence in the safety and availability of water provided by the IRP systems, leading to increased usage for essential purposes.

Figure 11: Households consuming more than 30 litres of water for drinking and cooking



Close to 88% of the households have reported that the water collected is always sufficient to meet their daily needs after IRP installation (Table 3). This was just 67% before. This increased and sustained availability of safe drinking water eliminates the need for communities to seek an alternative potentially unsafe water source to meet their needs. This helps in improving the overall health and wellbeing of the households.

Table 3: Proportion of households that are always satisfied with the water before and after IRP

After IRP	Before IRP	Difference	Standard Error of Difference	Z-Statistics	P-value	N-After	N-Before
0.88	0.67	0.20	0.04	5.57	0.00***	260	260

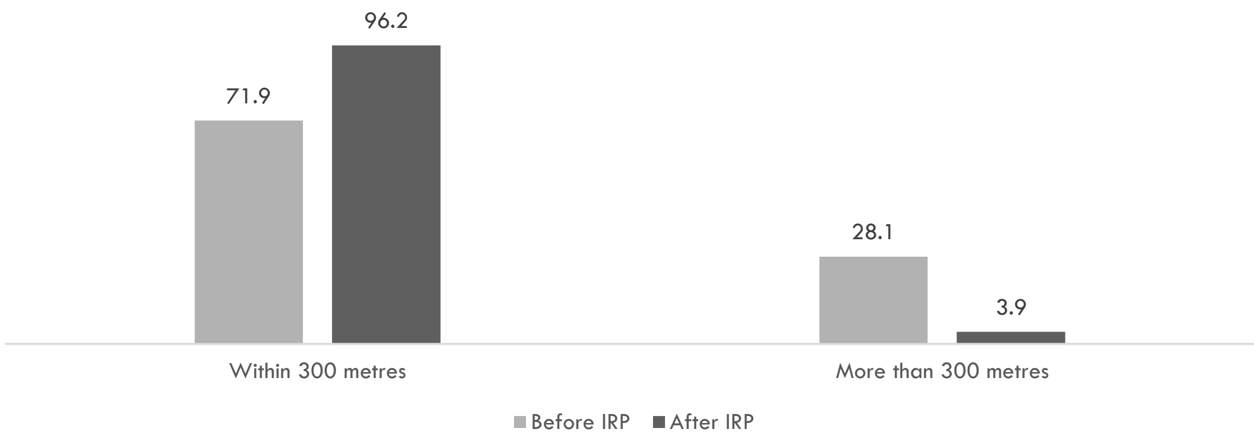
*p<0.1; **p<0.05; ***p<0.01

3.1.4. Reduction in distance travelled to collect water

The installation of IRPs near households has drastically reduced the need to travel long distances to rivers or wells. A VWC member from Dihabaring, Bari block, Jajpur, noted, ***"Earlier, we had to walk all the way to the river to collect water… Now, with the IRP system installed nearby, it takes just about 10 minutes to fetch clean water."***

Installation of IRPs have helped households save their efforts and time by reducing the burden of water collection and treatment. IRP had a significant impact on the distance travelled and the frequency of water collection. Before IRP installation, the proportion of households that had to travel more than 300 metres to fetch drinking water was close to 28%. This has reduced significantly after the IRP installation (Figure 12).

Figure 12: Distance travelled by households to collect water before and after IRP



3.1.5. Reduction in time spent on collecting water

The data shows a substantial reduction in the time households spend collecting water daily after the implementation of the IRP programme. Before the IRP, households spent an average of 137.9 minutes per day on water collection, which decreased to 65.5 minutes after IRP, resulting in an average time saving of 72.5 minutes per day. This difference is statistically significant (Table 4).

This reduction is due to the proximity and reliability of IRP systems, reducing the need to travel to distant or contaminated sources such as rivers, ponds, or tube wells. The time saved is a critical benefit, as water collection, often performed by women and children, can be a significant daily burden in rural settings. This freed-up time can be redirected toward education, work, household chores, or leisure, potentially enhancing overall well-being and economic productivity.

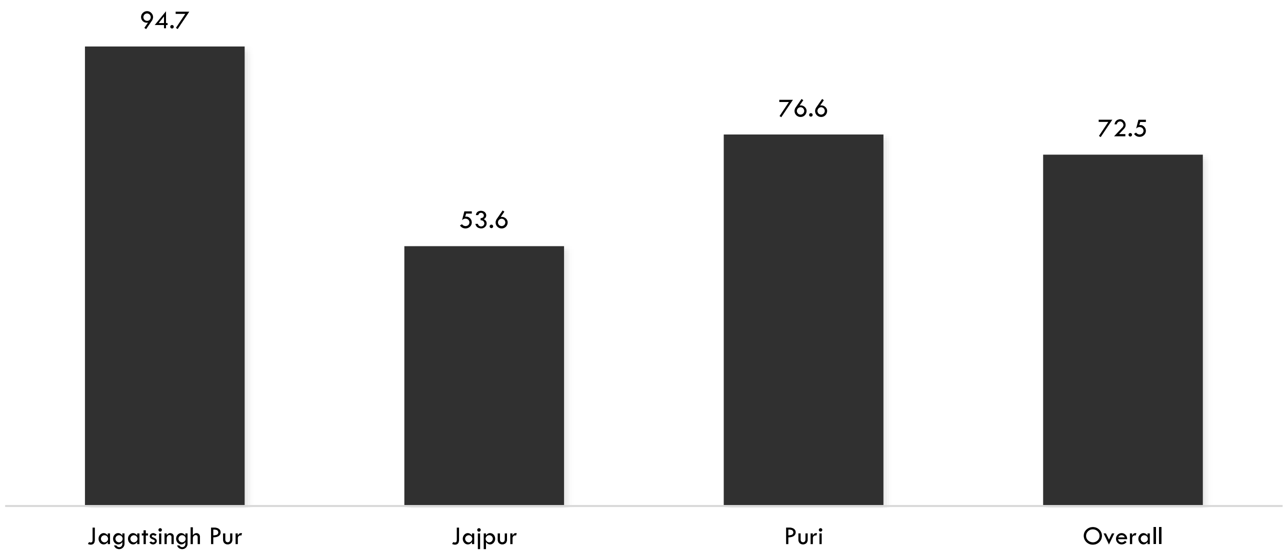
Table 4: Reduction in time spent (in minutes) on collecting water in a day

After IRP	Before IRP	Difference	Standard Error of Difference	T-Statistics	P-Value	N - After	N- Before
65.5	137.9	-72.5	4.53	-15.97	0	260	260

*p<0.1; **p<0.05; ***p<0.01

Jagatsinghpur shows the highest time saving at 94.7 minutes, suggesting that the IRP implementation was particularly effective in this district, possibly due to factors such as better accessibility, higher community engagement, or previous reliance on distant water sources (Figure 13). Puri follows with a saving of 76.6 minutes, indicating a significant but slightly lower impact. Jajpur, reports the lowest time saving at 53.6 minutes.

Figure 13: Time saved by districts (in minutes)



The reduction in water collection time aligns with the programme's goal of improving access to safe drinking/cooking water and building community capacities. In addition, access to the IRP is saving on time spent on purifying water, as seen in section 3.2.1. Research from similar water intervention programmes, suggests that providing clean water at the community level can significantly reduce the time spent on water-related tasks, particularly for women and children[8][9].

The time savings of approximately 72.5 minutes per day, on average, could translate into substantial cumulative benefits. For example, over a week, this amounts to over 8 hours saved, equivalent to a full workday, which can be used for education, income-generating activities, or community development. This is particularly impactful for children, who may have more time for schooling, and for women, who can engage in economic activities or rest, potentially improving gender equity and household income.

[8] Low-cost, low-maintenance solutions helped an Odisha village get clean drinking water *[Link]*
[9] The Simple Interventions That Brought Clean Water to These Odisha Villages *[Link]*

3.1.6. Satisfaction with water quality

The feedback from the households on the water taste, color and odor after IRP installation is positive, even though water quality lab testing is not conducted regularly.

Close to 82 percent of the households reported high satisfaction with water quality post IRP installation against 27 percent in the pre-IRP scenario (Table 5).

Communities report that IRP water is clearer, tastier compared to other sources of water in the village, and free from iron deposits, making it a dependable source year-round. A project staff member from Kanas block, Puri, noted, ***"After the installation of the IRP, it was observed that there was a substantial reduction in iron content of the water. The thickness of the water reduced, became tastier and was good to consume, so people became dependent on it."***

Table 5: Proportion of the households reporting high satisfaction with water quality before and after IRP

After IRP	Before IRP	Difference	Standard Error of Difference	Z	p	N – After	N- Before
0.82	0.27	0.55	0.04	12.50	0.00***	260	260

*p<0.1; **p<0.05; ***p<0.01

3.1.7. Challenges in accessing water

The IRP programme has significantly reduced water access challenges in Puri, Jajpur, and Jagatsinghpur. (Table 6). Before the IRP, 38% of respondents reported long distance of water source to home. This reduced to 10% in the post IRP scenario, reflecting an improvement of 28 percentage points. Similar responses for long waiting times and breakdown in supply of safe water for drinking and cooking purpose are mentioned below.

Table 6: Reduction in challenges faced due to establishment of IRP

S.No.	Challenges in accessing safe drinking/cooking water	Improvement After IRPs, in percentage points
1	Distance from home	28
2	Long waiting times	13
3	Frequent breakdown of water sources	12

The high uptake of IRP is seen from the fact that 55.25% of surveyed households exclusively use IRP systems for their drinking/cooking water purposes. Overall, 71% of drinking/cooking water consumption is sourced from IRPs, indicating strong adoption of the programme's technology. However, 44.75% of households still rely on secondary sources, with tube wells/hand pumps (28.02%) and piped water connections (17.51%) being the most common alternatives. The continued use of potentially unsafe sources, such as rivers/streams/lakes/ponds (15.18%) and open wells (4.67%), suggests that while the IRP programme has made significant strides, some households may face challenges in fully transitioning to IRP systems.

These challenges could include accessibility, maintenance issues, or preferences for traditional sources.

- **Limited IRP Capacity for Larger Communities**: Community stakeholders reported instances where the IRPs are unable to provide sufficient water for drinking purposes alone, indicating that IRPs may not have the capacity to meet the total water demand in larger villages or during peak usage times. This forces households to supplement with secondary sources, such as tube wells or piped water connections.
- **Water availability post 4 PM**: Odisha's frequent floods and cyclones, coupled with iron-rich groundwater, exacerbate water access challenges. The IRP programme's solar-powered design mitigates some of these issues. However, in the absence of grid connectivity, relying exclusively on solar panels to run water pumps, tends to negatively impact availability of water post 4 PM. This was revealed through qualitative discussions across districts.
- **Habitual preferences and cultural factors**: Some households might prefer traditional water sources due to familiarity, taste, or cultural practices. The continued use of rivers/streams/lakes/ponds (15.18%) and open wells (4.67%) indicates that some communities may still rely on these sources due to proximity or habit, despite the availability of IRPs.

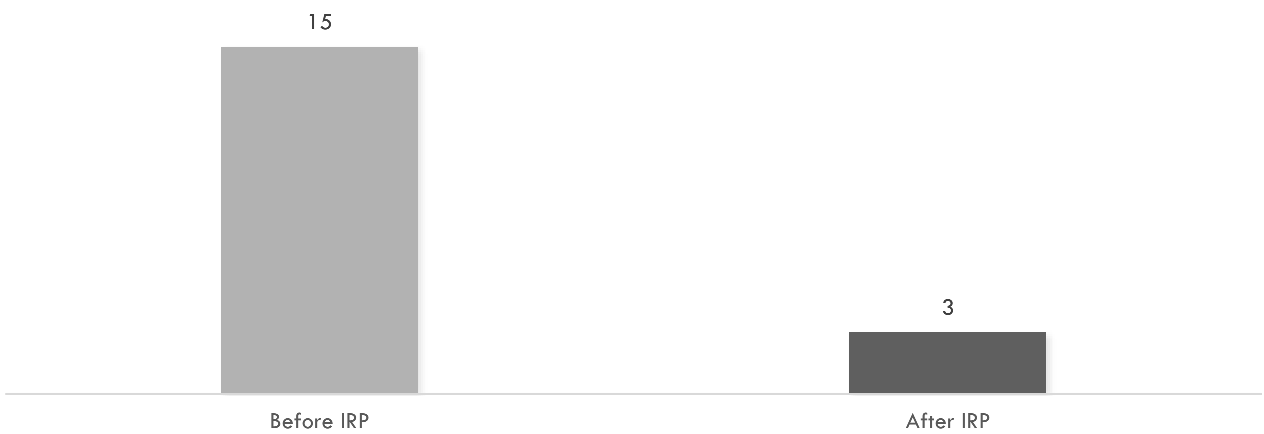
3.2. Improved women's agency and increased participation in economic activities

The IRP programme has significantly reduced the burden of water collection in Puri, Jajpur, and Jagatsinghpur, exclusively on women (Table 7). Stories like that from Dihabaring, where water collection now takes "just about 10 minutes," highlight the programme's impact on women's empowerment.

3.2.1. Reduction in time spent on treatment and fetching of water for drinking/cooking

In section 3.1.5, we saw that post IRP, there was a reduction in time spent in collecting water. Figure 14 shows a substantial reduction in the average time households spend treating water for drinking and cooking after the implementation of the IRP programme. Cloth filtration and boiling are common methods used by households for treating water, both before and after IRP implementation. Before the IRP, households spent an average of 15 minutes per day on water treatment, which decreased to 3 minutes after IRP, resulting in a mean time saving of 12 minutes per day. This reduction is likely due to the effectiveness of the IRP systems, which are designed to remove iron and other contaminants at the community level, eliminating the need for households to engage in time-consuming treatment methods such as boiling, filtering, or using chemical disinfectants.

Figure 14: Time saved on treatment of drinking/cooking water after IRP



This change is significant in the context of rural water management, where traditional treatment methods can be labor-intensive and inconsistent. For instance, boiling water requires fuel and time, while cloth filtration or chemical treatments may not effectively remove iron. The IRP programme's community-based approach ensures that water is treated centrally, providing safe drinking/cooking water directly to households, thereby reducing the daily burden of individual treatment.

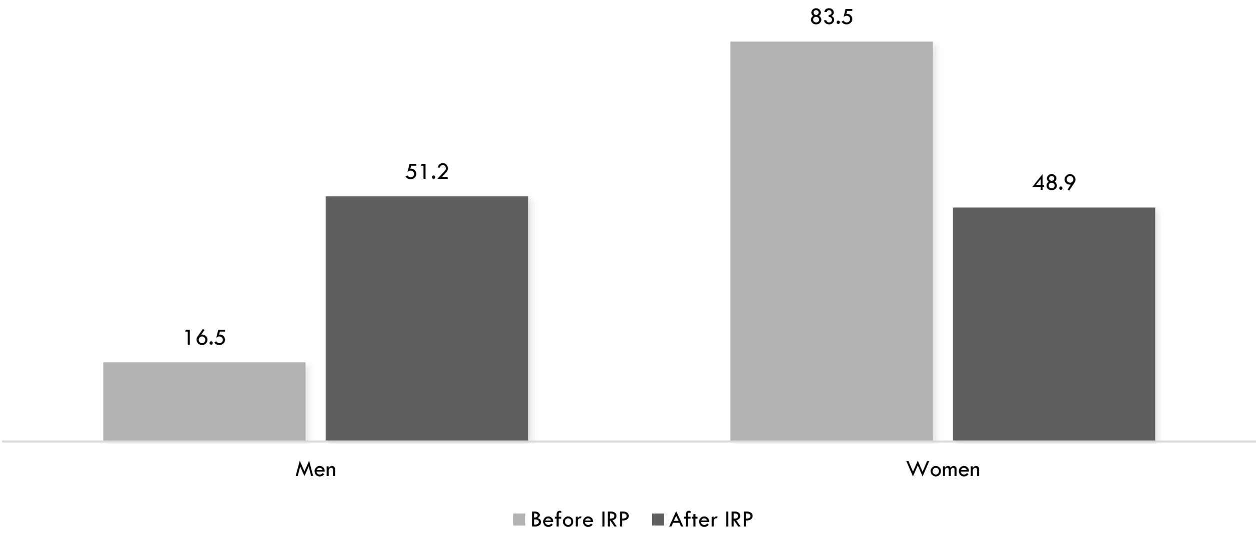
A VWC member from Jodapadar, Kanas block, Puri, shared, ***"We no longer need to boil the water. It is clean and ready to use and is easily available."***

3.2.2. Burden of water collection

An FGD participant from Puri shared, ***"Initially, my mother-in-law was responsible for fetching water. Post marriage, this duty fell to me. It was cumbersome, but we had no alternative. My husband, a daily wage laborer, works long hours. With our family of six, managing water collection was extremely challenging with other household work. I never complained, but the installation of the IRP has been a blessing. My water collection duties have been reduced by more than half. Now, even my children can collect water in plastic bottles, and my mother-in-law can easily walk to the IRP to fetch water sometimes. The burden has significantly reduced"***

The burden of fetching drinking water in a household falls disproportionately on women limiting their participation in education and employment activities. This gendered responsibility becomes more pronounced if the source of drinking water is away from the household premises. Prior to IRP installation, in 83.5% of the households the responsibility of water collection was exclusively with women. It is interesting to note that the installation of IRP has contributed towards making collection of drinking water in a household, a shared responsibility (Figure 15). This indicates that a reduction in water collection responsibilities provides a chance to women in engage in income generating activities and improve their agency.

Figure 15: Responsibility for collection of drinking water in a household- before and After IRP



This statistically significant shift ($p<0.01$) reflects a move toward shared responsibility, with men increasingly involved in water collection, enabling women to engage in social activities like Self-Help Groups (SHGs) (Table 7).

Table 7: Proportion of households where women collect water before and after IRP installation

After IRP	Before IRP	Difference	Standard error of Difference	Z-Statistics	P-value	N-After	N-Before
0.49	0.83	-0.35	0.04	-8.34	0.00***	260	260

*p<0.1; **p<0.05; ***p<0.01

Additionally, discussions revealed the following:

- **Decreased physical drudgery**: The proximity of IRPs has alleviated the physical strain of water collection, primarily for women. A VWC member said, ***"All the households reported a reduction in drudgery"*** reflecting relief from long treks to distant, unsafe sources.

> Socially, improved water availability enhances community desirability, as seen in *Sujanagar, Kanas block, Puri, where* **better water quality has shifted social perceptions, making villages more appealing for marriage alliances,** as reported by an NGO Project Staff

- **Shift in gender roles**: The programme has fostered shared water collection responsibilities, reducing the burden on women. A project staff member from Ersama, Jagatsinghpur, observed, ***"There has been a change in people's habits"*** indicating broader household involvement in water tasks.

- **Empowerment through time savings**: Time saved enables women to engage in education, work, and community activities like SHGs. One PRI member from Puri noted that women are able to be involved in mending fishing nets, drying paddy, making pickles, picking up economic activities, due to the time saved from collecting water. Besides economic activities, many respondents also noted that they are able to rest in the time saved up for water collection.

The reduction in the burden of water collection, particularly for women, carries notable implications for rural Odisha. By alleviating the time and physical demands of fetching water, the IRPs empower women to pursue education, employment, and community roles, fostering gender equity and economic resilience.

3.2.3. Case Study 1

Turning challenges into choices: Women empowerment through access to safe drinking water

38-year-old Rani from Kaudikhani village of Puri district, smiles brightly as she collects water from the village's Iron Removal Plant (IRP). She talks of how things have changed from before the IRP, when access to safe drinking water was a daily struggle. ***"We were constantly battling illness,", she says. "Our families, especially children, were always sick. The endless hospital visits and mounting medical bills were a constant burden"***, Rani recalls. The water and bills tasted bitter, but they had no other way.

> Access to safe drinking water transforms daily life- leading to improved health outcomes, consistent school attendance for children and gives freedom to woman. The connection between Sustainable Development Goals 6 and Sustainable Development Goal 5 is clear access to safe drinking water provides the time and stability women need to thrive.

Like other women in many rural areas, traditionally the responsibility of fetching water for household consumption fell on Rani and her fellow women villagers. Before dawn, they would walk to the nearest water source, carrying containers of every possible size to fetch water from the river/pond for cooking, cleaning and drinking. These uncounted cycles took a heavy toll on their time and energy. The village had a deep-dug tubewell, but its water was heavily contaminated with iron, making it unfit for drinking.

> Rani shows a plastic container in which she used to earlier store water and the container has turned red at the bottom due to the iron contamination

In 2022, a meaningful shift began in the village with the arrival of a cost-effective IRP installed with the village's existing tubewell. This simple system uses a gravity-based filter to clean the groundwater, removing iron and other harmful substances. The result is water that is safe, clear, and good to drink.

The difference in Kaudikhani has been striking. Collecting water, once a heavy task mostly done by women, has become much easier. With the IRP close by and the water now clean, less time and effort are needed. What used to take hours has been cut in half, giving people more time for other important activities.

Now Rani helps her husband with tasks like managing crops after harvest. She also makes sure her children go to school every day. With safe water easily available, she can focus more on her family's future. Beyond that, Rani plays a key role in the village water committee, handling its finances with care.

3.3. Impact of IRPs at community level

Nagari Village in Jagatsinghpur district serves as a remarkable example of resilience and adaptation following a natural disaster, after a cyclone and subsequent flooding forced the community to relocate to higher ground within the paddy fields. The installation of an Iron Removal Plant (IRP) in the new location had a transformative impact on the lives of the people so much so that the villagers still celebrate its inaugural day as a festival.

The programme enhances community well-being by reducing the physical and emotional toll of water collection, as seen in Jajpur where residents now rely on nearby IRPs. Environmentally, the programme's solar-powered systems, mentioned in FGDs, reduce reliance on bottled water, minimizing plastic waste. These outcomes align with Sustainable Development Goal 6 (clean water and sanitation), as per the UN Sustainable Development Goals framework, positioning the IRPs as a scalable model for other regions facing water access challenges. The programme's community-driven approach, with active VWC involvement, ensures sustainability, as seen in Jagatsinghpur where communities "*take steps to manage and maintain the IRP for long run.*"

3.3.1. Sustainability of community ownership model

In this section, we discuss the financial, technical and operational sustainability of the community ownership model.

3.3.1.1. Financial sustainability

The data reveals that a significant proportion of households actively participate in the maintenance of IRP systems, with 64% making regular monetary contributions (Figure 16). This high level of engagement is essential for the programme's sustainability, as it shifts the responsibility from external entities to the community, promoting self-reliance and collective action.

Jajpur stands out with a contribution rate of 97.01%. Jagatsinghpur follows with 69.23%, indicating a solid but slightly lower level of engagement (Figure 17).

Figure 16: Households making regular contributions to IRP maintenance

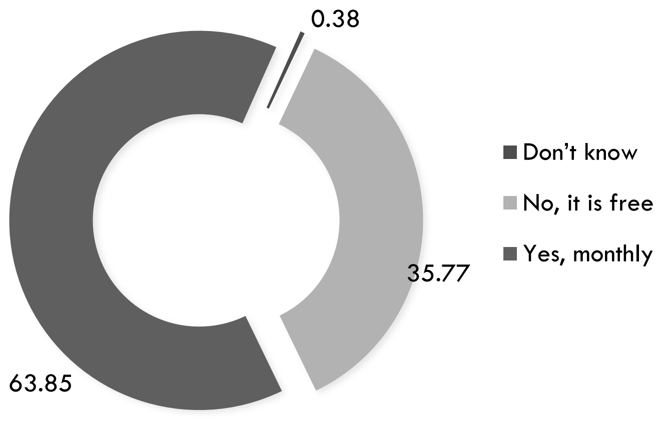
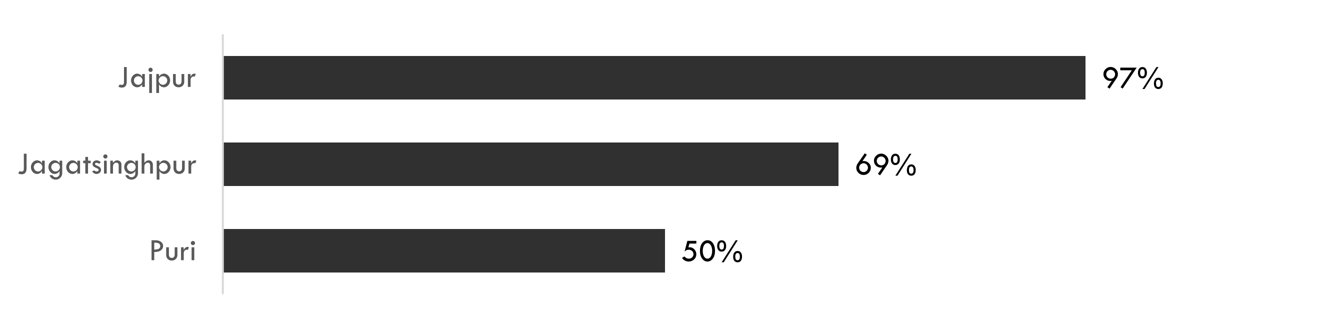


Figure 17: District-wise distribution of households making regular contributions to IRP maintenance

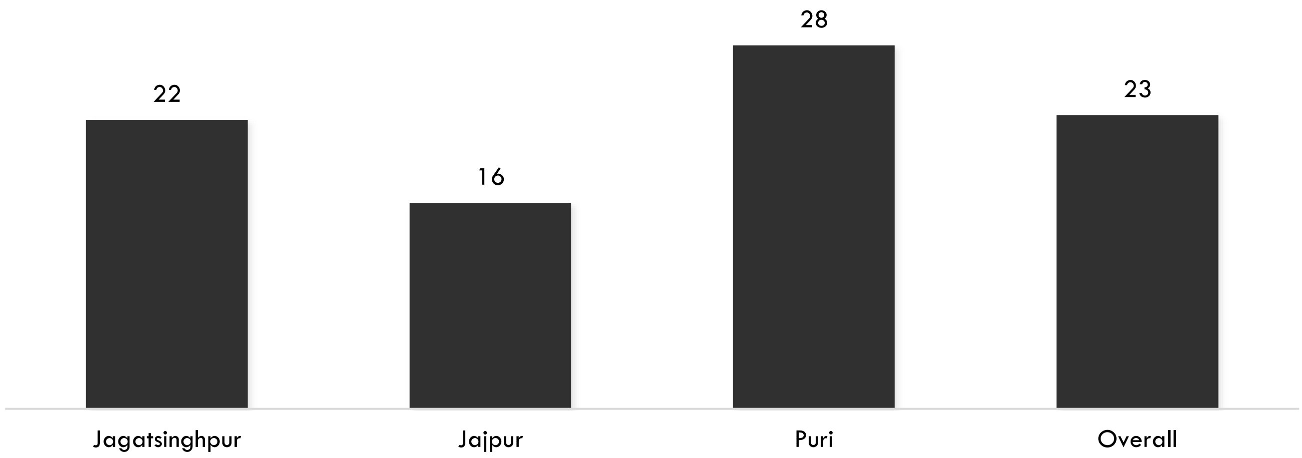


Note: VWC members in four out of seven villages in Puri reported that the overall operation and management of the IRPs are under direct supervision of Village Committee. These are informal entities created at village level for local governance and community development. A certain amount of fund is contributed towards the village fund from wide range of activities like seasonal agriculture harvest, fish harvest from community pond etc. These funds are later used for the community development, specific temple functions or for maintenance of other useful assets.

A village head from Puri shared, ***"100 percent people from our village use the water from IRP. We do not ask for any money. The village committee manages the operation and maintenance of IRP. The health has improved, skin diseases have reduced, water wastage is reduced. What more shall we ask for? It is being well managed under the village committee"***

The households have reported that they make an average monthly contribution of INR 23 for operation and maintenance of IRPs (Figure 18).

Figure 18: Monthly contribution for IRP maintenance (In INR)



Additionally, 92% of respondents find their household contributions "Very Affordable," which is a critical factor in sustaining high participation levels (Figure 20a). 90% of respondents reported that the contributions to the IRP's operation and maintenance are transparently collected and utilized (Figure 20b).

Figure 20a: Respondents' perception on the affordability of monthly IRP maintenance contribution

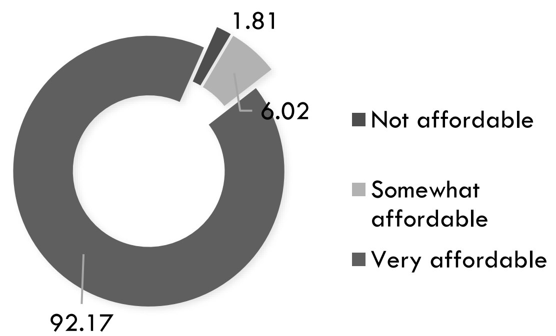
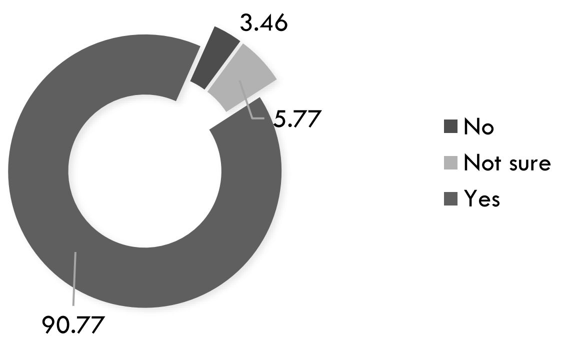


Figure 20b: Respondents' perceptions on contributions to the IRP's operation and maintenance are transparently collected and utilized



3.3.1.2. Technical Sustainability

The IRPs employ gravity-based Terafil filters, crafted from locally sourced materials, river clay, sand, and sawdust, ensuring affordability and ease of maintenance. The filters effectively remove iron and other contaminants, producing water that is clear, odorless, and palatable, meeting the needs of rural households. The IRPs' technical sustainability is underpinned by key design features:

- **Renewable energy integration**: IRPs are powered by solar panels, ensuring a reliable, eco-friendly energy source that reduces operational costs and maintains functionality during power outages, common in Odisha's cyclone-prone environment.
- **Low-maintenance filtration**: Terafil filters, requiring cleaning only every two weeks, have a lifespan of 1-1.5 years and maintain high efficiency, as evidenced by 83% of plants having clean, clog-free filters across surveyed villages (Table 8).
- **Robust climate resilient infrastructure**: Durable RCC tanks with a 3,200-liter capacity and raised structures protect against flood damage, ensuring consistent water availability even during extreme weather.

We carried out Iron Removal Plant (IRP) observations in the 12 villages covered in the study. The technical sustainability of the IRPs is underpinned by several key indicators, as shown in the following Table 8.

Table 8: Key observations from the IRP plant visits across 12 villages covered in the study

Key Indicators	Overall	Puri	Jagatsinghpur	Jajpur
Terafil filters clean and clog-free	83%	71%	100%	100%
Water is clear, odorless, without particles	92%	86%	100%	100%
IRP connected to electricity grid	58%	71%	50%	33%
IRP uses renewable energy (e.g., solar panels)	100%	100%	100%	100%
Renewable energy components functioning securely	100%	100%	100%	100%
IRP surrounding area clean, free from contaminants	75%	57%	100%	100%

However, district-level variations reveal areas for improvement. Puri shows lower performance in filter maintenance (71%) and water quality (86%), suggesting challenges such as higher iron concentrations or inadequate cleaning practices. Similarly, only 57% of IRP sites in Puri are free from surrounding contaminants, which could compromise water quality or plant functionality. In contrast, Jagatsinghpur and Jajpur report optimal performance across these indicators. The fact that only 58% of IRPs are connected to the electricity grid overall, with Jajpur at 33%, indicates need for careful planning to ensure adequacy during adverse weather conditions and during evening hours.

Table 9 depicts the qualitative findings on technical sustainability as discussed with Institute of Minerals and Materials Technology (IMMT) scientists.

Table 9: Technical sustainability of IRPs

Aspect	Description
Disaster-resilient design	The gravity-based Terafil filters, made from locally sourced clay, sand, and sawdust, require no electricity, ensuring functionality during floods and cyclones.
Cost-effective and accessible	The filters' low cost and use of readily available materials make them affordable and sustainable.
Long lifespan with simple maintenance	With a lifespan of 1-1.5 years, the filters require manual cleaning every two weeks to maintain efficiency.
Scalable and adaptable	The technology's adaptability, with 127 licensees nationwide, supports its scalability.
Ongoing innovation	Research continues to enhance filters for removing additional contaminants like arsenic and fluoride, and ongoing work on removing hexavalent chromium, arsenic, and fluoride.

3.3.1.3. Operational Sustainability

Observations from visits to IRP sites across 12 villages reveal a robust framework for operational sustainability (Table 10). The majority of IRPs are well-maintained, with regular cleaning schedules, documented maintenance plans, and trained personnel handling repairs, ensuring consistent water output and high user satisfaction with water quality. All plants are connected to main roads or pathways, facilitating access, and are equipped with safeguards against theft and vandalism, as well as designated contact persons for prompt issue resolution. Community guidelines to prevent water wastage are in place in many villages, further supporting efficient resource use.

However, challenges persist in certain areas, with about a quarter of the sites, notably in Jajpur and Puri, facing physical barriers that impede access for vulnerable groups such as the elderly, individuals with disabilities, or children. The barriers observed include steps lacking ramps, which present challenges for those using mobility aids. Additionally, the terrain is sometimes uneven, featuring muddy patches and potholes that further complicate navigation for these groups.

Maintenance practices also vary, with Jajpur showing lower adherence to regular cleaning schedules and community guidelines compared to Jagatsinghpur, which demonstrates exemplary management. These variations suggest that local factors, such as community organization, infrastructure conditions, or training effectiveness, influence the programme's success across districts.

Table 10: Key observations from the IRP plant visits across 12 villages covered in the study

Key observations	Overall	Puri	Jagatsinghpur	Jajpur
IRP site connected to main roads/pathways	100%	100%	100%	100%
Physical barriers impacting access for vulnerable populations such as elderly, disabled, or children	25%	29%	0%	33%

Key observations	Overall	Puri	Jagatsinghpur	Jajpur
Regular cleaning/maintenance schedule for IRP filters	67%	71%	100%	33%
Water output available 24/7 without disruptions	83%	86%	100%	67%
Community guidelines to prevent water wastage	67%	71%	100%	33%
IRP structure well-maintained, no damage/corrosion	67%	57%	100%	67%
Major breakdowns resolved promptly	92%	86%	100%	100%
Documented maintenance plan for IRP	67%	57%	100%	67%
Maintenance tools/supplies accessible on-site	83%	71%	100%	100%
Maintenance by trained personnel	92%	86%	100%	100%
Safeguards against theft/vandalism	100%	100%	100%	100%
Contact person/team for repair needs/assistance	100%	100%	100%	100%

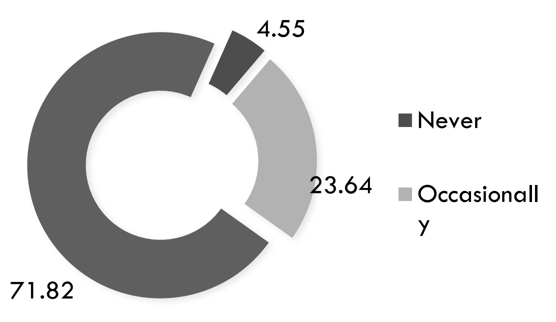
Community Engagement and Local Governance

The programme's sustainability is significantly bolstered by strong community involvement, particularly through Village Water Committees (VWCs). In Puri, for instance, four out of seven villages have village committees directly supervising IRP operations, managing funds from community activities like agricultural or fish harvests to support maintenance. This integration with local governance structures fosters accountability and ensures resources are available for upkeep.

The high participation rate in VWC meetings, with nearly three-quarters of members attending regularly, reflects a commitment to collective responsibility (Figure 21).

94.6% of respondents perceive the community's ability to handle IRP maintenance and address issues as "Very Effective", demonstrating the operational sustainability of the community driven model (Figure 22). 83% of respondents reported that IRP issues are resolved within 1-3 days.

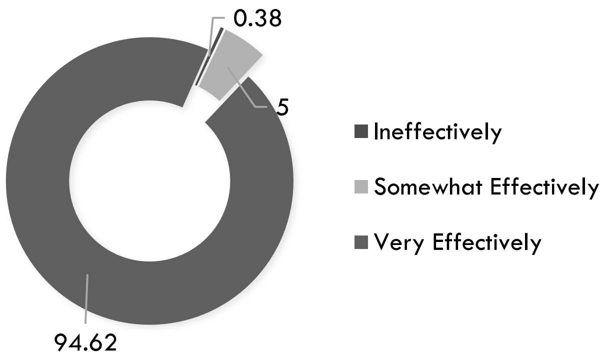
Figure 21: Participation in VWC meeting by households that are a part of the VWC



The IRP programme in Odisha demonstrates a robust model for operational sustainability, driven by strong community engagement, reliable infrastructure, and effective local governance.

However, periodic monitoring and refresher training for VWCs could addresses issues like poor water quality in areas where maintenance lapses have led to dissatisfaction. Standardization can include periodic log sheets for VWCs to track maintenance, ensuring longevity and trust for scaling. Continued support for VWCs, training, and infrastructure improvements will be crucial to sustaining and expanding these gains, ensuring long-term access to safe drinking water and improved quality of life.

Figure 22: Respondents' perception on community being able to handle maintenance requests or issues raised by members related to the IRP



3.3.2. Case Study 2

IRP a community anchor, built to endure natural disasters

Context

Puri district, located on Odisha's eastern coast, is a region of profound cultural significance, home to the Jagannath Temple and the biodiverse Chilika Lake. However, its coastal geography renders it highly susceptible to recurrent cyclones and floods, which disrupt infrastructure, undermine livelihoods, and exacerbate challenges in accessing safe drinking water. The region's groundwater, a critical resource, is often contaminated with elevated iron levels due to its mineral-rich geology, posing risks of waterborne diseases, including digestive disorders and skin infections, with long-term health implications such as kidney damage. Monsoon floods further compound the issue, polluting rivers and ponds with sediment and submerging wells, leaving communities reliant on unsafe water sources. For rural households, particularly women and children tasked with water collection, this scarcity translates into hours spent daily fetching water, limiting opportunities for education, income generation, and community development.

The Challenge

In Jodapadar village, access to safe drinking water was a persistent struggle before 2018. Iron-contaminated tube wells and polluted surface water sources, such as rivers affected by backwaters, were the primary options. Women, who predominantly bore the responsibility for water collection, often traveled long distances to gather water that required labor-intensive treatment, such as boiling, to be marginally safe. This process consumed significant time and exposed families to health risks, with frequent illnesses imposing financial burdens. Cyclones and floods, common in Puri, intensified these challenges, rendering wells unusable and contaminating water sources, leaving communities vulnerable during crises.

The Climate-Resilient Solution: Iron Removal Plants (IRPs)

Introduced in 2018, Iron Removal Plants (IRPs) have emerged as a climate-resilient response to Puri's water challenges, providing safe drinking water to villages like Jodapadar. These plants utilize a gravity-based filtration system with Terafil filters, constructed from locally sourced materials - river clay, sand, and sawdust - ensuring affordability and sustainability. The filters effectively remove iron and other contaminants, delivering water that is safe, clear, and palatable. Central to the IRPs' success is their climate-resilient design, tailored to withstand Puri's extreme weather conditions:

- Raised structures protect critical components from floodwaters, ensuring operational continuity during monsoons.
- Demountable solar panels enable rapid removal before cyclones and swift reinstallation, maintaining power supply for water treatment.
- Durable RCC tanks, with a 3,200-liter capacity, provide substantial storage, safeguarding water availability during disruptions.

This design ensures that IRPs remain functional in the face of natural disasters, offering a reliable lifeline for communities.

Impact on Jodapadar

The IRPs have transformed life in Jodapadar. The proximity of the IRP has halved the time spent collecting water, from hours to minutes, easing the physical burden on women and children. This time savings has enabled women to engage in income-generating activities, such as crop management, and ensure regular school attendance for their children.

Another key point noted during the qualitative interactions was that ***the water was clean and reliable, "even after storms"***

The IRP's climate resilience was proven during Cyclone Fani in 2019, which struck Puri with winds reaching 220 km per hour, uprooting trees and submerging wells. Despite damage to solar panels, the Jodapadar IRP was restored within days, providing clean water to the village and neighboring communities during the crisis. This reliability underscores the IRP's role as a critical community asset in disaster-prone areas.

Community water committees, often led by women, manage the IRPs' maintenance, fostering local ownership and accountability. These committees ensure regular upkeep, such as filter cleaning, and manage contributions from households, reinforcing social cohesion and equity. The involvement of women in leadership roles has empowered them to shape community decisions, enhancing gender equity.

Conclusion

The Iron Removal Plants in Puri district exemplify how climate-resilient infrastructure can address water security in disaster-prone regions. In Jodapadar, they have not only provided safe drinking water but also strengthened community resilience, and empowered women. As climate challenges intensify globally, the IRP model offers a scalable, sustainable framework, demonstrating that resilient, community-led solutions can ensure safe water access, fostering hope and stability for vulnerable populations.

3.3.3. *Case Study 3*

Empowering Communities: The Success Story of a Model IRP

For decades, the women of Apiti village walked miles each day for drinking and cooking water, a burden that left little time for leisure or economic opportunities. Today, thanks to the Iron Removal Plant (IRP), safe drinking water is more accessible to their homes. But the transformation is about more than just water; it's a story of empowerment, financial literacy, and women taking charge of their community's future.

The IRP, Story of Sarita and the "Gateswari Jal 'o' Parimal Committee"

In 2022, the Iron Removal Plant was established in Apiti village of Brahmagiri block of Puri district with financial support from Livpure Foundation along with partner organizations. The implementing partners created the **Gateswari Jal o Parimal Committee - the Village Water Committee**. Sarita, however, saw an opportunity. Encouraged by a visiting NGO worker, she joined the VWC. ***"At first, I was shy" she admits. "I had never spoken in front of so many people before"***. But the implementing NGO staff and the village elders held multiple training sessions explaining the importance of including women into the VWC and the role they would be playing in managing the community asset.

The VWC's first task was to oversee the operation and management of the Iron Removal Plant. The VWC needed to manage the system, collect user fees, and ensure its long-term sustainability. That's where the financial literacy training became valuable.

"Before, I didn't even know how to read a simple bill," Sarita chuckles. "But after the training, I understood budgeting, bookkeeping, and how to track expenses." She meticulously managed the books and expenses, and over the years became the VWC's treasurer.

With passing years, the IRP needs a major repaint and repair of the cracks. The VWC needed funds urgently for repairs. Sarita, remembering her training, presented a clear and concise budget to the village water committee. Her meticulous records and convincing explanation made everyone transparent about the funds to be incurred towards the repair works. Within few days the IRP was painted, a concrete cement structure was made at the base, and the IRP was beautified by cleaning the surroundings. Sarita and other VWC members also did some labor contribution. Seeing Sarita's success, other women in the VWC stepped up.

Now, Sarita is able to spend time for her children's education and is able to run a small tailoring business at home, thanks to the time she saved by having water readily available. The "**Gateswari Jal 'o' Parimal VWC**" has not only brought access to safe and clean water in the village but has also empowered women like Sarita to become leaders, entrepreneurs, and agents of change. Through financial literacy, community ownership, and commitment to gender equality, the VWC is showing the world how access to water can unlock a community's true potential.

Financial Literacy and Asset Ownership

Apiti is also exploring innovative ways to enhance the financial stability of women in the VWC. Along with the NGO they are piloting different livelihood avenues through SHG formation and user fees channelization for income generation. Plans for mushroom cultivation is on its way and also, they have thought to take loans for starting small businesses related to water management, such as producing and selling water filters.

"We want the VWC to be more than just a water committee," Sarita says.

3.4. Social Returns on Investments (SROI)

We have conducted a Quick Social Return on Investment (QSROI) analysis measures the social and economic outcomes created by the project compared to its financial costs. The QSROI approach relies on primary data to assess these benefits. To convert these non-monetary benefits into monetary terms, we have used secondary data as financial proxies. This approach shows the value generated by the project relative to the investment made, providing a comprehensive view of the IRP's impact on the community.

Table 11 outlines the indicators used to evaluate the benefits from the IRP. The analysis was performed with and without health indicators to offer a nuanced understanding of the project's impact. For each indicator, baseline and endline data from the primary survey are used to calculate the benefits resulting from the intervention. Please note that the baseline data is based on beneficiaries' recall.

Table 11: SROI calculation

Indicators	Benefit after the intervention (per HH)	Proxy for monetisation	Total benefit in monetary terms per household/year	Total benefit in monetary terms per year (4,892 households as of Sep '23)
Average daily time saved on fetching/collecting water (Minutes)	72.5	Minimum wage with VDA per day with effect from 1st April 2025 (Odisha)	₹25,457	₹124,533,958
Average daily time saved on treating water (Minutes)	5.3	Minimum wage with VDA per day with effect from 1st April 2025 (Odisha)	₹1,873	₹9,165,014
Average monthly water treatment savings (INR)	12.3	Already in monetary terms	₹147	₹720,447

Indicators	Benefit after the intervention (per HH)	Proxy for monetisation	Total benefit in monetary terms per household/year	Total benefit in monetary terms per year (4,892 households as of Sep '23)
Days of work gained due to waterborne illnesses in the last one month from the day of interview (April 2025)	0.9	Minimum wage with VDA per day with effect from 1st April 2025 (Odisha)	₹4,755	₹23,261,684
Average reduction medical expenditure on waterborne illness *[Instances of waterborne diseases per month, that required doctor or hospital visit]*	0.6	Expenditure on medicines per episode of Diarrhea (NSSO) for Rural Odisha, for hospitalization cases	₹12,407	₹60,693,002
Total benefits per year (without Health Indicators)			**₹27,477**	**₹134,419,419**
Days of work gained due to waterborne illnesses in the last one month from the day of interview (April 2025)	0.9	Minimum wage with VDA per day with effect from 1st April 2025 (Odisha)	₹4,755	₹23,261,684
Average reduction medical expenditure on waterborne illness *[Instances of waterborne diseases per month, that required doctor or hospital visit]*	0.6	Expenditure on medicines per episode of Diarrhea (NSSO) for Rural Odisha, for hospitalization cases	₹12,407	₹60,693,002
Total benefits per year (with Health Indicators)			**₹44,639**	**₹218,374,105**

SROI calculation

Without health indicators:

SROI = Total Benefits Per Year/ Total Investments Per Year

SROI = ₹134,419,419/₹3,780,178 = **36**

With health indicators:

SROI = Total Benefits Per Year/ Total Investments Per Year

SROI = ₹218,374,105/₹3,780,178 = **58**

This means that for every ₹1 invested in the IRP project, approximately ₹36 of social and economic value is created. When health indicators are included, this value rises to ₹58. The SROI of 36x (and 58x with health) indicates that the project delivers substantial benefits, highlighting its significant contribution to community well-being.

Please note t**hat complementary interventions may have contributed to the stated reduction in waterborne disease episodes requiring a doctor visit.** These include interventions such as reduction in open defecation due to toilet construction, greater awareness of good sanitation practices such as handwashing practices etc. The entire reduction may not be attributable to the IRPs.

It should also be noted that the improvements in indicators used for the SROI analysis are based on a pre-post analysis of programme beneficiaries. In the absence of a counter-factual, we cannot conclude that the entirety of the benefits was caused by the IRP intervention.

4

Conclusion

4. Conclusion

4.1. Conclusion

The Iron Removal Plants (IRP) programme, implemented from August 2017 to August 2023 across 66 villages in Puri, Jajpur, and Jagatsinghpur districts of Odisha, has transformed access to safe drinking and cooking water for 4,892 households. The programme addresses iron contamination in groundwater, a persistent challenge in Odisha's mineral-rich geology. This conclusion synthesizes the programme's impact at household and community levels, integrating quantitative data and qualitative insights from Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs), while offering suggestions to enhance its reach and sustainability.

Access to Safe Drinking Water

The IRP programme has improved access to safe drinking water, from 55% to 100% of surveyed households, a 45% increase. This has eliminated reliance on contaminated sources like rivers and tube wells, reducing waterborne diseases.

Availability of Safe Water

Year-round access to safe water has increased from 70% to 88.9%, a 27% relative improvement, ensuring reliable availability even in flood-prone Odisha. This reliability has reduced dependence on unsafe sources, though occasional water shortages in some villages, as noted in Jajpur, suggest the need for additional IRPs to meet demand.

Water Consumption

The programme has boosted daily water consumption for drinking and cooking, with households using over 30 liters daily rising from 71.15% to 76.15%. This reflects growing trust in IRP water quality, encouraging better hygiene practices. A project staff member from Ersama, Jagatsinghpur, observed, "The community members are more dependent on the IRPs for daily water usage".

Distance and Time for Water Collection

The IRPs have significantly reduced the burden of water collection, with the proportion of households traveling over 300 meters dropping by 28%. Daily collection time has decreased from 137.9 to 65.5 minutes, saving 72.5 minutes on average. A VWC member from Dihabaring, Jajpur, stated, "Now, with the IRP system installed nearby, it takes just about 10 minutes to fetch clean water." This has alleviated physical drudgery, particularly for women, though remote households still face accessibility challenges.

Satisfaction with Water

Satisfaction with water has soared, with 88% of households reporting sufficient water daily (up from 67%) and 82% highly satisfied with water quality (up from 27%). A VWC member from Apithi, Puri, highlighted, "The water had an alkaline component, but now it tastes better after being filtered." This high satisfaction fosters community trust and sustained use of IRPs.

Women's Agency and Economic Participation

The programme has reduced the burden on women, with the proportion collecting water dropping from 83.5% to 49%, fostering shared responsibilities. This has enabled women to engage in economic activities and social activities like Self-Help Groups.

Community-Level Sustainability

The programme's sustainability is robust, with 64% of households contributing to maintenance and 92% finding it affordable. Jajpur's near-universal contribution rate (97.01%) reflects strong community cohesion, while Puri's lower rate (49.7%) suggests room for improved mobilization. A project staff member from Ersama, Jagatsinghpur, noted, "People are now taking steps to manage and maintain the IRP for long run." Technical sustainability is supported by solar-powered, gravity-based Terafil filters, though Puri's maintenance challenges require attention.

Social Return on Investment

The IRP programme has achieved an exceptional SROI ratio of 36:1 (including health it is 58:1), indicating that for every ₹1 invested, approximately ₹38 in social and economic value is created for the community. This high return is driven by significant benefits, including an average daily time saving alongside a reduction in medical expenditures due to fewer waterborne illnesses. The programme's health benefits, such as reduced skin diseases and diarrhea, as noted by a project staff member from Bramhagiri, Puri, "Many families have seen change in health aspects," further enhance household financial stability by lowering medical costs. This SROI underscores the programme's transformative impact, aligning with Sustainable Development Goal 6 (clean water and sanitation), as per the UN Sustainable Development Goals framework, and offers a compelling case for investment in community-based water solutions.

4.2. Suggestions

In Table 1, we have provided suggestions based on our learnings from the study.

Table 12: Suggestions

S.No.	Suggestion	Details
1.	Integrate IRPs into local development plans	Collaborate with local governments to embed IRP costs into Village or Gram Panchayat Development Plans (GPDP). This ensures sustained funding and aligns with local priorities, facilitating expansion to high-demand areas like those near Chilika Lake, where iron contamination is severe. In Puri, VWC-managed funds from other sources can be a model, ensuring financial viability for scaling to new villages. As identified by Jal Jeevan Mission (JJM), there is iron contamination in the groundwater of approximately 1,100 villages, the IRP may be implemented in all affected areas to improve access to cleaner, safer water and enhance residents' quality of life.[10]

[10] https://ejalshakti.gov.in/WQMIS/Report/Contaminantwise as accessed on 7th July 2025

S.No.	Suggestion	Details
2.	Enhance water quality monitoring	VWCs maybe provided with portable water testing kits and train members for periodic quality checks. This addresses the lack of testing noted across programme sites and ensures consistent quality, building trust for broader adoption.
3.	Improve power reliability for 24/7 access	All IRP could be connected to the grid or enhance solar capacity to address limited availability, particularly in areas where IRP water supply is disrupted post-4 PM. Grid connectivity can improve reliable safe water availability.
4.	Pilot IRP projects in non-intervention areas	A pilot projects maybe initiated in non-intervention areas, like those near Chilika Lake, to test adaptability and refine the model. The demand for IRPs in non-intervention villages, as noted in Pahilundi, suggests potential for expansion. Pilots can address local challenges, such as water quality and accessibility, ensuring the model's success before large-scale replication, aligning with the programme's SROI-driven value proposition.
5.	Plan for barrier-free access for vulnerable populations, such as the elderly, individuals with disabilities, or children	Observations across districts have identified physical barriers affecting access for vulnerable populations, such as the elderly, individuals with disabilities, or children, at some IRP sites. To promote accessibility, it's important to incorporate considerations for barrier-free access into both the site selection and design phases. This includes installing ramps alongside steps and addressing uneven terrains like muddy patches. Implementing these measures can help ensure that all community members can easily reach and benefit from the facilities.