Dalmia Bharat Foundation

Impact Study

of Soil and Water Conservation Initiatives in Rajasthan, Andhra Pradesh, Uttar Pradesh, and Tamil Nadu

2023

Acknowledgement

This report is an outcome of the Impact study undertaken by the CII Centre of Excellence for Sustainable Development (CESD) for Dalmia Bharat Foundation (DBF) in 2023. The study covers Soil and Water Conservation Initiatives in Kadapa district of Andhra Pradesh, Jhunjhunu in Rajasthan, Sitapur and Shahjahanpur in Uttar Pradesh and Tiruchirappalli and Ariyalur districts in Tamil Nadu.

We wish to express our sincere gratitude and appreciation to the corporate office program team for initiating the study and Dalmia Bharat Foundation (DBF) team for consistent support in providing relevant data and information regarding the programmes during the study phase and planning site visit for several villages in Uttar Pradesh and Tamil Nadu.

The study would not have been possible and complete without the active participation of the respondents and other key stakeholders who had taken time to participate in one-to-one interactions and group discussions to share their experiences. Their inputs have enabled us to understand the challenges, opportunities, and processes for engaging them in different initiatives. They have also brought to light the current scenario, which has enriched the study immensely.

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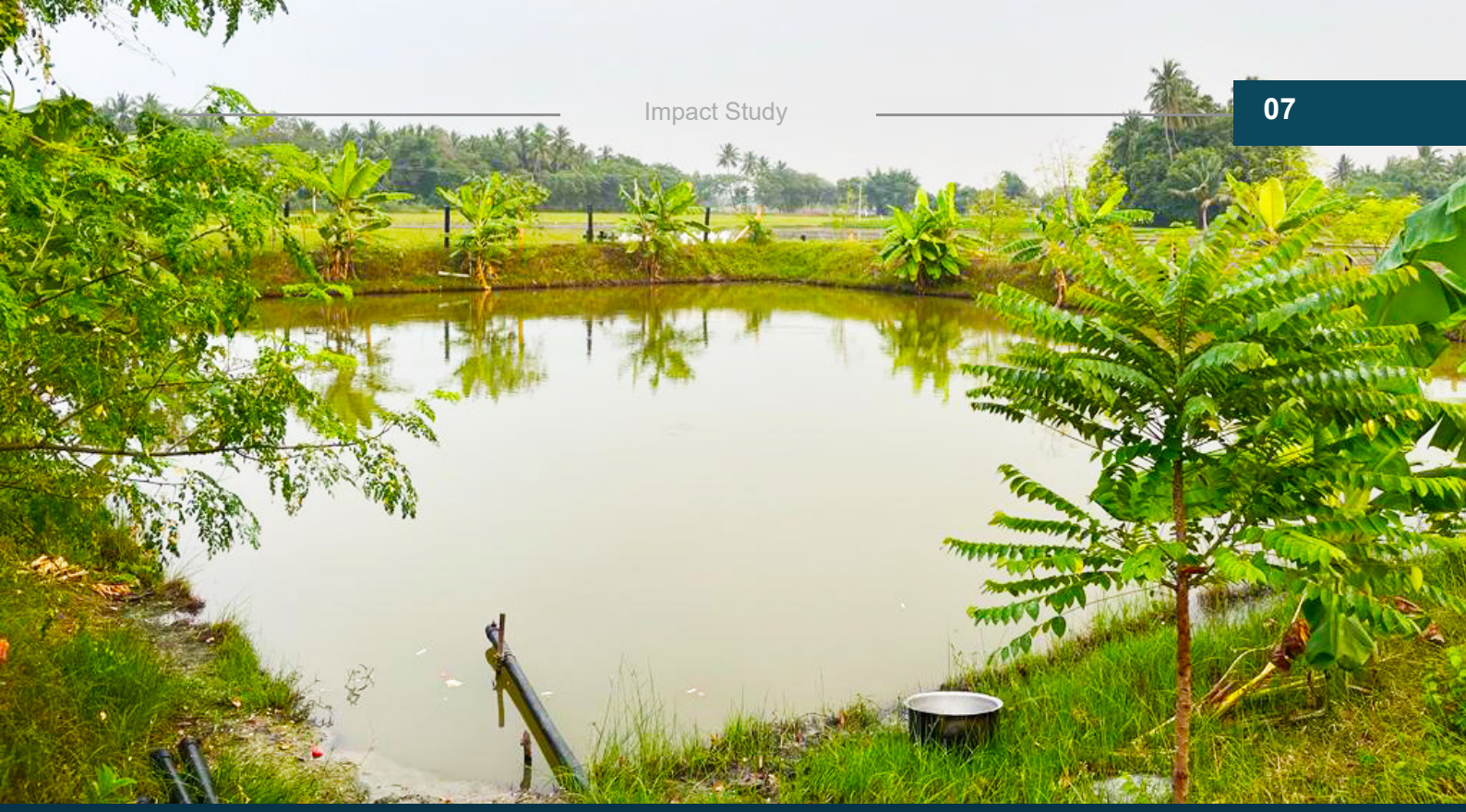
List of **Abbreviations**

BPL	**Below Poverty Line**
CAPI	**Computer Assisted Personal Interviews**
CGWB	**Central Ground Water Board**
DAC	**Development Assistance Committee**
DBF	**Dalmia Bharat Foundation**
FGD	**Focus Group Discussion**
KVK	**Krishi Vigyan Kendra**
MGNREGA	**Mahatma Gandhi National Rural Employment Guarantee Act**
MS	**Microsoft**
NABARD	**National Bank for Agriculture and Rural Development**
OBC	**Other Backward Classes**
OECD	**Organisation for Economic Co-operation and Development**
O&M	**Operation and Maintenance**
PM KUSUM	**Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan Yojana**
SC	**Scheduled Caste**
ST	**Scheduled Tribe**
UP	**Uttar Pradesh**
VDC	**Village Development Committee**
WUG	**Water User Group**



Executive **Summary**

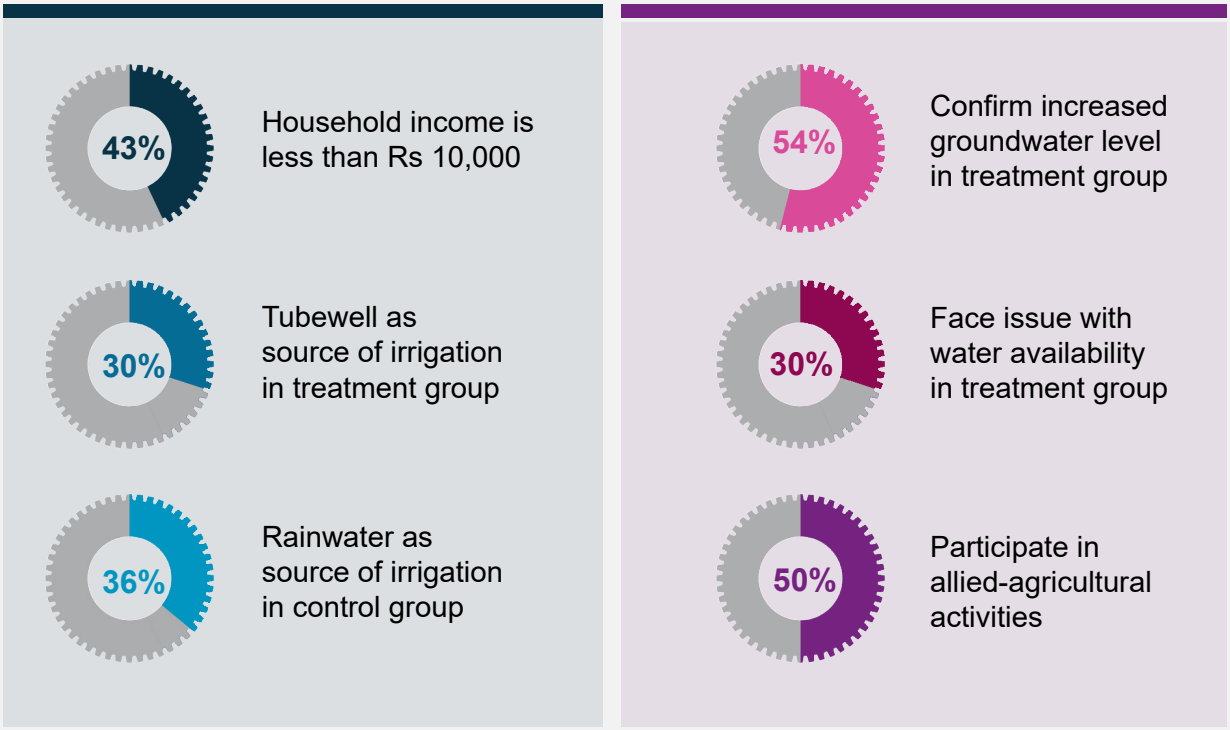
This report is an outcome of the Impact Study conducted by CII Centre of Excellence for Sustainable Development (CESD) for Soil and Water Conservation Initiative of Dalmia Bharat Foundation (DBF) in 2023 in four states, namely, Andhra Pradesh, Tamil Nadu, Rajasthan, and Uttar Pradesh (UP).

Since 2013 Dalmia Bharat has been implementing the initiative in Kadapa district of Andhra Pradesh, Jhunjhunu in Rajasthan, Sitapur and Shahjahanpur in Uttar Pradesh and Tiruchirappalli and Ariyalur in Tamil Nadu. DBF is the implementing arm of Dalmia Bharat Limited for this initiative.

The findings from the study will enable DBF to improve the existing initiatives and develop new initiatives for future action. The study outcomes build a data repository that DBF can use to monitor and evaluate the project's progress and effectiveness while it continues to implement projects and post-project completion phase. Findings and recommendations of this study will provide essential directions for improvements in the project strategy and execution. This will further help to track progress towards achieving desired outcomes.

The scope of the impact assessment covers last three FY 2021 to 2023. The impact assessment was conducted with 370 respondents. 50 non-beneficiaries have also been covered as the control group population for understanding the progress and impact of the project.

Brief Summary of Key Findings and Recommendations



Agriculture is the predominant occupation among both the treatment and control group. **43%** of respondents have a household income of less than Rs 10,000 in the treatment group and most of the beneficiaries are BPL card holders. Tubewell (**30%**) are the most popular source of irrigation amongst treatment groups against rainwater in the control group. While respondents in the control group are dependent on rainwater (**36%**). **30%** respondents in the treatment group are facing issues with respect to water availability as opposed to **58%** of the control group. The increase in groundwater level is confirmed by **54%** of the treatment group respondents in comparison to **38%** of the control group, thus highlighting the increase in groundwater levels in areas where DBF has constructed the structures. More than **50%** of respondents are practicing allied-agricultural activities such as dairy and horticulture. There is limited involvement of community in the decision-making process (**16%**), the participation of women in meetings related to operation and maintenance is negligible.

The organisation may engage more women in the village meetings regarding operation and maintenance of structures. Investment in irrigation facilities and agriculture inputs such as trash mulcher and borewell is required for reducing the consumption of water and preventing crop failure before harvest. The community may be involved at a greater level in the planning and decision-making process. Shramdaan may be made mandatory, and awareness and sensitisation of the community may be regularly conducted. There is a need to develop watershed committees and strengthen village development committees at all the locations to ensure sustainability of structures and build ownership of community.

Voices from **the Field**

"I am a farmer, I used to bring water from nearby canal to irrigate my fields, which added extra cost of fuel and was time intensive. Ever since DBF linked me with the government subsidy on farm pond, I am able to irrigate entire 9 acres of land. I am no more dependent on other water sources. The pond has increased the groundwater level from 300ft to 40ft. The green cover has increased, and I am able to cultivate chilies on 5 acres and other crops such as maize and cotton on rest of the land. This has increased my income, and I am able to save my time and cost of fuel. I use the farm pond water for spraying chemical fertilisers and pesticides on my crops".

-Beneficiary, Tamil Nadu

"DBF has provided me with training on vermicomposting along with high equality of earthworms. Today I have an annual income of Rs 4-6 lakhs. I run my dairy farm and use the cow dung to make the compost. My annual production is 1500 quintals, which I sell to other local farmers. I am thankful to DBF, for training me and providing the handholding support".

-Beneficiary, Uttar Pradesh

"I am farmer, with 5 acres of land, earlier I used flood irrigation to irrigate my land, that consumed lot of water. DBF team told me about drip irrigation and the benefits of using drip system. They provided me with subsidy on drip irrigation. Currently I am cultivating crops like maize, banana and sugarcane using drip irrigation system. The water usage has decreased, and I am able to save more water. I run water pump for short duration only as a result my expenditure on electricity bill has also reduced and my savings have increased."

-Beneficiary, Tamil Nadu

Objectives of the Study

The aim of the study was to assess the environmental, social, and monetary impact of Soil and Water Conservation Initiatives supported by Dalmia Bharat Limited and implemented by DBF.

- Perception of the beneficiaries on the quality of the interventions.
- Post-intervention changes in behaviour and practice among beneficiaries.
- Perceptions of other stakeholders about the interventions and,
- Provide insights to help design or improve future interventions.

Methodology of Study

Study Design

A non-experimental study design using a mixed method approach was used to conduct third-party impact evaluation of the projects. The mixed method research design aims at combining the strengths of both quantitative and qualitative evaluations.

Both primary and secondary data were collected for the study. Triangulation was ensured, the findings of the quantitative research have been verified with the insights from the qualitative research, and the report has been structured to reflect this point.

Primary sources of data: During the study, information was gathered from target beneficiaries and other stakeholders and is regarded as primary data.

Secondary sources of data: DBF provided program-related documents, reports, and other information that was used as secondary data. These were used in addition to published research papers, publications, along with available government data sources.

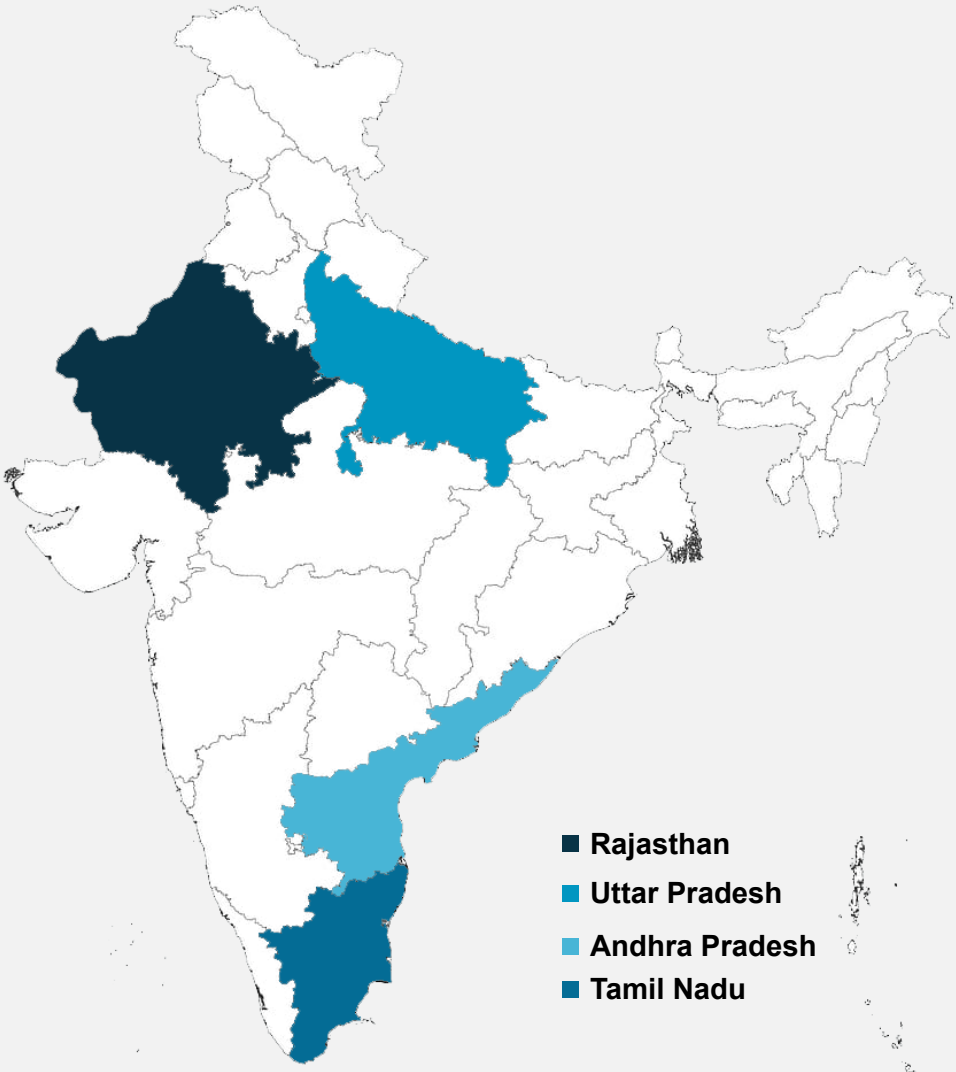
Study Locations

The study was conducted in four states, namely Chirawa, Rajasthan; Dalmiapuram and Ariyalur in Tamil Nadu; Kadapa, Andhra Pradesh and Sitapur and Shahjahanpur, Uttar Pradesh. The data was collected virtually in Rajasthan and Andhra Pradesh, and on-site from Tamil Nadu and Uttar Pradesh respectively.

Study Tools

The study used both quantitative and qualitative methods and tools to collect data. Surveys were developed to capture quantitative data, while interview schedules and focused group discussions (FGD) guidelines were developed to collect qualitative data. The quantitative tool was converted into an electronic version for computer assisted personal interviews (CAPI) based data collection using webtool. Separate schedules were developed for conducting in-depth interviews with key stakeholders for each project. Quantitative data was analysed using online statistical tool and qualitative data was analysed against key parameters.

Study Locations



Sample **Distribution**

The sample size has been developed using the scientific method of taking 95% confidence level with a margin of error of 5%. The total beneficiary population for impact assessment was 6,800 in the last 3 years. Using simple random sampling technique, a total of 370 respondents were surveyed as part of the study. The quantitative data was collected using questionnaire survey, from 188 respondents. 182 respondents were further covered through focus groups discussions. The table provides a breakup of the sample collected from all the locations both quantitative and qualitatively.

Location	Quantitative Data		Qualitative Data	Total
	Treatment Group Sample	Control Group Sample		
Ariyalur	22	5	30	57
Chirawa	21	9	31	61
Kadapa	22	9	31	62
Shahjahanpur	24	9	30	63
Sitapur	23	8	30	61
Dalmiapuram	26	10	30	66
Total Sample	**138**	**50**	**182**	**370**

Data Analysis and Report Development

Data analysis started during the data collection process. CESD research team reviewed the collected data, clarified issues, and identified gaps daily during the site visit. Further the data was collated and organised in a scientific manner.

The research team used an online tool, to develop the survey questionnaire, administer the survey using mobile application version, collect, and organise the quantitative data daily. The tool efficiently captures qualitative and quantitative information and provides real-time information with analytics.

After the site visit, data was organised into defined indicators and converted into infographics, tables, and charts. The report highlights the socio-demographic profile of project beneficiaries, direct and indirect impact of the initiative and how the identified gaps can be mitigated.

Limitations of the Study

Just like every study, this study too has its limitations. The limitations mostly stem from research methodologies and tools, and from on-the-ground challenges of securing respondents and their responses.

Specifically for this study, a key limitation is in determining the impact achieved during the three years 2020-2023. The scope of the study is to determine the impact of the CSR activities and spending made by the organisation, in these three years. But it is to be noted, that some water infrastructure was constructed by DBF in 2013. It is very likely that the beneficiary groups started to experience the benefits of the water structure from 2013/14. The respondents might have recalled and retold those impacts as if they experienced between 2020-2023. This overlay in the time period could have a bearing on some of the impact indicators. For instance, the rise in ground water table or the increase in annual incomes from agriculture and allied activities, might have happened in the early years immediately after the infrastructure was built, rather than during the period 2020-2023.

Key Findings

- Agriculture is the predominant occupation among the population in treatment group (**79%**) and control group (**90%**).
- Around half of the respondents have a household monthly income of less than Rs 10,000 (**43%** in the treatment group and **56%** in the control group)
- More than **50%** of the respondents in treatment group are BPL card holders, signifying that the initiative is catering to the economically marginalised population.
- Tubewell (**30%**) is the most popular source of irrigation amongst treatment groups. While respondents in the control group are dependent on rainwater (**36%**).
- **30%** respondents in the treatment group are facing issues with respect to water availability as opposed to **58%** of the control group.
- **54%** of the treatment group respondents agree to an increase in groundwater level in comparison to **38%** of the control group.
- **61%** of the treatment group respondents agreed they practice allied agricultural activities against **48%** of the control group.
- Only **16%** of respondents mentioned being involved in the decision-making process with respect to construction of water harvesting structures.
- Low groundwater levels, limitation of growing only rainfed crops, unavailability of water for irrigation were some of the challenges faced by community before the construction of water harvesting structures.
- Water from constructed structures such as check-dam, rooftop rainwater harvesting structure, village ponds and farm ponds is used for irrigation, drinking purposes, raising livestock, etc.
- Less than **50%** of respondents have received training from DBF on water conservation, water harvesting practices, awareness of government schemes, etc.
- **72%** respondents acknowledged the presence of watershed committees and **91%** mentioned these committees are capable of check-dam maintenance.
- **75%** mentioned the constructed infrastructure are functional and well maintained.
- **36%** respondents said panchayats are responsible for repair and maintenance of structures.

- The use of irrigation sources such as village pond and farm pond has increased by **13%** post construction, borewell by **5%**, canals by **1%** and well by **2%**.
- There is a change in cropping pattern post construction. The cropping has diversified, respondents growing two crops has increased by **5%** and three crops by **10%**. Respondents undertaking one crop has reduced from **46%** to **31%**.
- More than **50%** of the respondents rated village pond, farm pond, borewell recharge structure, village pond-borewell recharge shaft, and check-dam built under NABARD project as important.
- Post construction of water structures, the quality of life of most respondents has improved (**61%**) respondents mentioned their quality of life has improved post the construction of water harvesting structures.
- The crop yield has increased by 5 quintals per acre. Majority of respondents mentioned they have benefitted from better profits (**50%**), diversification of farming (**27%**), better quality of produce (**12%**) and better input management (**11%**).
- Only **14%** respondents mentioned their irrigation areas has increased post the construction. Most respondents acknowledged that water harvestings structures have increased the groundwater level.
- More than **70%** respondents acknowledged the rise in groundwater level due to the water harvesting structures. In Ariyalur, the groundwater has high concentrations of salt which makes the soil unfit for cultivation and groundwater unfit for drinking. Having a RO plant will help the community to avail quality and safe drinking water. Currently they are dependent on pipe water supply from government, however they reported the supply being irregular. The RO plant will ensure community has safe and clean water available for their use.
- Only **31%** of respondents mentioned the presence of Water User Groups (WUGs) and more than **50%** denied.
- *Shramdaan* in the form of manual labour was confirmed by **17%** of 138 respondents only.
- **54%** respondents acknowledged there is a mechanism of grievance redressal with respect to any issue they might face with the infrastructures.

Recommendations

Sustainable Farming

DBF may move to the next level in its work with the farmers by adopting sustainable farming methods particularly moving them from flood irrigation to the regular use of drip irrigation and sprinklers especially with sugarcane farmers in Uttar Pradesh. This method will ensure conservation of water through active participation of the community. Water efficiency can improve between 1.5 to 2.5 times over the current 35% efficiency in flood irrigation; similarly average germination can be up to 70% as compared to 35% in the current practice.[1]

- Getting sugarcane farmers to adopt scientific irrigation methods will also substantially benefit Dalmia Group's sugar business. It will de-risk the sugarcane supply from vagaries of rainfall and pest infestations, substantially reduce water use in its supply chain at the farm level, improve ground/surface water levels, and ultimately, help DBF achieve/increase its water positivity.

- DBF may increase the coverage of farmers using micro-irrigation, by assisting eligible farmers to obtain government subsidies and promoting the use of drip irrigation systems especially in sugarcane farming. Most of the farmers mentioned that they are not aware of the technicalities in applying for government schemes and subsidies.
  30% respondents in the treatment group are facing issues with respect to water availability as opposed to **58%** of the control group.

- More trainings programs and field demonstrations may be organised with the sugarcane farmers on micro-irrigation to arm them with technical support. These trainings will help farmers in correct usage of the drip system and empower them by developing their capacities towards solving any problem that may arise.

- DBF may address some of the challenges that users of drip irrigation face. Working with farmers in addressing the challenges and encouraging them to use micro-irrigation will reduce water consumption by considerable amount especially for sugarcane irrigation. The respondents mentioned they have been users of drip irrigation; however, they faced certain challenges in using the drip systems over a period of time and later abandoned using it due to lack of maintenance, lack of technical expertise and shortage of replacement part. Some farmers reported they are unable to install drip system post preparing the field after harvesting due to high labour cost. Non-suitability of the filters for other crops besides sugarcane, high cost of other filters and deposition of sand or salt in the filter resulting in clogging, which makes it non-functional.

- The organisation may further investigate these concerns and take necessary measures to ensure farmers continue to use drip system and get access to technical support whenever required or training to handle any technical difficulty that they may face.

1. Srivastava, T. K., Prasad, Kamta, Sah, A. K., Gupta, Rajendra and Singh, K. P., 2011. Farmers' Participatory Action Research on Water Use Efficient Technologies for Improving Productivity and Sustainability of Sugarcane https://iisr.icar.gov.in/iisr/download/publications/report/fparpfinalreport.pdf

- Awareness and advocacy sessions need to be organised to encourage farmers still practising flood irrigation to adopt micro-irrigation. This can be done my mapping sugarcane farmers undertaking flood irrigation and undertaking regular follow-ups and meetings with respect to their usage of micro-irrigation system and trash mulching. Collaborating with community to reduce their water withdrawal will positively impact the groundwater level.

Enterprise Model for Harvesting Machinery

There is a need to create an entrprise model for harvesting machinery, especially in Uttar Pradesh.

- DBF may consider providing the community with trash mulcher. Sugarcane farmers will use the machine to mulch leaves and use them in fields to maintain soil moisture and reduce the water intake of the crop. Currently there is only one mulcher that is provided by the government on subsidy to farmers. The rest of the farmers are dependent on that machinery, which increases their waiting time and delay sowing of new crop.

- Providing community with machinery in lieu of service fee, in the form of village level entrepreneurship model will ensure all farmers have timely access to the mulcher and this will invariably help in bringing down the water consumption rate amongst the sugarcane farmers.

- Such enterprise models have successfully come up in parts of UP, but mainly in Punjab and Haryana. Many corporate foundations and NGOs have the experience of working with them. CII Foundation has also had projects that included farm equipment lending businesses.

Leverage Government Schemes

There is a need to organise awareness camps and workshop on government schemes such as drip irrigation, Fasal Bima Yojana, PM Kisan Yojana, PM Kisan Urja Suraksha Evam Utthaan Mahabhiyan (KUSUM) Yojana and PM Vishwakarma Yojana and other social protection schemes. Many state government schemes complimenting these central government schemes are also applicable to the communities.

- The awareness sessions can be focussed on providing details on when and how the community can apply, they can also be handheld in applying to these schemes. The announcement with respect to applications of subsidies and other government schemes are often not communicated. As a result, farmers are not able to apply at the given time and receive the benefits.

- The benefit to DBF could be in terms of leveraging the financial resources available through these schemes to get more impact for the communities. This could free up some of DBF's finances for areas that deserve its attention and are usually neglected by government programmes. Complimenting rather than duplicating efforts and resources is everyone's desire. Leveraging government resources is one of effective ways of achieving that.

Improve Community Participation in Decision-Making

Increase or improve community participation or collective action in the decision-making related water harvesting structures. This could improve community ownership and engagement in maintenance and long-term sustainability of the structures. It further reduces the obligation on DBF creating space to do newer projects or scale up the existing ones.

- The community may be involved in the planning and construction phase, operational phase, and maintenance phase. This can be done by using participatory planning methods which involve identifying community needs, designing initiatives around the needs. Currently only a small portion of the respondents are involved in this process and most of these people are members of panchayat. Limited involvement of community can affect resource mobilisation, impede ownership of the water structures, and hinder participation in the later phases such as in operation and maintenance.

Constitiute Water Committees

DBF may consider constituting Water User Groups (WUGs) at the time of planning for every check-dam that it constructs. The study observed functional watershed committees only existed for check-dams built under the NABARD funded projects.

- The WUGs help in the maintenance of the structures, develop a sense of ownership in the community, and ensures community's responsibility towards the overall maintenance of the infrastructures.

- The formation of the WUG may be done in a democratic way, which will ensure active participation of the community, and improve the effectiveness of the initiative. As of now there is limited participation from members other than the President in the user group.

- Create awareness regarding the importance of the user groups during village meetings and increase the participation of women in such groups. Further, the community may be equipped with skills and knowledge that will support them with the basic repairs and upkeep, post-handover through capacity building and trainings.

Develop Exit Strategies for Project Sustainability

There is a need for conducting proper handover of the water harvesting structure to the community for their regular operation and maintenance.

- DBF should handover the water harvesting infrastructure in a structured and organised manner, again involving the larger population instead of the select few as is practised now. This could include having committees/groups being selected/elected to oversee the operation and maintenance of the infrastructure; securely handover all types of documents to the Panchayat or comparable unit of governance; establish systems for accountability of the committee/group/Panchayat on successful running of the infrastructure create financial provisions and contributions for O&M expenses. The exit strategy should be communicated to the community through village level meetings before the handover. Although DBF has handed over all the community infrastructure to the panchayat, less than **50%** of respondents acknowledged that the panchayat was responsible for the maintenance of the structure. This lack of awareness or trust could be addressed by conducting proper handover functions by inviting the larger population and making people aware of their rights and responsibilities, in addition to the points mentioned above.

Ensure Community Contribution

Need for robust engagement with the community on importance of community contribution. Community contributions or shramdaan, are mostly in the form of labour. However, during discussions in the field, it was observed that manual work such as deepening the pond, removing silt, and other related work was done by earthmovers and excavators. Moreover, there is a lack of awareness in the community regarding the need for contribution and only a few members of the community reported contributing either labour or money.

- DBF may hold regular village-level meetings to create awareness regarding the need for contributions in the larger framework of sustainability involving the maintenance and operation of water structures.
- DBF may ensure that the community contributes both monetarily and through their labour to such activities. Monetary contributions can be used as operation and maintenance funds.
- DBF can set up separate bank accounts for carrying out any need-based maintenance. The fund created in the form of shared capital, will help in taking up any O&M work of check-dams, recharge shaft, borewell recharge structure, village pond, etc.

Capacity Building

Increase the frequency of trainings and awareness sessions on water conservation practices and access to government schemes.

- More trainings may be held with the community, encouraging them to undertake water harvesting practices and water conservation. Frequency of awareness sessions on water management and on government schemes and subsidies such as on solar pumps, drip, or sprinkler irrigation may be increased. Currently only a few respondents could recollect the trainings held and mentioned participating in the trainings.
- Mobilisation of community for participating in the trainings is required. The meetings can be held regularly on a fixed day of the week, and the same may be communicated to everyone in the village using platforms such as WhatsApp or through Panchayat, etc. This will ensure participation of everyone and will minimise the risk where people are not adequately informed about such meetings.
- Women during the focus group discussions mentioned that mostly men were called for trainings and meetings, and they requested that they may be included in such meetings, as well in those meeting where operation and maintenance of water structures such as soak pit, farm ponds are discussed.

Introduction

Groundwater in India serves as a lifeline for agriculture, industries, and domestic purposes, meeting nearly 40% of the country's water demands. It plays a pivotal role in sustaining the livelihoods of millions and contributes significantly to India's food security. Over the past few decades, rampant and often unsustainable extraction of groundwater resources has led to a significant decline in water tables across various regions. According to data from the Central Ground Water Board (CGWB), around 54% of India's groundwater wells are experiencing a decline, showcasing the severity of the situation.[2] In some areas, the depletion rate surpasses the rate of recharge, exacerbating the crisis. States like Punjab, Haryana, Rajasthan, and parts of southern India are among the worst affected, witnessing an alarming drop in groundwater levels due to excessive exploitation for agricultural and industrial purposes.

The dependence of communities on groundwater remains substantial, especially in rural areas where agriculture is the primary occupation. Small and marginal farmers rely extensively on groundwater for irrigation, often using outdated and inefficient methods. The consequences of declining groundwater levels are far-reaching, impacting water availability and causing ecological imbalances. Urgent and concerted efforts are imperative to mitigate this crisis, emphasising sustainable water management practices, the adoption of efficient irrigation techniques, and the implementation of policies that regulate and monitor groundwater extraction across different sectors.

DBF through its Soil and Water Conservation Initiatives is trying to improve the existing water landscape across communities it is working in. The objectives of these concentrated efforts are towards improving the groundwater levels along with providing the community with water for consumption and varied other uses such as raising livestock and diversifying farming. As part of the initiative, the organisation has constructed water structures such as check-dams under its watershed project in collaboration with NABARD, rainwater harvesting structures, farm ponds, kund bagwani, borewell recharge shaft, deepened village ponds, village pond borewell recharge structures etc.

The regions under consideration have distinct geo-climatic characteristics, influencing their water conservation needs and challenges. Kadapa in Andhra Pradesh, with its semi-arid climate and sporadic rainfall patterns, faces acute water scarcity during dry spells. While Jhunjhunu in Rajasthan has an arid landscape, experiencing elevated temperatures and scant annual rainfall. In contrast, Tiruchirappalli and Ariyalur in Tamil Nadu experience a tropical climate with seasonal monsoons, necessitating effective water management to combat both excesses and deficiencies in rainfall. Lastly, Sitapur and Shahjahanpur in UP, are characterised by a subtropical climate, which confront fluctuations in precipitation levels, leading to water stress during certain periods.

2. Niti Ayog, 2018. Composite Water Resources Management: Performance of States. Retrieved from https://social.niti.gov.in/uploads/sample/water_index_report.pdf

To address these diverse climatic nuances and pressing water conservation needs, DBF's strategic implementation of varied water harvesting infrastructures such as borewell recharge shaft, village pond borewell recharge shaft, check-dam, soak pit, and rooftop rainwater harvesting structure holds immense significance. These interventions cater to the specific requirements of the region and are influenced by the terrain, rainfall patterns, and water usage requirements.

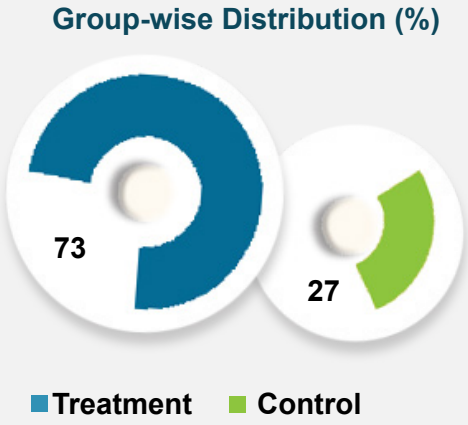
The borewell recharge shaft tends to replenish groundwater reserves, especially in regions like Sitapur, Shahjahanpur and Dalmiapuram, where groundwater depletion poses a significant challenge. Similarly, the construction of check-dams in Dalmiapuram and Kadapa aids in regulating water flow, preventing soil erosion, and facilitating groundwater recharge during monsoon seasons. The implementation of rooftop rainwater harvesting structures becomes crucial in regions like Chirawa, which anyway faces shortage of rainfall and high concentration of iron in the groundwater making the water unfit for drinking and agricultural purposes.

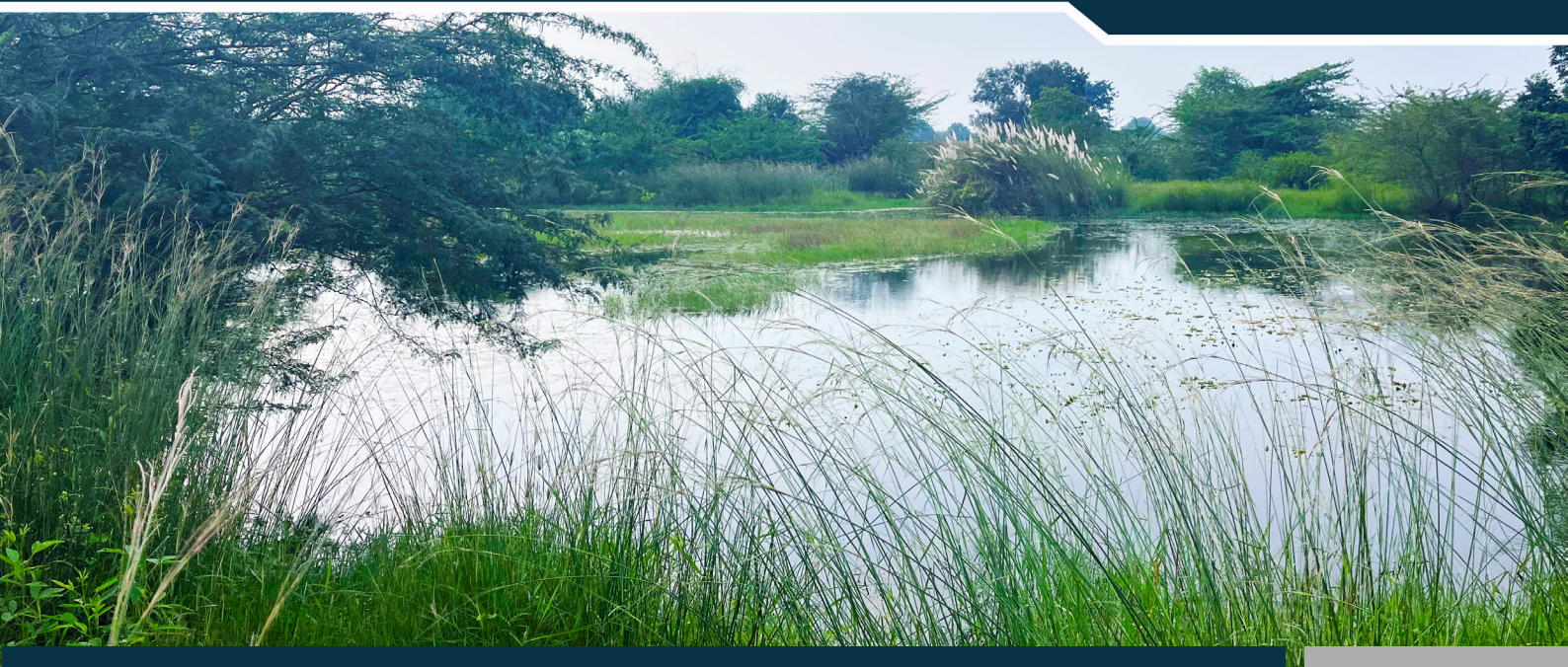
Moreover, construction of village pond borewell recharge shaft and soak pit have been able to enhance local water retention capacities and mitigate runoff losses across all these diverse regions. These initiatives not only serve as immediate solutions to water scarcity but also contribute to the long-term resilience of these communities against climatic uncertainties.

This report comprehensively examines the impact and efficacy of DBF's water harvesting infrastructure across the varied geo-climatic conditions of Kadapa, Jhunjhunu, Tiruchirappalli, Ariyalur, Sitapur, and Shahjahanpur.

Group-wise Distribution

The study surveyed a total of 188 respondents. Out of which **73% are treatment group** i.e., they are the direct beneficiary of the initiative while remaining **27%** are control group (non-beneficiaries)



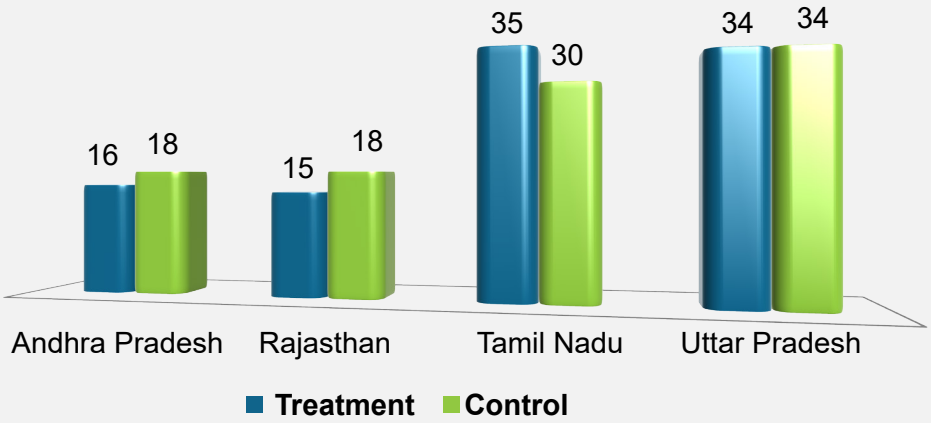


Overview of Responses Across States

The initiative has been implemented in four states namely, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, and Rajasthan.

In the treatment group, Tamil Nadu formed 35% of the respondents, Uttar Pradesh **34%**, Andhra Pradesh **16%**, and Rajasthan **15%**. In the control group, **34%** respondents are from UP, **30%** from Tamil Nadu, and **18%** from Andhra Pradesh and Rajasthan, respectively. Two locations in Tamil Nadu (Dalmiapuram and Ariyalur) and UP (Sitapur and Shahjahanpur) were part of the study, as result more respondents were covered from these two states.

State-wise Distribution of Respondents (%)

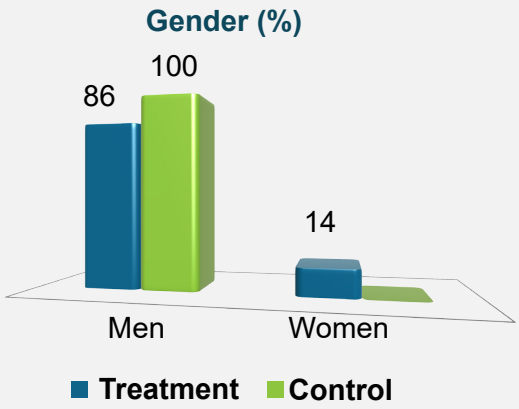


Socio-Demographic **Profile**

Male respondents outweighed the female in the survey. Most respondents in the treatment group are in the age group of 46-60 years and belong to OBC category. Agriculture is the predominant occupation and average monthly household income is less than Rs 20,000. Most respondents are BPL card holders, and the average family size is 1-4 members.

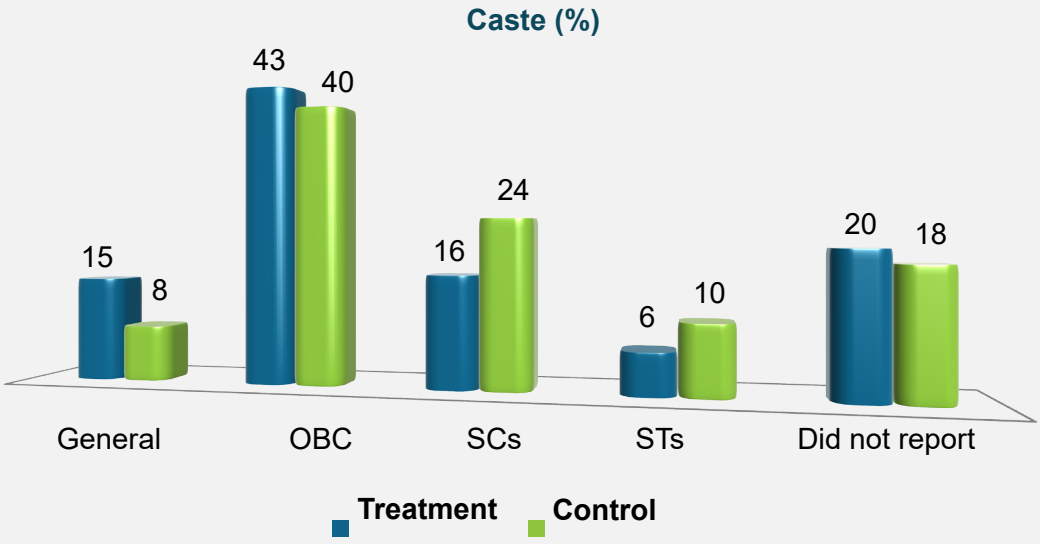
Gender Distribution

The survey included participation from both men and women across all four states. However, in the treatment group, the representation of men outweighed that of women, with **86%** of participants being men and **14%** being women. On the other hand there was no women representation from the control group.



Caste Distribution

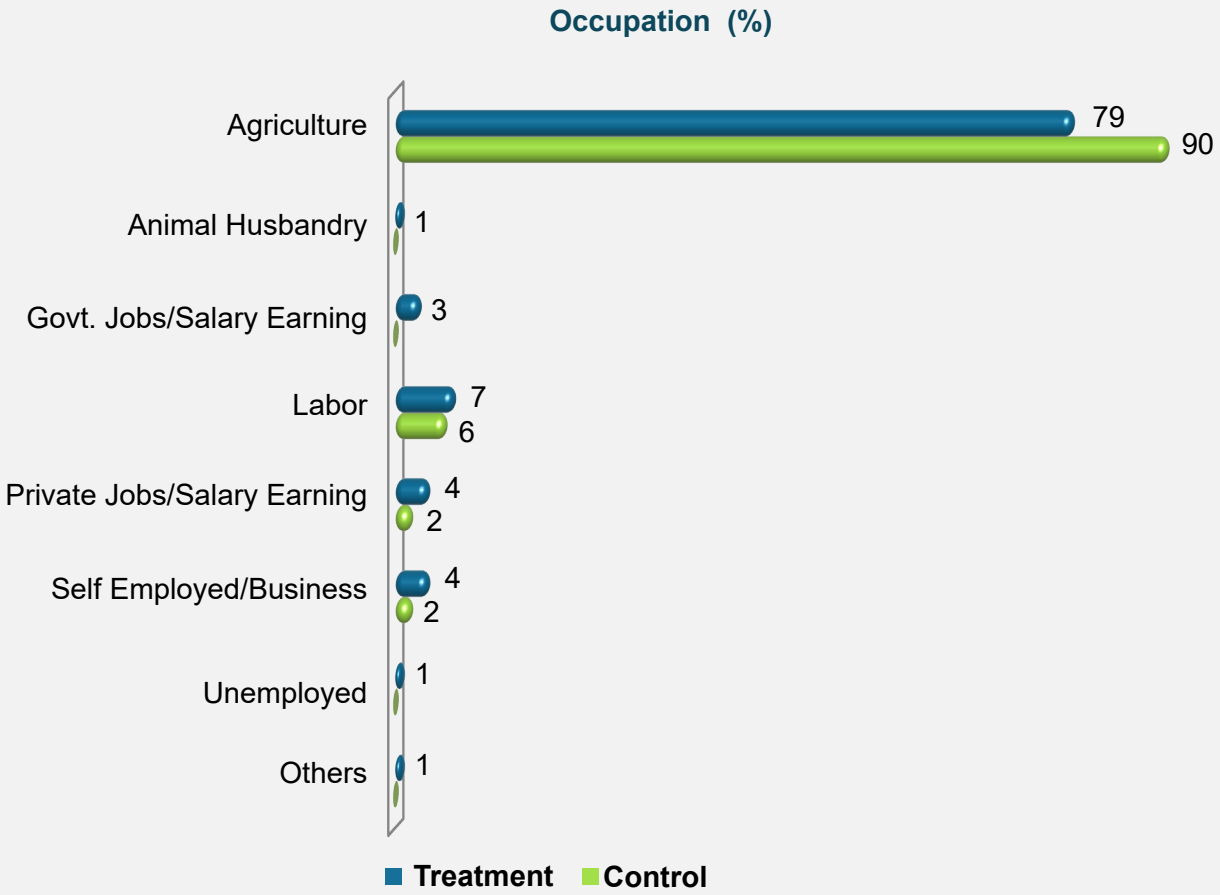
The majority of respondents in both groups belong to the Other Backward Class (OBC) category. However, there is a higher representation of Scheduled Caste (SC) individuals in the control group. In the treatment group, **15%** respondents identified their caste as General, **16%** as Scheduled Caste (SC), **6%** as Scheduled Tribe (ST), and **43%** as Other Backward Class (OBC). Additionally, **20%** of households in treatment group and **18%** in the control group did not respond.



Occupation

The following chart depicts the occupations of the surveyed respondents. **The data highlights that agriculture continues to be the predominant occupation among the population, with a significant majority of respondents in both groups engaged in agricultural activities.** Specifically, **79%** of respondents in treatment group and **90%** in the control group identified agriculture as their primary source of livelihood.

Further, in the treatment group, **1%** of households cited animal husbandry as a source of income, **3%** have government jobs, **7%** work as labourers, **4%** are in private jobs, and another **4%** have their own businesses, **1%** of are unemployed. Additionally, **1%** respondent mentioned they were student, hence selected 'other' as a response. In the control group, **90%** of respondents are engaged in agricultural activities, while **6%** work as labourers. Another **2%** have private jobs and their businesses, respectively. It is noteworthy that none of the respondents in the control group indicated unemployment.

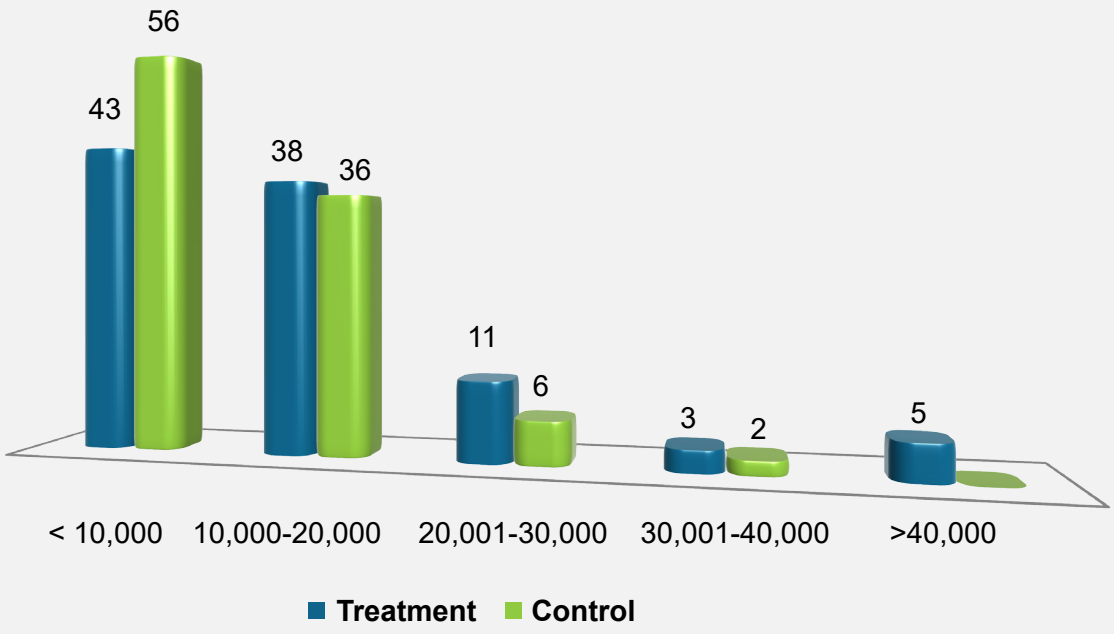


Monthly Household Income

The collected data demonstrates that most respondent from both groups have monthly income of less than Rs 10,000. Wherein, **43%** respondents in the treatment group and, **56%** in the control group fall under this category.

In treatment group, **38%** of have income between Rs 10,000 to 20,000, **11%** reported Rs 20,001-30,000 per month. **3%** mentioned an income of Rs 30,001-40,000 and **5%** have a monthly income over Rs 40,000. In the control group, a majority (**56%**) respondents have monthly income of less than Rs 10,000, followed by **36%** respondents that mentioned Rs 10,000-20,000. **6%** mentioned Rs 20,001-30,000 and the rest **2%** between Rs 30,001-40,000 per month. Notably, none of the respondents in the control group reported earnings above 40,000 per month.

Household Income In Rs (%)

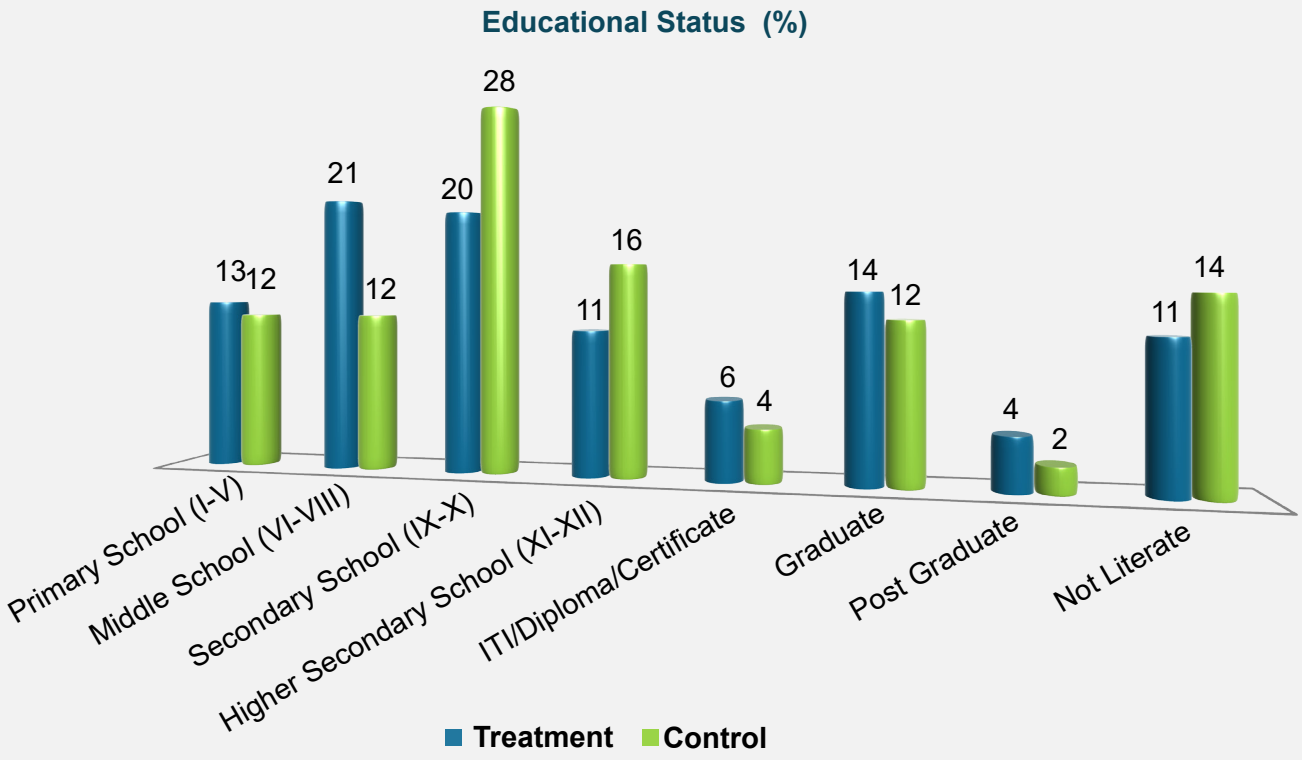


Status of **Education**

The graph provided illustrates the educational qualifications of respondents in the surveyed area. A significant majority of participants in the treatment group have completed education up to the middle school (**21%**), and secondary school (**20%**) whereas in the control group, respondents that have completed secondary education is higher (**28%**).

In the treatment group, respondents' educational status is as follows: **13%** have completed primary school, while **21%** till middle school, **20%** till secondary school, **11%** up to high school, **6%** have diploma/ITI, **14%** are graduates, **4%** postgraduates and **11%** have no formal education.

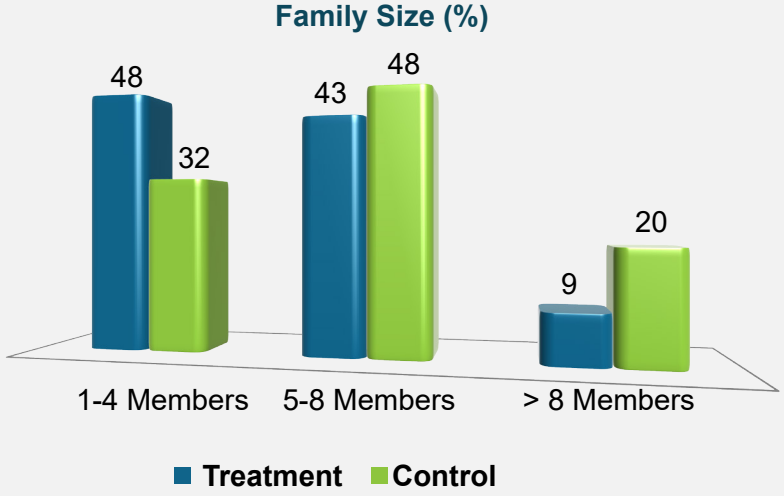
In the control group, **12%** of respondents have completed primary school, and middle school respectively, **28%** up to secondary school, **16%** till higher secondary school. Furthermore, **4%** have completed either a diploma or ITI, **12%** have a graduation degree, **2%** are pursued post-graduates and **14%** are without formal education.



Average Family Size

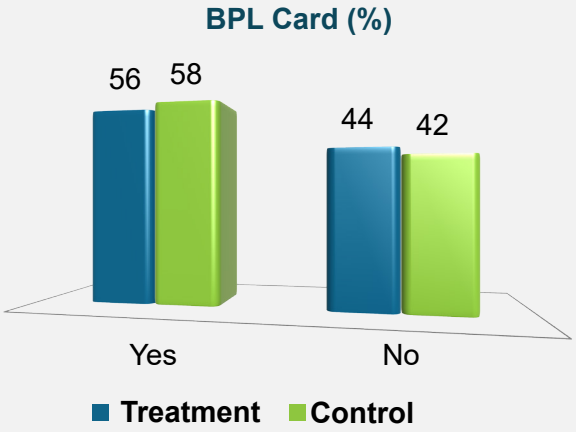
The distribution of average family size in the graph below shows most of the respondents in the treatment group have an average family size of 1-4 members, as it accounts for **48%** of total respondents in the group, followed by 5-8 members (**43%**) and more than 8 members as mentioned by **9%** respondents.

In the control group the family size is bigger with 5-8 members on an average, as mentioned by **48%** respondents of the group, **20%** respondents have more than 8 members and **32%** have 1-4 members in their family. The analysis indicates that the treatment group has 4 members, while the family size is double in the control group which indicated that respondents in the control group might be living join families more when compared to the treatment group.



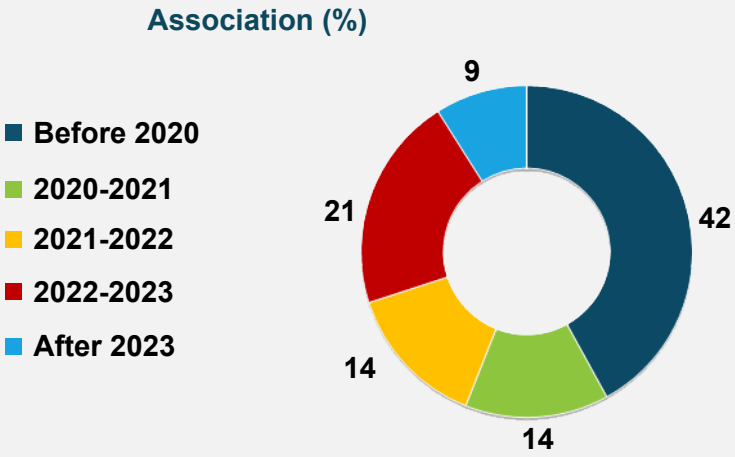
BPL Card Holder

Most respondents in the group are BPL card holders, signifying they are economically marginalised. Hence, the initiative caters to majority of respondents who are below the poverty line.



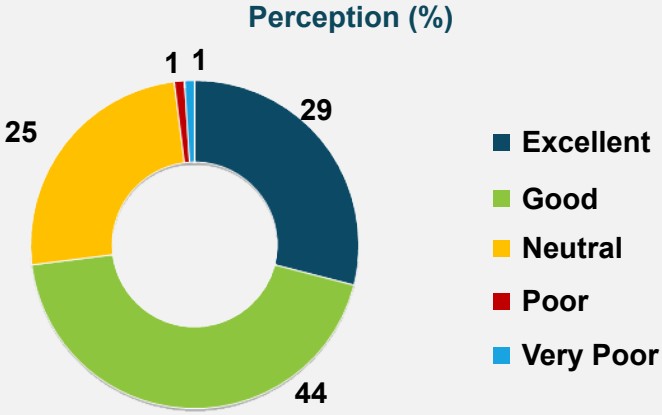
Association with the Organisation

The respondents in the treatment group were asked about their association with DBF. Majority of respondents (**42%**) have been associated before 2022, indicating that the organisation has been actively engaging with the community.



Perception about the Organisation

The perception graph provided, shows most respondents have a positive perception towards DBF. This indicates the DBF team has built a positive relationship with the community. Out of the total respondents in the treatment group, **29%** mentioned 'Excellent', **44%** said 'Good', **25%** 'Neutral', **1%** mentioned 'Poor' and 'Very Poor' respectively.



Activities Implemented by **the Organisation**

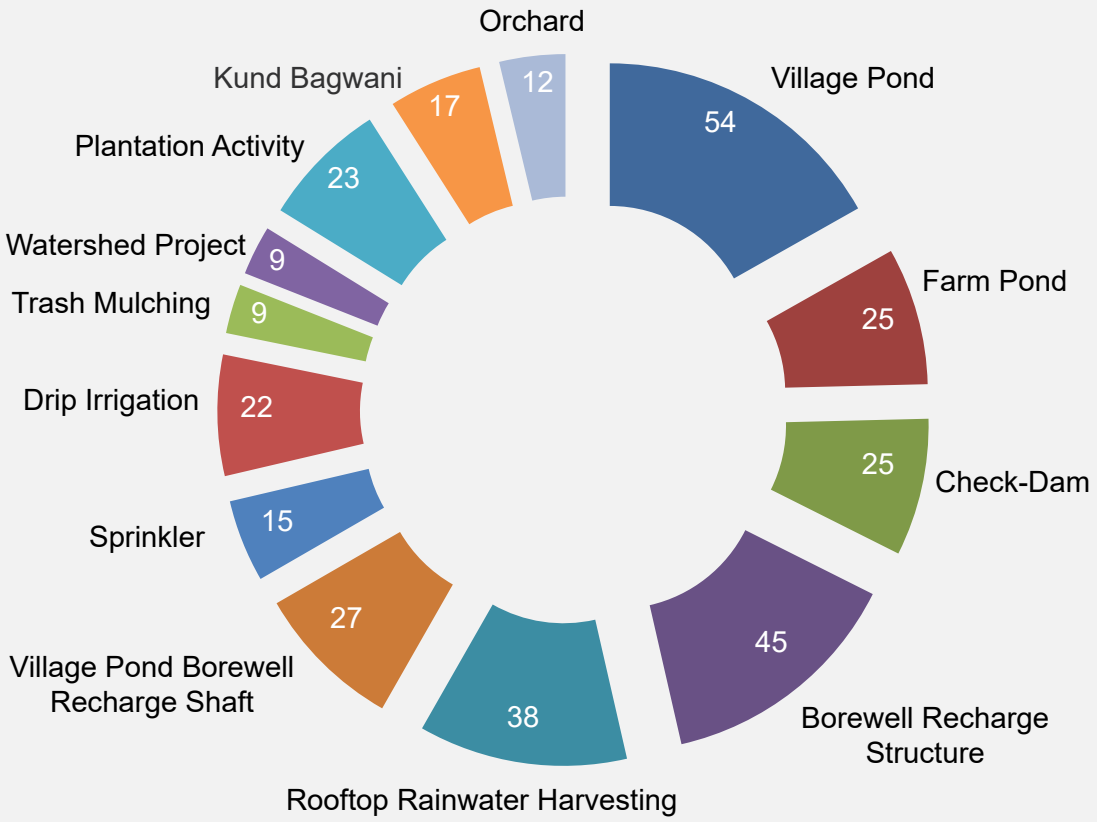
DBF has been working in all the four states with the aim of conserving water and increasing groundwater levels. To meet these objectives, the organisation has undertaken construction of structures such as check-dam, farm pond, borewell recharge structure, rooftop rainwater harvesting structure, soak pit and deepening of village pond. The organisation is also encouraging sugar farmers in UP to adopt trash mulching in their farms. This helps the soil to retain the higher moisture for a longer time, prevents farmers from burning cane leaves thereby reducing air pollution, and most importantly it reduces water consumption by two-third. A report from Indian Council of Agricultural Research shows that mulches enhance the soil's biological activity, enriches it with nutrients and improves the soil fertility.[3]

Infrastructure Constructed by DBF

Infrastructure	Yes	No	Total
Village Pond	54%	46%	100%
Farm Pond	25%	75%	100%
Check-Dam	25%	75%	100%
Borewell Recharge Structure	45%	55%	100%
Rooftop Rainwater Harvesting	38%	62%	100%
Village Pond Borewell Recharge Shaft	27%	73%	100%
Sprinkler	15%	85%	100%
Drip Irrigation	22%	78%	100%
Trash Mulching	9%	91%	100%
Watershed Project	9%	91%	100%
Plantation Activity	23%	77%	100%
Kund Bagwani	17%	83%	100%
Orchard	12%	88%	100%

3. https://sugarcane.icar.gov.in/wp-content/uploads/2023/05/pp35_41.pdf

Water Harvesting Infrastructure and Activities (%)

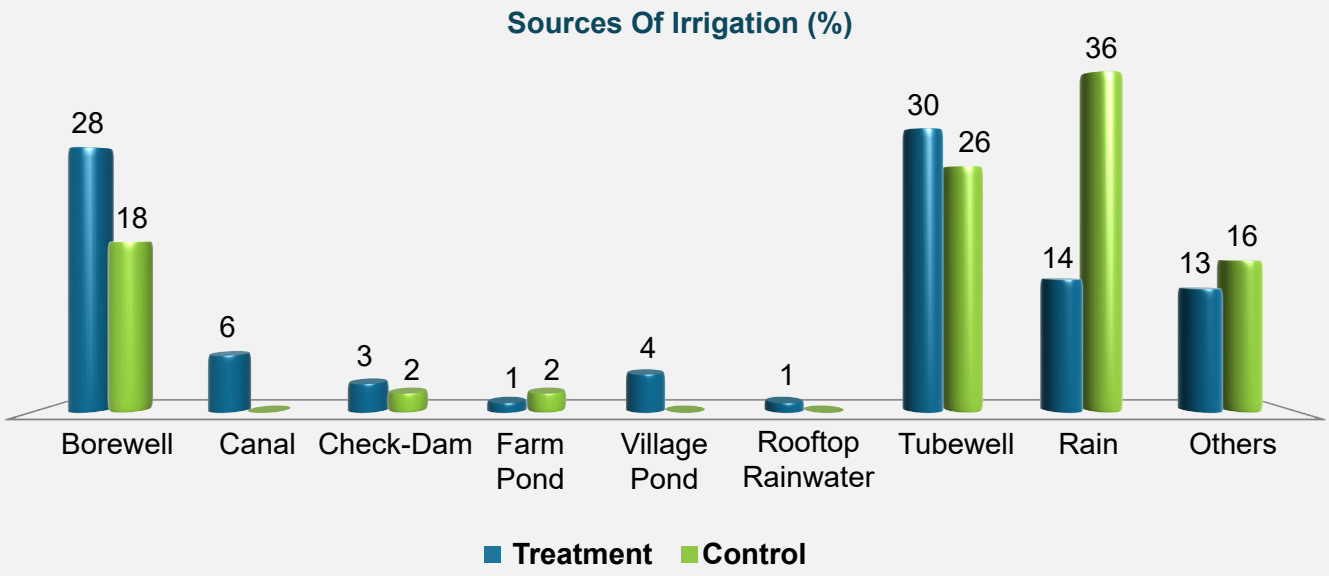


Current Irrigation Sources

The graph below provides detailed information regarding the different irrigation sources. Overall tubewell in the treatment group is the predominant source (**30%**) of irrigation followed by bore-well (**28%**), **14%** mentioned rain, **6%** reported rainwater, **4%** village pond, **3%** check-dam and **1%** mentioned rooftop-rainwater and farm pond, respectively. While in the control group, most respondents are dependent on rainwater (**36%**), **26%** mentioned tubewell, **18%** use borewell and **2%** use check-dam and farm pond, respectively. **13%** respondents in the treatment group and **16%** in control group mentioned 'other sources' such as sprinkler, renting borewell, and tubewell.

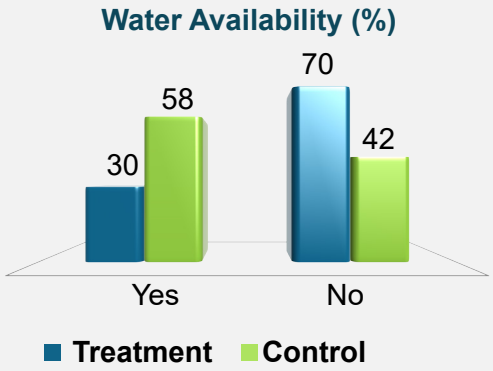
The respondents during discussion highlighted that, earlier the groundwater levels had depleted as a result the handpumps went dry due to the unavailability of water. As a result, respondents resorted to using tubewell, which enables them to draw water from deeper depths. Due to DBF's intervention, the defunct handpumps have become functional.

The increase in percentage of usage of tubewell and borewell in the treatment group can also be linked with two factors namely the availability of groundwater level and the factor mentioned above resulting in increased percentage of tubewell and borewell.



Concerns on Availability of Water

The respondents were asked if they are facing any issue with respect to the availability of water. In the treatment group **30%** reported no issue, however in the control group **58%** mentioned facing issues such lower ground water levels, erratic rainfall, high concentration of fluoride, salt, limited availability of water for drinking and irrigation.

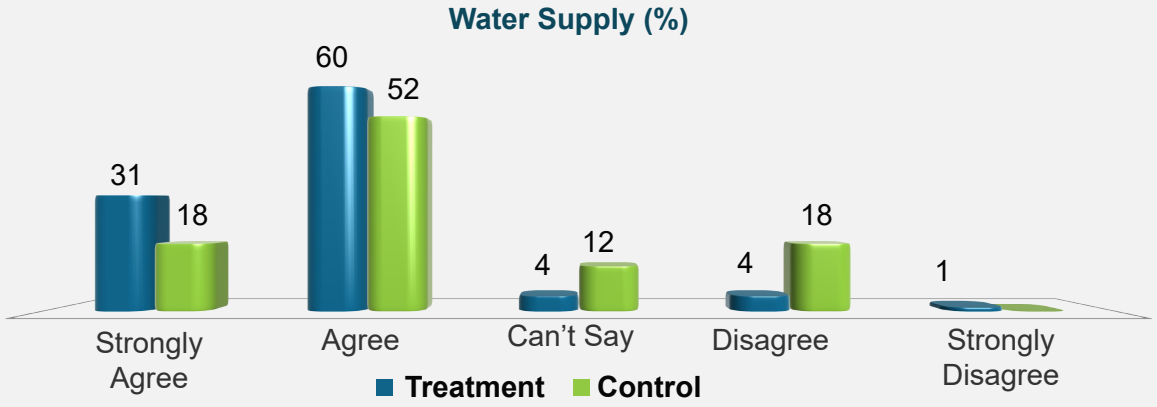


However, the graph given, shows more respondents in the control group are facing problems with respect to availability when compared to the treatment group. During discussions, treatment group respondents highlighted that they faced greater issue during summers earlier when there was no water available for irrigation, but now the issue is addressed to a considerable extent. Despite this, respondents in Sitapur requested for borewell, as it would ease the burden of farming and they would not be dependent on a couple of farmers that provide water on rent.

Respondents from the group were given with a set of statements and were asked if they agreed or disagreed to those statements. This was done to understand the existing conditions in both the groups and draw comparisons between them.

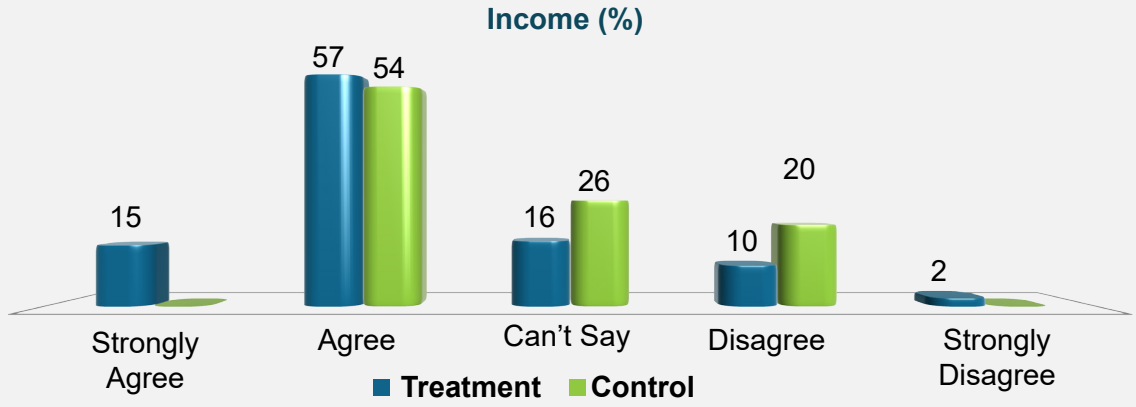
Availability of Water Supply

In the treatment group, **60%** respondents agree they have access to adequate water supply while in the control group **52%** agree. Overall, more respondents in the treatment group agree to the statement when compared with control group, highlighting that water supply is better in the treatment group villages.



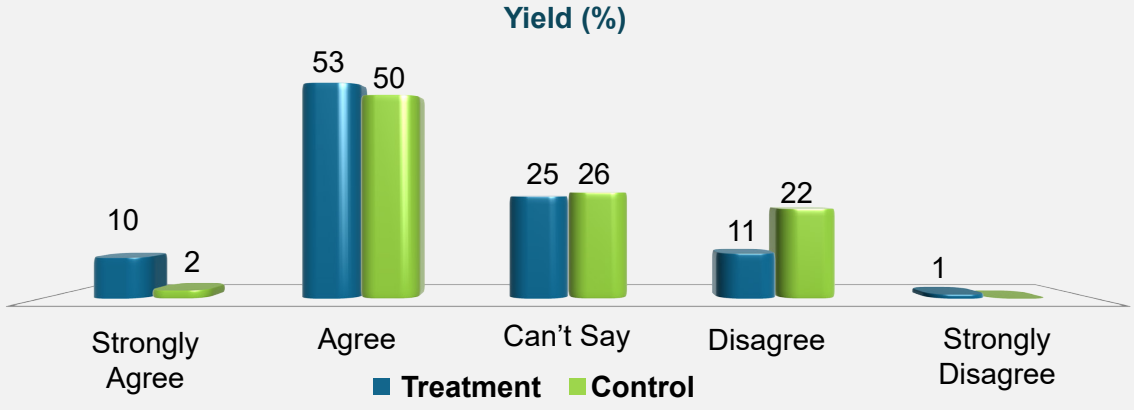
Increased Family Income

More than **50%** of respondents in both the groups agree their family income has increased in the last three years. Overall, more than **72%** respondents have seen an increase in their family income as compared to **54%** in the control group.



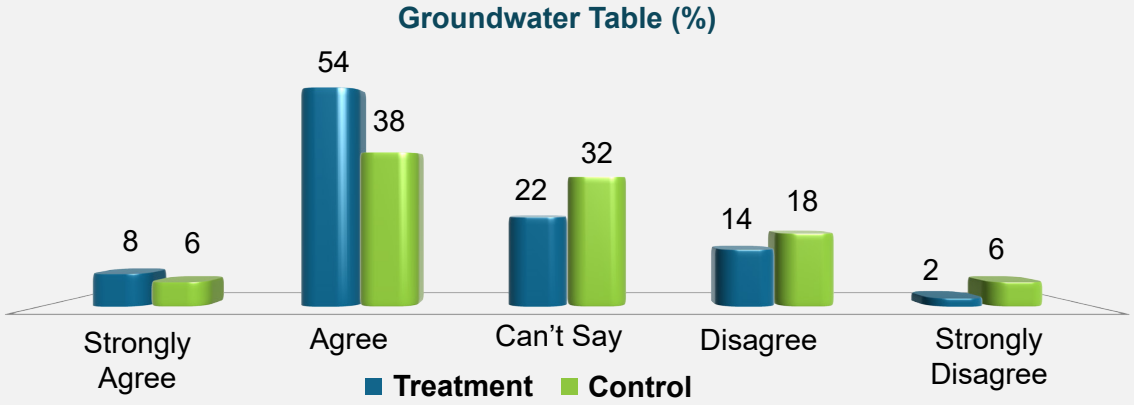
Increased Crop Yield

Overall respondents agreed that their crop yield has increased, which can be linked with the availability of sufficient water for irrigation. **53%** of the respondents in the treatment group agree and **10%** strongly agree that their crop yield has increased in the last three years. **25%** could not give proper justification, **11%** disagree and **1%** strongly disagree with the statement. In the control group only **2%** strongly agree, **50%** agree, **26%** were not sure and **22%** disagree to the statement.



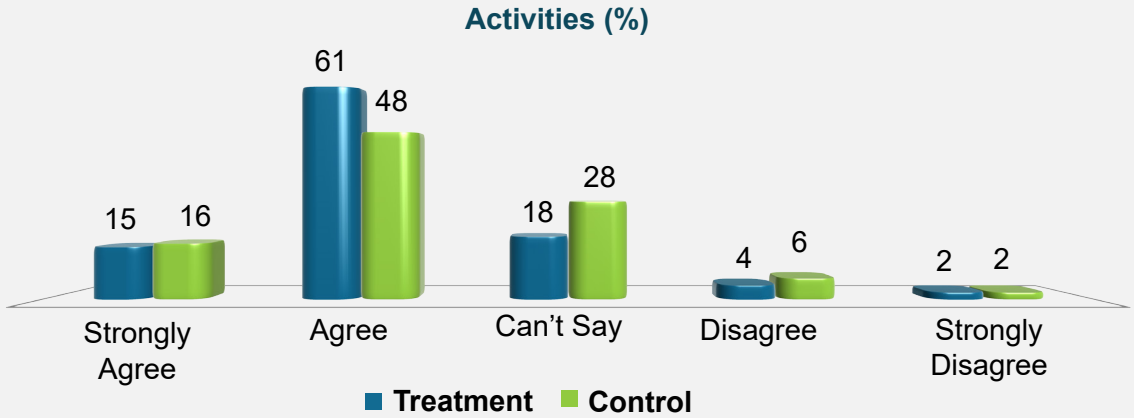
Increased Groundwater Table

The percentage of respondents that strongly agree or agree to the statement that groundwater table has increased is more in the treatment group than the control group. **8%** respondents strongly agree as compared to **6%** in the control group and **54%** treatment group agree that groundwater table has increased as opposed to **38%** in the control group. More percentage of respondents in the control group disagree highlighting that the water table in those villages is far lower than the treatment group villages.



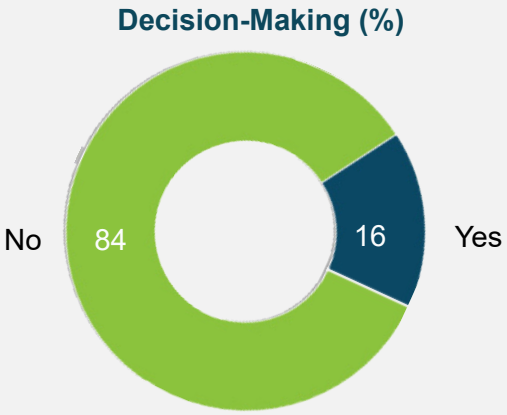
Practice Allied-Agricultural Activities

The groundwater level has influence on the availability of green pastures, drinking water for livestock and other activities. Increase in the groundwater level, encourages people to practice allied agriculture activities such as fishery, animal husbandry, dairy farming etc. Overall, more percentage of respondents in the treatment group (**61%**) when compared with the control group (**48%**) agree they practice allied agricultural activities. However, a slightly higher proportion (**16%**) of respondents in control group strongly agree to the statement. During the field visit it was observed that the treatment group respondents do practice activities such as rearing milch animals such as buffaloes, cows for dairy, poultry, horticulture, and animal husbandry. During the field interactions, respondents mentioned they had stopped rearing milch animals, as water was not available for rearing them nor there was any green pasture for grazing. However, with the deepening of village ponds and construction of village pond borewell recharge structures this problem has been solved to substantial extent.



Participation in Decision Making

The study found, the contribution of respondents in the planning and decision-making process with respect to selecting the location of the infrastructure constructed is found to be extremely low. Only **16%** respondents agreed being part the process while **84%** denied. The graph underscores the need to make the entire process of planning the initiative more participatory. Involving the community at various stages will help incorporate and meet the needs of the community.[4] This bottom-up approach of involving community and their ownership of the initiative are critical factors with respect to the sustainability of the infrastructure. **Hence, greater involvement and active participation of the community in the decision making may be sought and encouraged to increase the ownership and improved the effectiveness of the initiatives.** [5]



OECD Framework

The research team has used OECD framework 'Principles for Evaluation of Development Assistance'[6] to evaluate the initiative on six evaluation criteria- relevance, effectiveness, efficiency, impact, and sustainability.

4. https://www.iosrjournals.org/iosr-jhss/papers/Vol.%2022%20Issue7/Version-1/C2207011024.pdf
5. Gozie, I. (2007). "Imperative of a Mutually Beneficial Relationship between the Community and Donor Agency in Community Project Development in Nigeria". Lagos: Unwin Publishers Ltd.
6. OECD (2006), "Guidance for Managing Joint Evaluations", OECD Papers, vol. 6/2, https://doi.org/10.1787/oecd_papers-v6-art6-en ;https://www.oecd.org/dac/evaluation/49756382.pdf

Relevance

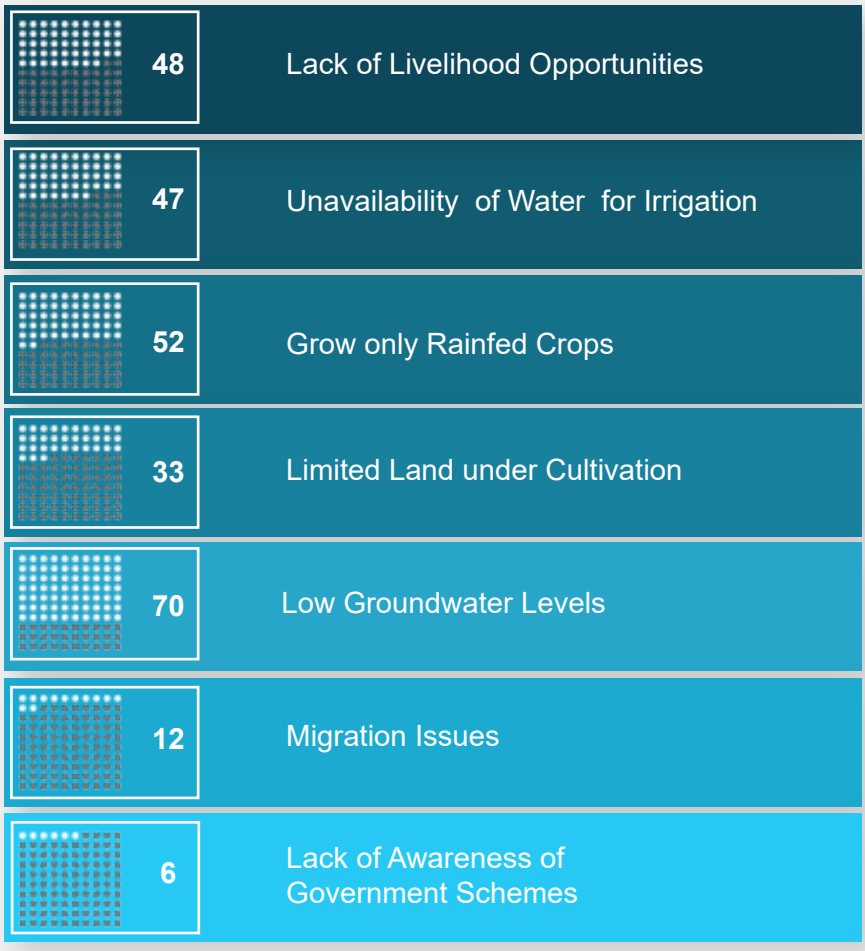
This criteria tries to understand to what extent the community required the initiative. This has been done by mapping the water situation and related challenges faced by the respondents prior to the construction of structures, inquiring about the importance of infrastructure and varied usage of structures as per the needs of the respondents.

The analysis shows, low groundwater level coupled with less rainfall are the foremost reasons behind the construction of water structures in terms of challenges faced by the community and the need of constructing the structures. Furthermore, respondents feel the structures are moderately important and mostly used for irrigation purposes.

Major Challenges Faced Before the Construction of Infrastructures

Prior to the construction, most respondents faced the problem of low groundwater levels. It was observed during the discussions that groundwater levels in Nigohi, UP before the construction of water structures were more than 70 feet, 50 feet in Ariyalur, Tamil Nadu and around 80 feet in Kadapa Tamil Nadu. Respondents could grow only rainfed crops, unavailability of water for irrigation was another concern the respondents highlighted. Lower ground water levels coupled with unavailability of irrigation sources and high dependency on rain further exacerbated the risk of migration and raised concerns about livelihood opportunities. Availing government schemes is another challenge reported which is due to lack of awareness.

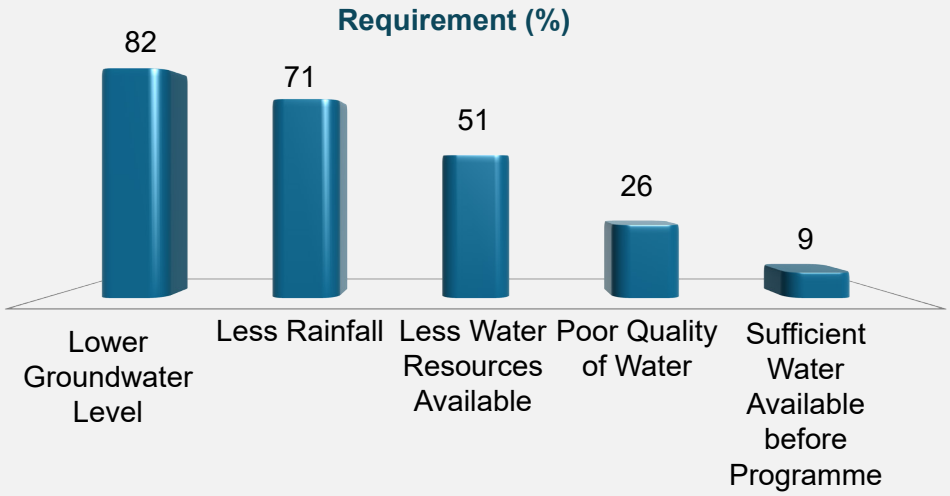
Challenges (%)



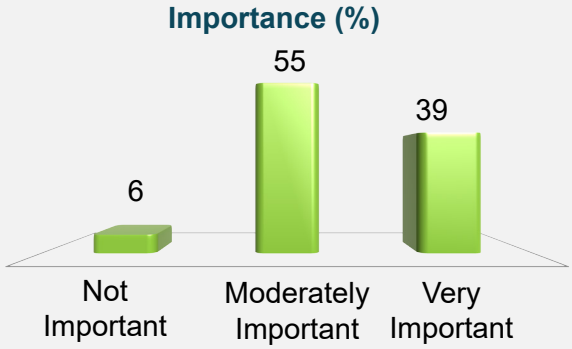
Requirement for Construction

The socio-development initiatives should always have community centric approach, wherein the needs of the community are at the helm of planning and decision-making process. The study tried to understand the underlying needs of community which they think were the basis of constructing the water harvesting and conservation infrastructures. **The top three reasons according to the respondents, which were behind the construction of structures are lower levels of groundwater, followed by less rainfall and limited availability of water resources.**

Regions such as Sitapur and Shahjahanpur in Uttar Pradesh are semi-arid regions with average rainfall of 430 mm, soil is sandy in nature that does not having water holding capacity. Furthermore, interaction with government department in Sitapur showed, the region has sandy soil, while the precipitation is good, however the region is dependent on rivers such as Mandakini, Gomati. These rivers further feed the ponds and other natural water bodies in the area. Due to the changing climatic conditions and increasing pollution, the river is unable to recharge other water structures, which further creates problem for the people dependent on smaller water resources.[7]



Importance of Water Harvesting Structures



55% of the 138 respondents in the treatment group find the constructed infrastructures as 'Moderately Important', **39%** said 'Very Important' and **6%** feel the structures are unimportant. **Overall, most respondents find the structures to be important.**

7. https://www.firstpost.com/india/strugling-to-keep-up-with-climate-change-and-unchecked-discharge-of-waste-the-mandakini-river-of-chitrakoot-is-facing-the-threat-of-extinction-5597511.html

The respondents rated the importance of water harvesting structures on a 5-point scale. **Overall, the respondents across the locations feel the water structures are important.** Qualitative data collected during the field also indicates the same. In Ariyalur, Dalmiapuram and Sitapur the respondents mentioned, village pond borewell recharge shaft, and borewell recharge structure has proved to be important especially during rainy seasons when the area used to get flooded. With the construction of the structure, the excess water gets absorbed, and it also helps in the gradual increase of the groundwater table.

Further, respondents in Chirawa, Rajasthan mentioned that groundwater has increased content of fluoride due to which they were cases of dental fluorosis and severe join pains. However, with the consumption of stored drinking water harvested through rooftop rainwaters harvesting structure, these cases have reduced substantially.

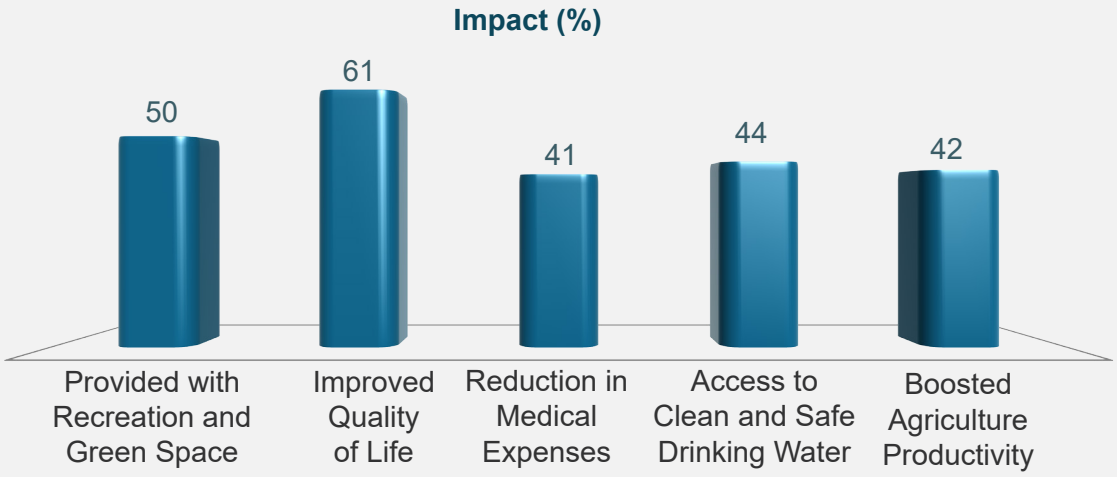
More than **50%** of the respondents rated village pond, farm pond, borewell recharge structure, village pond-borewell recharge shaft, and check-dam built under NABARD project as important. Respondents rated check-dam (**46%**) and rooftop rainwater harvesting structure (**49%**) built by DBF as very important.

Importance of Water Structures (%)

	Very Important	Important	Neither	Unimportant	Very Unimportant
Village Pond	23	62	08	04	03
Farm Pond	27	51	14	03	05
Check-dams	46	30	11	03	11
Borewell Recharge Structure	25	52	14	06	02
Rooftop Rainwater Harvesting	49	36	08	03	05
Village Pond Borewell Recharge Shaft	28	51	13	06	02
Micro Irrigation	31	46	10	00	13
Trash Mulching	21	36	29	00	14
NABARD Watershed	07	53	20	07	13

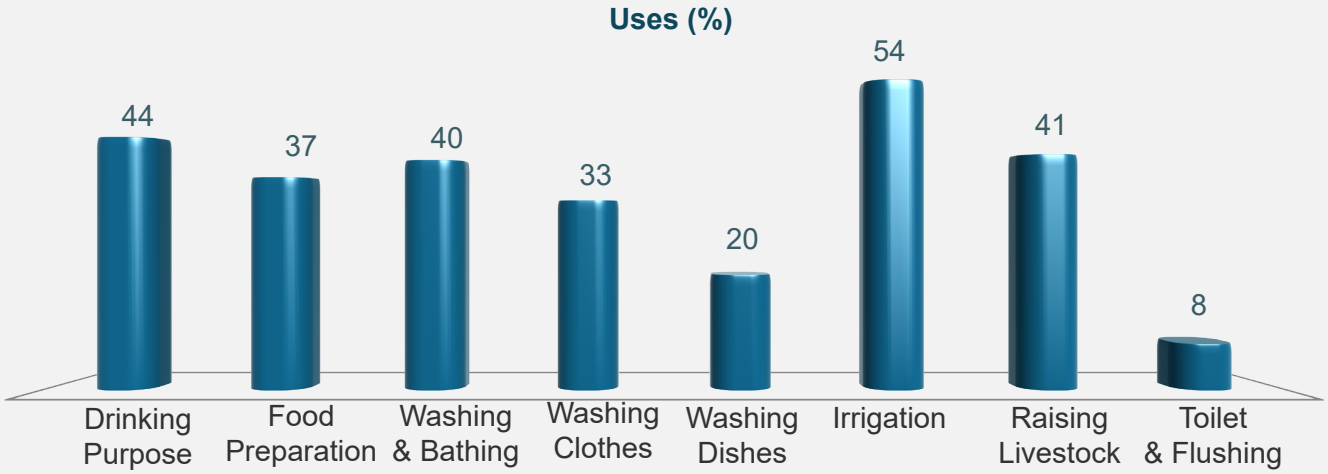
Impact of Infrastructure

The major impact of the constructed water harvesting structure is improved quality of life as reported by **61%** respondents. Other impact reported are providing respondents with the recreational and green space, boost in agricultural productivity, access to safe drinking water especially in Chirawa Rajasthan, and reduction towards medical expenditure. Additionally, the drudgery of people especially women has reduced, they now take their animals to nearest village pond for bathing. Further families are also rearing ducks and fishes in their farm pond which contributed to more income, thereby also improving their livelihood opportunities.



Patterns of Water Usage

The graph on uses of water, provides the list of activities where the water from the constructed water resources is being used. **54%** respondents mentioned using the water for irrigation, **44%** use water from rooftop rainwater harvesting structures for drinking purposes, **41%** use ponds for bathing their animals and farm ponds for raising ducks and fishes, other uses are washing of clothes and dishes, and household work.

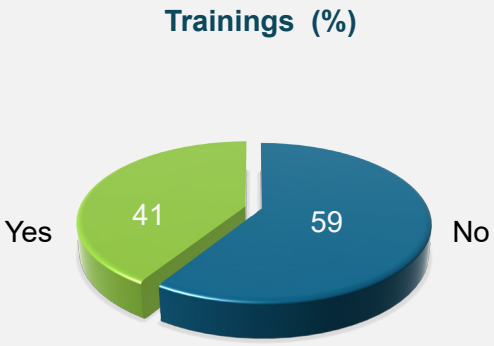


Effectiveness

The effectiveness pillar aims to evaluate the initiative basis the extent to which the objectives have met, or the intended results have been achieved. To map effectiveness of the initiative, research team tried to understand how equipped the community in managing the resources, whether the water infrastructures fulfil their intended objectives and steps taken by the DBF to ensure the community is equipped to manage the infrastructures.

The analysis shows that only **41%** of respondents have received trainings by DBF on water harvesting techniques, operation, and maintenance of structures. More than **50%** acknowledged the presence of watershed committees and feel they are capable of maintaining the water structures.

Trainings

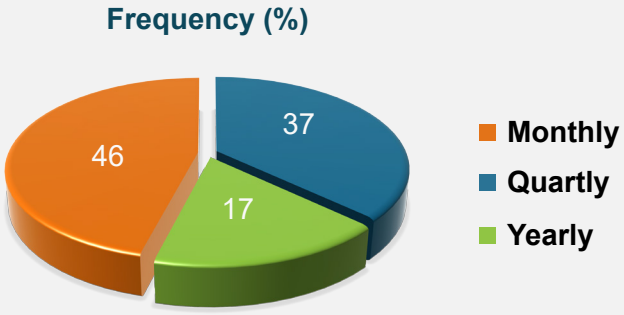


One of the objectives of the initiative is to instil water conservation and harvesting practices in the community through regular awareness and training sessions. However, **only 41% were able to identify the trainings provided by DBF, few women mentioned the training is only provided to men, as a result they are not able to contribute much to the farming or in the maintenance of the structures. While women participate equally in the agriculture, the active visibility and contribution of their labour remains invisible. DBF may encourage women as well to participate as well to participate in the meetings, which will add to their existing capacities.** This indicates a need to increase village level meetings and organise trainings more frequently with diverse stakeholders including women. Respondents in Kadapa mentioned, trainings are held in collaboration with Krishi Vigyan Kendra (KVK) on vermi-compost development, pest management, best agricultural practices for growing high value crops such as chilies. Exposure visits have also been organised to existing watershed initiatives in collaboration with agriculture department.

The topics covered in these trainings are on importance of rainwater harvesting, its uses; awareness on government schemes such as drip irrigation and sprinklers. It was observed during the discussion in Sitapur and Shahjahanpur, the trainings were more focussed on creating awareness regarding different sugarcane varieties, new machinery, and water conservation. These trainings are mostly held by the sugarcane team in collaboration with the CSR team. Other topics include, organic farming, training on vermicompost, pest control and management.

Frequency of Trainings

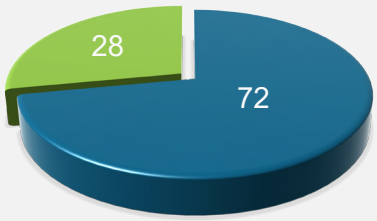
With regard to frequency of trainings, **46%** reported trainings are conducted monthly, **37%** mentioned quarterly and **17%** said annually.

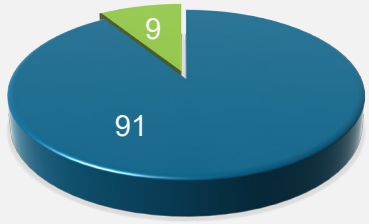


Watershed Committee

DBF and NABARD have formed village-level watershed committees under their watershed initiatives. A total of 43 out of 103 treatment group respondents are beneficiaries of check-dam and watershed. Out of these 43 respondents, **72%** (34) acknowledged the formation of the watershed committees. **91%** of these 34 respondents believe the committee is capable of handling the structures which involves its regular maintenance.

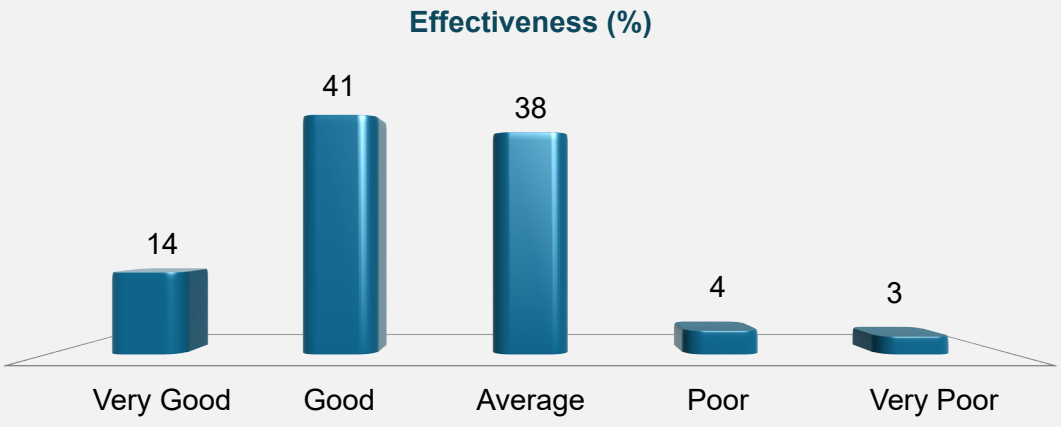
In Kadapa, Andhra Pradesh there are 4 micro watershed committees as part of the watershed initiative funded by NABARD. These watershed committees are provided a revolving fund of Rs 7 lakhs only once during the formation of the committee, which is used for operation and maintenance but is also used for giving loans to families to purchase milch animals such as buffaloes and goats etc. The responsibilities of watershed committees are, to decide the need for construction and finalise the location of construction and organise regular meetings with the community as required, and to monitor the quality of infrastructure post completion.





Effectiveness of the Initiatives

The respondents rated the effectiveness of the initiative on a 5-point scale. **Overall, the initiative is effective in achieving its objective of water harvesting and soil conservation**. More than **50%** of respondents have given a positive rating to the initiative. **38%** rate the initiative as average, **4%** rated as poor and **3%** as very poor.



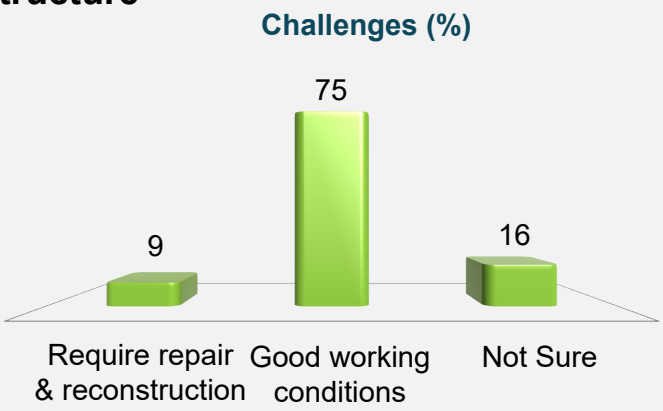
Efficiency

The efficiency pillar evaluates the basis of the extent to which the results are delivered. In terms of construction quality, respondents feel the infrastructure was in good working conditions. Panchayat is responsible for the repair and maintenance and quality of construction is good.

Construction Quality

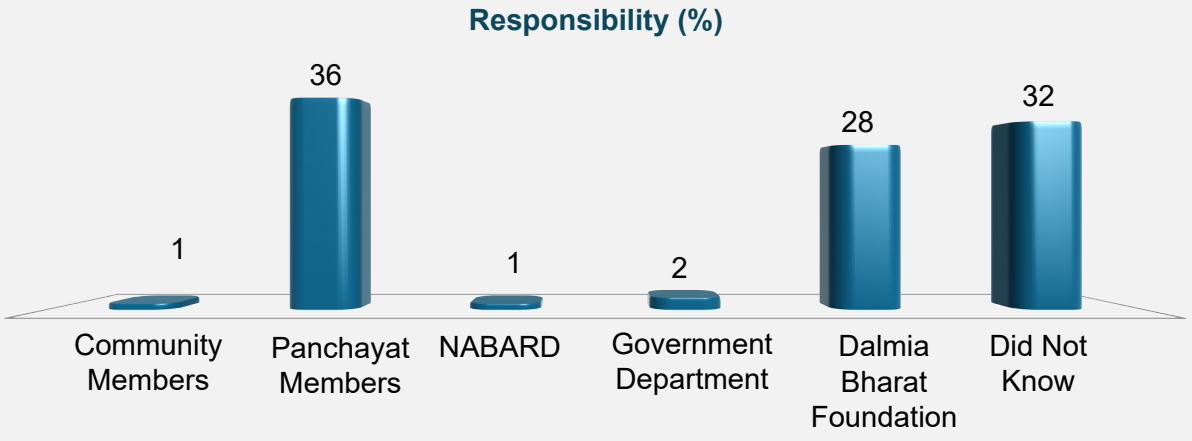
Current Condition of the Infrastructure

More than **50%** of the respondents mentioned the infrastructures are in good working condition (**75%**), **9%** mentioned, they require repair, reconstruction, and rest **16%** were unsure. Overall, the structures are well-maintained well. Check-Dam and borewell recharge structure were functional



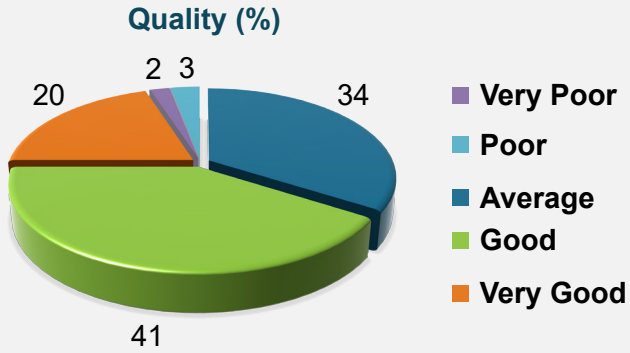
Repair and Maintenance of Infrastructure

The respondents were probed to understand the responsibility for the maintenance of structures other than check-dam, **36%** respondents mentioned panchayat to be responsible for the maintenance of the infrastructure, **28%** reported DBF, **2%** mentioned government departments and 1% mentioned community and NABARD, respectively. However, **32%** respondents were not aware who is responsible for the maintenance of the structures. DBF may conduct proper handover functions in collaboration with Panchayat. **Trainings and workshops conducted, will provide knowledge to the community on the maintenance of structures such as soak-pit, borewell recharge structure, and de-silting of village pond and farm pond.**



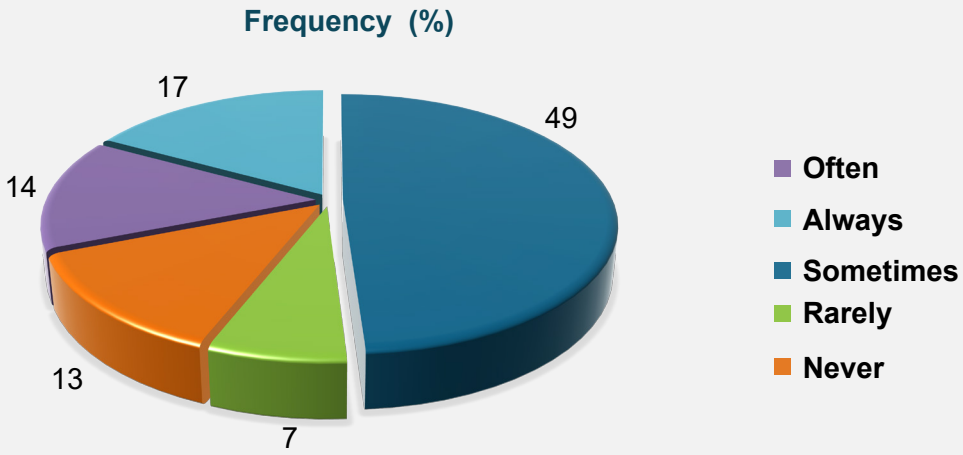
Quality of Construction

The overall construction quality is good. This further increases its efficiency, reduces the cost of repair. More than **50%** respondents find the quality of construction to be on the positive side.



Frequency of Maintenance by Panchayat

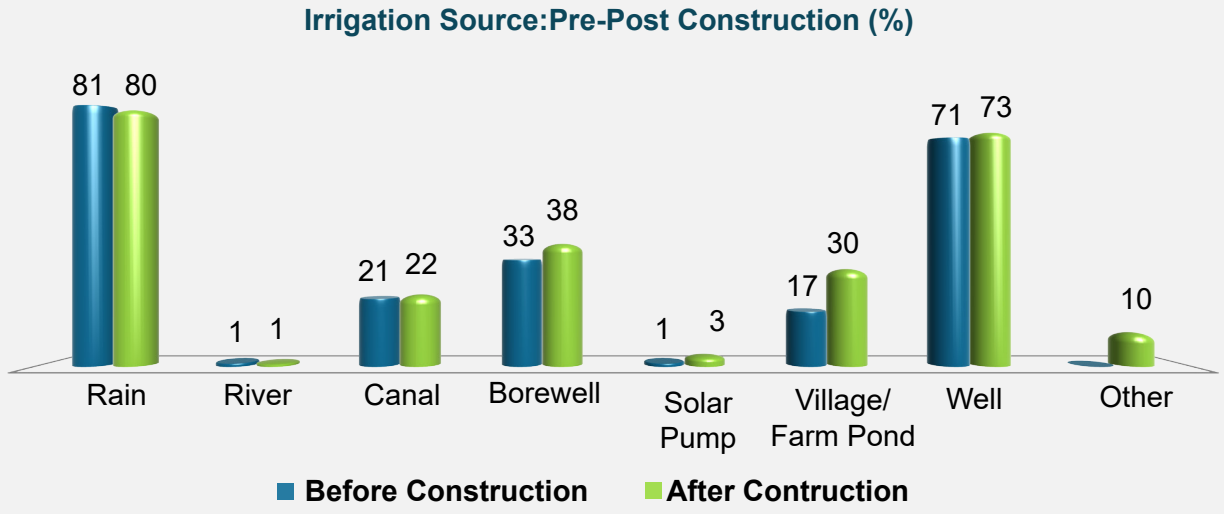
More than **50%** respondents mentioned the Panchayat maintains the structures. Further, **49%** reported sometimes, **17%** said always and **14%** said often. **Panchayat is undertaking de-silting of ponds through MGNREGA funds, post the handover of the structures**. Interactions with respondents also revealed, respondent often write letters to panchayat if they want to repair the structure such as recharge borewell shaft. However, in case when panchayat does not have funds, DBF takes the responsibility of maintenance on the request of the community and panchayat, respectively.



Impact

Sources of Irrigation Pre-Post Construction

Rainwater stays the major source of irrigation before and after the construction of water structures. However, usage of village ponds and farm ponds has increased by **13%** post construction, borewell by **5%**, canal by **1%** and well by **2%**. **10%** respondents mentioned other sources such as renting tubewell and submersible pumps for drawing water, further all the respondents that are renting submersible pumps to draw water were from UP. During interactions they mentioned, due to low groundwater levels, their personal motor pumps are unable to draw water. As a result, they are dependent on few people who have submersible pumps. They rent water for a day or two at a cost of Rs 200 per bigha. This cost is exclusive of electricity cost any maintenance or repair cost.

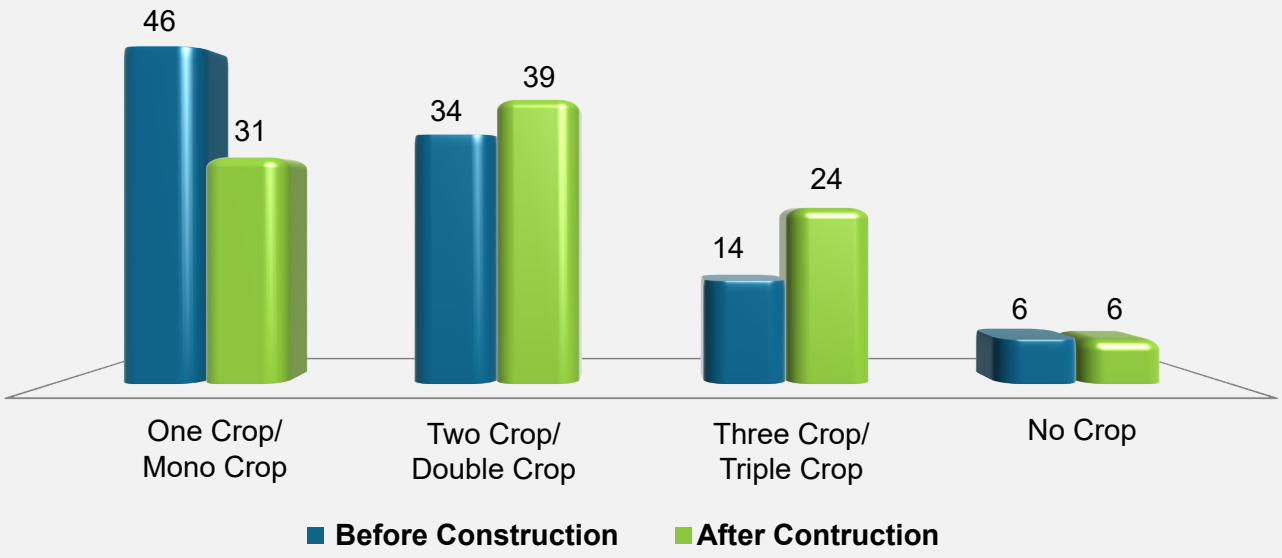


Cropping Pattern and Livelihood

Post the construction of water harvesting structures, respondents are growing more crops, which indicates availability of groundwater. However, at locations such as Sitapur and Shahjahanpur, submersible pumps irrigate the land. Discussion on field highlighted that pumps run for a shorter duration as compared to earlier which also indicates a rise in the groundwater level. **There is an overall increase in the percentage of respondents growing two crops by 5% and three crops by 10%**. Respondents undertaking one crop has reduced to **31%**. While farming is rainfed in Kadapa, Ariyalur and Dalmiapuram. Farmers are growing more than one crop such as cotton, wheat, mustard, chilies, peanuts, pumpkin. This is a positive change with respect to diversification of farming, increases production and yield.

In Sitapur and Shahjahanpur, UP respondents are growing crops such as mustard, potatoes, peas, and Bengal gram in addition to sugarcanes. In Kadapa apart from Bengal gram, respondents are growing chilies and cotton. In Ariyalur and Dalmiapuram respondents were growing maize and cotton. However, due to high salt content in the soil, farming any other crop is difficult and most people work in either Dalmia Bharat cement factories or as labourers.

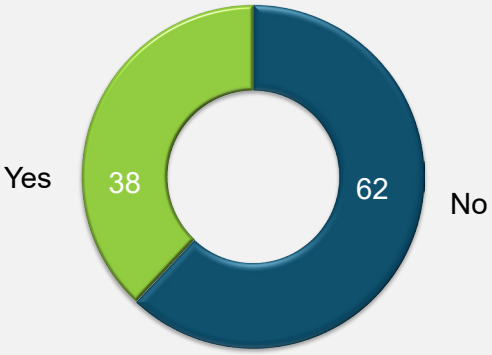
Number of Crops: Pre-Post Construction (%)



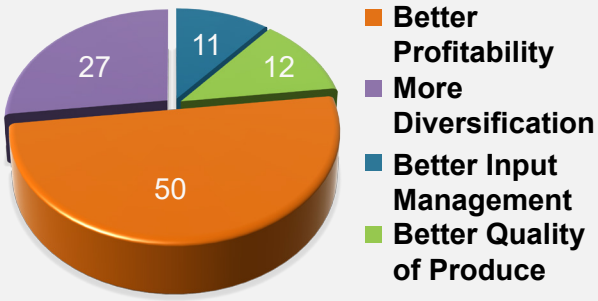
Impact on Crop Yield and Crop Productivity

In terms of increase in crop yield post the construction of water harvesting structures, **38%** (52) responded positively. **On an average the respondents mentioned an increase of 5 quintals per acre.** However, more than **50%** denied any change. These 52 respondents were probed further, to understand the associated changes with the increase crop yield. **Majority of respondents mentioned they have benefitted from better profits (50%)**, diversification of farming (**27%**), better quality of produce (**12%**) and better input management (**11%**).

Increase in Crop Yield Post Construction (%)



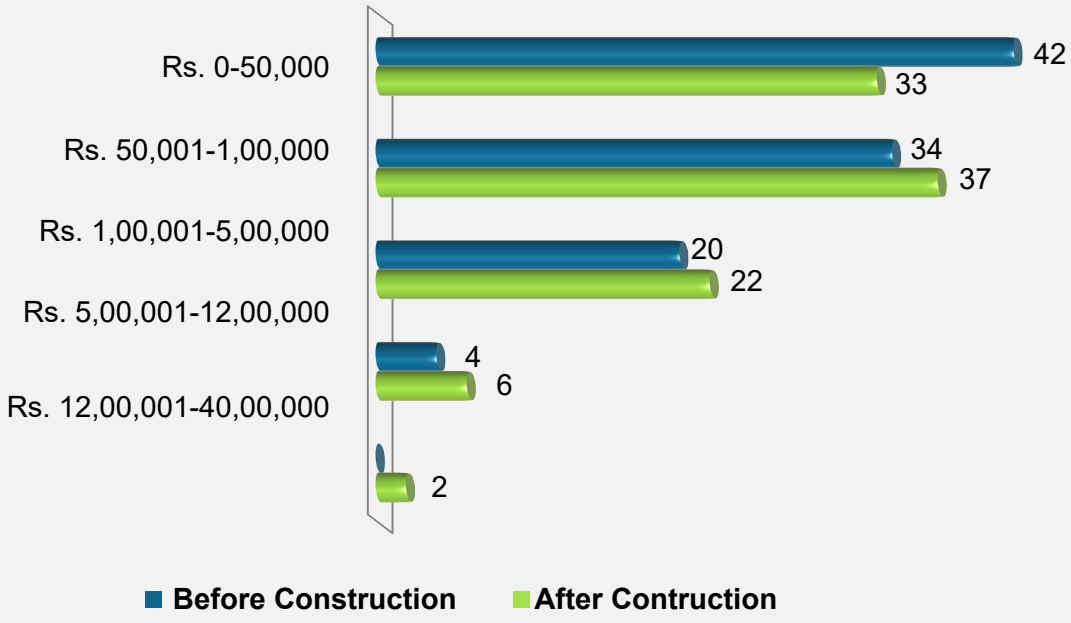
Associated Changes (%)



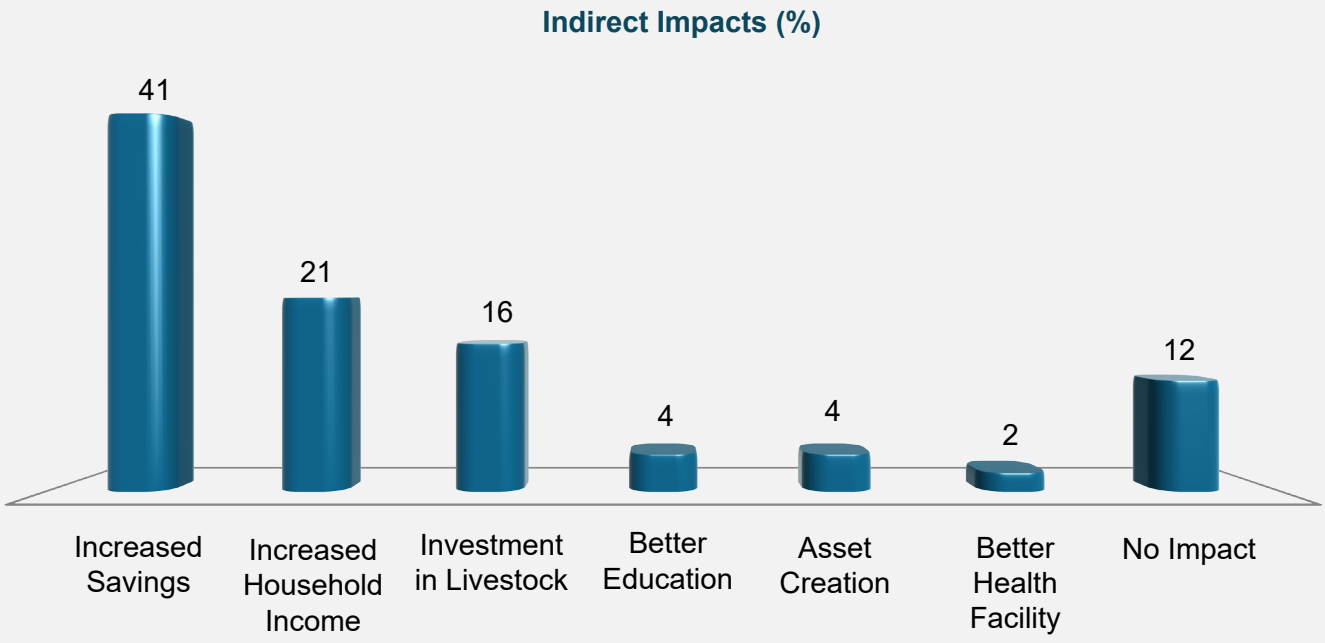
Impact on Annual Income and Other Indirect Impacts

Post the construction of water harvesting structures, the annual income has marginally increased by 2-3%. There is **3%** rise in annual income for Rs 50,001-1,00,000, **2%** increase in 1,00,001-5,00,000, and 5,00,001-12,00,000, respectively. No respondent reported an annual income of 12,00,001-40,00,000 before the construction of water harvesting structures, however **2%** have reported this income post the construction, which indicates a positive trend.

Change in Annual Income (%)



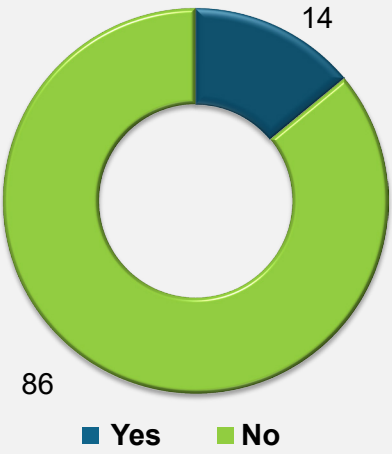
Indirect impact of increase in annual income are the increase in savings and household income, and more investment in livestock. Other benefits are better education for their children, more asset creation, and access to better health facilities.



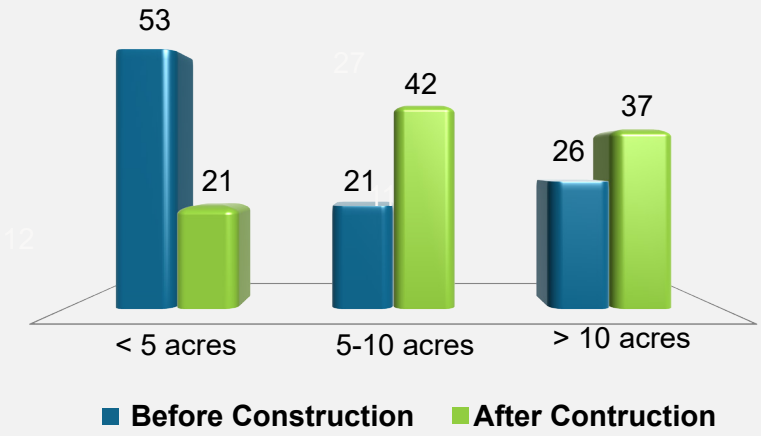
Change in Irrigation Area and Impact on Land Usage Efficiency

Out of 138 respondents, only **14%** (19) have seen an increase in irrigation area post the construction of water harvesting structures. Out of these 19 respondents, those irrigating 5-10 acres has increased by **21%**, 11% more respondents are irrigating more than 10 acres of land post the construction of water harvesting structures. Earlier **47%** respondents were irrigating more than 5 acres, presently **79%** are irrigating more than 5 acres. **This is a substantial increase, which indicates that the groundwater level has increase, which allows the respondents to increase their cultivating area and the freedom to take more crops.**

Increase in Irrigation Area (%)



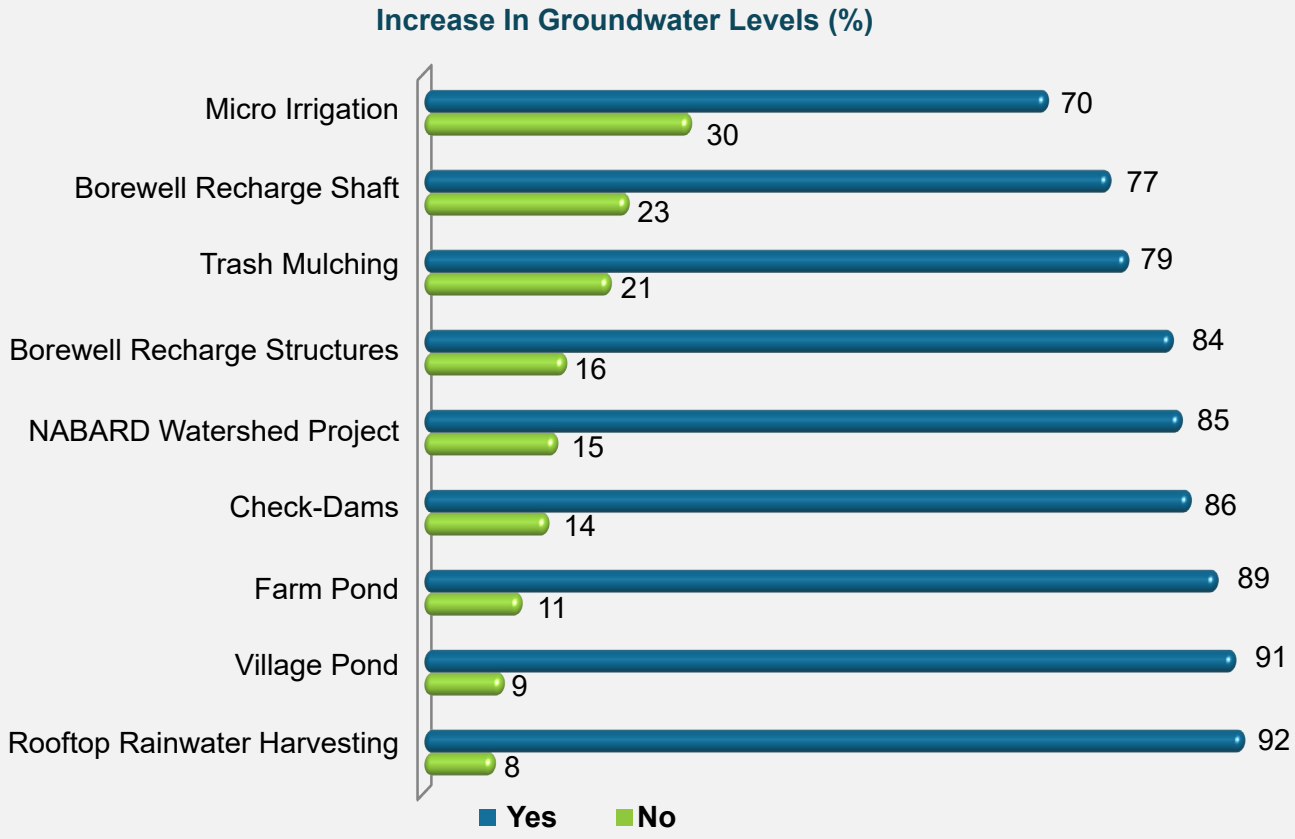
Land Under Irrigation (%)



Increase in Groundwater Availability

Most respondents acknowledged that water harvestings structures have increased the groundwater level. The structures wherein more than **80%** respondents agreed, there has been increase in groundwater levels are rooftop rainwater harvesting structure (**92%**), village pond (**91%**), farm pond (**89%**), check-dam (**86%**), check-dam built under NABARD project (**85%**), and borewell recharge structure (**84%**). The respondents in UP and Dalmiapuram raised concerns regarding not using drip irrigation system. In UP, the farmers mostly grow sugarcane, they have to re-install the entire drip system during every farming season and with every new crop they are including when they till the land and sow the seeds. The entire process is cost intensive with labour cost at Rs 250-300 per day in UP. Further respondents in Tamil Nadu reported that subsidy was only for farmers growing sugarcane. Moreover, the drip system gets accumulated with salt depositions and the same filter cannot be used for another crop. Farmers were reluctant towards investing in purchasing small size filters which suits the need of the crop.

As a result, despite having micro-irrigation facilities, farmers are resorting to flood irrigation, which results in over-extraction and increased consumption of groundwater, thereby also impacting the groundwater levels. Flood irrigation which is a conventional method of irrigation reduces soil fertility and crop production.[8]



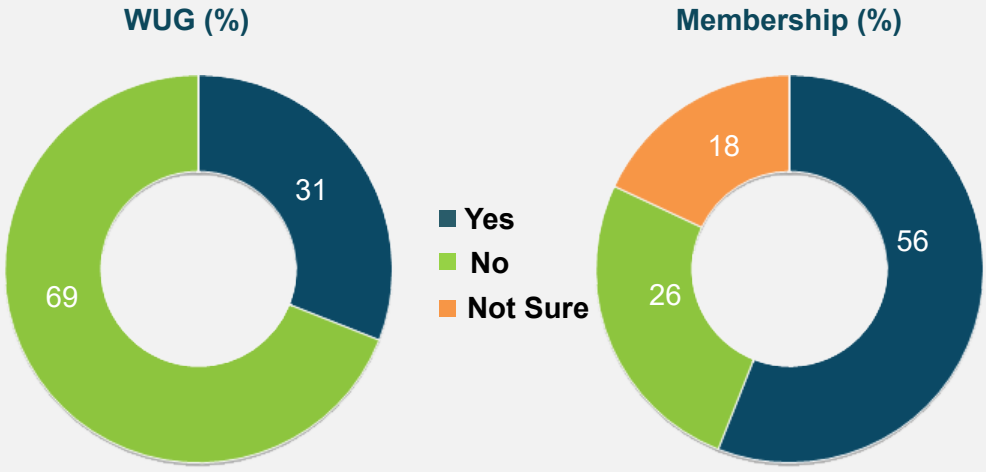
8. https://ndpublisher.in/admin/issues/IJAEBv14n3j.pdf

Sustainability

To ensure the sustainability of the project, DFB is collaborating with multiple stakeholders such as NABARD, KVK, MGNREGA, panchayat, agriculture, and irrigation departments. The responsibility has been divided amongst its stakeholders, KVKs are providing technical awareness to community through trainings on maintenance of structures. Maintenance of water structures such as village pond are taken up through MGNREGA by panchayat. Irrigation department and NABARD are actively involved in the watershed projects. While NABARD has provided funding for the watershed projects, the irrigation department provides technical assistance and support in construction of check-dam and other structures such as borewell recharge shaft and village pond borewell recharge shaft.

WUGs

DFB forms WUGs for the maintenance of the water harvesting structures. These groups have on an average 10-15 members, formed before the construction of structures. The community purely does the selection of these members along with the Panchayat members. Less than **50%** respondents acknowledged the presence of water user groups and **69%** denied. **This underscores the need to create awareness regarding the groups during village meetings. Further the community may be equipped with skills and knowledge that will support them with the basic repairs and upkeep.** Out of 43 respondents, **56%** mentioned they were part of the group, **26%** denied and **18%** were not sure. The WUGs help in the maintenance of the structures, develop a sense of economy in the community with respect to the water structure, delineates the responsibility of maintenance and ensures community's responsibility towards the overall maintenance of the infrastructures.[9]



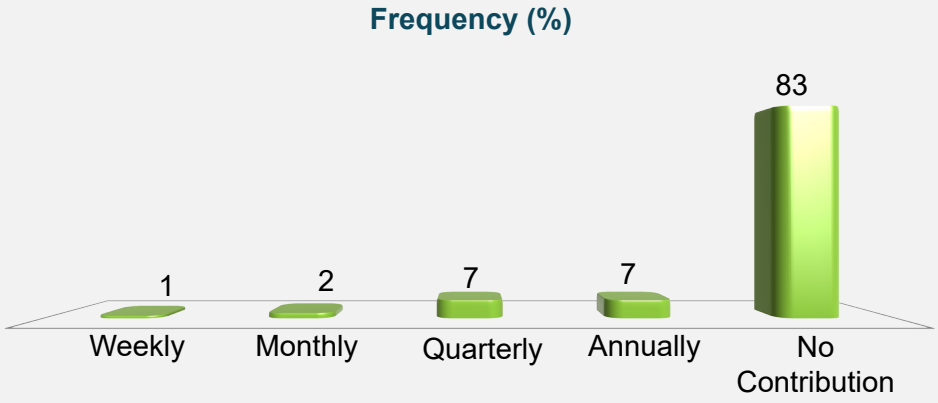
9. http://www.iiwm.res.in/pdf/Bulletin_31.pdf

Community Contribution

Community contribution ensures participation of the community, develops an ownership which smoothens the handholding process. DBF in their initiatives have component of community contribution, wherein the community contributes money or labour as part of the '*shramdaam*' during the construction of water structures

Frequency of Contribution-Monetary or Labour

Out of the total respondents, only 24 (**17%**) respondents contributed monetarily in shramdaan. **7%** contribute quarterly and annually respectively, **2%** monthly and **1%** weekly. **Most respondents were not confident when asked if they were contributing through *shramdaan* or monetarily.**



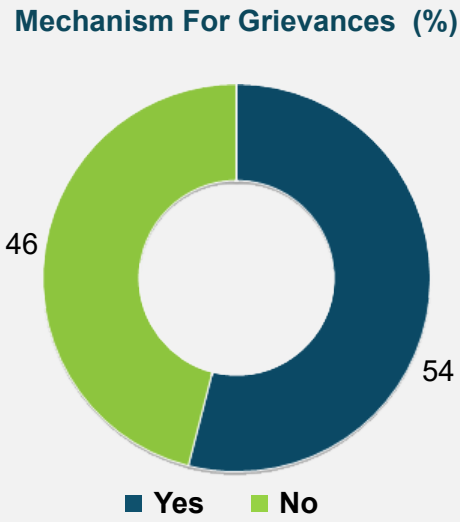
The respondents were probed to find the amount they pay for the maintenance of the structures. Only 5 (**4%**) respondents mentioned paying more than Rs 1000, rest **96%** are not contributing any amount.

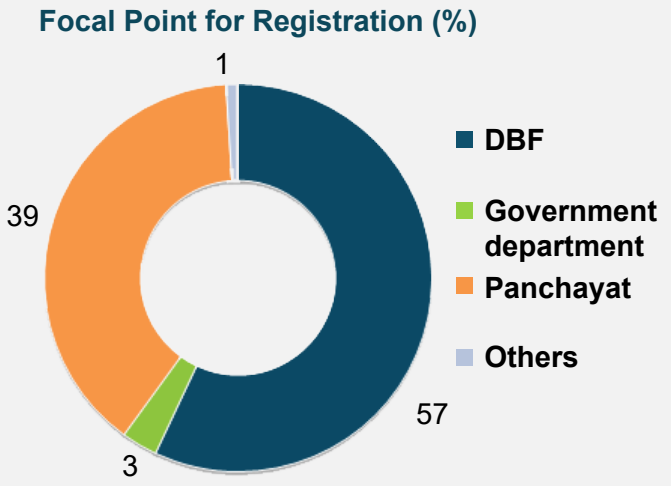
Lack of awareness regarding importance of community contribution calls for an urgent need to hold regular sessions with the community for the sustainability of the structures through participatory management. Additionally, the organisation can set up separate bank accounts for conducting any need-based maintenance. The fund created in the form of shared capital, will help in taking up any Operation and Maintenance (O&M) work of check-dam, recharge shaft, borewell recharge structures, village pond.

Grievance Redressal

54% respondents acknowledged there is a mechanism of grievance redressal with respect to any issue they might face with regard to the activities undertaken as part of the initiatives.

The graph on focal point, highlights that there is lack of clarity amongst the respondents regarding the focal point for registering their grievance. More than **50%** respondents are going to DBF; despite the infrastructures being handed over to the panchayat. **This underscores the need for proper handover of structures, creating robust mechanisms and streamlining the existing process. The process of submitting grievances may be communicated in the village level meetings. This will ensure the prompt resolution of complaints and satisfying the community's needs and expectations.**





Water Positive Strategy 

India is amongst the most water stressed countries in the world. It constitutes 18 percent of the world's population, but only has 4 percent of the world's water resources.[10] Water plays a critical role in sustaining life and agriculture. India depends highly on rainfall to meet its water requirements. The prevalent climatic conditions, erratic rainfall coupled with rapid industrialisation and increasing population[11] are further exacerbating this challenge and putting pressure on groundwater which is one the most important source of irrigation. Rapid water consumption poses a significant risk with respect to water availability. Its continued usage without responsible consumption and conservation will invariably widen the existing water supply gap.

Dalmia Bharat Limited, a pioneer in cement and sugar industry in India, is conscious of its water usage. The company realised there is a pressing need to conserve groundwater levels. Hence various measures have been taken to ensure that company remains water positive across its business units. The first water pledge was made in the years 2015 to achieve group level water positive status by 2017. In the Financial Year 2023, Dalmia became 14 times water positive and uses 31% recycled water in its operations.[12]

Given the circumstance, there is a need to undertake a multidimensional approach towards water conservation. This includes rainwater harvesting, restoring water bodies, constructing water harvesting structures such as well and check-dam, transforming old mines into water reservoirs, promoting the usage of low water intensive crop farming, and improving the usage of drip irrigation.

While Dalmia Bharat Limited (organisation) has been putting its efforts to ensure water positivity, the process can be speed up through collaboration and partnerships. The organisation can work with community collectively to manage water resources and ensure water conservation at hyperlocal level. It is also important for community to resonate with organisation in their goal of becoming 20 times water positive for cement industry and 10 times for sugar industry. They may collaborate with different stakeholders to encourage community towards water conservation, by providing subsidy on drip and sprinklers. Identifying bottlenecks that are preventing farmers to adopt sustainable agricultural farming. Encouraging farmers to move to micro-irrigation from flood irrigation and organising community sensitisation workshops on limiting groundwater withdrawals. The organisation may also focus on sugarcane farmers and map their water consumption. As per their water consumption, initiatives can be designed to ensure community is responsibly withdrawing groundwater, and adoption of micro-irrigation and other sustainable farming practices.

Some measures that Dalmia Bharat Foundation can undertake at the plant and in the communities for becoming water positive are as follows:

10. https://www.worldbank.org/en/country/india/brief/world-water-day-2022-how-india-is-addressing-its-water-needs
11. https://siwi.org/latest/groundwater-crises-threaten-the-poor-in-india/
12. https://www.dalmiacement.com/wp-content/themes/DalmiaCement/assets/pdf/Annual-Report-FY-2021-22.pdf

At Plant Level

- Improve water conservation at mines, plants and Dalmia colonies, using various measures including reducing surface run-offs, water harvesting, water recycling and its use in toilets, cleaning, and gardening, installing water efficient toilets.
- Install sewage treatment plant in colony and plant site. Using the treated water in plant's operation as well as in colony.
- Use drip systems and sprinklers in gardens inside plant and utilise treated sewage water for purposes such as gardening inside the plant area and colonies.
- Increase the consumption of recycled water in operations and reduce the dependence on freshwater and groundwater.
- Construct rainwater harvesting structures inside plant and colonies to meet the water requirements in the operations and households.
- Install signages and wall painting on water conservation in plant, colonies, and communities nearby.
- Promote the usage of micro-irrigation such as drip and sprinklers for water conservation.
- Arrest water leakages at various locations at the plant.
- Provide sugar farmers with treated water from sugar plant for irrigation, will reduce their dependency on withdrawing fresh groundwater. However, the treated water should be scientifically tested and establish its suitability for irrigation.

At Community Level

- Construct water harvesting structures such as borewell recharge shaft, check-dam, soak pit etc. in sugar and cement plants, mines, and local community in and around the plant area.
- Restore existing water bodies by deepening and de-silting village ponds and farm ponds.
- Provide community with subsidy on micro-irrigation units, trash mulchers and ensure the community understands the needs and their benefits through advocacy and awareness sessions with community.
- Provide community with high yield and low water requirement seeds to improve productivity and reduce water requirements.
- Repurpose old mines and linking them with rivers and canals. They will act as water reservoirs to be used by community for various purposes such as agriculture and household use.
- Encourage farmers to practice low water-intensive crop farming, by providing them with seeds and advocating the benefits of growing such crops on the groundwater level.

- Promote sustainable agricultural practices especially among sugar farmers by undertaking trash mulching, trench planting, and bio-control measures to control pests and diseases in the sugarcane crop.

- Sensitise the community to minimise water withdrawal through regular meetings, advocacy sessions, exposure visits, wall paintings etc.

- Install rainwater harvesting structures in community and public buildings to enhance the availability of water around the year.

Existing Practices by Companies to Become Water Positive

- ACC (now Adani Cement) Limited in 2019 reduced its freshwater consumption by 31% in its cement operations as compared to 2015. It is 2 times water positive and is committed to increase it to 5 times by 2030. They are doing this by optimising water consumption in their plants, maintaining zero liquid discharge from their operations, harvesting rainwater in mines and communities. ACC has constructed water harvestings structures across plant's location, which ensures availability of water for drinking and irrigation especially during lean periods.[13]

- JK Cement has been implementing various water conservation initiatives that are aimed at producing more cement with lower water consumption. The usage of technology and construction of rainwater harvesting structures have reduced their dependency on ground-water, usage of treated city and sewage water and arresting water leakages and ensuring behaviour improvement towards water conservation and harvesting.[14]

- Ambuja Cements Limited (now Adani Cement) through Ambuja Cement Foundation is work-ing in the community to promote rainwater harvesting. ACF is building rooftop rainwater structures, percolation wells and check-dams, promoting farming low water-intensive crops. These initiatives have helped Ambuja to become 8 times water positive for 2019. Further Ambuja has also been focusing on promoting sustainable withdrawal, water efficiency, responsible water harvesting and groundwater. These activities ensure continuous supply of water and reduce chances of water scarcity amongst the community. ACF regularly engag-ing with community on management and efficient use of water, by promoting the use of micro-irrigation, crop selection and creating local WUG.[15] This ensures communities manage their water sources and its distribution.

- Shree Cement uses water sprinklers for dust separation. Usage of sprinklers helped in conserving 300 cubic meters of water per day and installation of automatic water sprinklers save 98 cubic meters of water in a day. Further, Shree Cement has been constructing water harvesting structures in the community and has increased the depth of water pits in mines. This has improved their water carrying capacity. These initiatives have overall helped the industry in reducing water usage and optimise water conservation.[16]

13. https://www.acclimited.com/AnnualReport-2021-22/pdf/ACC%20limited%20IR_2021_final.pdf
14. https://gccassociation.org/wp-content/uploads/2021/05/Water-Positive-GCCA-India-member-companies-1.pdf
15. https://indiancementreview.com/2023/12/13/water-is-always-a-priority-for-us/
16. https://www.shreecement.com/uploads/cleanupload/Shree-Cement-SR-2020-21.pdf

- Ultra Tech Cement has become 4 times water positive, by investing in rainwater harvesting structures, converting mine pits into reservoirs, constructing check-dams at used mines and implementing integrated watershed projects in its plant locations.[17]

- ITC turned water positive in 2003. It has implemented an integrated water stewardship programme that caters to both the demand and supply side. The programme covers 1.47 million water-stressed areas. ITC has built more than 28,000 water harvesting structures with a capacity of more than 48.9 million Kl of water. Further 4 river basin regeneration projects have been undertaken, with the aim to make their water positive. Ghod river basin in Maharashtra became water positive through supply and demand management in 5 years. ITC is working to maximise water-use efficiency across its operations by adopting water-efficient technologies, minimising water withdrawal, enhancing recycling and reuse, and continued reduction in specific water intake. ITC is working with sugarcane farmers in promoting drip irrigation, wider spacing and trash mulching to reduce water consumption and increase conservation. The demand-side water management interventions have reduced water consumption by 20% to 45%.[18]

- DCM Shriram Limited is 12 times water positive, its sugar business has conserved 299 billion litres of water through their flagship initiative 'Meetha Sona'.[19] The program is developing the capacity of farmers in water use efficiency. The sugar business has collaborated with Solidaridad and International Finance Corporation to improve sugarcane cultivation practice amongst the farmers using agronomic techniques such as rash shredding, mulching, composting, laser levelling and trench planting.[20]

17. https://gccassociation.org/wp-content/uploads/2021/05/Water-Positive-GCCA-India-member-companies-1.pdf
18. https://www.itcportal.com/ITC-Water-Stewardship-Mission.pdf
19. https://www.dalmiacement.com/wp-content/themes/DalmiaCement/assets/pdf/Dalmia-Integrated-Report-2022-23.pdf
20. https://www.dcmshriram.com/docs/sustainability-report/Sustainability-Report-2022-23.pdf

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