Impact Assessment Report- Haritha Samrudhi Project- Phase 1 (Kerala)

United Breweries Limited (UBL)

January 2024

Price Waterhouse Chartered Accountants LLP

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List of Acronyms

Acronym	Full form
APL	Above Poverty Line
BPL	Below Poverty Line
CAPI	Computer Assisted Personal Interviews
CBO	Community Based Organization
CEO	Chief Executive Officer
CI	Confidence Interval
CSR	Corporate Social Responsibility
CGWB	Central Ground Water Board
FGD	Focus Group Discussion
FPO	Farmer Producer Organisation
GLRWT	Ground Level Rainwater Harvesting Tank
IA	Impact Assessment
IDI	In-depth Interview
IOF	Integrated Organic farming
IRECS	Inclusiveness, Relevance, Effectiveness, Convergence. Sustainability
JSA	Jalyukt Shivar Abhiyan
KII	Key Informant Interview
KL	Kilo Liter
KOF	Key Opinion Former
KPI	Key Performance Indicator
LoE	Letter of Engagement
NA	Not Applicable
NAM	National Agriculture Market
NGO	Non-Governmental Organization
OBC	Other Backward Class

Acronym	Full form
OHRWT	Overhead Rainwater Harvesting Tank
OSRI	Organic System of Rice Intensification
PRI	Panchayati Raj Institution
PSSP	People's Service Society Palakkad
PW	Price Waterhouse
PWCALLP	Price Waterhouse Chartered Accountants LLP
RRWH	Rooftop Rainwater Harvesting
SC	Scheduled Caste
SHG	Self Help Group
SOP	Standard Operating Procedure
SPOC	Single Point of Contact
SSB	Subsurface Barrier
ST	Scheduled Tribe
TDS	Total Dissolved Solids
UBL	United Breweries Limited
UWB	United Way of Bengaluru
VWBA	Volumetric Water Benefit Accounting
WAT	Water Absorption Trenches
WMC	Water Management Committee
WRI	World Resources Institute

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1. Executive Summary

Executive Summary

Haritha Samrudhi Project – Phase 1 has been one of the CSR initiatives of United Breweries Limited (UBL) Corporate Social Responsibility (CSR) Programme. The Project was implemented between 2019 to 2022; aimed at creating sustainable livelihood opportunities for the local community in Pudussery Gram Panchayat of Palakkad District in Kerala. The project promotes climate resilient agricultural practices and water and soil conservation efforts.

To evaluate the impact of the aforesaid project, a mixed method approach leveraging both quantitative and qualitative research methods was deployed. Accordingly, **381 beneficiaries** were selected on sample basis out of a total of 21,322 beneficiaries for quantitative survey. In addition, consultations were conducted with relevant stakeholders including communities, committee members and key personnel. These consultations were held through **9 Focused Group Discussions (FGDs) and 1 In-Depth Interview (IDIs) and 1 Key Informant Interview (KII) with PRI members.**

Additionally, **49 physical visits** through purposive sampling for Community level & individual level water structures were conducted.

Brief Profile of respondents:

Majority (63%) (N= 381) of the study respondents were females. The prime reason observed for this was due to active involvement of female in the CBOs formed as a part of the intervention. Another possible reason for higher participation was that the survey was conducted during daytime when most of the male members of the family were at their workplaces. The average age of respondents was 45 years. The highest number of respondents i.e., 77% belonged to the Other Backward Caste, while the lowest percentage belonged to the Scheduled Tribe 1%.14% of the total respondents belonged to the General category. Additionally, when questioned about home ownership, 91% of the respondents claimed to have their own house.

Key findings:

Soil and water conservation structures

Beneficiaries of this intervention were provided with water conservation structures at both individual and community level as well basis the requirement such as rooftop rainwater harvesting systems, open well recharge, gully plugs, subsurface barriers etc. to support them with better irrigation and water related facilities.

- Prior to the intervention, most of the **challenges** highlighted by the Community members were related to Agriculture, thus affecting the livelihood of the people. Majority of respondents i.e., 40% (n=381) mentioned **insufficient water availability for agricultural purpose as their biggest challenge**. Similarly, 37% attributed lack of water to **reduced agricultural productivity** as a challenge because productivity was not as expected due to lack of water availability.

- 49% (N=381) of the respondents reported to receive support from a small & big pond deepening at village level and individual level as well while 34% mentioned receiving support as a part of project in the form of construction of check dams. The main purpose of creating a check dam was to facilitate the availability of water especially for irrigation purposes.

- Beneficiaries claimed that **Water Absorption Trenches (WAT)** led to **improvements in soil moisture**, **reducing loss of trees** compared to the previous year. However, the trenches were observed to be partially filled with soil indicating effectiveness in capturing eroded soil. Periodic maintenance involving clearing and reusing the captured soil within the WATs will ensure sustained benefits.

- Some **Gully Plugs** were observed to be broken, or partially or completely submerged by sediments. It was reported that flash floods in 2021 and 2022 had resulted in high river flows which damaged these gully plugs.

However, it was observed in Vadhyarchalla and Chullipallam, that, the gully plugs were **effective in capturing silt and improving soil moisture** nearby. Periodic maintenance involving clearing the captured silt, repairing the boulder cages, or restoring damaged gully plugs are required.

- Under the project, **Rooftop Rainwater Harvesting** was provided to 73 households. Each house was provided with gutters (if required) to collect rainfall from the roof, rooftop rainwater collection pipe, first flush, filters and 5,000 litre water storage tanks. 62% respondents of 22 surveyed beneficiaries, reported receiving trainings on the operation & maintenance of structures whereas 24% of them mentioned about sharing in cost establishment. Majority of the respondents (57%) who have been benefitted through RRWH system reported that the tank constructed to store water was filled to its full capacity. **Beneficiaries reported that earlier between the months of March to July the community members used to face water scarcity especially for drinking water which has stopped after intervention**.

- Rainfall was captured from rooftops and recharged into wells as part of the **Open Well Recharge** initiative, which included private as well as communal wells. Water from these wells predominantly **used for household purposes** other than cooking and drinking, as reported by 90% of the respondents. Piped water supply was preferred by beneficiaries for drinking and cooking. In case of disruptions to piped water supply, the well water is also used for human consumption. Some beneficiaries claimed improvements in taste, colour and smell of the well water.

- As part of the **Open Well Restoration** initiative, since household connections with piped water supply from the Malampuzha project have become available, dependence of the communities on open wells has reduced. As a result, the continued maintenance of the restored wells was found to be lacking in some areas.

- **Small & Big Pond Deepening** - respondents reported that after the intervention most of the ponds **no longer dry up in summer**, whereas earlier, they used to dry up completely during summer months. The water availability during the year was reported to have increased. It was also reported that post-intervention, farmers could **grow crops twice a year**. Increased water levels have supported nearby Paddy cultivation as well as promoted pisciculture.

- **Farms Bunds** reported to have **reduced run off and resulting erosion of the soil**. As a result, beneficiaries reported to have benefitted through **increased soil moisture and retention** of soil within their farms. This has enabled the farmers to undertake farming in those areas where farming was not possible earlier. **A significant impact of the intervention was that it has facilitated the farmers to do multiple crop farming.**

- **Subsurface Barriers** were perceived to have resulted in improved soil moisture to the neighbouring areas. For example, a farmer in the paddy fields near Kovilpalayam subsurface **barrier perceived improvement in soil moisture** since the structure was constructed.

- Construction of **Check Dam** was reported to have resulted in **increased availability of water for irrigation** enabling farmers to take **two crops in a year**. Ettadithode check dam was observed to be filled with silt and is required to be desilted to store and recharge water.

- The Volumetric Water Benefit Accounting (VWBA) method was used to estimate the benefits from the soil and water conservation activities. The total annual volumetric water benefits estimated are:
    - 146,502 KL/year for the conceptual design condition
    - 131,809 KL/year are the potential benefits likely considering current conditions.

Community Capacity Building and Promotion of Organic Farming

Under this component, beneficiaries were provided training and input materials aimed at improving knowledge, awareness, and skills.

- 52% (N=381) of respondents reported **lack of knowledge about organic farming before receiving training** under the project. About 19% of the respondents who were practicing organic farming even before

the intervention, reported lower yield as compared to the conventional (non-organic) farming during initial years.

- 46% of the respondents reported to have **improved their knowledge about Organic Farming, post intervention**. Moreover, 42% of the respondents reported **increased productivity**, and 36% of the respondents perceived **improvement in quality of produce** and 28% perceived improved nutrition levels for family members due to reduction in the use of chemical fertilizers.

- The intervention of **Nutrition Garden** has resulted in providing the community **access to healthier and more nutritious food**. Moreover, through nutrition gardening, beneficiaries were reportedly **saving INR 2,610/- every year** which was previously spent on buying vegetables from the market. The intervention has enabled people to **grow vegetables of their choice** and the results have motivated others in adopting Nutrition Garden. All the beneficiaries (100%) are using the nutrition garden produce for their household consumption and 16% are selling some amount of compost to their neighbours and 11% are selling in the market.

- 41% of the respondents from Pudussery east village were reportedly producing more than 36 kg of compost every year through **Pipe Composting** and 47% of them from same village (Pudussery East) were reportedly **selling the compost**. In Pudussery east, people having small patches of land have started using the land for nutrition garden as well as pipe composting. On an average, beneficiaries were **earning INR 2,600/- every year** through selling compost, produced through pipe composting.

- The **Water Management Committees (WMC's)** reported to manage water conservation structures and distribution of water for irrigation as well as domestic purposes. However, a general lack in maintenance of community related water conservation structures was observed.

- As reported b**y Farmers Producer Organization (FPO)** members the effectiveness of the FPO was limited due to the fact that the farmers were not properly aware of the functioning of the FPO and lack of access to market for organic produce.

Recommendations

Basis the key findings from the analysis and the impact created under the project, the brief of recommendations for the management's considerations are mentioned below:

Soil and water conservation

Define, map, and characterize the study area

- Identifying and defining the physical scope/ boundary is the foremost step in the water stewardship program. The physical boundaries define the area from where relevant information is required to be collected. As a standard practice physical scope should include relevant (location of the Site or location of the source of water) catchment but it can extend to the applicable administrative boundaries. It is important to define and map the study area in the context of site operations to be able to claim the benefits from the interventions to off-set the Site's impact.

- For Haritha Samrudhi Project Phase 1, Pudussery Gram Panchayat is identified as the intervention area. The water related problems faced by this area are documented in the Proposal and Project Completion Reports to a broad extent. However, no formal mapping of the area or its water bodies has been done. The location of UBL's Site with respect to the study area has also not been defined or mapped.

- Study area should be defined in the context of Site operations i.e., water withdrawal, wastewater discharges etc. The study area can be in the form of watershed, or buffer area cantered around the Site. However, if the source of the water for the Site is located at a distant location, a different study area may be selected.

- Once the study area is defined it should be mapped accurately using appropriate tools such as GIS software or similar tools, indicating locations of key features such as location of the Site, boundaries of the study area, location of the source of water, locations of wastewater discharge, administrative boundaries etc.

- Further, the study area should be characterized for natural and anthropogenic features such as topography, hydrology, hydrogeology, geology, land use pattern, water usage etc. Catchment areas of structures such as waterbodies and check dams must be delineated and mapped using topographic data. Analysis of the historical land use in the study area may also be beneficial in choosing the locations for intervention.

Identification, and mapping of intervention area

- The intervention areas should be identified clearly and mapped using appropriate tools such as GIS software, revenue maps, topo-sheets or other appropriate method, to show point location as well as areal extents of the target intervention. For structures such as farm bunds and WATs, areal extents of the intervention should be used to define the location.

- Any catchment areas or command areas identified must also be mapped along with the target structure.

Monitoring and tracking of quantifiable indicators

- Key Performance Indicators (KPIs) for monitoring and tracking the continued benefits of the project were defined in the Operation and Maintenance Plan. However, no records of monitoring the defined KPIs were provided. Interventions are recommended to be **monitored and tracking** based on predetermined quantifiable indicators at regular intervals of time during the project duration, especially for interventions located in public spaces such as ponds, check dams, etc. This will enable quick identification of project impact, and any potential issues to be addressed. The duration of monitoring and evaluation could be annual post project closure if and till such time that volumetric water benefits are claimed from the project.

Record keeping and documentation

- Assumptions, claims, objectives, steps, methodology, quantifiable data, and project specific outcomes at both pre and post implementation stages need to be documented in detail in baseline assessment report/endline assessment report as appropriate. Any changes in assumptions from year to year shall be described. Methodologies for selecting interventions and their locations shall be described in a scientific manner including descriptions of hydrology, hydrogeology, land use, structural considerations, etc. It is recommended that the project completion report shall present a complete overview of project activities from baselining to completion.

- When technical information such as structure dimensions or volumes are quantified, it is recommended to clearly state the unit of measurement and to use consistent units throughout the documents. Use of the SI-unit system is preferred.

- UBL may consider developing an internal standard operating procedure (SOP) defining minimum expectations from implementing partners with respect to baseline and endline assessments, documentation and reporting.

Continued stakeholder engagement

- It is recommended to have a tapered exit approach and maintain continued engagement with stakeholders of the project even after completion to ensure the regular operations and maintenance of all the provided infrastructure according to the training provided. This practice may facilitate identification of long-term impacts of the project as perceived by the community while also identifying scope for future community related projects. Stakeholder engagements shall be continued on an annual or bi-annual basis before monsoon season if and till such time that volumetric water benefits are required to be claimed from the project. It will also depend on the project duration of the CSR project.

- There are no standard timelines set for the duration of such engagement. However, Government of India has provided indicative timelines in Common Guidelines for Watershed Development Projects (2008). Accordingly, the guidance has suggested a phased approach as given below.

Phase	Name	Duration	Indicative actions
1	Preparatory phase	1-2 years	This phase aims at developing a mechanism for participatory approach and empowerment of local communities, institution. Undertake baseline assessment, prepare DPR etc.
2	Watershed works phase	2-3 years	Implementation of planned initiatives
3	Consolidation and Withdrawal Phase	1-2 years	Capacity building, allocation of roles and responsibilities, repair and maintenance, involvement of gram panchayat in addressing above aspects etc.

Community Capacity Building

- Limited involvement of the community-based institutions and their members was observed in ensuring the sustainability of the interventions. CBOs were formed with the purpose of mobilizing the community and supporting them in training and increasing awareness. However, it was observed that CBOs were not clear about their roles as a part of the project. Similarly, Water Management Committees formed within the project should be made responsible for the maintenance of all the community water structures created/ rejuvenated under the project. It was observed that the some of WMC's are not proactively taking responsibility for the assigned responsibilities. For instance, it was observed that in only one village WMC has initiated pisciculture in one of the big ponds and is maintaining the structure, but in other villages no such initiative /efforts were observed to ensure the maintenance of the water structures Hence, there is a need to ensure greater ownership for maintenance and sustainability of the structures by imparting regular trainings and conducting meetings during the project period and prepare some of the Key opinion Leaders who can steer the responsibility after the exit of UBL for strengthening the said institutions.

- Beneficiaries mentioned about the high cost of cultivation for organic farming due to which some of them suggested for **adoption of micro irrigation techniques such as solar-based mini sprinklers and drip systems** which can help in reducing water consumption, electricity cost, and effort required for irrigation. Moreover, such systems are known to enhance yield and hence, **can help in improving farm income of the local farmers**. Department of Horticulture, Govt. of Kerala provides subsidy support to farmers while purchasing mini-sprinklers and drip systems. The project can create **convergence with the Department** to ensure that the farmers are able to benefit from such schemes.

- Awareness among the FPO members about the purpose of forming a FPO and its functioning is most crucial part to make it sustainable. The newly added FPO members from Pudussery village were still identifying themselves as members of the earlier Farmers Welfare Association of their village. The project needs to ensure that the FPO members are aware about all the aspects and functioning of a FPO and the benefits that they can avail being a member of FPO viz. Access to marketing platform for selling the produce**.**

- In the next phase of the project, opportunities can be explored that the **FPO members are trained on leadership aspects and management of the FPO** which will be crucial to strengthen and sustain the institution. Further, **enabling the FPO leadership and staff to take informed decisions** based on real time market information using appropriate technologies such as eNAM (National Agriculture Market), Agmarknet, NCDEX, etc. to ensure that the FPO operations are profitable and viable in the long run.

- One of the major challenges with the farmers was lack of the technical know-how on production and usage of organic/ natural inputs. To overcome this challenge, **Farmer field schools, pilot plots, exposure visits and seed trials can be organized to give practical training to farmers on organic farming techniques.** CBO members can act as Master Trainers (provide regular technical and handholding support to the farmers) to create an effective extension model. **Identifying synergistic farming** (e.g., agroforestry and interact

cropping/ mixed cropping/ crop rotation models) and **training the farmers on adoption of such systems** can further help in improving soil health and farm productivity**.**

- **Convergence with Government schemes can be explored for the communities'** benefit. This would lead the project towards better resource efficiency. The Department of Horticulture ("Mission for integrated development of horticulture" State Horticulture Mission Kerala, Govt. of Kerala which also promotes Organic farming) has different schemes under which seeds, organic input material, manure etc. is provided at a subsidized rate to farmers. Opportunities can be explored to leverage such schemes and assist the local farmers in benefitting from such Govt. Initiatives.

A detailed analysis of the assessed impact of all the interventions can be found in the Key Findings section, and Recommendations can be found in the section titled in the report.

2. Introduction & Background

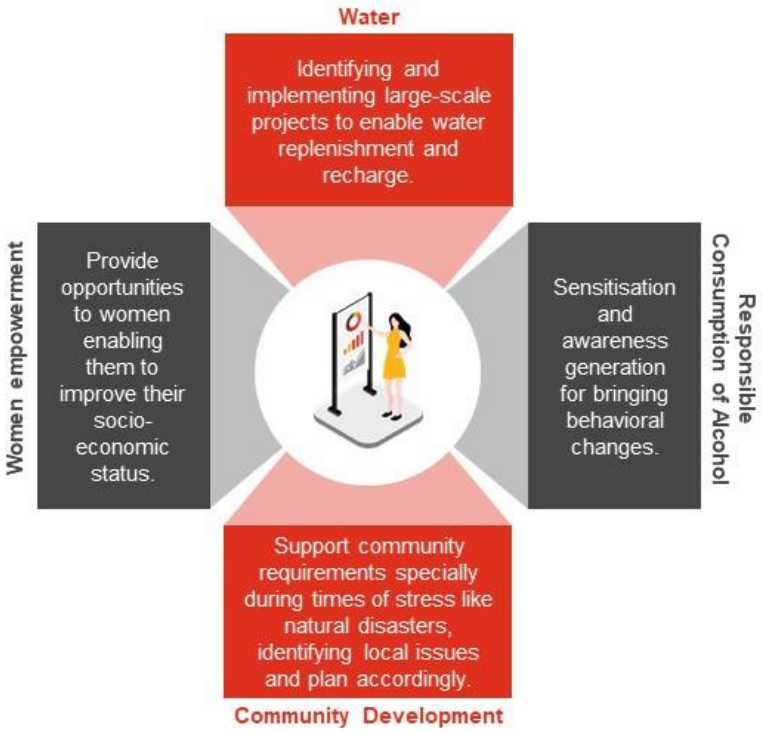
Introduction & Background

2.1. About United Breweries Limited (UBL)

United Breweries Limited (UBL) is an Indian company headquartered in Bengaluru, Karnataka. Its core business includes social beverages (alcoholic and non-alcoholic). Through its Corporate Social Responsibility (CSR) interventions, UBL intends to contribute to the preservation of environment & create social capital in the focus areas of water, women empowerment, community development and addressing harmful use.

The Company has its presence across different locations in India and has a strong focus on enhancing the quality of life of the local communities residing around its breweries and to minimize the impact of its business operations. UBL has integrated CSR in its corporate strategy and intends to drive it with a vision to bring about sustainable social development for its co-communities. To attain the same vision, the Haritha project – Phase 1 was executed and the project details of the implementing partner and about the project has been given below.

Figure 1: Key CSR thematic areas of UBL



2.2. About Haritha Samrudhi Project

Haritha Samrudhi Project – Phase 1 has been one of the CSR initiatives of UBL CSR Programme and implemented by UWB implementing partner of UBL. The Project was implemented from .2019 to 2022. The aim of the project was to promote water conservation and to create sustainable livelihood opportunities for the local community in Pudussery Gram Panchayat of Palakkad District in Kerala through:

- promoting Climate Resilient agricultural Practices
- water and soil conservation efforts and

- capacity building of the local community involvement for management and preservation of the natural resources.

The activities taken up under the project are from two perspectives: (i) community involvement including capacity building and (ii) creation/ rejuvenation of soil and water conservation structures

The details on these interventions are covered in the subsequent chapters.

The project was aimed at creating capacity building and creation/ refurbishment of physical infrastructure for soil and water conservation efforts as presented in Table 1.

Table 1 Overview of the Project Activities

Project Activities			
Community Capacity Building		**Water Conservation Structures**	
Project Output	**Quantity**	**Project Output**	**Quantity**
Formation of CBOs	20	Big Pond Rejuvenation	04
Water Management Committee	05	Open Well Restoration	10
Farmer producer organization (FPO)	01	Open Well / Bore Well Recharge	500
Setting up growth promoters and pest repellents	100	Roof Top Rainwater Harvesting Units	50
Training and establishing pipe composting units	200	Gully Plug	150
Nutrition Garden	1,000	Small Pond Deepening	15
Integrated organic farming (acres)	200	Water Absorption Trenches	5,000
Tree Plantation	10,000	Formation of Farm Bund Sub Surface Barrier	04
Organic System of Rice Intensification (acres)	20	Check Dam	02

2.3. About United Way Bengaluru

United Way Bengaluru (UWB) is a Non-Governmental Organization (NGO) and was roped in as the implementation agency for this initiative.

The organization is dedicated to enhancing individual well-being and tackles pivotal issues like climate change, water management, education, healthcare, and livelihood. Some of the major programmes taken up by UWB are: 'Wake the Lake,' 'Born Learning,' and 'Integrated Rural Development.'[1] The UWB is the implementing partner of UBL for Haritha Samrudhi project phase -1. With a view to streamline its efforts and gather necessary cooperation at the field level, UWB roped in People's service Society Palakkad (PSSP) as local partner for this Project.

[1] https://www.uwbengaluru.org/

2.4. Scope of Work for the Impact Assessment

PW has been engaged by UBL for conducting an Independent Impact Assessment of the project titled "Sustainable Livelihood through Climate resilient practices in Pudussery Gram Panchayat, Palakkad District, Kerala."

The scope of work for this assignment includes:

Understanding the Project implementation plan and process followed, reviewing the Key performance indicators (KPIs) as defined by the Management under the framework for implementing the CSR Project for the outputs, outcomes and impact of the Project. The framework would be Inclusiveness, Relevance, Efficiency, Convergence framework (the 'IRECS') and provide recommendation on the Project performance for Management's evaluation.

As part of the scope of work, PW has assessed the following:

1 Undertake review of all the activities implemented under the above-mentioned Project.

2 Assess the quality of the infrastructure created through the Project.

3 Evaluate the status and usage of the structures created.

4 Assess community awareness around water conservation - Undertake site visits for review of the data and conduct one on one meetings with the NGO, Gram Panchayat and community to assess the effectiveness, efficiency & sustainability of the Project.

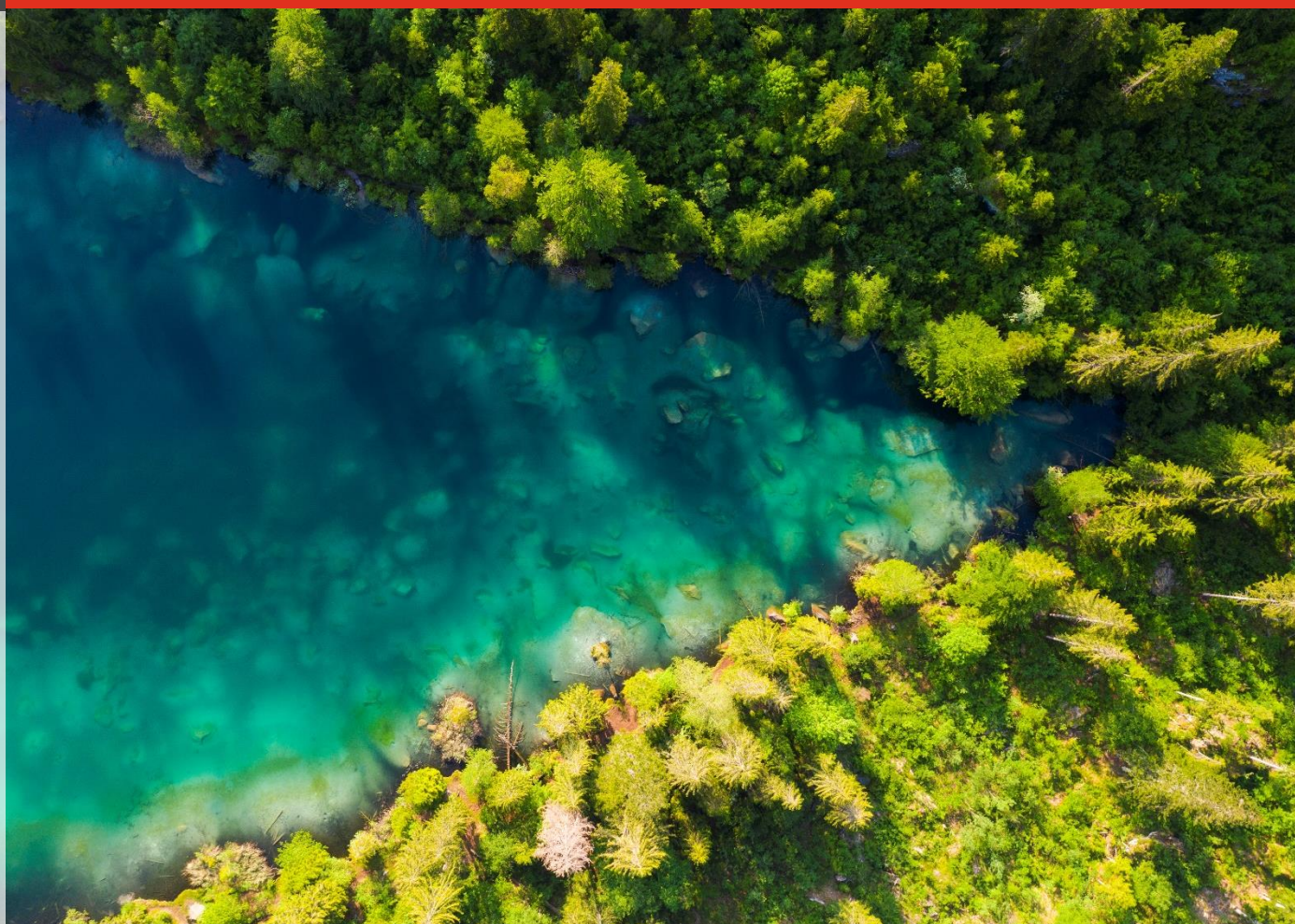
5 Derive the standard framework basis national and international guidelines on calculations for measuring water recharge and rainwater harnessed.

6 Review of Project data provided by NGOs against this framework - Prepare Gap assessment report by comparing the water conservation data from Projects with Brewery level data on water consumption to understand the impact towards water balancing relevant best practices or guidelines (e.g.: Volumetric Benefit Accounting methodology or VWBA method). Assessment of program results (Outputs, outcomes & impacts) through stakeholder Key Opinion Former's (KOF) survey to develop KOF survey perception index and review of social benefits associated with the Projects and the overall impact on the community.

7 Drafting and submission of an Impact Assessment Report and a presentation.[2]

[2] Scope of work has been taken from EL signed.

3. Approach and methodology

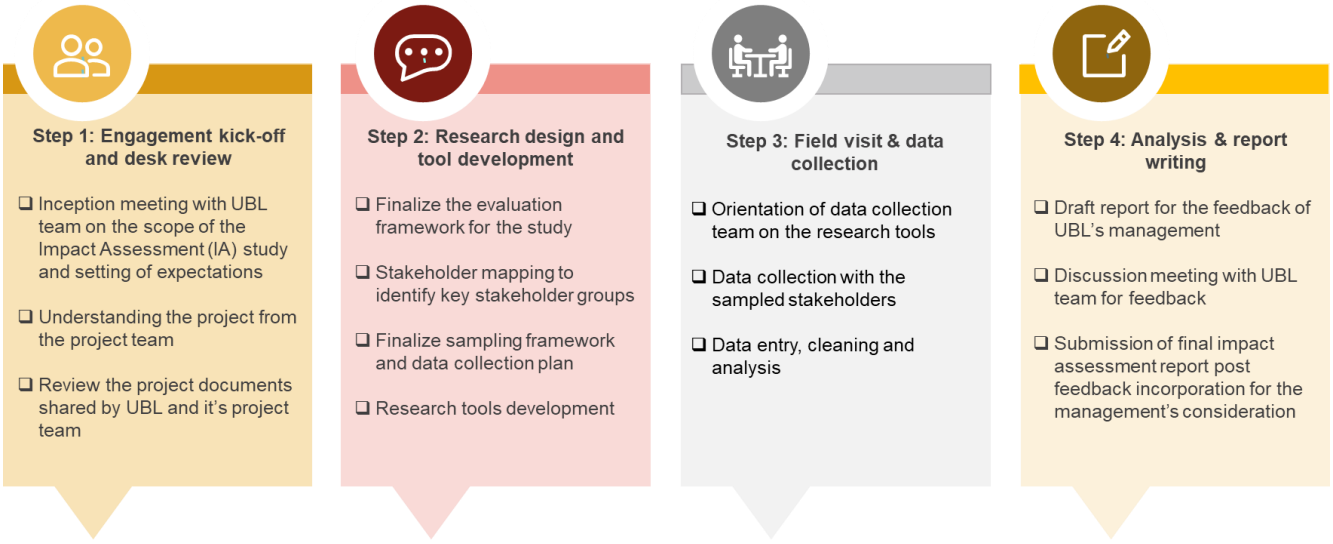


Approach & Methodology

3.1. Overall Methodology

The impact assessment study used an integrated and cohesive approach to assess the social impact of CSR project Haritha Samrudhi Phase-1 implemented by United Breweries Limited (UBL) in Palakkad, Kerala. The following step by step approach enabled the PW team to evaluate the direct and indirect impact on the lives of project beneficiaries. coming from marginalized section of the society:

Figure 2: Overall methodology for the assessment



Step 1: Engagement kick-off and desk review

The impact assessment was initiated with having kick off meeting with the project team of UBL and the implementation partner. The meeting was conducted to discuss the overall scope of work, align on the expectations of the UBL team from the assessment, and gaining a detailed understanding of the Haritha Samrudhi project. Post the meeting, a list of required documents for initiating the impact assessment was shared with the SPOCs from implementing partner. Once the documents were received (i.e., Progress reports, project closure reports, activity wise details and other projects specific documents etc.) the desk review of the documents was conducted and an overall approach for undertaking the assessment study was finalized in consultation with the UBL team.

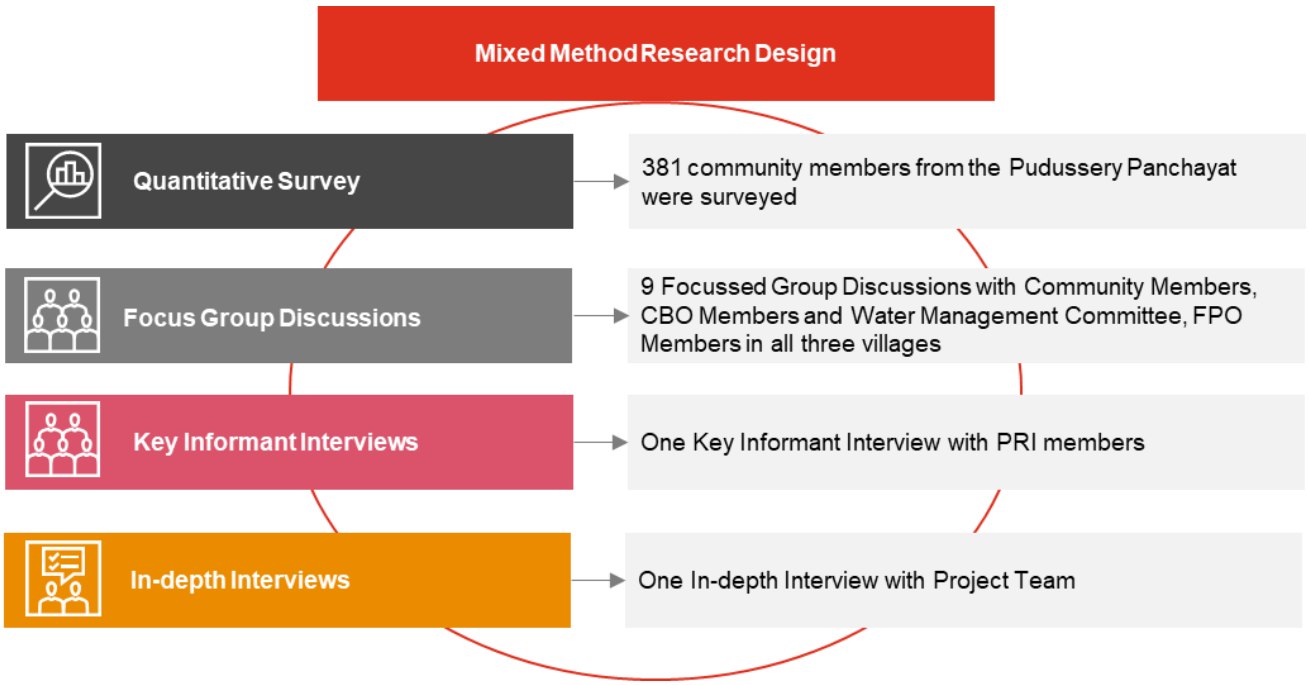
Step 2: Research design and tool development

Based on the detailed documentary review and the subsequent discussions held with UBL Team, the PW team developed understanding about the monitoring and implementation process for the Haritha Samrudhi project Phase 1. The Impact assessment study was guided by IRECS assessment framework which was used to provide overall feedback on the efficacy of implementation as well as its efficiency in achieving the desired project outputs with reference to inputs. Additionally, a gaps assessment was conducted using the VWBA technique to identify the gaps which has been described in detail in section 3.1.1.

Figure 3: IRECS Framework

After finalizing the assessment framework, team initiated the mapping of the stakeholders to draw the sample size for the purpose of impact assessment. The key stakeholders' groups were identified for the project to undertake the quantitative and qualitative interactions with the identified project stakeholders. Post mapping of the key stakeholder groups in consultation with the UBL, the team started developing the research tools for data collection process. The assessment adopted a mixed method approach (mix of quantitative and qualitative) which also included physical visits to the water conservation structures developed under the project.

Figure 4: Research design and tools used for the assessment



Quantitative Research

For the quantitative interactions, the sample size was calculated keeping in mind the statistical measures so that results and inferences drawn from the sample could be extrapolated for the larger universe of beneficiaries. An estimated sample size of 381 was calculated at 95% confidence interval (CI) and 5% margin of error after adjusting for the population was taken for the study. A proportionate sample was drawn from villages where the interventions were implemented. The formula used to calculate the sample size for quantitative interactions is mentioned below:

n' = n/1+ {[z2 * p (1-p)]/m2*N}

where the parameters are.

- n' – sample
- Z is z score depending on Confidence Interval (in this case CI = 95% and z = 1.96)

n = z2 * p(1-p)/m2

- N = population size (depending on individual projects as obtained from each project MOA)
- M = margin of error (5%)
- p = population proportion (considered as 50%,0.5)

Sample Selection:

The entire Pudussery Gram Panchayat was covered for the study. The Pudussery Gram Panchayat comprises of three (03) villages namely, **Pudussery West, Pudussery East & Pudussery Central** with **23 habitations** within them. All 23 habitations were covered under Haritha Samrudhi project phase -1. Some selected habitations were visited for qualitative interactions and for quantitative all 23 habitations were visited for the study purpose. The village wise sample was proportionately distributed among the three villages based on the proportion of its population, as per the details shared by the implementing partner.

Quantitative Data Collection: Village wise sample size

Table 2 Village wise sample for quantitative data collection

Village	Total population	% of total population	Village wise Sample
Pudussery West	6,155	29%	110
Pudussery Centre	5,570	26%	100
Pudussery East	9,597	45%	171
Total	**21,322**	**100%**	**381**

A consolidated list of beneficiaries covered under the project was provided by the implementation team out of which sampled beneficiaries were selected to cover under the study. Since, same beneficiaries were covered under multiple activities within the project, support was solicited from the implementation partner to identify the unique beneficiaries under each of the project activities. In cases where the beneficiaries were benefitted from more than one intervention, the responses were solicited with respect to applicable interventions. Village wise sample was proportionately distributed in all three villages based on the population of the villages.

Selection of villages and hamlets for the sample survey was done based on a number of activities conducted in each village. The below Table provides the distribution of the sample among three villages and the habitations within these villages which were covered as a part of the study are as follows:

Table 3 Village wise sample coverage during the study

Village Name	Habitation Name	Sample covered	Village wise sample covered
Pudussery East	Attapallam	91	171
Pudussery East	Chullimada	4	
Pudussery East	Pampapallam	14	
Pudussery East	Pettakad	62	
Pudussery West	Chodyankalai	58	110
Pudussery West	Kolaikodde	52	
Pudussery Central	Chullimada	16	100
Pudussery Central	Kanjikode	17	
Pudussery Central	Kanjikode South	67	

Based on the nature of intervention, activities were divided into two segments Soil & water conservation activities and Community Capacity Building initiatives, out of which some of were individual specific and rest community centric initiatives. The sample of 381 beneficiaries covered under the study included beneficiaries of both, individual centric as well as community centric initiatives. The distribution of intervention wise sample between the villages is described below.

Intervention Wise –Sample size

Sample for Rooftop Rainwater Harvesting (RWH) was selected by proportionately distributing the total beneficiary covered under the activity in each village whereas for activities like Pipe composting, Integrated Organic Farming and Nutrition Garden the sample has been distributed equally among all the three villages. As per the details shared, the activity pertaining to Organic System of Rice Intensification (OSRI) was undertaken only in Pudussery Central village hence, the sample beneficiary was covered from this village only.

Table 4 Intervention wise sample coverage

S. No.	Village Name	Nutrition Garden	Pipe Composting	OSRI	Rooftop RWH
1	Pudussery East	37	7		5
2	Pudussery West	37	7	12	2
3	Pudussery Central	36	6		15
	Total	**110**	**20**	**12**	**22**

Sampling methodology used for the for selection of activity wise sampled beneficiaries is described below. The details of the selected sample size for activities are as mentioned below:

Table 5 Intervention wise details of sampling methodology

S. No.	Type of Initiatives	Details of activities	Project Beneficiaries	Sample Beneficiaries	% of project beneficiaries
1	Community Capacity Building	Training and establishing pipe composting units	200	20	10%
2		Nutrition Garden	1,100	110	10%
3		No. of farmers covered on OSRI	20	12	60%
4	Soil & water Conservation	Roof Top Rainwater Harvesting Units	73	22	30%
		Total	**1,413**	**164**	

The 164 beneficiaries of individual specific activities were part of 381 sample size. The sample size for the Pipe composting and Nutrition Garden was derived from the 10% of the total beneficiaries covered under the project whereas for the Rooftop RWH (30%) and OSRI (60%) of the total project beneficiaries were selected as sample size for the quantitative survey. There was a combination of activities which were covered through all 381 beneficiaries of the sample through quantitative survey that are mentioned below:

- Big Pond Rejuvenation
- Open Well Restoration
- Recharging Open Well / Bore Well/Private wells.
- Gully Plugs
- Small & Big Pond Deepening
- Water Absorption Trenches
- Sub-surface barriers
- Training on Climate Resilient Methods and Organic Manure Preparation
- Check Dams
- Tree Plantation
- Formation of Farm Bunds

Qualitative Research

Like the quantitative component, the qualitative component was conducted in the 7 habitations distributed in 3 villages. As indicated in the Table **6**, total **11 interactions** were conducted as part of the qualitative study. The following stakeholders were covered during the qualitative part of the study.

Table 6 Qualitative sample covered during the study

S. No	Stakeholders	Village	Method	Number of interactions
1	Community Members	Pudussery East	FGD	1
2.	Community Members	Pudussery West	FGD	1
3	Community Members	Pudussery Central	FGD	1
4	CBO Members	Pudussery East	FGD	1
5	CBO Members	Pudussery West	FGD	1
6	CBO Members	Pudussery Central	FGD	1
7	Water Management Committee	Pudussery Central	FGD	1
8	FPO Members	Pudussery East	FGD	1
9	Water Management Committee	Pudussery West	FGD	1
10	PRI members	Pudussery	KII	1
11	Project team of PSSP	Pudussery	IDI	1
	Total			**11**

Step 3: Data Collection and Field visit

Post finalization of the field plan, the research team from PW was oriented on the research tools (quantitative and qualitative) and dos and don'ts on the field. The field visit plan for data collection purpose was finalized in consultation with UBL and the implementing partner. The methodology for the data collection of benchmarking and gaps assessment of the water structures visited was done using the VWBA which is described in section 3.1.1. Review from a civil perspective was not scope of the engagement. Once the quantitative and qualitative data was received from the field, data entry and cleaning were carried out.

3.1.1. Assessment of water recharge structures

Benchmarking and assessment against best practice:

An assessment was carried out to assess alignment of the approach and methodology adopted by the implementing partner compared with best practices. A reference template list of evaluation criteria was developed for each type of the intervention based on available national and international standards and/or guidelines. In cases where such standards or guidelines were not available, published journal / research articles or technically relevant publicly available reports of reputed organizations have been adopted for drawing contextual conclusions on appropriate methodology. Similar approach was used for cross-validation of beneficial impact accounting done

by implementation partner. Approach for the gaps assessment of intervention was divided and evaluated in two (2) phases as: Pre-implementation and Post implementation phase.

- Listed below are the primary reference material used for this purpose:
- Volumetric Water Benefit Accounting (VWBA)": A Practical Guide to Implementing Water Replenishment Targets, developed by CEO Water Mandate
- Volumetric Water Benefit Accounting (VWBA): A method for implementing and valuing water stewardship activities developed by World Resources Institute (WRI)
- Manual on Artificial Groundwater Recharge, developed by Central Ground Water Board
- Soil and Water Conservation Structures, Dr N. S. Raguwanshi, Chapter 29 http://ecoursesonline.iasri.res.in/mod/page/view.php?id=125115
- International Water Stewardship Standard, developed by Alliance for Water Stewardship
- Guidelines for JSA Assessment, Centre for Technology Alternatives for Rural Areas, Indian Institute of Technology Bombay

In addition to the standard/ guidance documents, benchmarking assessment took into consideration documented project details and documents mentioned below as shared by the implementation partners in the form of report(s) and field observations based on visual survey of the project site location and its surrounding area.

The documents provided by the implementation partner that were reviewed include:

- Baseline Assessment Report
- Project Completion Report
- Achievement Reports for Year 1 and Year 2 of project implementation
- Observation wells data
- Case study writeups on various structures
- Spreadsheet detailing structure-wise list of beneficiaries, coordinates and dimensions called ‘Geographic Locations’.
- Logic notes on proposed activity
- Reports of meetings with community-based organizations
- Panchayat approval letters

Additionally, the benchmarking assessment involved site visits to the water recharge structures. The sample size of structure visits during field visits are presented in Table 7. Details of the observations from the site visits are presented in Annexure- 1: Detailed Findings of the structures visited.

Table 7 Number of water conservation structures visited during the field visit

Structure	No. of structures
Rooftop Rainwater harvesting	10
Well recharge	11

Structure	No. of structures
Open well restoration	10
Water absorption trenches	3 clusters
Gully Plugs	2 clusters
Check dams	2
Subsurface barriers	3
Farm bunds	3
Big pond deepening	3
Small pond deepening	2

Step 4: Data Analysis & Report Writing

After the data entry and data cleaning, the analysis was carried out to arrive at the insightful and overarching findings for each of the projects. The draft report was prepared accordingly, and key findings were discussed with UBL for obtaining their review and inputs. PW submitted the final report to UBL for management's consideration post incorporating the inputs received from the team.

3.1.2. Volumetric water benefit accounting (VWBA)

For benchmarking potential volumetric water benefits estimated by the implementing partner, methodology prescribed in the document titled "Volumetric Water Benefit Accounting (VWBA): A Method for Implementing and Valuing Water Stewardship Activities" [3] developed in 2019 by the World Resources Institute (WRI) in association with LimnoTech, Quantis and Valuing Nature has been uses as the basis. VWBA methodology provides water stewardship practitioners with standardized methods for implementing stewardship actions as well as quantify benefits of various water stewardship activities.

The VWBA methodology has been applied to quantify the volumetric water benefit of the following water recharging structures implemented as part of the project:

- Pond deepening
- Check dams
- Gully plugs
- Water absorption trenches
- Well recharge
- RRWH

[3] Reig, P., W. Larson, S. Vionnet, and J.B. Bayart. 2019. "Volumetric Water Benefit Accounting (VWBA): A Method for Implementing and Valuing Water Stewardship Activities." Working Paper. Washington, DC: World Resources Institute. Available online at https://www.wri.org/publication/volumetric-water-benefit-accounting

To calculate additional infiltration potential created from the activities, the Capture and Infiltration Method described in Appendix A-4 of the VWBA working paper was adopted.

The capture and infiltration method estimates the groundwater recharge based on three parameters as given below:

Groundwater Recharge Estimation	
01	**Available Water Supply** The volume of water draining from a catchment (runoff) corresponding to the intervention under consideration
02	**Volume of Water** Volume of water captured by the intervention under consideration
03	**Water Loss** Losses due to evaporation and usage (i.e., withdrawal)

Accordingly recharge volume is calculated using the Equation A as presented below:

1. **Recharge volume = Volume captured – [Evaporation + Withdrawal]**

   Where, volume captured (actual volume captured by the intervention) is considered as minimum of the volume of the available supply or runoff from the catchment and the storage potential as presented in Equation B.

2. **Volume captured = Min [Available supply, Storage potential]**

   Storage potential is the volume of water stored by the intervention under consideration during the assessment period. Accordingly, the storage potential is calculated as the volume of the intervention multiplied by the number of times the structure is filled to its capacity during the assessment period (Equation c).

3. **Storage potential = Design storage capacity x Number of times filled to capacity**

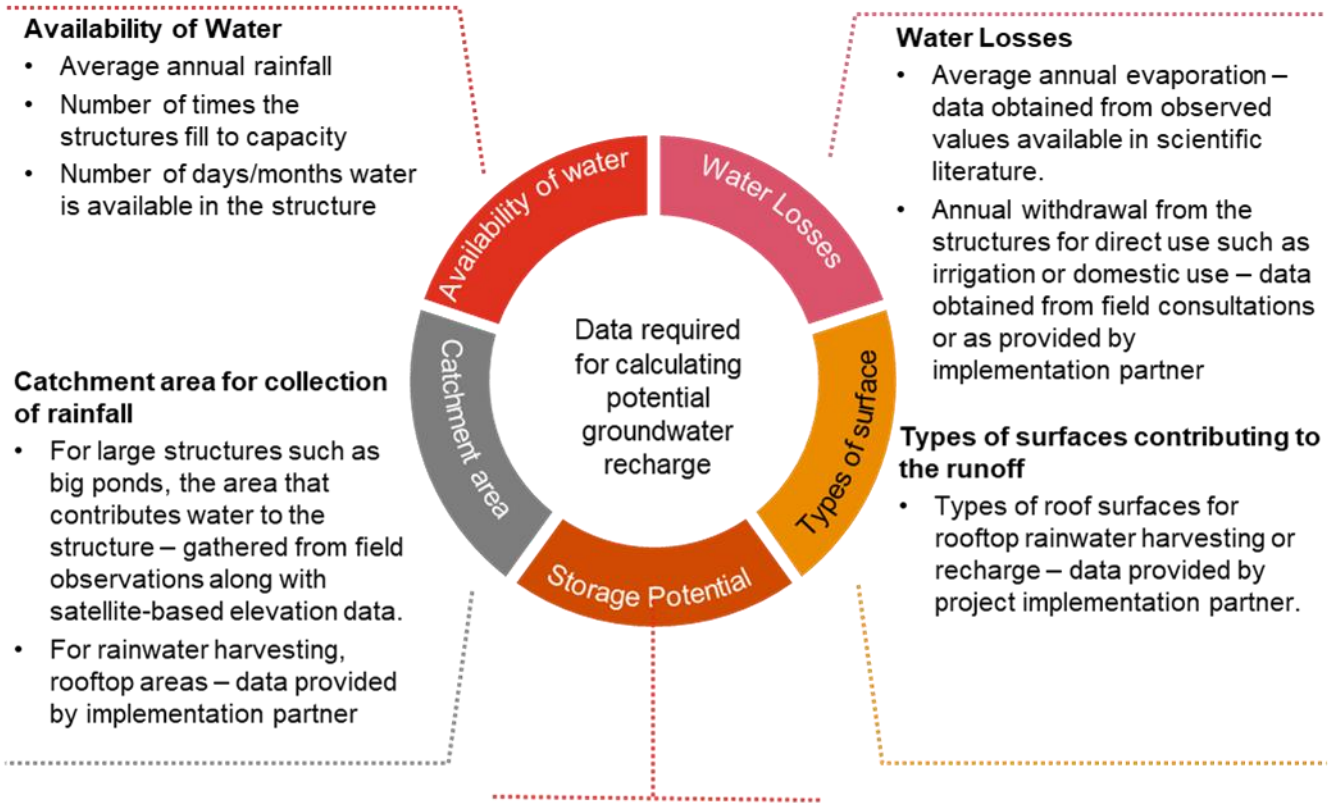
   Available water supply or runoff is calculated based on the catchment area, runoff coefficient, and the rainfall during the assessment period (e.g., year) as presented in Equation D.

4. **Available supply (aka runoff) = Catchment area x Runoff coefficient x Annual rainfall**

   For modified structures, these calculations are estimated for the baseline condition and then repeated using the improved storage capacity of the lakes after the rejuvenation activities. The difference would provide the additional recharge volume, or potential “volumetric water benefit” that has been created as a result of the project activities.

The data customarily used for calculation of beneficial impact of lake restoration using the VWBA method is presented in Figure 5.

Figure 5: Data requirement and used VWBA for lake/pond restoration activities



3.2. Assumptions and Limitations:

Assumptions and Limitations pertaining to this Study:

- Quality certification or attestation post review & analyses of quality of water infrastructure to the client was not part of the scope of work.
- The proposed sample for field inspection of soil and water conservation structures could not be met for some of the structures due to lack of accessibility.
- Technical assumptions have been made for the volumetric water benefit accounting which are enumerated in the report for each structure.
- Dimensions of ponds obtained from satellite imagery are not accurate due to distortion of satellite imagery as well as tree cover hindering the boundaries.

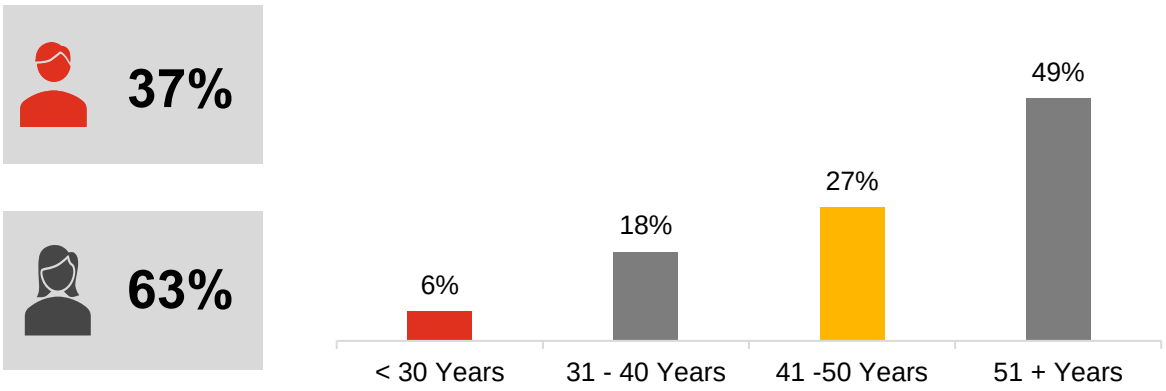
4. Key Findings

Key Findings

4.1. Profile of the Respondents

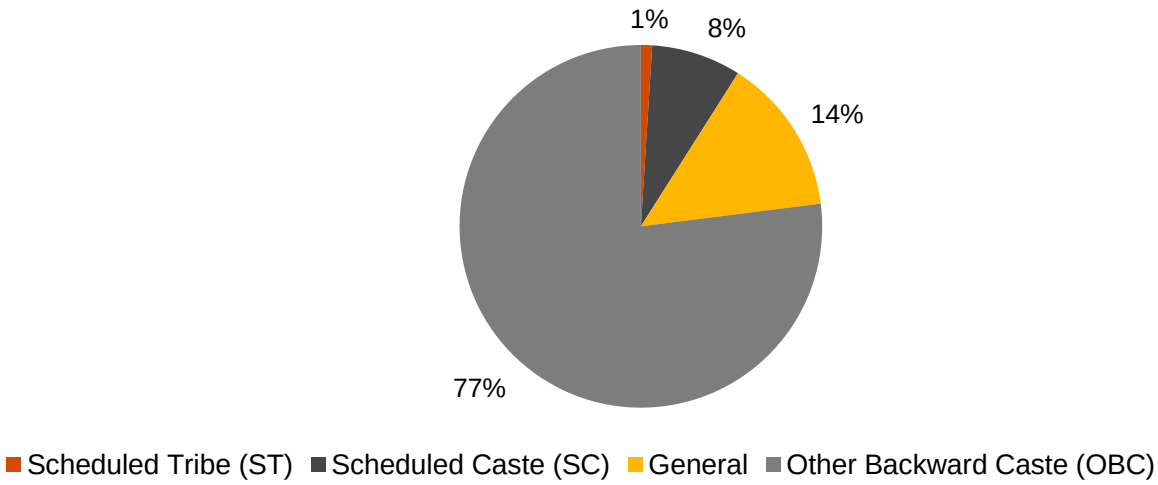
Majority (63%) (n=381) of the study respondents were females. The average age of respondents was 45 years. Refer below a snapshot of the distribution of respondents based on gender, social category, and economic profile.

Figure 6: Age of the respondents (n=381)



The highest number of respondents i.e., 77% belonged to the Other Backward caste, while the lowest percentage belonged to the Scheduled Tribe 1%. Whereas 14% of the total respondents belonged to the General category.

Figure 7: Social category wise distribution of Respondents (n=381)



One-third of the respondents (33 %, n=381) reported class 10th as their highest level of education, 7% of the respondents were reportedly illiterate. Three-fifth respondents (58%, n=381) reported to belong to Below Poverty Line (BPL) category. 99% of the respondents reported to have an Aadhar Card and an active Bank account in their name.

Figure 8: Education qualification of the respondents (N=381)

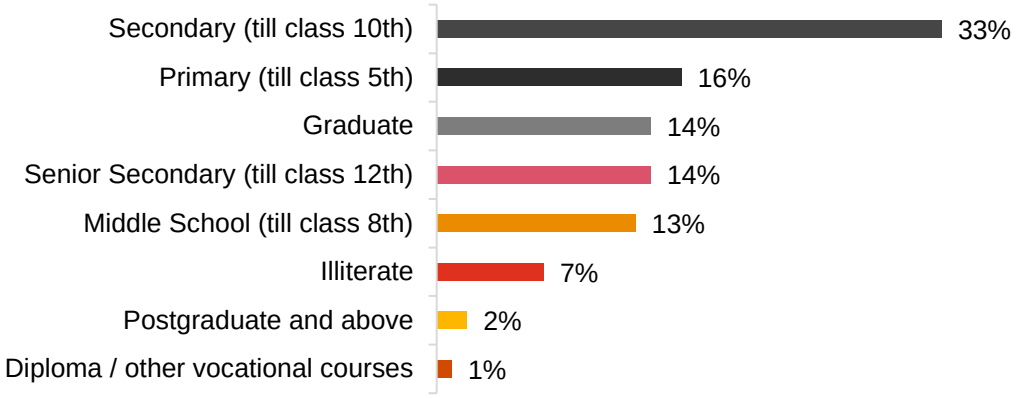
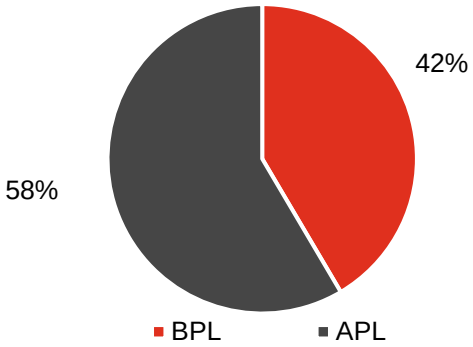


Figure 9: % of respondents Below Poverty Line (BPL) (N=381)



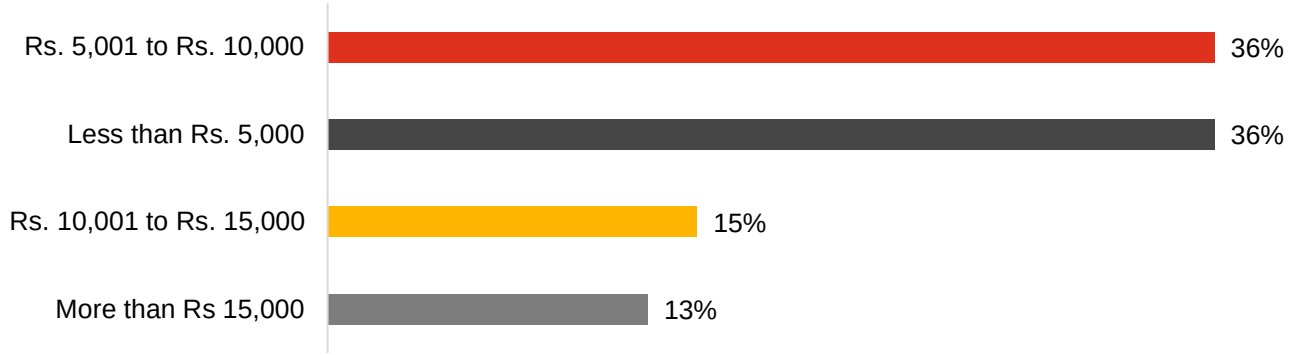
In terms of occupation, 30% of the respondents reported nonagricultural labor as the primary source of their income. One-fifth of the respondents reported not working.

Table 8 Occupation wise distribution of respondents (N=381)

Occupation of the respondents	%
Non-Agricultural Labor	30%
Not working	19%
Job: works in a private company	12%
Home-based worker / artisan/ handicrafts worker/tailor/Goat Rearing/Poultry	8%
Transport worker / driver/ conductor/ helper to drivers and conductors/ cart puller / rickshaw puller/ Migrant Worker	7%
No work, earns income from pensions/rent/interest	7%
Farming/Agriculture	6%
Job: works in a government organization	5%
Agricultural Labor	3%
Retail: shop worker/ assistant/peon in small establishment/ helper/ delivery assistant/ attendant/waiter	2%
Others	1%

Out of the total respondents (n=381), 72% stated that their average monthly household income from all sources was below Rs. 10,000, while 13% reported having an income exceeding Rs. 15,000 per month. Additionally, when questioned about homeownership, a significant 91% of the respondents claimed to possess their own house.

Figure 10: Household income per month from all sources (N=381)



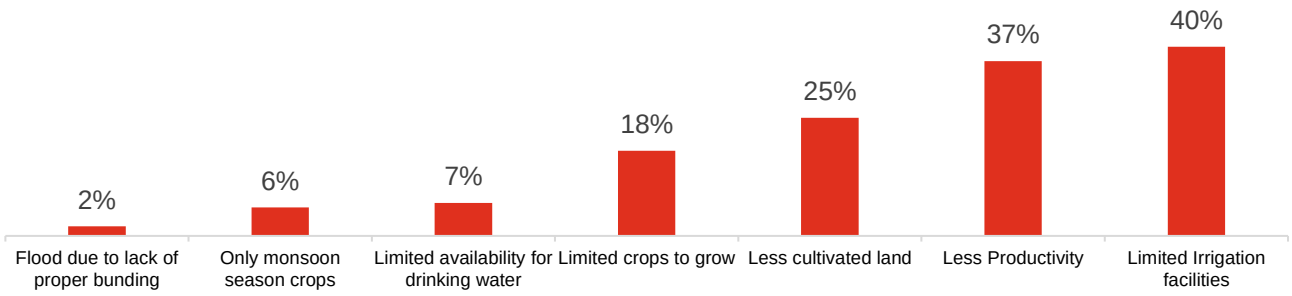
4.2. Soil and Water Conservation Structures

Water conservation structures that were built in this project including water absorption trenches, gully plugs, farm bunds, open well & bore well recharge, restoration of open wells, roof top rainwater harvesting, small & big pond deepening, sub surface barriers and check dams were created over a period of three project years with an objective to prevent soil erosion, improving ground water level and to improve soil fertility. In this section, details about each activity have been described along with the impact it has created on the lives of the community members. This section also talks about the challenges faced by the community before the intervention and the support provided under the project in terms of water conservation.

Challenges faced by the community before the intervention:

In order to understand the background of the project from the perspective of the community, challenges faced by the community before the intervention were asked pertaining to creation of soil & water conservation structures taken up under the Haritha Samrudhi Project Phase -1. Most of the challenges highlighted by the Community members were related to Agriculture, thus affecting the livelihood of the people. According to the majority of respondents i.e., 40% (n=381) mentioned limited irrigation facilities for agricultural purpose as their biggest challenge. Similarly, 37% reported about less agricultural productivity as a challenge because productivity was not as expected due to lack of water availability. Respondents also pointed towards issues like unclean drinking water and inadequate rainwater storage. People relied mostly on well water, which at times tasted salty and had minerals and was not considered healthy for consumption purpose. During the discussion, beneficiaries stated their major concerns about water quality such as water containing high levels of fluoride hardness in the water available within the village. It was also reported that lack of availability of water for irrigation led to reduced agricultural productivity.

Figure 11: Challenges faced before the intervention regarding water conservation (N=381)



Support provided to the community:

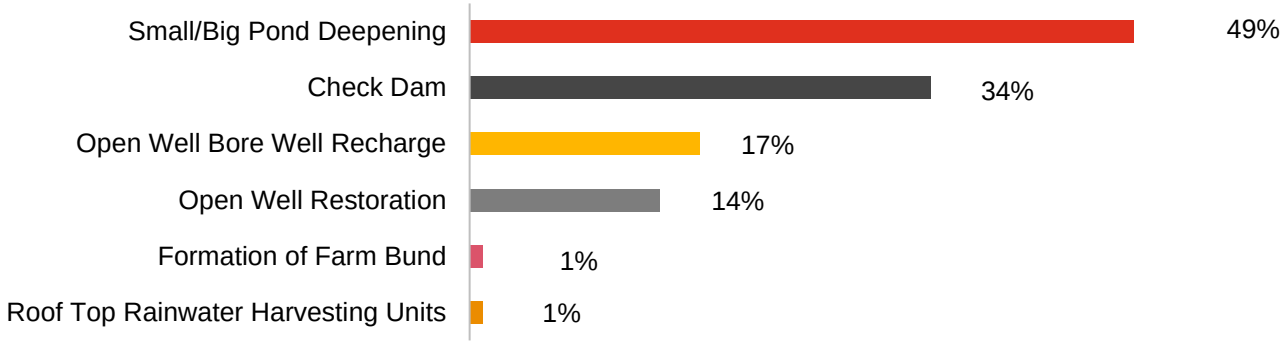
Haritha Samrudhi project provided multiple type of support to the community on the basis their needs and requirement of the village. 49% (N=381) of the respondents reported to receive support from a small & big pond deepening at village level and individual level as well while 34% mentioned receiving support as a part of project in the form of construction of check dams. The main purpose of creating a check dam was to facilitate the availability of water especially for irrigation purposes.

The beneficiaries of the rooftop rainwater harvesting structures were reported to have positively impacted mainly due to availability of storage for rainwater as well as water from the piped water supply. Recharge of open wells was reported to have resulted in increased availability of groundwater especially during dry season. Additionally, the open well recharge was also reported to have resulted in reduction in hardness and fluoride concentration in the groundwater.

Further, the deepening of big and small ponds which created additional storage capacity were reported to have resulted in increased availability of water through groundwater recharge as well as availability of water in the ponds during the months when the ponds used to go dry historically. The increased availability of water was reported to have facilitated farmers to take two crops in a year. In general implementation of water conservation structures such as gully plugs, sub surface barriers, check dams, farm bunds etc. were reported to have resulted in improved soil moisture and groundwater levels in the areas in vicinity of these structure.

The below mentioned graph depicts the percentage of respondents who were found to be aware of the programme and reported the various water related interventions made for the community within the village as a part of the Haritha Samrudhi Project.

Figure 12: Percentage of respondents recalling various water conservation works completed under the Project at the village level* (N=359)



**This is a multiple choice question. Hence, will not add upto 100%.*

Below section describes the details of each intervention implemented under soil & water conservation structures and the impact on the community people.

4.2.1. Water Absorption Trenches:

Water Absorption Trenches (WATs) are structures designed to harvest rainwater, allowing it to slowly infiltrate into the soil. They are typically utilized in areas prone to soil erosion, facing water scarcity.

Challenges Faced before the intervention:

During the interaction with the owner of the mango orchard who was one of the beneficiaries of the WATs, it was reported that the plantations used to get impacted due to lack of water for irrigation during dry seasons. As a result, the farmer reported the loss of about 10 trees in the previous year. Moreover, the run-off was reported to cause erosion of the soil and potential loss of fertile soil during the intense rains.

Impact created:

Beneficiaries claimed that **Water Absorption Trenches (WAT)** led to **improvements in soil moisture**, **reducing loss of trees** compared to the previous year. However, the trenches were observed to be partially filled with soil indicating effectiveness in capturing eroded soil. Periodic maintenance involving clearing and reusing the captured soil within the WATs will ensure sustained benefits.

Table 9 presents the estimates for potential volumetric water benefits due to WAT. The annual recharge potential from WATs is 9,645KL under ideal conditions where all the WATs are in good condition and function optimally. Considering the field observations, a 50% reduction is assumed due to the silted condition of the WATs and the current annual recharge potential is estimated at 4,822KL.

Table 9 Potential volumetric water benefits from water absorption trenches in terms of groundwater recharge

Project Activity	Number of structures	Water conservation estimated in Project Closure Report (PCR)* (KL/y)	Assumptions	Estimated VWBA (KL/y)	Type of benefit	Assumptions
Water absorption trenches	5,680	24,112	• 15 fillings • All WATs operate optimally. • Losses not considered	*Conceptual design condition*: 9,645 *Potential benefits likely considering current condition*: 4,822	Recharge potential	• 3 fillings # ^ • Current condition: 50% reduction due to silted condition observed. ^

* Estimations are as reported in the Project Closure Report, prepared in July 2022.
# Assumption used in estimation of conceptual design condition scenario VWBA
^ Assumptions used to estimate current VWBA
Number of fillings was estimated based on "Master Plan for Artificial Recharge to Groundwater in India – 2020, Central Ground Water Board, Government of India, October 2020" which recommends a consideration of 3 fillings for the Kerala region.

4.2.2. Gully Plugs:

Gully plugs are loose-boulder structures constructed across streams to slow down surface runoff and increase infiltration. Gully plugs are preferably constructed in 1st order stream with moderate to gentle slopes (2% to 5%) and they also serve to reduce soil erosion by accumulating silt.

127 gully plugs were constructed against the planned 150. 2 clusters (Vadhyarchalla and Chullipallam) were observed on site. The cluster at Chullipallam was observed to be in good physical condition. The gully plugs in cluster at Vadhyarchalla was observed to be broken and filled with silt. Damages included broken cages and collapsed gully plugs. Some **Gully Plugs** were also observed to be broken, or partially or completely submerged by sediments. It was reported that flash floods in 2021 and 2022 had resulted in high flows which damaged these gully plugs.

Challenges Faced before the intervention:

Availability of water for irrigation purposes was reported as a challenge. As a result, the farmers reported that they were not able to grow the crops in both seasons and the production of crops was less.

Impact created:

As observed in Vadhyarchalla and Chullipallam, the gully plugs were effective in capturing silt and improving soil moisture nearby. Periodic maintenance involving clearing the captured silt, repairing the boulder cages, or restoring damaged gully plugs are required. It was reported that approximately 50 gully plugs are presently damaged and therefore not functional. Dysfunctional gully plugs are assumed to be completely non-functional, and therefore are not considered to contribute to recharge or possess any water retention capacity. As observed in Vadhyarchalla, the functional gully plugs were effective in capturing silt. However, the effectiveness will decline without regular maintenance. Further, as is evident, gully plugs are inherently susceptible to damage due to high flows. For sustained impact, the broken gully plugs must be repaired, and all gully plugs must be routinely inspected and maintained for continual long-term benefits.

Since the construction of gully plugs, neighboring beneficiaries stated that they have been able to grow a second crop, perceived to be due to improved soil moisture. A beneficiary near Chullipallam reported improvements in well water levels towards the downstream end of the cluster, however this impact may be due to a combination of other recharge initiatives and altered rainfall in general.

Table 10 presents the annual estimates for potential volumetric water benefits due to gully plugs. The annual recharge potential from gully plugs is 8,446 KL under ideal conditions where all the gully plugs are in good condition and functioning as intended. Considering the field observations and consultations with the implementing partner, 50 damaged gully plugs have been excluded since they are non-functional, and the current annual recharge potential is estimated at 4,857 KL.

Table 10 Potential annual volumetric water benefits from gully plugs in terms of groundwater recharge

Project Activity	Number of structures	Water conservation estimated in PCR* (KL/y)	Assumptions	Estimated VWBA (KL/y)	Type of benefit	Assumptions
Gully plugs	127	215,646	• All gully plugs operate optimally. • 15 fillings • Losses not accounted	*Conceptual design condition*: 8,446 *Potential benefits likely considering current condition*:4,857	Recharge potential	• 3 fillings. # ^ • Evaporation losses considered. # ^ • Current condition: 50 gully plugs have been deducted to account for non-functional structures. ^

* Estimations are as reported in the Project Closure Report, prepared in July 2022.
# Assumption used in estimation of ideal condition VWBA
^ Assumptions used to estimate current VWBA
Number of fillings was estimated based on “Master Plan for Artificial Recharge to Groundwater in India – 2020, Central Ground Water Board, Government of India, October 2020” which recommends a consideration of 3 fillings for the Kerala region.

4.2.3. Rooftop Rainwater Harvesting (RRWH) System:

A Rooftop rainwater harvesting system involves collection of rainwater that falls on the rooftops of houses, storing it in tanks for later use. The rooftop of a house acts as the catchment area, where rainwater is collected and through the gutters and downpipes it channelizes the rainwater from the rooftop to a storage tank. Under the project, Rooftop rainwater harvesting was provided to 73 households. Each house was provided with gutters (if required) to collect rainfall from the roof, rooftop rainwater collection pipe, first flush, filters and 5,000 litre water

storage tanks. The main objective of providing RRWH system was to provide additional source of water to the community members.

Figure 13: Percentage of respondents on receiving Rooftop RWH under the project (N=22)

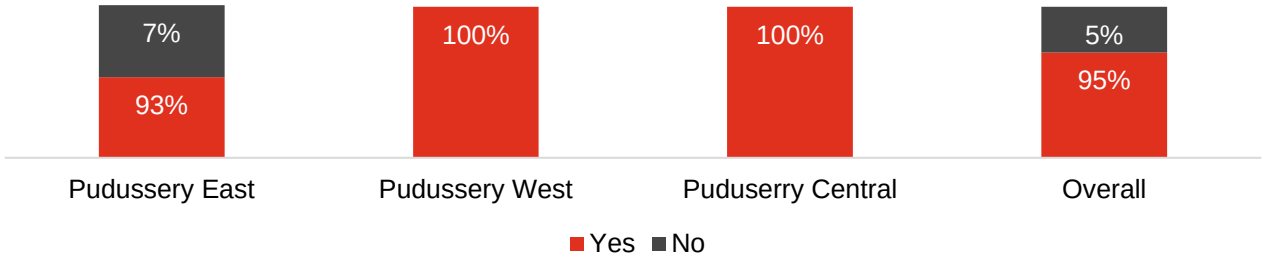
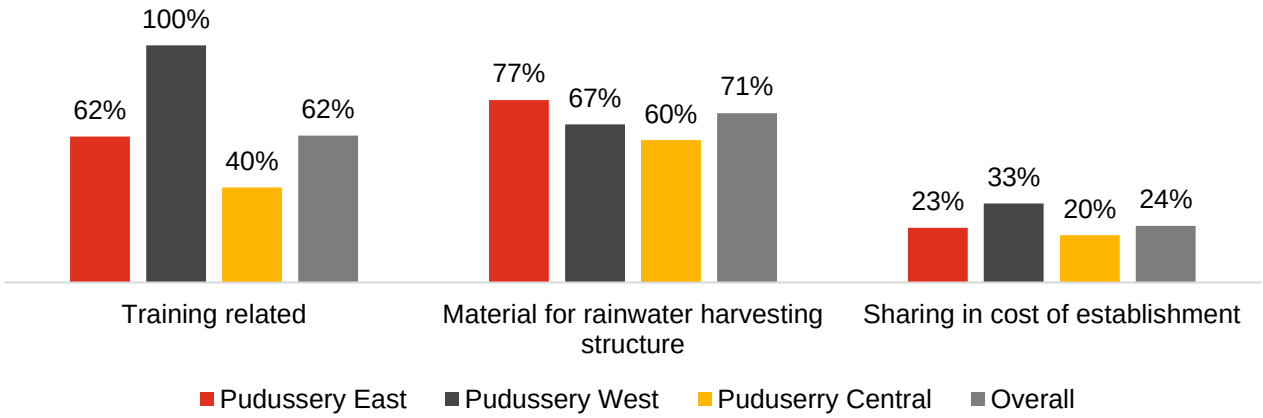
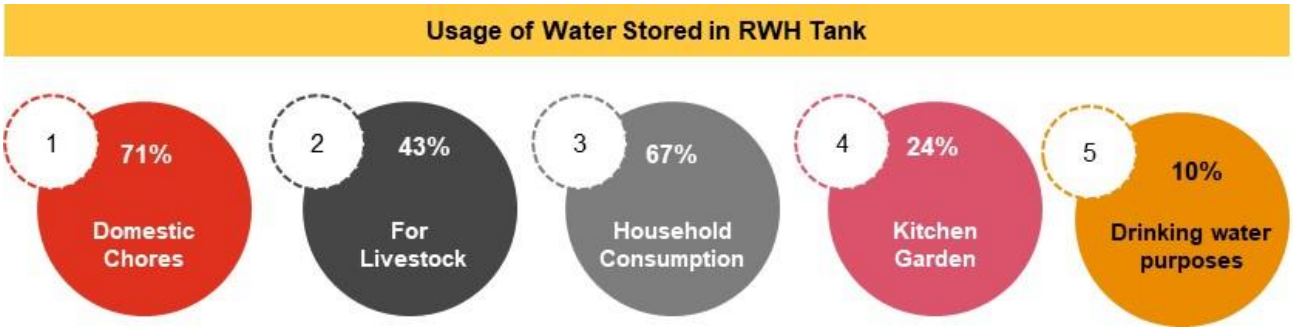


Figure 14: Type of support received for RRWH (N=22)



Overall, 95% (N=22) of the people interviewed agreed that they were covered under the project through provision of Rooftop Rainwater Harvesting System. As a part of the project beneficiaries were provided with the material required for the construction of rainwater harvesting tanks. 73 beneficiaries were provided with **Rooftop Rainwater Harvesting Systems,** which included gutters for collection of rainfall from the roofs, collection pipes, first flush diversion, filter and a concrete 5000L storage tank**.** 62% respondents of 22 surveyed beneficiaries, reported receiving trainings on the operation & maintenance of structures whereas 24% of them mentioned about sharing in cost establishment.

During the field, the structures visited were mostly in functional condition and majority of the beneficiaries are using them for the drinking as well as for the other domestic usage. A few instances of blocked overflow pipes of tanks were observed. Rooftops and gutters observed were kept clean by beneficiaries by using the filters.



Impact created:

During the interaction in Pudussery East village beneficiaries reported that the water available in the area is contaminated and also have high fluoride content due to which it cannot be used for drinking purposes. Majority of the beneficiaries were found using the water stored through Rooftop Rainwater Harvesting for drinking and domestic purposes. Beneficiaries reported increased awareness of and importance of practicing first flush release. Most beneficiaries were aware of and practicing regular cleaning of filters. The filters and first flush provisions were accessible.

Figure 15: Quantity of water stored last year through RRWH (N=22)

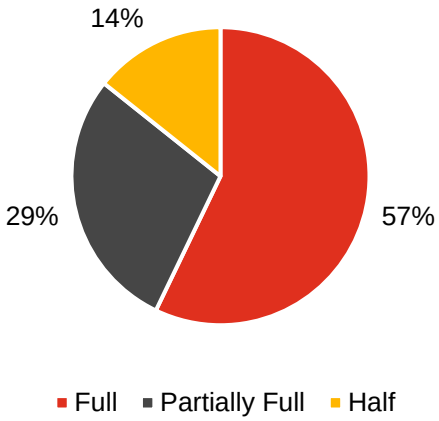
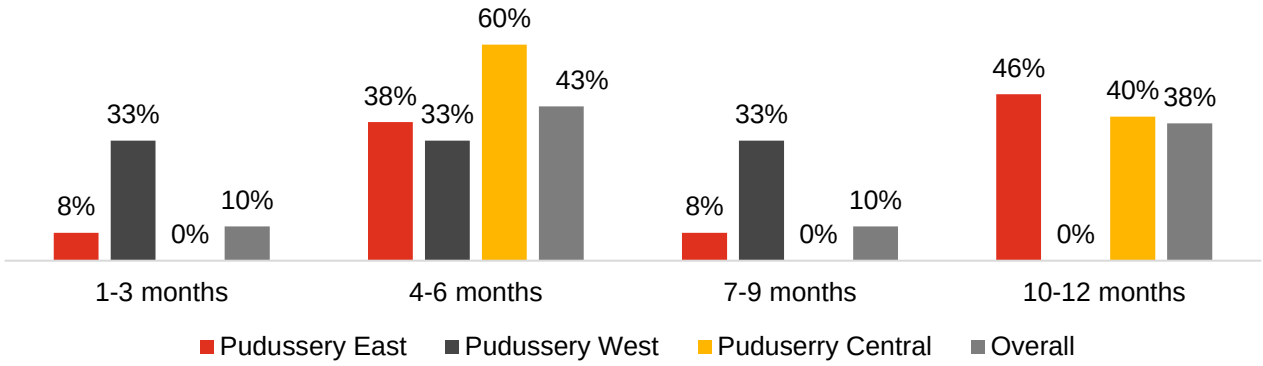


Figure 16: Number of months water availability in RRWH tank (N=22)



Majority of the respondents (57%) who have been benefitted through RRWH system reported that the tank constructed to store water was filled to its full capacity whereas 29% of the respondents opined that the tank was partially full. Beneficiaries reported that earlier between the months of March to July the community members used to face water scarcity especially for drinking water which has stopped after intervention. After the provision of RRWH system, during the rainy seasons, beneficiaries were able to capture rainwater into the storage tanks, reducing the need to collect water from other sources.

However, most of the beneficiaries were also found to be filling the tanks with piped water supply, potentially reducing rainwater capture potential. Beneficiaries preferred piped water for cooking and drinking. Captured rainfall in rainwater harvesting tank was being used for all other domestic purposes such as laundry, bathing, gardening, and cleaning.

The primary benefit reported by the beneficiaries was the storage capacity of the tank, which they were able to use to store municipal water which is supplied only for a few hours per week. This spares the effort of having to collect water from long distances on days when supply is not available. The RRWH is being actively used by the

community for storage of piped water as well as rainwater. The said practice has reduced the vulnerability of the community towards erratic water supply.

Table 11 summarizes the volumetric water benefits from RRWH and the comparison with the water conservation volumes reported in the Haritha Samrudhi Project Phase – 1 Completion Report, along with the key assumptions made for each assessment. The current assessment considers an ideal condition where all the rainwater harvesting tanks are able to complete 10 filling cycles [4] from capturing rainfall. A current scenario with 50% reduction from the ideal scenario has been considered to take into the account the potential reduction in rainfall captures due to the storage tanks remaining filled with piped water supply.

Table 11 Potential annual volumetric water benefits in terms of rainfall captured for rooftop rainwater harvesting

Project Activity	Number of structures	Water conservation estimated in PCR* (KL/y)	Assumptions	Estimated VWBA (KL/y)	Type of benefit	Assumptions
Rooftop rainwater harvesting by constructing 5000L capacity tanks	73	174,045	• 15 fillings per year • 82 beneficiaries were considered, but as clarified later, number of beneficiaries was 73. • Calculation errors were observed. The multiplication factor used was wrong.	*Conceptual design condition*: 3,650 *Potential benefits likely considering current condition*: 1,825	Rainwater captured	• Number of fillings based on rainfall pattern: 10. # ^ • Current condition: 50% reduction considered as the users fill tanks with municipal water. ^

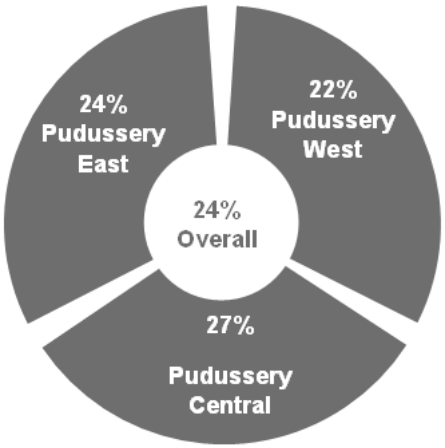
* Claims mentioned are as per the Project Completion report
# Assumption used in estimation of ideal condition VWBA
^ Assumptions used to estimate current VWBA

4.2.4. Recharging Open Well/Borewell:

Open well recharge was aimed at recharge of groundwater through open wells or borewells. The groundwater recharge initiative in the project area can be considered as important considering the over exploited stage of the groundwater in the region. Rainfall was captured from rooftops and recharged into wells as part of the **Open Well Recharge** initiative, which included private as well as communal wells.

Total 352 units of open wells/borewells were recharged under the project against the planned 500 units across the three villages. As reported by the project team, many of the wells within the Pudussery Gram Panchayat were recharged either by the government or through some other organizations. Hence, the balance amount was revised basis the current scenario. The main purpose of recharging open well / bore well was to raise the groundwater table and ensure the availability of sufficient water throughout the year for drinking purpose and household needs. The beneficiaries were provided with gutters, first flush and water filters as a part of the intervention.

Figure 17: Village wise respondents who own Open well/Borewell (N=359)



[4] Based on the annual rainfall pattern, it was determined that the rainwater harvesting tanks can be filled a maximum of 10 times in a year.

All the visited open wells & borewells were found to be in working condition. A fee of INR 1,000/- per household was paid for pipe material to the implementing partner. Ward members actively collaborated with CBO members to identify beneficiaries and offered support during the project's implementation.

Under the survey, 359 people were covered who were aware about any sort of water related intervention happened within their village out of which 87 respondents i.e., 24% (N=359) respondents were direct beneficiary of the intervention.

Sources and availability of drinking water:

The intervention was reportedly aimed at reducing water scarcity by recharging the groundwater table. The rainwater falling on the rooftops was directed through gutters, pipes and filters to the wells from where it could be percolated into the aquifer or utilised by the well owners.

Figure 18: Various sources of drinking water (N=359)

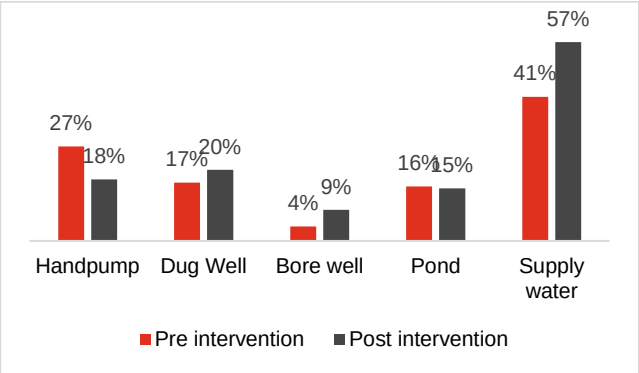
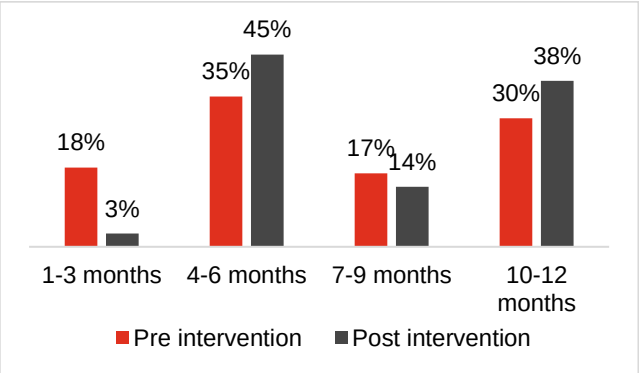


Figure 19: Duration of availability of water (N=359)



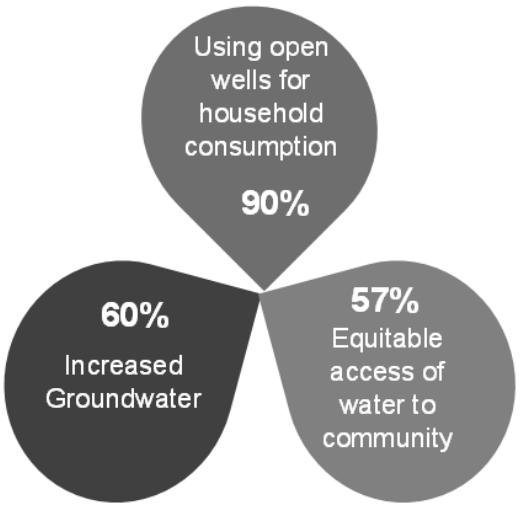
It can be seen from the graph that over the period of time the dependency for drinking water among the community members has increased on Dug wells and borewells. The municipal corporation has also started supplying piped water through the Malampuzha Project. There were concerns of hard water and presence of high fluoride content in the water and community members who had other options for water supply preferred those sources.

During the interaction with PRI members, it was reported that during the months of March to June water tankers were used to supply water to the villagers to mitigate the water scarcity in terms of drinking water which has been stopped after the intervention. 38% of the respondents reported the water availability in the region has been increased to throughout the year.

Impact created:

The interventions pertaining to Recharging open wells and borewells primarily focused on enhancing the availability of groundwater.

All beneficiaries consulted were aware of and practising release of the first flush of rainfall. This practice is important as the first rainfall after a long gap will wash out dirt and debris accumulated from the rooftops which must not be discharged into the well. Filter cleaning was also reportedly done regularly. Filters and first flush were accessible. Rainfall was captured from rooftops and recharged into wells as part of the **Open Well Recharge** initiative, which included private as well as communal wells. Water from these wells were predominantly used for household purposes other than cooking and drinking, as reported by 90% (N=359) of the respondents. Piped water supply was preferred by beneficiaries for drinking and cooking. In case of disruptions to piped water supply, the well water is also used for human consumption. Some beneficiaries claimed improvements in taste, color and smell of the well water. For the Open Well



Recharge systems, households have taken on the responsibility for its maintenance. Beneficiaries reported cleaning of the filters once or twice in a year primarily after the first significant rain to ensure their effectiveness.

Currently, most of the community members were dependent primarily on the piped water supply initiated more than a year ago. However, the household still use the facilities of the project intervention as a secondary source of water.

Table 12 presents the potential annual volumetric benefits from recharging open wells/borewells. All the rainfall from the connected roof areas is assumed to be captured into the well. The captured rainwater benefits the local residents either by being made available for withdrawal, or by recharging the groundwater. The estimated annual volume of rainfall captured is 36,989 KL.

Table 12 Potential annual volumetric water benefits in terms of rainfall capture from recharge of open wells and borewells

Project Activity	Number of structures	Water conservation estimated in PCR* (KL/y)	Assumptions	Estimated VWBA (KL/y)	Type of benefit	Assumptions
Recharge of open wells and borewells	352	742,875	• 15 fillings per year • 5000L storage per filling • Calculation errors were observed	36,989	Rainwater captured	• All rainfall captured from the rooftops were captured and redirected to the well. • Roof size and material were considered
* Estimations are as reported in the Project Closure Report, prepared in July 2022.						

4.2.5. Open well restoration:

Reviving open wells involved cleaning, desilting, and often re-lining them to improve water storage capacity and access to the water.

Challenges Faced before the intervention:

Previously, communities experienced challenges with respect to access to the well water due to poor conditions including silting of the well, vegetation growth, dumping of debris, and damaged parapet walls and lining. The damaged lining was particularly reported to have resulted in seepage of contaminated water (wastewater) into the wells. Under the intervention, these wells were restored, to improve the access to water existing water source.

Impact created:

Beneficiaries reported improved availability of water since the restored wells are used as a secondary water source. It was reported that they used the water from the wells for domestic purposes when their piped water supplies (primary source) were disrupted, especially during summer months. Some beneficiaries of wells that were covered under the restoration as well as recharge initiatives reported improvements in water quality in terms of smell, hardness, odor or color. However, these improvements were based on visual inspections rather than laboratory tests. Well restoration alone without recharge is unlikely to impact water quality.

Overall, 10 community wells were restored as part of the **Open Well Restoration** initiative. Since household connections to piped water supply from the Malampuzha project have become available, dependance of the communities on open wells has reduced. As a result, the continued maintenance of the restored wells was found to be lacking in some areas.

Volumetric water benefits in terms of groundwater recharge will not be created from restoration of open wells as this initiative does not involve any capture and recharge of rainwater. However, the initiative generates volumetric water benefits in terms of improved access to water for the beneficiaries.

The improved water access can be quantified as per VWBA as "the amount of water withdrawn from the restored water source". The improved access could not be quantified for this initiative at this stage as quantification requires additional monitoring of the number of beneficiaries actively withdrawing water from the restored wells and the quantity of withdrawal over the project duration.

4.2.6. Small and Big Pond Deepening:

Pond Deepening entails increasing the depth of existing ponds to augment their water-holding capacity. The objective is to improve the storage capacity of the ponds and reduce runoff. Improved storage capacity in the ponds could improve water availability and groundwater recharge. Under the intervention, the target was to deepen 4 large ponds and 15 small ponds. In the first year, 2 big ponds were reported to be successfully deepened, followed by baby ponds being created within 2 big ponds in the second year. As reported, in the first year, 5 small ponds were deepened, and in the second year, 10 more small ponds were successfully covered.

Challenges faced before the intervention:

It was reported during the discussions that the ponds used to dry up before the project intervention and around 40 to 50 households staying near the big pond in Pudussery central used to face water availability related challenges in the summer months. During the visit to the pond site located in Pudussery east, it was reported that around 60 acres of land was cultivated in the past. However, most of the farmers joined a nearby cement factory since farming had become challenging due to lack of availability of water for irrigation. As a result, the area under cultivation was reported to have reduced to 30 acres.

Impact created:

Post-intervention done for **Small & Big Pond Deepening**, the respondents reported that now most of the ponds no longer completely dry up in summer, whereas earlier, they used to dry up completely during summer months. Accordingly, for the purpose of VWBA, 1 filling was considered. Big ponds were observed to be provided with outlets for withdrawal of water for irrigation. Whereas water from smaller ponds was reported to be withdrawn using pumps. The water availability during the year was reported to have increased. More than 40 farmers are benefiting from it. It was also reported that post-intervention, farmers could grow crops twice a year. Increased water levels have supported nearby Paddy cultivation as well as promoted pisciculture. The Water Management Committee (WMC) set up near Bodichettieri big pond reported that they now practice pisciculture in the lake which has also led to the generation of an additional income.

In addition to the deepening of the pond at Paraeri, the pond bunds were reported to be strengthened. The strengthening of the bunds was reported to be not in the initial scope of the project. However, based on the feedback from the communities the bund was strengthened to reduce the seepage losses.

Table 13 presents the potential annual volumetric benefits from pond deepening in terms of ground water recharge potential created by the initiative. The estimated volumes are compared against the water conservation volumes as per assumptions reported in the Haritha Samrudhi Project Completion Report. The assumption made in the present assessment that each pond completes a single annual filling cycle was based on interactions with beneficiaries during field visits who reported that the ponds contain water throughout the year. It is estimated that the annual potential recharge is 6,515 KL and 883 KL from the big pond deepening and small pond deepening activities, respectively.

Table 13 Potential annual volumetric water benefits from pond deepening in terms of groundwater recharge

Project Activity	Number of structures	Water conservation estimated in PCR* (KL/y)	Assumptions	Estimated VWBA (KL/y)	Type of benefit	Assumptions
Big pond deepening	• **4** • 2 big ponds deepened • 2 big ponds provided with a total of 6 baby ponds	73,225	• 15 fillings • Losses not accounted • Direct withdrawals are not accounted	6,515	Recharge potential	• A maximum of 1 filling was considered based on field observations. • Evaporation losses are considered. • Direct withdrawals have not been accounted.
Small pond deepening	15	102,969	• 15 fillings • Losses not accounted	883	Recharge potential	• A maximum of 1 filling was considered based on field observations. • Evaporation losses considered. • Direct withdrawals have not been accounted.

* Estimations are as reported in the Project Closure Report, prepared in July 2022.

4.2.7. Farm Bund:

Farm bunds are raised embankments or barriers constructed along the periphery of agricultural fields to restrict water flow and prevent soil erosion. They are typically made of soil, earth, rocks, or a combination of these materials and are strategically placed either along the entire periphery or near the boundary with the lowest elevation, to control the flow of runoff or soil erosion generated during rainfall or irrigation.

The farm bunds constructed under the project were 2 feet in width and 1 foot in height. A total of 52.8 acres of farmland was provided with farm bunds, against the planned 100 acres. The total length of farm bunds constructed was reported to be 2,940 meters. These farm bunds were created in the Pudussery west and Pudussery central villages.

For construction of farm bunds, farmers reportedly constructed the structures at their own expense, and upon filing an application form, were reimbursed up to 80%. However, there was a limit of 200 meters of farm bunding each farmer could avail under the project. It was reported that farmers were reluctant to opt for farm bunding due to personal monetary contribution required at the initial stage. Community members suggested that the total cost should be borne by the project leading to greater acceptability of the intervention.

Impact created:

Beneficiaries stated that farms bunds help retain rainfall within their property rather than flowing out. It was observed that the visited bunds had retained their structure and are functioning as intended. Out of total 4 beneficiaries of farm bund consulted at site; one beneficiary stated that the farm bunds enabled them to begin cropping on one portion of their property which was previously left uncultivated due to the terrain. **Farms Bunds** reported to have **reduced run off and resulting erosion of the soil**. As a result, beneficiaries reported to have benefitted through **increased soil moisture and retention** of soil within their farms. This has enabled the farmers to undertake farming in those areas where farming was not possible earlier. **A significant impact of the intervention was that it has facilitated the farmers to do multiple crop farming.**

Table 14 presents the potential annual groundwater recharge created by the farm bunding initiative, compared against the water conservation claimed as per the project completion report. It is estimated that 15% of rain falling on the farm surfaces can be infiltrated into the soil resulting in an annual recharge potential of 72,115 KL per year.

Table 14 Potential annual volumetric benefit from farm bunding in terms of groundwater recharge

Project Activity	Total area covered by farm bunds	Water conservation estimated in PCR* (KL/y)	Assumptions	Estimated VWBA (KL/y)	Type of benefit	Assumptions
Farm bunds	52.8 acres	12,480	• 15 fillings • The volume of the bund appears to be considered instead of the area of land covered.	72,115	Recharge potential	15% of rain falling directly on the 52.8 acres of bunded farmlands are considered to get infiltrated.
* Estimations are as reported in the Project Closure Report, prepared in July 2022.						

4.2.8. Subsurface barriers:

A subsurface dyke / ground water dam / subsurface barrier (SSB) is a solid barrier constructed across a stream channel for arresting/retarding groundwater flow and increase the ground water storage [5]. 4 Subsurface barriers were constructed across 3rd order streams in the project area, as per the proposed plan. This was done by digging the surface layer of the sand/soil and constructing concrete structures with a dimension of 4-5 m length, 0.3 m width and 1 – 1.5m height. Of the total height of the structure, about 0.3 m is visible above ground and the remaining lies beneath the surface. The construction of subsurface dam helps in the reducing the flow of water and hence infiltrate water into the underground sources for recharging.

Two SSBs were constructed in Pudussery central village (near Kannode and Chullipallam habitation), one in Pudussery East (near Kottamutty habitation) and one in Pudussery West village (near Kovilpalayam habitation).

Impact created:

During field interactions with beneficiaries near one of the project implementation sites, it was reported that the **Subsurface Barrier** were perceived to have resulted in improved soil moisture to the neighboring areas. For

[5] Manual on Artificial Recharge of Ground Water, Central Ground Water Board, Ministry of Water Resources, Government of India, September 2007

example, a farmer in the paddy fields near Kovilpalayam subsurface barrier reported improvement in soil moisture since the structure was constructed. About 15 households were reported to have experienced improved availability of groundwater.

Table 15 presents the potential annual groundwater recharge created by the subsurface barriers, compared against the water conservation claimed as per the project completion report. As subsurface barriers lie majorly beneath the surface and do not store much water, the recharge potential generated is estimated at 0.57 KL per year.

Table 15 Potential annual volumetric water benefits from subsurface barriers in terms of groundwater recharge

Project Activity	Number of structures	Water conservation estimated in PCR* (KL/y)	Assumptions	Estimated VWBA** (KL/y)	Type of benefit	Assumptions
Subsurface barrier	4	25,470	• All structures are operating optimally. • 15 fillings • The full structure dimensions including the subsurface portion (total depth of 1.35 – 1.5 m) was considered • Losses not accounted	0.57	Recharge potential	• All structures operating optimally. • 3 fillings • Only water storage area above ground, with a depth of 0.3 m has been considered • Evaporation losses considered.

* Estimations are as reported in the Project Closure Report, prepared in July 2022.

Number of fillings was estimated based on “Master Plan for Artificial Recharge to Groundwater in India – 2020, Central Ground Water Board, Government of India, October 2020” which recommends a consideration of 3 fillings for the Kerala region.

4.2.9. Check Dams:

Two check dams were constructed, one near Vadhyarchalla and the second near Chellankavu, as planned. These were constructed across Ettadi stream and the stream near the habitation of Chullimada habitation, respectively.

Check dams serve multiple functions such as creating water storage that can be utilized, improved groundwater recharge due to the ponding of water by the structure, improved control over the flowrate of the stream and for captured eroded soil/silt.

Impact created:

Construction of **Check Dam** was reported to have resulted in **increased availability of water for irrigation** enabling farmers to take **two crops in a year**. Chellankavu check dam was constructed with a diversion channel

for irrigation which was stated to be beneficial to 50 acres of farmlands. Ettadithode check dam was observed to be filled with silt and is required to be desilted to store and recharge water.

Adjacent wells reported having experienced increases in water levels, which have not only served the purpose of irrigation but have also improved access to water for domestic use.

Regular maintenance of the check dams is essential to mitigate the accumulation of silt that occurs during each rainy season, failing which the storage capacities of the structure will diminish. This was observed in the Ettadi stream check dam which is now filled with silt and has no storage capacity. The silt captured by these structures is a valuable material that can be harvested during maintenance cycles.

Table 16 presents the potential annual groundwater recharge created by the check dams, compared against the water conservation claimed as per the project completion report. Annual recharge potential was estimated to be 8,258 KL under ideal conditions with both check dams in good condition and functioning as intended. The current scenario takes into account the field observations that Ettadithode check dam is completely silted and cannot store or recharge water, leading to annual recharge potential of 3,802 KL/y from the check dams.

Table 16 Potential annual volumetric water benefits from check dams in terms of groundwater recharge

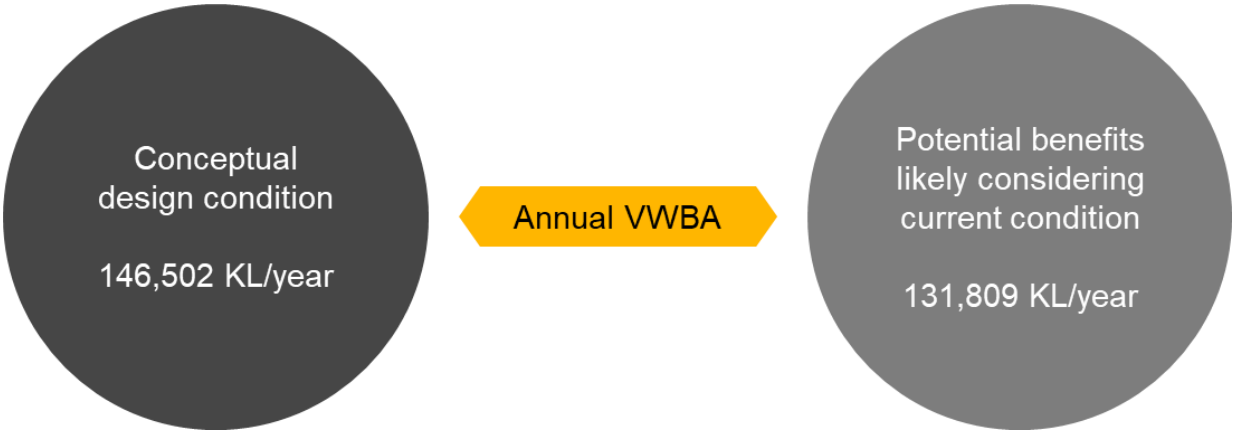
Project Activity	Number of structures	Water conservation estimated in PCR* (KL/y)	Assumptions	Estimated VWBA** (KL/y)	Type of benefit	Assumptions
Check dam	2	61,553	• 15 filling per year • Both check dams operate optimally • Losses not accounted	*Conceptual design condition*: 8,258 *Potential benefits likely considering current condition*: 3,802	Recharge potential	• 3 fillings # ^ • Evaporation losses are considered. # ^ • Direct withdrawals not accounted. # ^ • Current condition: Ettadithode check dam is omitted as it has no storage capacity due to complete siltation. ^

* Estimations are as reported in the Project Closure Report, prepared in July 2022.
# Assumption used in estimation of ideal condition VWBA
^ Assumptions used to estimate current VWBA
Number of fillings was estimated based on “Master Plan for Artificial Recharge to Groundwater In India – 2020, Central Ground Water Board, Government of India, October 2020” which recommends a consideration of 3 fillings for the Kerala region.

4.2.10. Summary of volumetric water benefits of the project

The annual volumetric water benefits from project considering soil and water conservation activities as detailed from sections 4.2.1 to 4.2.9 are summarized in Figure 20, for both conceptual design condition and for the scenario considering current conditions.

Figure 20 Annual volumetric water benefits of Haritha Samrudhi Project – Phase 1



4.2.11. Potential for improvement in accordance with best practices

A detailed assessment of the soil and water conservation structures was carried out based of review of documents provided by the implementing partner, and sample-based site observations and compared against best practices defined in CGWB manuals and other technical documents for relevant structures. Some of the key findings are presented as follows:

Pre-implementation best practices

- **Baselining of study area**: The baseline report consisted of social perceptions. However, the baseline information on water balance (demand and supply) and hydrology must be included in the baselining of the study area.

- **Baselining of water conservation structures**: Water demands for various purposes – irrigation, domestic water use, etc. – from the created water storage structures are not quantified. For example, water demands from each of the ponds for irrigation are not quantified in the reports. Such structure-wise water withdrawal information will facilitate more realistic estimations of volumetric water benefits as withdrawals can also be accounted.

- **Documentation of methodologies**: The documentation of the project activities does not cover all the hydrogeological assessments carried out prior to the study as was described by the implementing partner during consultations. It was stated that field assessments and community consultations were carried out to determine the hydrology of the project areas and for selection of locations for implementation. However, these details were not documented in the provided documents. During consultations with the implementing partner, use of technological devices for identifying the location of fracture lines was mentioned. However, these methodologies and tools are not described in the report.

- Further, the reasoning behind assumptions made such as the annual number of fillings for each structure are inconsistent between various reports submitted (Achievement Report 2020, Achievement Report 2021 and Project Completion Report). The justifications or references used for arriving at these assumptions are also not clearly defined. Additionally, errors and inconsistencies in calculations of water conserved were observed in the reports mentioned. Dimensions of structures were observed to be inconsistent in different documents or inconsistent unit systems were used. As a best practice, the project completion report must serve as a single concise document highlighting a complete overview of the project from baselining to completion, including all methodologies, assumptions and calculations used.

- **Mapping**: Mapping exercises of the study area and implementation areas have not been carried out. Preparation of maps serve to visualize the overall spatial coverage of the various interventions of the project. The current documentation does not contain any maps to indicate the locations of the interventions in terms of hydrological features or administrative boundaries. The preparation of maps will also facilitate ease in locating the structures during field visits.

Post implementation best practices

- **Training of beneficiaries**: It has been reported and documented that beneficiaries and CBOs were trained in the operation and maintenance of the provided structures at the time of handover. However, specific details of the training provided are not documented.

- **Monitoring and continued tracking**: A detailed list of Key Performance Indicators (KPIs) for monitoring of the project impacts was provided, stating that beneficiaries and WMCs are responsible for the monitoring. However, no quantitative reports were available indicating that the monitoring is being carried out or that the list of KPIs were conveyed to the relevant beneficiaries. Since responsibilities of the operation and maintenance are handed over, continuous tracking and documentation of the project activities are not being carried out after completion. Thus, there is no record of the continued involvement of the involvement of communities and sustainability of the project.

4.3. Community Capacity Building and Promotion of Organic Farming

Haritha Samrudhi Project was envisaged keeping in mind the requirements of villages of Pudussery Gram Panchayat. Hence, the activities planned for the implementation were designed in such a way that they could provide benefits at community as well as individual level. Capacity building was aimed at increasing their knowledge, awareness and skill sets.

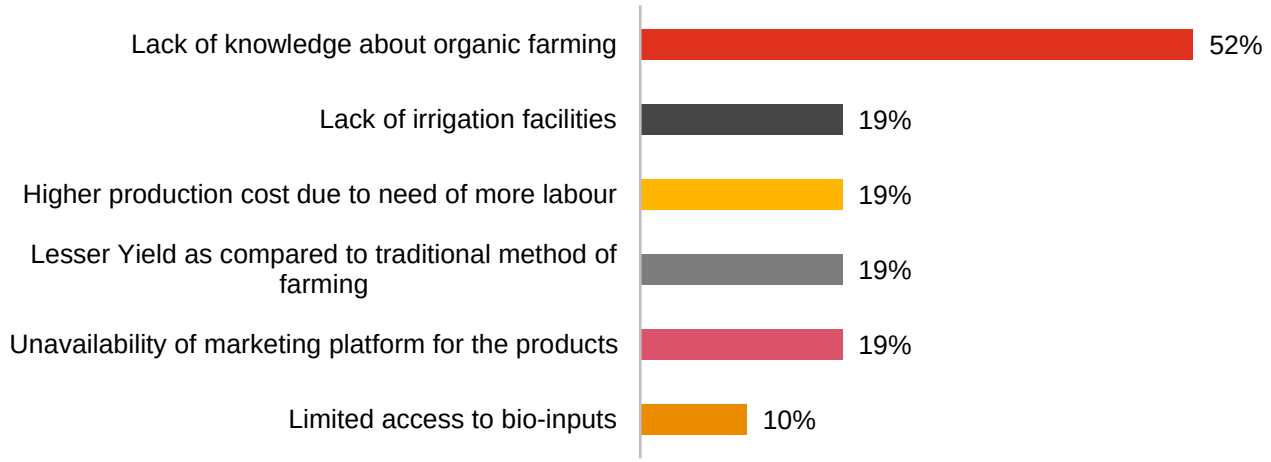
Challenges Faced by farmers pre- intervention:

Community members highlighted a lot of challenges in practicing organic farming. 52% (N=381) of respondents acknowledged lack of knowledge about organic farming before receiving training under the project.

About 19% of the respondent who were practicing organic farming even before the intervention, reported lower yield as compared to the conventional (non-organic) farming during initial years. It was reported that the organic farming would require three times of cultivation as compared to conventional farming to produce same amount of produce. Hence, considering the higher cost of the organic manure, organic farming was deemed nonviable.

Additionally, 19% of the respondents reported lower yield when they were using organic methods even before the intervention compared to conventional farming techniques because as informed by the beneficiaries that it would take around three times of cultivation on same land to improve the productivity through organic farming and farmers could not afford the same due to high manure prices. Other challenges which were highlighted by the community were insufficient irrigation facilities and high production costs due to labor expenses.

Figure 21: Pre-intervention challenges faced by community in terms of organic farming* (N=381)



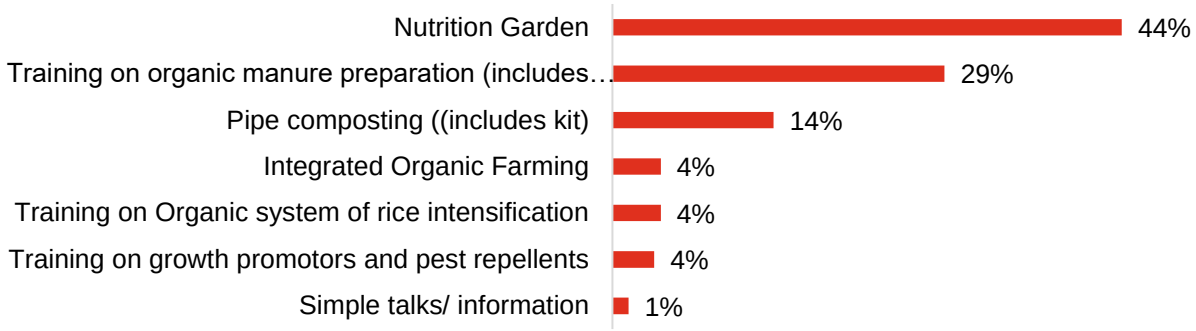
**This is a multiple-choice question. Hence, will not add upto 100%.*

During the interaction, respondents mentioned the absence of a marketing platform for their produce. Respondents identified the higher cost of organic manure as a major obstacle and expressed a desire to use organic methods if it were more affordable.

Support received under the project:

The support provided under the Organic Farming component included training of identified farmers on climate resilient sustainable farming methods, organic manure preparation. Nutrition Garden & Pipe composting were also integrated with the component of organic farming. Two separate training programs were also organized at Walayar and Attapallam hamlets where more than 80 farmers were introduced to climate resilient farming. More than 100 farmers were trained in the preparation of organic manure.

Figure 22: % of respondents on type of support provided under the project (N=381)



About 44% and 29% of the respondents reported having received training on Nutrition Garden and organic manure preparation respectively. The number of respondents receiving support under Nutrition Garden is higher because maximum number of beneficiaries from the villages were covered under this intervention. All the trained farmers were given organic manure kit on a pilot basis. Some of the community members were reported to have already practicing organic farming but were not fully aware about the organic farming practices. Accordingly, the training was reported to have benefitted the farmers to get structured training and improve the knowledge about organic farming. Details of various activities conducted as part of capacity building are detailed in following sections.

4.3.1. Integrated Organic Farming:

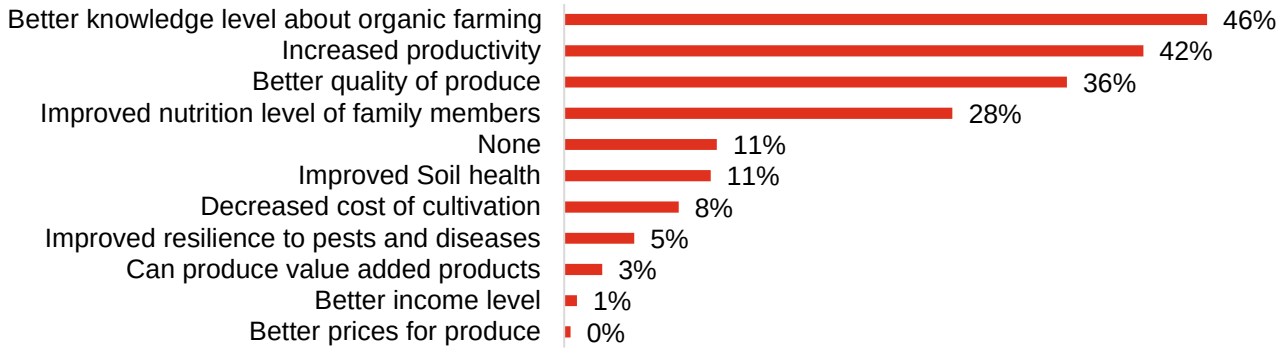
Integrated organic farming is a holistic and sustainable approach to agriculture. It aims to promote the use of locally available natural resources (e.g., organic manure and pesticides) to reduce dependency on chemical fertilizers and pesticides.

The Organic farming intervention involved multiple activities such as training of farmers on manure preparation, Organic system of Rice Intensification (OSRI), training farmers on how to develop natural growth promoters and pest repellents etc. 200 landowning farmers were provided services under Integrated Organic Farming. Promotion of Organic farming practices was also extended to individual households through interventions such as promotion of Pipe composting, Nutrition Gardens which were taken up under this project.

Impact created:

Transition to organic farming was a time-consuming and challenging process for adoption of organic farming by the farmers as reported by project team. Hence, necessary efforts and continuance persuasion with the farmers were made to make them understand possible benefits of adopting the farming technique and motivate them to attend the training.

Figure 23: Impact created through organic farming* (N=381)



This is a multiple-choice question. Hence, will not add upto 100%.

46% of the respondents reported to have **improved their knowledge about Organic Farming, post intervention.** Moreover, 42% of the respondents reported increased productivity. 36% Respondents also perceived improvement in quality of produce and 28% perceived improved nutrition levels for family members due to reduction in the use of chemical fertilizers. Adoption of organic farming is also perceived to reduce pollution of waterways (due to chemical fertilizers) and improved soil health.

However, during discussions with community members, it was highlighted that while chemical fertilizer costs approximately INR 10,000/- per acre, organic manure expenses rise to INR 20,000/- per acre. Labor costs remain fixed at INR 20,000/-. Due to the similar revenue but increased costs associated with organic farming, there has been a slight reluctance among the farmers to fully adopt organic farming implement the project.

4.3.2. Nutrition Garden:

Nutrition garden was aimed at growing vegetables, fruits, and herbs using organic manure. About 1100 households (beneficiaries) were identified for the initiative with the help of gram panchayat members and trained for the nutrition gardening. The beneficiaries were provided with 15 growbags containing organic manure used for growing of vegetables, fruits, and herbs. The beneficiaries were also provided with seeds of Cauliflower, Cucumber, Pumpkin, Bell pepper, Spinach, Pea, Tomato, Brinjal, Ladies finger, and Radish.

Figure 24: % of respondents received Nutrition Garden under the project

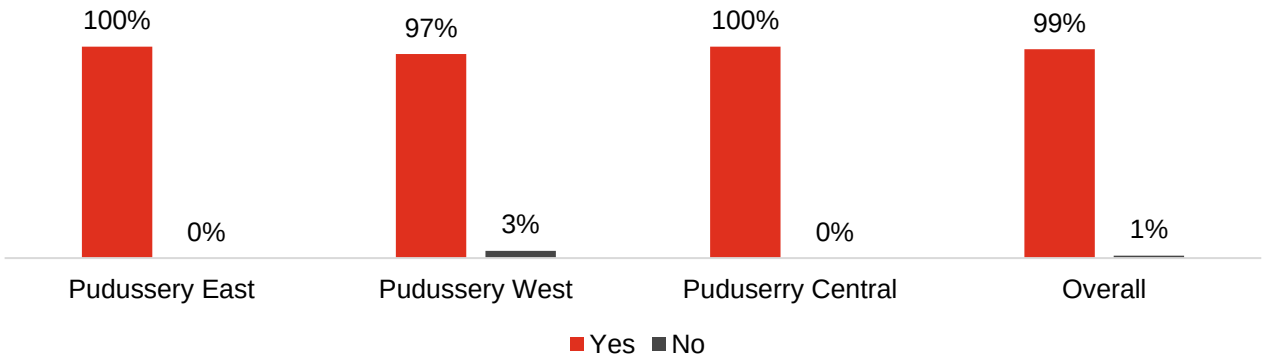
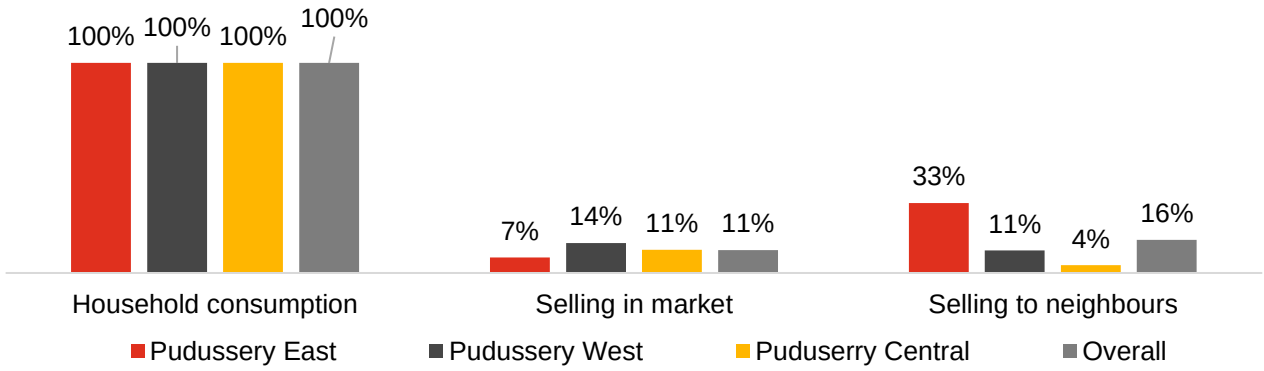


Figure 25: Use of produce of nutrition garden



A total of 82 beneficiaries of Nutrition Garden were interviewed during the survey. As depicted in the graph above, 99% (N=82) of the respondents covered under Nutrition Garden confirmed receiving support under the said intervention. During the discussion with CBO members, it was reported that the households who have been provided support under the Nutrition Garden were enjoying chemical-free vegetables for more than two weeks in a month. Notably, there's an excess yield of Brinjal (local name-Vazhuthananga) with an average productivity of 4-7 Kg per grow bag in every two months. All the beneficiaries (100%) are using the nutrition garden produce for their household consumption and 16% are selling some amount of compost to their neighbors and 11% are selling in the market.

Impact created:

Nutrition garden has created a significant impact on the community members, as stated by the community the trainings provided helped them in developing an understanding about the organic farming. The intervention of Nutrition Garden has resulted in providing the community access to healthier and more nutritious food. Moreover, through nutrition gardening, beneficiaries were able to save INR 2,610/- every year which was previously spent on buying vegetables from market.

Parameters	Pre-intervention	Post-intervention
Average land being used for the nutrition garden per household in cents	0	3
Average cost of cultivation per household in INR	100	350
Average quantity of vegetable purchased every year in Kg	168	30
Average price of vegetables per Kg	20	25
Average spends on purchasing vegetables for household consumption per year in INR	3,360/-	750/-

The said intervention has resulted in people growing vegetables as per their choice and the results have motivated others in adopting Nutrition Garden. As a result, people have willingly demanded the grow bags and have started a Nutrition Garden in their backyard. **The intervention has helped in getting the community together by sharing information and best practices enabling a sense of ownership and cooperation**.

4.3.3. Pipe Composting:

Pipe composting also known as trench composting or underground composting, is a method of composting organic matter in a confined space created by partially putting a perforated pipe under the ground. This method provides an efficient and space-saving way to decompose organic waste materials, such as kitchen scraps,

garden and yard waste. The manure created is used for improving soil fertility. Under Haritha Samrudhi project, 200 units of pipe compost were distributed to the beneficiaries of Pudussery Gram Panchayat. The purpose of the activity was to inculcate the organic method of cultivation and enable people to do efficient decomposition of organic waste.

Total 47 respondents of pipe composting were covered during the survey out of which 32 have been benefitted through both nutrition garden and pipe composting. Under the project, beneficiaries were provided two pieces of PVC pipes each with a length of 1.5 meters and a width of 6 inches. The pipe was kept in the backyard of every household with a part of the pipe, about 1 foot, under the ground. Beneficiaries stated that it took around 2-3 months for the pipe to be filled with compost and withdraw the waste on quarterly basis.

55% (N=47) of the total respondent interviewed were using pipe composting since 2020 and 100% of the respondents received training on efficient use of organic waste and the way it could help them in generating compost. The pipe compost activity and trainings were integrated with nutrition garden component so that community people can use the same manure for growing vegetables as well and it could save the cost of manure for nutrition garden.

Impact created:

Waste management in rural areas has been a significant issue leading to issues like unpleasant odor and pest issues. Adoption of Pipe composting technique helped the community to reduce the unpleasant odor as well as pest related issues. According to the people, the trainings have increased their knowledge and awareness about sustainable waste management in a cost-effective manner.

Figure 26: Production of compost in a year (in Kg) (N=47)

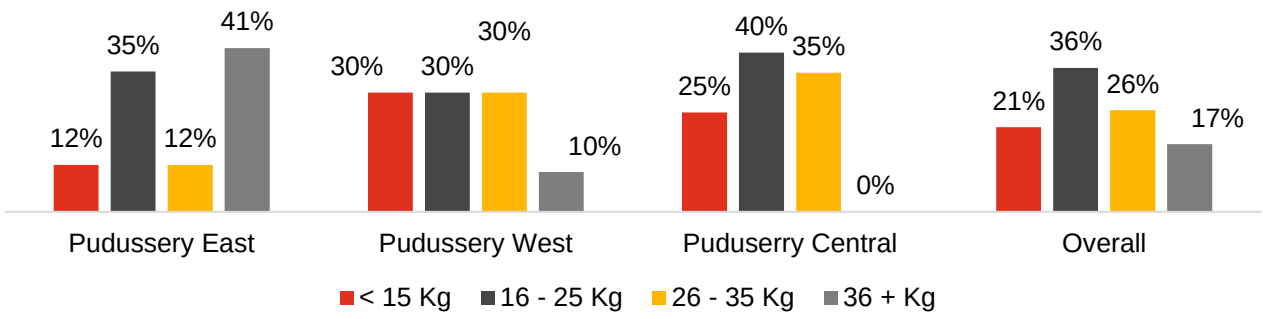
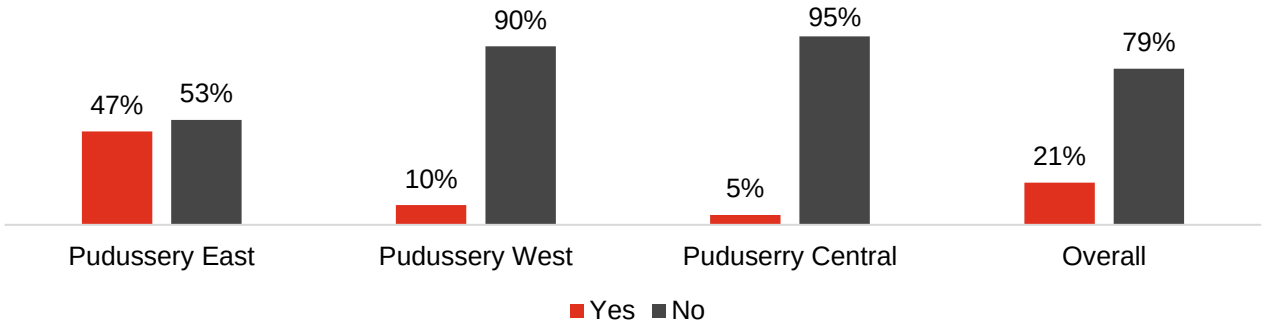


Figure 27: % of respondents selling the compost (N=47)



As mentioned in the figure 25, majority of the respondents (41%) from Pudussery east village were producing more than 36 kg of compost every year through pipe composting provided under the project and as mentioned in Figure 26, 47% of them from same village (Pudussery East) were reportedly selling the compost. The rest of the respondents use the compost in their own kitchen garden.

In Pudussery east, people having small patches of land have started using the land for nutrition garden purpose as well as pipe composting. On average, beneficiaries were earning INR 2,600/- every year through selling compost produced using pipe composting. The Pipe composting activity has not only resulted in generating additional income but has also saved the cost of buying manures. The major impact of this activity has been created in the form of promoting sustainable farming by enhancing soil health and reducing the dependency on chemical inputs.

According to the beneficiaries, earlier people were facing issues like waste smell, pest issues, diseases to their vegetables but after the intervention community was able to make effective use of their kitchen waste due to increased awareness level. The provision of compost infrastructure ensured efficient waste management and nutrient-rich soil.

4.3.4. Organic System of Rice Intensification (OSRI):

The OSRI method of rice cultivation was taken up as a pilot initiative. Hence, only the farmers willing to volunteer were included in the said intervention.

Ten farmers in year 1 and another ten in year 2 agreed to pilot OSRI in their land. These farmers were first trained through a virtual platform which involved demonstrations of various stages like seed selection, bed preparation, transplantation, weeding, manure making and application, pest management etc. and later the field component was done. A package of practice was also developed as part of the project and shared with the farmers. The 20 farmers covered under the intervention were reported to have cultivated around 1 acre of land each.

Impact created:

According to the beneficiaries, OSRI supported in improving income through increased production. It was also reported that usage of organic material such as compost and organic manure for cultivation has helped in enhancing soil fertility and led to healthier soil.

Parameters	Pre-intervention (Conventional Method)	Post-intervention (OSRI Method)
Average time period since community members involved in OSRI (in years)	-	2
Average land used for rice cultivation (in cents)	48	75
Average yield (in Kg)	1,291	2,683
Average cost of cultivation (in INR)	1,938	1,672

With reported doubling of the production, increase in the productivity is seen as a major impact of the intervention. Beneficiaries mentioned that the project interventions provided an opportunity to cultivate rice in both the seasons of the year.

4.3.5. Tree Plantation

During the interaction with implementation partner, it was informed that 17,000 trees were planted in Pudussery village under the Haritha Samrudhi Project Phase –1. The locations for plantation were identified with the help of Panchayat members and key opinion leaders of the village and most of which was Common Land. Some of the trees planted were Blackberries, Gooseberries among others including those having herbal properties. The implementation partner provided support for two years in terms of looking after the plantation including provision of tree guards. However, during the visit, it was observed that there was no clear demarcation to identify the trees planted under Haritha Samrudhi project Phase –1.

Impact created:

35% of the respondents believed that the tree plantation activity has assisted in reducing the issue of soil erosion. Similarly, 54% mentioned that the said activity has helped in increasing the groundwater level. However, 11% of the respondents had no idea on the impact of the tree plantation activity.

4.4. Creating and strengthening local community-based institutions

As a part of the project, community institutions were formed in all the three villages with an objective of ensuring the participation of local community in ensuring long term sustainability of interventions. These institutions involved selected members from the villages having better understanding of the local communities, culture, and their needs.

Pudussery gram panchayat reported to have provided essential support in forming of these community-based institutions. Three types of institutions formed under the project were: Community Based Organization (CBO), Water Management Committee (WMC), and Farmer Producer Organization (FPO).

4.4.1. Community based organizations (CBOs)

Community based organizations (CBOs) were formed with an aim of creating a local support system to ensure the sustainability and maintenance of the infrastructure created/ rejuvenated under the project to the community. 20 CBOs with more than 300 farmers were formed in three project intervention villages. Each of the CBOs received training on respective roles and responsibilities. In addition, 13 training programs were held with the group members on topics of climate adaptive measures, integrated organic farming, organic manure preparations, nutrition garden etc.

Formation of CBOs:

The CBOs in all the three villages i.e., Pudussery East, West and Central were formed in the year 2019. The villages already had a few existing SHG's such as Punarjani Vanitha Kootayima in Pudussery West and Ayalkootam committee in Pudussery Central and some of which were transformed into CBO's. While others were formed afresh. Each of the CBO consists of 15-20 members.

The process for the formation of the Community-Based Organization (CBO) involved a collaborative effort between the implementation partner, village officials, and the local community. The key steps in this process were as follows:

Community Meetings: The implementation partner initiated the process by conducting community meetings in each village where community members were informed about the activities that need to be taken up under the project along with discussion on the challenges and need identification. Subsequently, villagers expressed their specific needs and preferences related to these project activities, engaging in discussions with both the implementation partner and village officials.

Beneficiary selection Criteria: To ensure successful project implementation, selection criteria such as land availability for activities like nutrition garden, Integrated Organic Farming (IOF), open well recharge and rainwater harvesting were finalized for the selection of beneficiaries. For IOF initiatives, the selection criteria also included the availability suitable land with direct sunlight. The beneficiaries were identified in conjunction with village officials including ward members.

Role of CBOs:

CBO members were responsible for implementation of the project related activities. The responsibility of providing input (materials that need to be distributed as per the activity) to the identified beneficiaries was given to the CBO members. Construction activities for open well recharge and rainwater harvesting were carried out by the implementation partner with the active involvement of the Community-Based Organization (CBO) members and other stakeholders. CBOs were instrumental in coordinating and overseeing the various activities aimed at improving the water resources and promoting sustainable farming practices though:

- Identification challenges faced by communities
- Organizing trainings for farmers and other community members
- Distribution of seeds for organic farming
- Undertaking regular operation and maintenance of water conservation structures

CBOs have established trust and strong relationships within the community. This trust is vital for gaining community cooperation and it was also noted that people are more likely to support and participate in projects initiated by organization they trust. Being a member of same community, CBO members are closely connected to the community members. This allows them to engage with individuals and families on a personal level, understanding their concerns, preferences, and aspirations. This engagement helps ensure that projects are aligned with community priorities.

CBO members has helped other community members in developing understanding of the project interventions and due to the training provided to the CBO members, they could help other community members in better operations and maintenance of the structures or services provided under the project. Several trainings were provided to the beneficiaries who were also part of the CBO groups which has enabled them to improve their awareness level climate resilient practices, organic farming, how they can improve their productivity. community-based organizations for projects are essential because they leverage local knowledge, trust, and relationships to design and implement initiatives that are well-suited to the specific needs and circumstances of a community.

4.4.2. Water Management Committees (WMCs)

Water management committees play a crucial role in ensuring the sustainable and equitable management of water resources within the community. Water management committees consist of local community members who are directly affected by water-related issues. Their involvement ensures that decisions regarding water resources are made with an understanding of local needs and concerns. Under the project, **five water management committees** were formed in Pudussery West and Pudussery Central villages.

Formation of WMCs:

All Water Management Committees (WMC) were formed in the year 2020. Many of these committees were formed during the time when Covid induced lockdowns and related restrictions were in place. As a result, it was not possible to have physical meetings and trainings. Hence the committee formation took time. The WMC members in Pudussery East & Central were selected from the Padashekara Committee (An existing Farmers Welfare Association within the village).

Each of the committee consists of approximately 10-15 members, and the committee members were identified with the help of key opinion leaders of the village and panchayat members. The members from the Padashekara committee and other community members joined the WMC considering the needs of the community and the support of the implementation partner. The involvement of the community members was driven by the belief that the WMC could make a meaningful contribution to water management initiatives and Organic farming practices within the community.

Role and functioning of WMCs:

The WMC members have been a part of the project planning and implementation process. The involvement included need identification, project implementation and monitoring support. WMC also suggested the requirements of the village as well to the implementing partner to identify the appropriate beneficiaries. The water management committee of Pudussery central manages the water structures established in Pudussery East as well and supports the operation and maintenance of those structures.

During the meetings with the implementation partner, WMC's highlighted developmental concerns of the villages during the project implementation process. WMC members have facilitated implementation of the project activities and were also made responsible for the maintenance of structures. The secretary of the WMC used to take the lead in selecting the beneficiaries and prioritizes the distribution of input materials based on demand and need.

Activities implemented through WMCs:

The WMC has supported in organizing several trainings for the farmers on integrated organic farming, O&M of water structures, OSRI etc. The members identified the activities that can help to improve availability of sufficient water for farming based on the requirement of the village. WMC members supported in identifying locations for water structures like Sub-surface barriers, gully plugs, ponds requiring deepening and also beneficiaries for open well recharge and RRWH.

Regular maintenance of Ponds activities including the opening of valves, is typically carried out in the months of November or December every year by the WMC. Fish farming is another aspect in the Bodichettieri pond of Pudussery Central which also caters to Pudussery East as well, which commences in the month of June and continues till April - May. WMC members purchased different varieties of fishes from outside market and reared them in the rejuvenated pond. Fish food is provided by the WMC members itself. WMC earned around INR 50,000/- on an annual basis by selling the fishes. A vendor has been contracted for the maintenance of water structures provided to the villagers. The vendor is paid through the earnings from fish sales for managing the structures. The profit earned after payment to vendor was being shared between the members of WMC. Fishes cultivated in the pond were also being used for household consumption by WMC members.

It was stated by the community that WMC played a vital role for allocating water resources among different users, such as farmers and households. WMC facilitated fair and equitable distribution of water reducing conflicts over access to the water for various purposes including drinking and agriculture.

The Water Management Committees (WMC's) reported to manage water conservation structures and distribution of water for irrigation as well as domestic purposes. However, a general lack in maintenance of community related water conservation structures was observed. The regular maintenance of water conservation structure was done by WMC only in one village for the Bodichettieri pond that helped to keep the structure in good conditions and maintain conservation capacity.

Water management committees brought about a wide range of impacts in villages, ranging from improved access to drinking water and agricultural productivity to enhanced community empowerment and environmental conservation. Their role is vital in ensuring sustainable and equitable access to water resources to the community members.

4.4.3. Farmer Producer Organization (FPOs)

A Farmer Producers Organization (FPO) is a cooperative entity formed by farmers with the aim of improving their economic and social well-being and also to improve their knowledge. FPOs are typically registered entities formed under relevant laws and regulations and operate as a business unit owned and managed by the member farmers.

There was an existing FPO named "Polima" through the Padashekara committee in Pudussery village. With the support of the project, 139 farmers were associated with the FPO as a member. The FPO members were selected through the general body meeting with a focus on farmers in need and have substantial amount of land. The

selection process was carried out in collaboration with Krishi Department of Pudussery. The FPO was officially initiated in the year 2019-2020.

Role of FPOs:

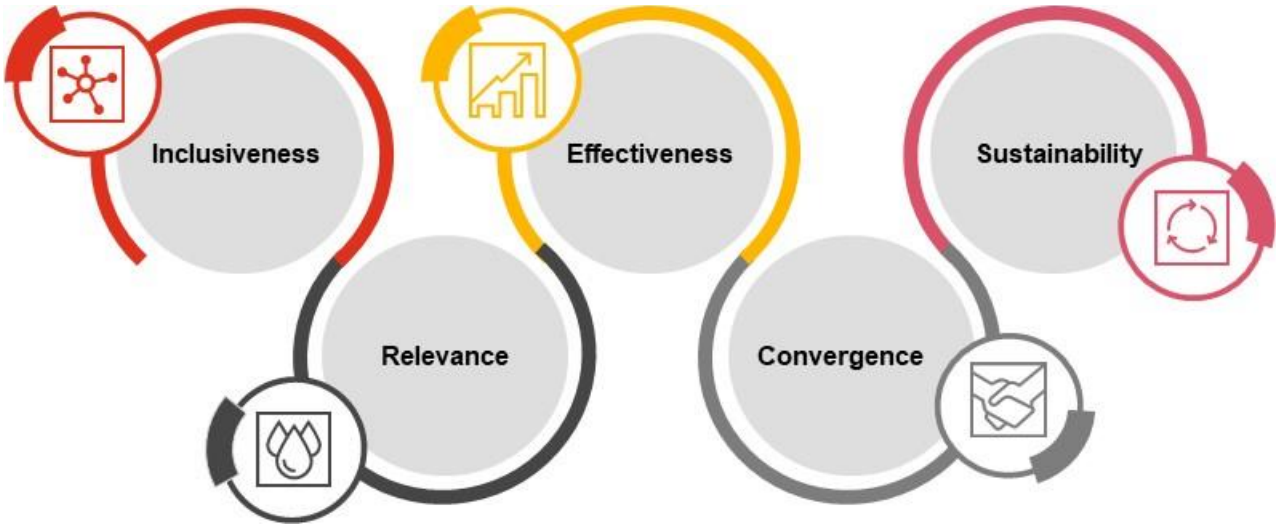
The FPO plays an important role in conducting trainings for the benefit of its members. The implementation partner supported the FPO in organizing trainings on topics related to Organic farming, manure preparation and few additional trainings on the roles & responsibilities of FPOs as an institution and its members. The FPO conducts regular meetings every quarter to oversee the operations and activities. However, during the interaction, FPO members reported less involvement in these meetings and mentioned that their issues were not discussed in these meetings.

According to FPO members, they can help each other collectively to understand the challenges such as climate-related diseases to the crops and pest outbreaks and are able to have discussions around the possible solutions to mitigate the challenges. The trainings provided under the project has enabled them to apply climate resilient & sustainable farming practices which are more environmental conservation and environment friendly. The newly introduced innovative coconut farming has widened the roads to improve the livelihood options for better earning because earlier the farmers were practicing traditional method of coconut farming which was not very productive.

However, some of the FPO members also mentioned that the efforts made under the project were not that significant because it was a one-time input, and there was a lack of demand for organic products in the market. Farmers could not utilize the FPO platform properly due to lack of knowledge and awareness about the use of FPO. As reported by Farmers Producer Organization (FPO) members the effectiveness of the FPO was limited due to the fact that the farmers were not properly aware of the functioning of the FPO and lack of access to market for organic produce.

4.5. IRECS analysis

After engaging with key stakeholders and conducting a thorough review of the documents, the project's effect was assessed using the 'IRECS framework'. The condensed findings from the IRECS analysis are outlined in the table below:



Parameter	Assessment from the study
Inclusiveness	• The project adopted a household-centred approach to implementation, ensuring inclusivity across genders in accessing available support, thereby preventing any gender-based disparities in development.

Parameter	Assessment from the study
	• Among the respondents, 58% identified themselves as belonging to the Below Poverty Line (BPL) category based on their ration cards. Furthermore, 78% reported affiliations with the Scheduled Caste (SC) and Scheduled Tribe (ST) categories. Additionally, 72% stated their monthly income to be less than Rs.10,000 from all sources. Thus, it can be observed that the project has been able to reach out to the people at the bottom of the pyramid.
Relevance	• The project support for improving ground water recharge level by creating or rejuvenating individual & community specific water conservation structures was **relevant for the villages as there was a scarcity of water for agriculture as well as for drinking purposes along with low groundwater availability. Initiatives undertaken have worked in the direction of providing access to water for the community.** • It was reported that groundwater is hard in nature and contains high fluoride content due to which people prefer piped water supply and rainwater stored through rainwater harvesting system for drinking as well as other household purpose. However, wells and other ground water sources are still used as a secondary water source. This makes the project interventions relevant for the community members. • Panchayat president mentioned that due to the water scarcity especially during the months of April to June, water tanker supply was provided to the villagers to deal with the scarcity. Post Haritha Samrudhi Project Phase – 1, tanker supply has been stopped due to availability of sufficient water from various sources.
Effectiveness	• Most of the respondents have reported receiving support from the project. The different interventions under the project have enhanced earning opportunities for local farmers, strengthened the availability of water throughout the year and assisted in conservation of soil and water resources. • During the interaction in Pudussery East village, which is an industrial area, beneficiaries reported that the water available in the area is contaminated and has high fluoride content, due to which it cannot be used for drinking purposes. Intervention pertaining to Rainwater recharge system under the project has helped the community by **reducing the concentration of fluorides** as reported[6]. Beneficiaries reported **increased awareness of and importance** of practicing first flush release. Most beneficiaries were **aware of and practicing regular cleaning of filters**. The filters and first flush provisions were accessible. • The deepening of the ponds increased water storage and groundwater recharge capacity, as reported by the respondents. It was conveyed during interactions that **strengthening pond bunds had prevented water leakage**. Improved availability of water was reported to have facilitated farmers to grow two crops per year. The respondents reported that now most of the ponds **no longer completely dry up in summer**, whereas earlier, they used to dry up completely during summer months. • **Farms Bunds** reported to have **reduced run off and resulting erosion of the soil**. As a result, beneficiaries reported to have benefitted through **increased soil moisture and retention** of soil within their farms. This has enabled the farmers to undertake farming in those areas where farming was not possible earlier. **A**

[6] These changes in water quality were perceived by the beneficiaries based on the improved taste and reduced scaling in the vessels. No water quality testing was done.

Parameter	Assessment from the study
	significant impact of the intervention was that it has facilitated the farmers to do multiple crop farming. • However, based on the responses, certain challenges were also highlighted by the community on the effectiveness of few aspects of the interventions undertaken. • As stated by the community people that the trainings provided under the project helped them in developing an understanding about the organic farming and could provide healthier and nutritious food to their families. After starting nutrition garden, beneficiaries were able to **save INR 2,610/- every year**. However, it was reported that grow bags provided under the Nutrition Garden initiative were torn after one and half years and beneficiaries were not provided new grow bags or any alternatives. • In the context of organic farming, the discussion with community members about cost comparisons revealed that while chemical fertilizer costs approximately 10,000/- per acre, organic manure expenses rise to 20,000/- per acre. Labour costs remained fixed at 20,000/- for the methods. However, the organically grown produce did not provide higher price as compared to conventionally grown agricultural produce. This was reported to lead to slight dissatisfaction among the farmers to fully implement the project. The intervention lacked to create the substantial impact it could have been created. • It was reported by some of the **FPO members** that the efforts made under the project were not that significant because it was a one-time input, and there was a lack of demand for organic products in the market. Farmers could not utilize the FPO platform properly due to lack of knowledge and awareness about the use of FPO.
Convergence	• There's potential for the project to align with various Government departments viz. Agriculture, Fisheries, Kerala Water Authority, and the District Planning Office and various schemes such as Jalanidhi Project for water supply in rural areas through Rainwater Harvesting, Groundwater based Drinking water scheme, Groundwater conservation and Recharge etc. with a view to expand the project's outreach. Moreover, partnering with the Ministry of Micro, Small, and Medium Enterprises will provide the project with additional resources, for promotion of irrigation facilities, access to organic inputs, marketing, etc.), and supporting establishment of micro processing units in project villages. Additionally, the scheme of the Department of Horticulture **("Mission for integrated development of horticulture")** State Horticulture Mission Kerala, Govt. of Kerala which also promotes Organic farming and has different schemes under which seeds, organic input material, manure etc. is provided at a subsidized rate to farmers could also be looked at from a convergence perspective.
Sustainability	• The project has fostered community capacity building and established water conservation structures in Pudussery village. This initiative imparts training on organic farming and climate-resilient practices, with the aim of ensuring self-sustained support beyond the project's current efforts. • The project has focused on creating and strengthening community-based institutions for upkeep and maintenance of the different interventions under Haritha Samrudhi Project phase –1. The idea is to empower the community itself to maintain and oversee the operations even after the project duration and take decisions as per the requirement, thus ensuring sustainability of the efforts.

Parameter	Assessment from the study
	• The maintenance of the water conservation structures, constructed through the project falls under the jurisdiction of WMCs, who are tasked with their upkeep. • For wide acceptance of organic farming and marketing the produce without any project support Community-Based Organizations (CBOs), Farmer Producer Organizations (FPOs), and Water Management Committees (WMCs) have been established and strengthened.

5. Recommendations

Recommendations

Basis the key findings from the quantitative and qualitative data analysis, Haritha Samrudhi project has managed to create an impact in the lives of the beneficiaries. Recommendations for the management's considerations which are discussed in the below section:

Soil and water conservation

Define, map, and characterize the study area

- Identifying and defining the physical scope/ boundary is the foremost step in the water stewardship program. The physical boundaries define the area from where relevant information is required to be collected. As a standard practice physical scope should include relevant (location of the Site or location of the source of water) catchment but it can extend to the applicable administrative boundaries. It is important to define and map the study area in the context of site operations to be able to claim the benefits from the interventions to off-set the Site's impact.

- For Haritha Samrudhi Project Phase 1, Pudussery Gram Panchayat is identified as the intervention area. The water related problems faced by this area are documented in the Proposal and Project Completion Reports to a broad extent. However, no formal mapping of the area or its water bodies has been done. The location of UBL's Site with respect to the study area has also not been defined or mapped.

- Study area should be defined in the context of Site operations i.e., water withdrawal, wastewater discharges etc. The study area can be in the form of watershed, or buffer area cantered around the Site. However, if the source of the water for the Site is located at a distant location, a different study area may be selected.

- Once the study area is defined it should be mapped accurately using appropriate tools such as GIS software or similar tools, indicating locations of key features such as location of the Site, boundaries of the study area, location of the source of water, locations of wastewater discharge, administrative boundaries etc.

- Further, the study area should be characterized for natural and anthropogenic features such as topography, hydrology, hydrogeology, geology, land use pattern, water usage etc. Catchment areas of structures such as waterbodies and check dams must be delineated and mapped using topographic data. Analysis of the historical land use in the study area may also be beneficial in choosing the locations for intervention.

Identification, and mapping of intervention area

- The intervention areas should be identified clearly and mapped using appropriate tools such as GIS software, revenue maps, topo-sheets or other appropriate method, to show point location as well as areal extents of the target intervention. For structures such as farm bunds and WATs, areal extents of the intervention should be used to define the location.

- Any catchment areas or command areas identified must also be mapped along with the target structure.

Monitoring and tracking of quantifiable indicators

- Key Performance Indicators (KPIs) for monitoring and tracking the continued benefits of the project were defined in the Operation and Maintenance Plan. However, no records of monitoring the defined KPIs were provided. Interventions are recommended to be **monitored and tracking** based on predetermined quantifiable indicators at regular intervals of time during the project duration, especially for interventions located in public spaces such as ponds, check dams, etc. This will enable quick identification of project impact, and any potential issues to be addressed. The duration of monitoring and evaluation could be annual post project closure if and till such time that volumetric water benefits are claimed from the project.

Record keeping and documentation

- Assumptions, claims, objectives, steps, methodology, quantifiable data, and project specific outcomes at both pre and post implementation stages need to be documented in detail in baseline assessment report/endline assessment report as appropriate. Any changes in assumptions from year to year shall be described. Methodologies for selecting interventions and their locations shall be described in a scientific manner including descriptions of hydrology, hydrogeology, land use, structural considerations, etc. It is recommended that the project completion report shall present a complete overview of project activities from baselining to completion.
- When technical information such as structure dimensions or volumes are quantified, it is recommended to clearly state the unit of measurement and to use consistent units throughout the documents. Use of the SI-unit system is preferred.
- UBL may consider developing an internal standard operating procedure (SOP) defining minimum expectations from implementing partners with respect to baseline and endline assessments, documentation and reporting.

Continued stakeholder engagement

- It is recommended that UBL should have a tapered exit approach and maintain continued engagement with stakeholders of the project even after completion to ensure the regular operations and maintenance of all the provided infrastructure according to the training provided. This practice may enable UBL to facilitate identification of long-term impacts of the project as perceived by the community while also identifying scope for future community related projects. Stakeholder engagements shall be continued on an annual or bi-annual basis before monsoon season if and till such time that volumetric water benefits are required to be claimed from the project. It will also depend on the project duration of the CSR project.
- There are no standard timelines set for the duration of such engagement. However, Government of India has provided indicative timelines in Common Guidelines for Watershed Development Projects (2008). Accordingly, the guidance has suggested a phased approach as given below.

Phase	Name	Duration	Indicative actions
1	Preparatory phase	1-2 years	This phase aims at developing a mechanism for participatory approach and empowerment of local communities, institution. Undertake baseline assessment, prepare DPR etc.
2	Watershed works phase	2-3 years	Implementation of planned initiatives
3	Consolidation and Withdrawal Phase	1-2 years	Capacity building, allocation of roles and responsibilities, repair and maintenance, involvement of gram panchayat in addressing above aspects etc.

Community Capacity Building

- Limited involvement of the community-based institutions and their members was observed in ensuring the sustainability of the interventions. CBOs were formed with the purpose of mobilizing the community and supporting them in training and increasing awareness. However, it was observed that CBOs were not clear about their roles as a part of the project. Similarly, Water Management Committees formed within the project should be made responsible for the maintenance of all the community water structures created/ rejuvenated under the project. It was observed that the some of WMC's are not proactively taking responsibility for the assigned responsibilities. For instance, it was observed that in only one village WMC has initiated pisciculture

in one of the big ponds and is maintaining the structure, but in other villages no such initiative /efforts were observed to ensure the maintenance of the water structures Hence, there is a need to ensure greater ownership for maintenance and sustainability of the structures by imparting regular trainings and conducting meetings during the project period and prepare some of the Key opinion Leaders who can steer the responsibility after the exit of UBL for strengthening the said institutions.

- Beneficiaries mentioned about the high cost of cultivation for organic farming due to which some of them suggested for **adoption of micro irrigation techniques such as solar-based mini sprinklers and drip systems** which can help in reducing water consumption, electricity cost, and effort required for irrigation. Moreover, such systems are known to enhance yield and hence, **can help in improving farm income of the local farmers**. Department of Horticulture, Govt. of Kerala provides subsidy support to farmers while purchasing mini-sprinklers and drip systems. The project can create **convergence with the Department** to ensure that the farmers are able to benefit from such schemes.

- Awareness among the FPO members about the purpose of forming a FPO and its functioning is most crucial part to make it sustainable. The newly added FPO members from Pudussery village were still identifying themselves as members of the earlier Farmers Welfare Association of their village. The project needs to ensure that the FPO members are aware about all the aspects and functioning of a FPO and the benefits that they can avail being a member of FPO viz. Access to marketing platform for selling the produce.

- In the next phase of the project, opportunities can be explored that the **FPO members are trained on leadership aspects and management of the FPO** which will be crucial to strengthen and sustain the institution. Further, **enabling the FPO leadership and staff to take informed decisions** based on real time market information using appropriate technologies such as eNAM (National Agriculture Market), Agmarknet, NCDEX, etc. to ensure that the FPO operations are profitable and viable in the long run.

- One of the major challenges with the farmers was lack of the technical know-how on production and usage of organic/ natural inputs. To overcome this challenge, **Farmer field schools, pilot plots, exposure visits and seed trials can be organized to give practical training to farmers on organic farming techniques.** CBO members can act as Master Trainers (provide regular technical and handholding support to the farmers) to create an effective extension model. **Identifying synergistic farming** (e.g., agroforestry and interact cropping/ mixed cropping/ crop rotation models) and **training the farmers on adoption of such systems** can further help in improving soil health and farm productivity.

General Recommendations

Convergence with Government schemes can be explored for the communities' benefit. This would lead the project towards better resource efficiency. The Department of Horticulture ("Mission for integrated development of horticulture" State Horticulture Mission Kerala, Govt. of Kerala which also promotes Organic farming) has different schemes under which seeds, organic input material, manure etc. is provided at a subsidized rate to farmers. Opportunities can be explored to leverage such schemes and assist the local farmers in benefitting from such Govt. Initiatives.

6. Annexures

6.1. Annexure- 1: Detailed Findings of the structures visited

6.1.1. Rooftop Rainwater Harvesting

Rooftop rainwater harvesting sites observed during field visits were scored based on a standard maintenance checklist. [7] The scoring rubric is provided below.

Table 17 presents the observations recorded by the PW field team.

Scoring Pattern	
Good condition.	Well maintained, no action required.
Moderate condition.	Adequately maintained, routine maintenance needed.
Degraded condition.	Poorly maintained, routine maintenance and repair needed.
Serious condition.	Immediate need for repair or replacement.
Abbreviation	
UGRWT	Underground Rainwater Harvesting Tank
GLRWT	Ground Level Rainwater Harvesting Tank
C	Could not be assessed or observed (due to inaccessibility)
NA	Not Applicable

[7] https://www.townofbluffton.sc.gov/DocumentCenter/View/2315/PC-BMP-Inspection---Rainwater-Harvesting-PDF

Table 17 Field observations on rooftop rainwater harvesting systems.

Sl. No	Description	Results										General Remarks
		Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7	Survey 8	Survey 9	Survey 10	
I.	General Details											
1	Village	Pudussery West	Pudussery West	Pudussery Central	Pudussery Central	Pudussery Central	Pudussery Central		Pudussery Central	Pudussery East	Pudussery East	
2	Habitation	Edaparambu/ Suryachira	Edaparambu/ Suriyachira	Chullimalla	Chullimalla	Chellankavu			Chinnamala	Nadupathy	Pulampara	
3	Type of Tank	UGRWT	UGRWT	UGRWT	UGRWT	GLRWT	UGRWT	UGRWT	UGRWT	UGRWT	UGRWT	
4	Size of the Tank [In Litre]	5000L	5000L	5000L	5000L	5000L	5000L	5000L	5000L	5000L	5000L	
5	Type of Roof	Flat Roof	Flat Roof	Flat Roof	Flat Roof	Sloping roof	Flat Roof	Flat Roof	Flat Roof	Flat roof	Flat Roof	
II.	Contributing Drainage Area (Roof Area)											
1	Excessive leaves and debris in gutters/downspouts	Good condition	Good condition	Good condition	Good condition	Good condition	C	Good condition	NA	Good condition	Good condition	
2	Other materials/debris on roof surface (e.g., excessive bird droppings)	Good condition	Good condition	Good condition	Good condition	Good condition	C	C	Good condition	Good condition	Good condition	
3	Clear overhanging trees/vegetation	Good condition	Good condition	Good condition	Good condition	Good condition	Good condition	Good condition	Good condition	Good condition	Good condition	

Sl. No	Description	Results										General Remarks
		Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7	Survey 8	Survey 9	Survey 10	
	over roof surface											

Sl. No	Description	Results										General Remarks
		Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7	Survey 8	Survey 9	Survey 10	
III.	Pre-treatment											
1	Maintenance access to pre-treatment facility	Good condition	Good condition	Good condition	Moderate condition	Good condition	Good condition	Good condition	Good condition	Good condition	Good condition	There were instances where filters were positioned at elevated locations, making routine cleaning and maintenance difficult to access
2	Check first flush diverters/filters for proper functioning (e.g., not bypassing too much water). Clean debris from filter screens	Moderate condition	Moderate condition	Good condition	Good condition	Good condition	Good condition	Good condition	Good condition	Good condition	Serious condition	Most first flush diverters were found to be working well and regularly used by the beneficiaries.
IV.	Inlets											
1	Check all conveyances into tank; remove debris; check for clogging	Moderate condition – pipe from rooftop was disconnected temporarily for roof repair.	Moderate condition	Good condition	C	Good condition	C	Good condition	Good condition	Good condition	Good condition	In some cases, inlet pipes were found to contain debris, including plant leaves and dust

Sl. No	Description	Results										General Remarks
		Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7	Survey 8	Survey 9	Survey 10	
2	Patch any holes or gaps	Moderate condition	Moderate condition	Good condition	C	Good condition	C	Good condition	C	Good condition	Good condition	
V.	Tank or Cistern											
1	Maintenance access to practice	Good condition	Good condition	Good condition	Good condition	Good condition	C	Good condition	Good condition	Good condition	Good condition	
2	Check storage tank lids											
	a. Vents and screens on inflow/outflow spigots	Good condition	Good condition	Degraded condition	Good condition	Good condition	NA	NA	NA	Good condition	Good condition	
	b. Lids in place, properly secured	Good condition	Good condition	C	Good condition	Good condition	C	C	Good condition	Good condition	Good condition	
3	Overflow pipes & downstream flow path											
	a. Debris/clogging in overflow pipes	Degraded condition	Degraded condition	Serious condition	Good condition	Good condition	C	Good condition	Good condition	Good condition	C	Pipe blocks caused by mud were observed in a few structures
	b. Erosion, excessive debris, clogging of flow path	C	C	Serious condition	Good condition	Good condition	C	Good condition	Good condition	Good condition	C	
	c. Condition of downstream secondary runoff reduction practice (see	C	C	Good condition	Good condition	Good condition	C	Good condition	NA	Good condition	C	In all viewed conditions, downstream secondary runoff was towards the

Sl. No	Description	Results										General Remarks
		Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7	Survey 8	Survey 9	Survey 10	
	applicable checklist)											direction of the garden or farmlands.
4	Sediment build-up in tank	Good condition	Good condition	C	Good condition	Good condition	C	Good condition	C	Good condition	C	
5	Structural integrity											
	a. Tank and foundation	Good condition	Good condition	Good condition	Good condition	Good condition	Good condition	NA	C	Good condition	Good condition	Integrity of the foundation could not be ascertained for underground tanks
	b. Pump and pump housing	Good condition	Good condition	Moderate condition	NA	Good condition	Moderate condition	Good condition	C	Good condition	C	Some structures had hand pumps for extraction of water from the tank.
	c. Pipes	Good condition	Good condition	C	Good condition	Good condition	Moderate condition	Good condition	C	Good condition	C	
VI.	Miscellaneous											
1	Water Use	Based on the survey responses, it was determined that most of the users utilize the water stored in the rainwater harvesting tanks for domestic and small-scale agricultural purposes. However, use of harvested rainwater for drinking purposes was reported to be limited.										
2	Complaints from beneficiaries	There were no major complaints from beneficiaries.										
3	Adequate safety measures	The tanks were observed to be provided with a lid and properly sealed as per visual observations.										

Sl. No	Description	Results										General Remarks
		Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7	Survey 8	Survey 9	Survey 10	
4	Any other specific remarks	They key observations are: 1 It was observed that in few instances tanks may exhibit inefficiency in collecting rainwater from the rooftops due to improper placement of water collection pipes considering the slope of the roof. 2 A few RRWH tanks were observed to be in the vicinity or same side as the septic tanks. However, this was not a common observation. 3 Several users are utilizing the rainwater tanks to collect piped water supply, finding it to be a more reliable source. 4 Recent availability of piped water supply has resulted in beneficiaries preferring to use the tank for piped water storage. Accordingly, the availability of the storage tanks was stated by the beneficiaries to have a positive impact on their lifestyles due to improved storage capabilities. Several reported that the presence of the storage tank spared them the effort of multiple daily trips to manually collect water from distant sources. Although not the intended purpose of the initiative, this may be considered as a complimentary benefit of the project.									

6.1.2. Open well/bore well recharge

Out of the planned 15 wells, 11 well recharge structured were observed by the team on field.

Table 18 Observations from open well/bore well recharge

Sl. No.	Village Name	Habitat	Ownership	Observations
1	Pudussery East	Attapallam	Private	Roof Type: Asbestos Type of well: Open Well Services provided: Gutter for rainwater collection from roof, pipes, first flush and filter. Baseline conditions: Very hard water conditions prevailed, and soap would not lather. The water had a high fluoride content. The beneficiary informed the PW team those dental problems especially yellowing of teeth, due to fluoride content in the water in this area. Boiled water from the well would contain sediments result in scaling of the vessels. Current conditions: The water has become softer than before. Quality of water has seemingly improved based on taste and visual inspection and the sediment quantity in the water has reduced. Scaling of vessels also reduced. No improvements in water level were reported.

Sl. No.	Village Name	Habitat	Ownership	Observations
				Uses of water: All domestic purposes except drinking and cooking since piped water supply is now available.
2	Pudussery East	Attapallam	Private	Roof Type: Tiled Type of well: Open Well Services provided: Gutter for rainwater collection from roof, pipes, first flush and filter. Baseline conditions: Water quality was good. The well used to go dry in March. Current conditions: There is less dust in the water and a slight improvement in water availability. Uses of water: All domestic purposes except drinking and cooking since piped water supply is now available.
3	Pudussery Central	Old Precot Colony	Community	Roof Type: Tiled and sheet Type of well: Open Well Services provided: Gutter for rainwater collection from roof, pipes, first flush and filter. Well restoration was also carried out. Baseline conditions: The well is used regularly by around 200 households. There is a pump to draw water which existed before the project. A drain passes by near the well which contains some sewage contaminated water. The beneficiaries stated that leaks from this drain to the well-used to occur. Current conditions: A slight increase in water availability was reported. Some beneficiaries also reported lower hardness and improved taste, despite no formal water testing being carried out. The leaking sewage contaminated drain was fixed. The well is still used by the community but primarily as a backup source. Uses of water: All domestic purposes except drinking and cooking since piped water supply is now available. It is used for cooking and drinking when piped water is unavailable. Suggestions by the beneficiaries: They beneficiaries requested support in annual maintenance.
4	Pudussery Central	Umminikulam	Community	Roof Type: Tiled and sheet Type of well: Open Well Services provided: Gutter for rainwater collection from roof, pipes, first flush and filter. Well restoration was also carried out. Baseline conditions: The well is used regularly by the community in this area. The well gets almost dry in December but never completely dry. Current conditions: No appreciable change in water availability or quality.

Sl. No.	Village Name	Habitat	Ownership	Observations
				Uses of water: All domestic purposes except drinking and cooking since piped water supply is now available. It is used for cooking and drinking when piped water is unavailable. Use of the well was observed during the site visit.
5	Pudussery Central	KN Pudur	Private	Roof Type: Sheet roof and flat roof Type of well: Open Well Services provided: Gutter for rainwater collection from roof, pipes, first flush and filter. A grill was also provided to cover the well. Baseline conditions: The well has not dried up in the last decade. The total depth is 18 ft. The well is desilted annually. Current conditions: Hardness has reportedly reduced. Uses of water: All domestic purposes except drinking and cooking since piped water supply is now available.
6	Pudussery Central	Kanjikode (at Shree Chaitanya Mahaganapathy Temple)	Community	Roof type: Flat roof Type of well: Open Well Services provided: Gutter for rainwater collection from roof, pipes, first flush and filter. A grill was also provided to cover the well. Baseline conditions: Could not estimate as no beneficiaries were present. Current conditions: All the physical structures were observed to be in good condition upon visual inspection.
7	Pudussery West	Khurudikadu	Private	Roof Type: Sheet Type of well: Open Well Services provided: Pipes from the gutters to the filter, first flush and filter. Baseline conditions: The water is yellow in color and cannot be used for cooking or drinking. There is no odor. It dried up completely once, historically. In other years there is always a little water even during the summers. Current conditions: Well has not gone dry since the project. Uses of water: All domestic purposes except drinking and cooking since piped water supply is now available. It is also used for irrigating coconut trees in the summer. When piped water supply is interrupted, 3 households in the neighborhood also use this well
8	Pudussery West	Khurudikadu	Private	Roof Type: Flat roof Type of well: Open Well

Sl. No.	Village Name	Habitat	Ownership	Observations
				Services provided: Gutter for rainwater collection from roof, pipes, and filter. Baseline conditions: Well dries up completely in summers. Current conditions: Well dried up even after the intervention. Uses of water: All domestic purposes except drinking and cooking since piped water supply is now available. When piped water supply is interrupted a few other households withdraw water from the well. Withdrawal is done manually.
9	Pudussery West	Pudussery	Private	Roof Type: Sheet Type of well: Open Well Services provided: Gutter for rainwater collection from roof, pipes, and filter. Baseline conditions: Water is available throughout the year. In the monsoon the well is almost full and in summer it becomes almost empty but never fully dry. The water has a slightly bad taste. Current conditions: No appreciable change in water availability or quality. Uses of water: All domestic purposes except drinking and cooking since piped water supply is now available. It is also used for irrigating coconut trees in the summer. When piped water supply is interrupted, 15-20 households in the neighborhood also use this well.
10	Pudussery West	Venoli	Private	Roof Type: Sheet and tiled Type of well: Borewell Services provided: Gutter for rainwater collection from roof, pipes, and filter. Baseline conditions: Water quality has always been good. However, a slight odour is present in the water immediately after drawing, which disappears itself. The depth of the well is 120 ft. Water is available throughout the year. Current conditions: No appreciable change in water availability or quality. Uses of water: All domestic purposes except drinking and cooking since piped water supply is now available.
11	Pudussery West	Kunnekadu	Community	Roof Type: Sheet and tiled Type of well: Open Well Services provided: Gutter for rainwater collection from roof, pipes, and filter. The well was also restored. Baseline conditions: There were sediments in the water. Water is ways available in the well throughout the year.

Sl. No.	Village Name	Habitat	Ownership	Observations
				Current conditions: No appreciable change in water availability or quality, except for reduction in sediments. The pipe from the rooftop was observed to be broken during the field visit. The beneficiary informed the team that the pipe has broken once before and was fixed by the implementing partner. Some dumping and burning of garbage were observed beside the well. Uses of water: About 50 households take water from this well when piped water supply is interrupted.

6.1.3. Open Well Restoration

All 10 wells that were restored under the project observed at site. In general, it was observed that the activities involved in well restoration were cleaning and desilting the inside of the well, building and painting of concrete exteriors and fixing of safety grills at the top of the well.

The locations of the restored wells are:

- Old Precot Colony
- Precot Colony
- Umminikulam
- Vadhyarchalla
- Nadupathy
- Aallampallam
- Cent Colony
- Kunnekadu
- Kalariparambu
- Chellankavu

The locations match the reported locations in the Project Completion Report. Some community wells were restored and recharged through rooftop rainwater harvesting as described in the section above.

The general observation from the well repair activity is that most of the repaired wells are currently in use only when piped water supply is not available. In areas where the wells are not used daily, dumping and burning of solid wastes around the well was observed (Precot Colony, 4 cent colony, Kalariparambu and Kunnekadu). At 4 Cent Colony, solid waste was also observed to be floating inside the well. Many of the wells are in poor condition including growth of the vegetation since the wells are not in regular use.

The remaining wells were observed to be maintained in good condition. No beneficiaries reported use of the water from the wells for irrigation purposes. They were only used by communities as a secondary water source for household purposes.

The Kalariparambu well lies beside the highway. It was stated by a nearby resident that the well is mostly used by truck drivers to fill up their bottles. The houses nearby draw water from the well only when there is no electricity to power their household pumps.

6.1.4. Water Absorption Trenches

3 locations with water absorption trenches were visited by the PW field team – Venoli (Pudussery West), Paytikadu-Chellankavu (Pudussery Central) and Pulampara (Pudussery East). Each of these locations were individual farmlands with WATs constructed across them.

The field in Venoli was not being used for any agriculture and the beneficiary was not available for consultation. The WATs were found to be mostly filled with silt and vegetation and no clear contours were evident. All the WATs had been provided with a small earthen berm on one side. The dimensions were approximately 4 or 5 ft in length and about 2 feet across. Depths varied based on the amount of silt gathered.

The WATs in Paytikadu were located in a coconut grove. At this location as well, the WATS were almost completely covered and difficult to observe. The beneficiary was present and stated that the structures were helpful in retaining soil moisture. However, there were growing concerns in this farm and surrounding areas due to damage caused by elephants. Due to these concerns, farmers in this area had reportedly started selling their property to private industrial estates and moving away to safeguard their families.

The WATs in Pulampara were located within a mango grove. The WATs were located near the trunks of the mango trees and also largely covered by grass and silt. However, the beneficiary was present and stated that the WATS helped him to safeguard his trees despite the failed monsoon earlier this year. He reported that the WATs were able to collect rainfall whenever occurred and meet the water requirement of the trees, with reduced need for irrigation.

Table 19 Changes to a field provided with WATs, 2019 – 2022 (Source: Images retrieved from Google Earth Pro on 22 Oct 2023)

	
March, 2019	January, 2020
	
March, 2021	March, 2022

6.1.5. Gully Plugs

A total of 127 gully plugs were reportedly constructed as part of the project. The gully plugs were built in clusters consisting of a series of cascading gully plugs constructed across a particular stream. 2 clusters of gully plugs – One in Vadhyarchalla and one in Chullipallam were inspected on field. The observations from the field are detailed below.

Table 20 Field observations on gully plugs

Sl. No	Description	Results	
		Survey 1	Survey 2
I.	Location		
1	Village	Pudussery Central	Pudussery East
2	Habitation	Chulipallam	Vadhyar Challa
II.	Suitability		
1	Terrain slope (not more than 20%)	Yes	No visible upstream
2	Order of stream (Catchment area should be less than 10 ha)	1st Order steam	2nd Order steam
3	Steam Width	~3 Meter	~3 Meter
4	Locally available stones for Gully Plug	Yes; The stones used are locally purchased	Yes; The stones used are locally purchased
III.	Structural soundness		
1	Foundation width provided	Yes; 1.5 to 2 Feet boulder	Yes; 1.5 to 2 Feet boulder
2	Dimensions	Length: 3 to 4 M Width: 0.5 to 0.6 M Depth: 1M from foundation to top	The structures were mostly submerged under the silt that got accumulated over the previous rainy seasons. Some structures were also found to be destroyed, reportedly due to heavy rainfall.
3	Tapered or trapezoidal Shape of Gully Plug	No; The gully plug is constructed with a rectangular shape.	No; The gully plug is constructed with a rectangular shape.
4	Maximum height should be 1M	Yes	Could not be determined.
5	Arrangement of stones	Moderately arranged, there was only 1 instance of lost cage	Could not be determined.

Sl. No	Description	Results	
		Survey 1	Survey 2
6	Covers entire stream width and 1M extra on both sides	Covers the entire stream, but no further extension is constructed	Covers the entire stream, but no further extension is constructed
IV.	Miscellaneous		
1	General Observations	1. After construction, neighbouring agricultural lands reported that have been effectively utilized for the cultivation of second crops. 2. Nearby wells were reported by locals to have presented increases in water levels, which have not only served the purpose of irrigation but have also improved access to water for domestic use. 3. Regular maintenance of these gully plugs is essential to mitigate the accumulation of silt that occurs during each rainy season 4. The quality of water in the observed streams were good based on visual observations. The water was clear and no foul odours were discernible. Local residents reported that there were no practices of wastewater discharge into the streams in these areas.	

6.1.6. Farm Bunds

A total of 52.8 acres of farm area was reported to be covered by farm bunds. Against the planned 4 visits, PW team visited 3 locations where farm bunding was constructed as part of the project activities. The visited sites were:

- Pudussery East: Attapallam and 2 X Pulampara

Although the project completion report states that farm bunds were mainly located in Pudussery West and Central villages, during the field visits it was determined that the farm bunds are located in Pudussery East and not the other villages, as stated by the implementing partner.

At Attapallam, beneficiary Vinod stated that a section of land that he owned previously used to be sloping outwards from his plot and was barren as all rain falling on the surface would flow out of the plot. Vinod explained to the PW team that beneficiaries were required to fill out an application form to avail the benefits of farm bunding. Accordingly, his property was cleared, levelled and bunds were constructed around the periphery. Vinod has since started growing crops in this section of his land (palm trees) after the farm bunding. The farm bunding activity was stated by him to have arrested erosion and improved soil moisture.

6.1.7. Subsurface Barriers

Table 21 Field observations of subsurface barriers

Sl. No	Description	Results		
		Survey 1	Survey 2	Survey 3
I.	Location			
1	Village	Pudussery Central	Pudussery Central	Pudussery West
2	Habitation	Chullippallam	Kannode	Kovilpalayam
II.	Suitability			
1	30 – 75 CM below the round level	No, 1 M	No, 1 M	Yes, around 70 CM
2	In the vicinity of wells / handpumps	There are wells around 500M radius; There are reported increase in water levels in those wells	Since its rocky strata its mostly bore wells	Yes
3	Constructed in nala / stream	Yes, the stream was full at the time of the visit.	Yes, the stream was full at the time of the visit.	Yes – the stream was stated to contain water only during rainy seasons. It was dry at the time of the visit.
III.	Structural Soundness			
1	Dimensions	Could not be determined – the structure was not directly accessible due to the stream being full.	Length: 7M Breadth: 0.3M Depth: 1M	The height above ground was approximately 0.3m. The depth below ground level was stated to be 0.7m.
2	Constructed up to hard rock	No since the depth was just 1 M	No	No
3	Perpendicular to direction of flow	Yes	Yes	Yes – the SSB was also constructed directly downstream of a previously existing check dam. The check dam was not a part of the current project activities and was not functional.
4	Provided boulder check / recharge trench on u/s	No	No	No
5	Drains on both sides	No	No	No
6	Maintained	No	No	No

Sl. No	Description	Results		
		Survey 1	Survey 2	Survey 3
7	Community benefits	Quality improvements were not evident. However, a beneficiary stated that 2 crop cycles are possible since the SSBs were set up, provided adequate rainfall occurs during the monsoon.	At Kannode, it was stated that farmers occasionally pump water directly from the stream for use. However, this was not observed on the field. The beneficiary stated that the SSB has helped in terms of improved water availability.	A farmer present stated that the SSB improved soil moisture in the surrounding paddy fields.
IV.	Miscellaneous			
1	General Observations	The introduction of subsurface barriers has improved water availability in nearby are by increasing soil moisture. These barriers were reported to have elevated groundwater levels and improved the water availability.		

6.1.8. Check dams

Table 22 Field observations of check dams

Sl. No	Description	Results	
		Survey 1	Survey 2
I.	General Details		
1	Village	Pudussery East	Pudussery Central
2	Habitation	Ettadithode	Chellankavu
II.	Suitability		
1	Depth of Nala	Less than 1.5M	3M
2	Slope of Nala bed (Should be less than 3%)	Gradual Slope	Gradual Slope
3	On sharp curve	No; However, there is a sharp curve on d/s end.	No
4	Does it get filled in rainy season	Yes; It gets filled every rainy season	Yes; It gets filled every rainy season
5	Extent (length) of water pooled upstream of the structure	Could not be determined due to thick vegetation and inaccessibility	~ 100M
III.	Structural Soundness		

Sl. No	Description	Results	
		Survey 1	Survey 2
1	Dimensions of the main body	Length: 6.5M Breadth: 0.8M Spillway: 1.5M [Width] X 2M; Height: 0.5M	Length: 3.9M Breadth: 0.65M Gate Width: 0.7M
2	Apron Presence	Yes	Yes; Wing Walls
3	Freeboard at 0.3M	Available, however its completed silted	Available
4	Does water enter into adjoining fields during monsoons?	Yes; Towards the downstream as claimed by the PSSP.	Yes; There is a diversion canal for irrigation
5	D/S slode provided	Yes	No
6	Leakages at main body	Could not be determined. None observed visually.	Could not be determined. None observed visually.
7	Leakages at side walls	Could not be determined. None observed visually.	Could not be determined. None observed visually.
8	Overall anchorage of all parts	Yes	Yes
9	Silt deposition	Heavy deposits were observed. The water storage area water filled with silt and storage capacity was entirely diminished.	Mild deposits were observed
10	Condition of main body	Good	Good
IV.	Utility		
1	How many month water is stored	Approximately 6 months; Current situation with the silt the capacity has been reduced	Approximately 6 months;
2	Water present till which month	Could not be determined.	Could not be determined.
3	Found useful in the last dry spell	Could not be determined.	Yes, the soil stays wet.
4	How many times it gets filled	Could not be determined.	Could not be determined.
5	Water used for	Could not be determined.	Irrigation Purposes
6	Is there a well nearby (number if many)	Could not be determined.	Yes
7	Well water level increased due to CNB construction	Could not be determined.	Yes;
V.	Miscellaneous		
1	General Observations	The following benefits of check dams were reported during the field visits: 1. Farmers reported that they were able to grow a second crop, increasing overall productivity.	

Sl. No	Description	Results	
		Survey 1	Survey 2
		2. Increase in availability of groundwater as indicated by reported increased groundwater levels, resulting in increase in availability of water for agricultural and domestic purposes Regular maintenance of these check dams is essential to mitigate the accumulation of silt that occurs during each rainy season. It is important to conduct annual or seasonal desilting to maintain the maximum storage capacity of the structures.	

Table 23 Changes in condition of the stream after construction of Chellankavu check dam, 2019 – 2022 (Source: Images retrieved from Google Earth Pro on 22 Oct 2023)

	
March, 2019	April, 2020

	
December, 2021	August, 2022

	Historical satellite images for assessment of Chellankavu check dam	
Rabi (Nov-Feb)	Dec 2012 	Jan 2015 

	Jan 2017 	Jan 2018 
	Jan 2021 	Jan 2022 

	Farmers' claims regarding increased overall productivity through the cultivation of a second crop are evaluated using historical satellite imagery. Analysis of satellite pictures taken before and after the intervention during the Rabi farming season, spanning from November to February, does not indicate any significant changes in the cropping patterns. However, availability of historical satellite imagery is limited.

6.1.9. Big and Small Pond Deepening

Table 24 Field observations from big and small pond deepening activities

Sl No	Description	Results				
		Survey 1	Survey 2	Survey 3	Survey 4	Survey 5
I.	Location					
1	Village	Pudussery East		Pudussery West	Pudussery	Pudussery East
2	Habitation	Pulampara / Poolampara	Nadupathy	Suriyachira	Bodichettieri	Attapalam – Paraeri
II.	Suitability					
1	Pond type	Small Pond	Big Pond	Small Pond	Big Pond with Baby Ponds	Big Pond
2	Pond elevation compared to stream elevation	Downstream Side of the farm	Downstream Side of the farm	No stream visible	No stream visible	No stream visible.
3	Type of bed strata soil	Could not be determined.	Clay	Could not be determined.	Could not be determined.	Clay
4	Farm Pond ownership	Private	Public	Private	Public	Public
III.	Structural Soundness					
1	Dimensions	Total depth of the pond: 33ft. Surface area as per satellite imagery: ~ 190 m^2	Length: 25.5 M Breadth: 25.5 M Depth: 1.5 M Surface area as per satellite imagery : ~ 630 m^2	Could not be determined. Surface area as per satellite imagery: ~400 m^2	Could not be determined. Relatively very large Surface area as per satellite imagery: ~ 16,200 m^2	Could not be determined. Relatively very large Surface area as per satellite imagery: ~ 10,140 m^2
2	Berm Present	All sides are protected by berm / bunds.	All sides are protected by berm / bunds.	All sides are protected by berm / bunds.	All sides are protected by berm / bunds.	All sides are protected by berm / bunds. One of the

Sl No	Description	Results				
		Survey 1	Survey 2	Survey 3	Survey 4	Survey 5
						sides was rocks, so it's also protected
3	Outlet Provided	Yes, A pump is connected	Yes, however its currently blocked by mud.	Yes, towards the field the outlet is provided	Yes, towards the field the outlet is provided	Yes, towards the field the outlet is provided
4	Maintained Slope of pond sides	Yes, Steep walls are provided	Yes.	Yes	Yes	Yes
5	Soil compacted	Yes. Excavated soil from the pond was used for bund strengthening.	Yes, its compacted using mechanical methods [JCB]	Yes	Not visible / Could not be determined.	Yes
6	Pitching or revetment	Yes, however the farmers did this themselves before the project.	Yes, however its covered only 3 sides of the pond.	No	Could not be determined.	Stone pitching was provided on one embankment
III.	Utility					
1	Water present till which month	The water is available for throughout the year. However, during the summer months maximum water is pumped out of the pond.	The water is available for throughout the year, however during the summer months the level is reduced drastically to less than 0.5M height.	Could not be determined.	The water is available for throughout the year, however during the summer months the levels are reduced drastically.	The water is available for throughout the year, however during the summer months the levels are reduced drastically.
2	Is there a well near to pond (number if many)	Yes	Yes	Yes, One big open well	Yes	Yes
3	Well water level increased due to pond construction	No; Pond was constructed more than 50 years ago; the project increased the depth of the pond. The beneficiary reported that about 6-7 years' worth of accumulated silt was removed during the project activity. Hence, no major increase in water level was observed, however the storage capacity has	Could not be determined.	Could not be determined.	No; Pond was constructed long ago; the project increased the depth of the pond. Hence no major increase in water level was observed, however the storage capacity has increased that ensures more water availability.	Could not be determined.

Sl No	Description	Results				
		Survey 1	Survey 2	Survey 3	Survey 4	Survey 5
		increased that ensures more water availability.				
4	Water Use and scale	This water source supports the agricultural needs of five farmers, collectively cultivating approximately 14 acres of land. This is the only source of water for irrigation for these farmers and it was reported they do not have enough water for a second crop. Based on visual inspection, it is suspected that after deepening, the pond is capturing base flow.	This water source supports the agricultural needs of farmers, collectively cultivating over 30 acres of land. It was reported that the scale of agricultural practices in this area was declining.	This water source lies within private property supports the agricultural needs of the beneficiary. Based on visual inspection, it is suspected that after deepening, the pond is capturing base flow.as there is a larger pond right adjacent to this one, sharing a common bund. The water level appeared to be the same for both ponds.	This water source supports the agricultural needs of more than 40 farmers, collectively cultivating about 50 acres of land. Fish farming has been initiated here which is generating an additional source of revenue for the farmers.	This water source supports the agricultural needs of farmers; however, the scale of impact could not be determined.
IV.	Miscellaneous					
1	General Observations	The revitalization of the ponds has contributed to augmenting water resources available to the village community. The farmers reported that they use water from the ponds for irrigation.				

Table 25 Changes in condition of Bodichettieri big pond from 2019 – 2022 (Source: Images retrieved from Google Earth Pro on 22 Oct 2023)

	
April, 2019	January, 2020
	
March, 2021	February, 2022

	Historical satellite images for assessment of Bodichettieri big pond	
Rabi (Nov-Feb)	Dec 2012 	Jan 2015 
	Jan 2017 	Jan 2020 

	December 2021 	February 2022 
	Farmers' claims regarding increased overall productivity through the cultivation of a second crop were evaluated using historical satellite imagery. Analysis of satellite pictures taken before and after the intervention during the Rabi farming season, spanning from November to February, does not indicate any significant changes in the cropping patterns during the Rabi season. However, availability of historical satellite imagery is limited.	

Table 26 Changes in condition of Nadupathy big pond from 2019 – 2022 (Source: Images retrieved from Google Earth Pro on 22 Oct 2023)

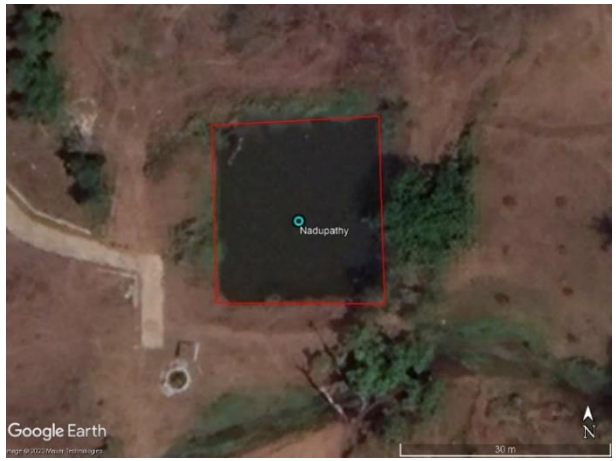
	
April, 2019	Janurary, 2020
	
March, 2021	March, 2022

Table 27 Changes in condition of Paraeri big pond from 2018 – 2022 (Source: Images retrieved from Google Earth Pro on 22 Oct 2023)

	
September, 2018	April, 2019
	
March, 2021	March, 2022

Table 28 Changes in condition of Pampakulam big pond from 2018 – 2022 (Source: Images retrieved from Google Earth Pro on 22 Oct 2023)

	
2018	April, 2019
	
Januray, 2020	March, 2022

Table 29 Changes in condition of Suryachira big pond from 2018 – 2022 (Source: Images retrieved from Google Earth Pro on 22 Oct 2023)

	
Janurary, 2018	March, 2019
	
December, 2022	December, 2022- Zoomed out to show the large pond adjacent to the small pond