



Impact Assessment Study- UBL

Participatory water conservation through rejuvenation of water bodies in Thiruvallur district, Tamil Nadu - United Breweries Limited

March 2023

Price Waterhouse Chartered Accountants LLP

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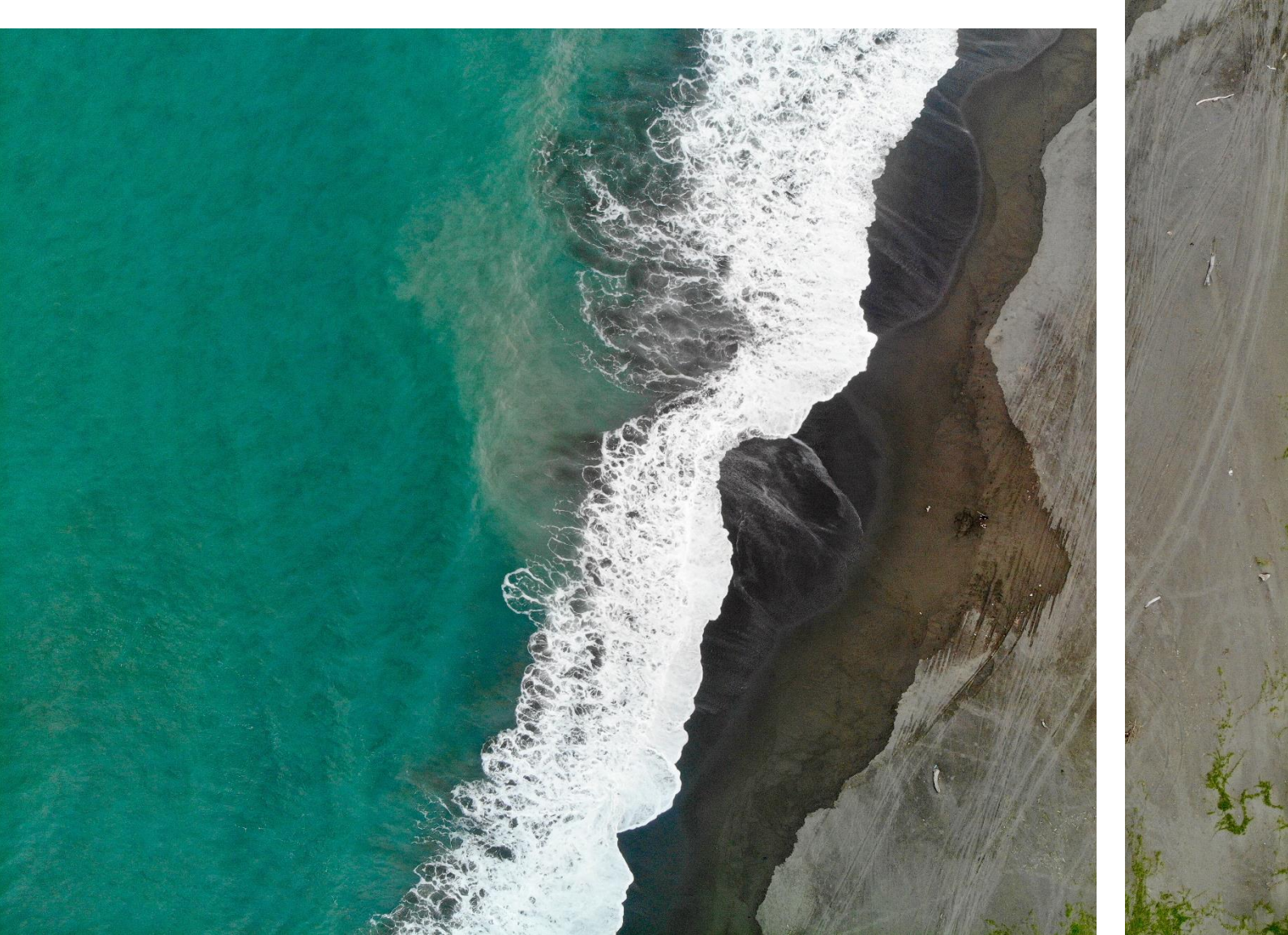
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Executive Summary



United Breweries Limited (UBL) is an Indian company headquartered in UB City Bangalore 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. As part of its CSR initiative, United Breweries Limited has worked towards the participatory water conservation project in 4 villages in Thiruvallur district, Tamil Nadu in association with its implementing partner, Dilasa Janvikas Pratishtan.

The first phase of this project was successfully implemented in FY 19 -21 where 7 lakes were rejuvenated in 4 villages of Thiruvallur district. The CSR project support included **rejuvenation of lakes, removal of *Prosopis juliflora*, tree plantation around the lakes and awareness session** on water conservation to the villagers and Gram Panchayat members as well. The overall objective of the intervention/project was to improve surface water storage and groundwater recharge by facilitating water conservation in 4 villages (**Aranvoyal, Murukancherry, Kuthambakkam North & Kuthambakkam South**) near UBL Chennai and Empee plants in Tamil Nadu through rejuvenation of lakes and participatory engagement. PW has been engaged to conduct an independent Impact Assessment study of water conservation project of United Breweries Limited (UBL) in 4 villages in Thiruvallur district, Tamil Nadu. The scope of work included the following:

- Undertake review of all the activities implemented under UBL's project titled 'Participatory water conservation through rejuvenation of waterbodies.
- Assess the quality of the infrastructure created through the project
- Evaluate the status and usage of the structures created
- Assess community awareness around water conservation - Undertake site visits for review of the data and conduct one on one meetings with the Non-Government Organizations (NGO), Gram Panchayat, and community to assess the effectiveness, efficiency & sustainability of the project.
- Derive the standard framework basis national and international guidelines on calculations for measuring water recharge and rainwater harnessed
- Review of water recharge and conservation data provided by NGOs against this framework - Prepare Gap assessment report based on 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.

A mixed methods approach leveraging both quantitative and qualitative research methods, in consultation with UBL & implementing partner was deployed to assess the impact of the programme on the lives of communities or beneficiaries. For this study a sample size of **266 beneficiaries** was collected in through quantitative survey and **54 samples** were covered through qualitative method - **7 Focussed Group Discussions (FGDs) with 50 beneficiaries** and Key Informant Interviews (KIIs) with **2 Gram Panchayat Presidents and One KII each with Implementing Partner and Community Mobilizer**. Additionally, as part of the impact assessment, benchmarking and gap assessment against best practice and the Volumetric Benefit Accounting (VBA) was also carried out.

Key findings of the study:

Impact of rejuvenation of lakes and ponds:

Under the initiative, 7 lakes were rejuvenated of 4 project villages to improve the groundwater recharge level at community level.

- **100% of the respondents were aware** about the rejuvenation of lakes and ponds initiative implemented by UBL.
- 56% (n=266) of the respondents have agreed facing water availability issues due to low groundwater recharge level and 39% have responded to have less agricultural activities due to lack of water for irrigation.

- Majority of the respondents (73%) noticed the **visible change in groundwater recharge level** as an impact of the intervention and 83% of the total respondents (n=266) highlighted that they have seen the **lake reach its full storage level for the first time after the intervention**.
- During the interaction community people have opined that the rejuvenation of lakes & ponds has created a **great impact on improving the ground water level** due to which agricultural activities have increased in the village which has also increased their family income.
- Before the intervention, villagers in Aranvoyal stopped engaging in agricultural activities due to lack of water within the village and converted entire land into private residential lands or were left unused; Post intervention, 25% respondents reported to cultivating during both the seasons while 13% reported to cultivating during only Kharif season in project villages.
- 51% respondents have shared that their farmland is less than 1 km far from the rejuvenated lakes and ponds which has helped them a lot in improving their agricultural productivity.
- Beneficiaries who are cultivating either in one or both seasons stated that the **area of cultivation has been expanded post the intervention** in all project villages due to availability of water within the village. Beneficiaries also opined that earlier some of their land was not in use due to scarcity of water which is now being used for various agricultural activities during both the seasons as a result of increased groundwater level and water storage potential.
- Volumetric Water Benefit Accounting (VWBA) method was used to quantify the benefits of the lake rejuvenation activity in terms of additional recharge opportunity created from the activity. Three distinct scenarios were considered, to incorporate variations between the dimensions reported in the various project related documents (such as Needs Assessment Report, MoU, project completion report) shared by Dilasa and the information gathered from the field facilitator during the Site visits. The parameters considered for the three scenarios are seen in the table below.

Scenario	Description of Scenario	Basis for Surface Area	Basis for lakes included in calculation	Basis for Excavated Depth	Evaporation Losses	Water withdrawal from lake	Loss of Storage due to Siltation	Baseline Condition	VWBA
Scenario 1	This Scenario represents the figures documented in MoU which reflect gross storage capacity of the target lakes assuming negligible losses and that the lakes fill up twice a year. The area of the lakes/ponds have been estimated based on maximum length and width of the water bodies as reported in the MOU.	Maximum length and width of subject water body	MoU	MoU	X	X	X	X	X
Scenario 2	Surface area of the lakes has been incorporated to reflect actual submergence area based on satellite imagery using Google Earth Pro software. Evaporation losses have been incorporated. Direct water withdrawal from the lakes is assumed to be negligible (if any). Loss of storage capacity due to siltation is assumed to be negligible, and lakes are assumed to fill twice in a given year. Excavated depths considered for computational purpose are unchanged from the MoU	Satellite imagery	MoU	MoU	✓	X	X	✓	✓

Scenario	Description of Scenario	Basis for Surface Area	Basis for lakes included in calculation	Basis for Excavated Depth	Evaporation Losses	Water withdrawal from lake	Loss of Storage due to Siltation	Baseline Condition	VWBA
	document and reflects excavation volumes per documented records. Baseline recharge has been considered to arrive at beneficial impacts. The VWBA approach was adopted to quantify benefits.								
Scenario 3	Surface area of the lakes visited have been incorporated to reflect actual submergence area based on satellite imagery. Evaporation losses have been incorporated. Direct water withdrawal from the lakes is assumed to be negligible (if any). Loss of storage capacity due to siltation is assumed to be negligible, and lakes are assumed to fill twice in a given year. Excavated depths considered for computational purpose is 1m based on information shared by the field facilitator of Dilasa during field visit. Baseline recharge has been considered to arrive at beneficial impacts. The VWBA approach was adopted to quantify benefits.	Satellite imagery	Field Visit	1m*	✓	X	X	✓	✓

- The total storage volume of the lakes post rejuvenation as per Scenario -1 is 957,000 KL. Potential volumetric benefits using the VWBA method as estimated under Scenario 2 accounts for 263,955 KL. Whereas potential volumetric benefits as estimated under Scenario 3 is 114,300 KL.

Impact of removal of *Prosopis juliflora*:

- 78% (n=207) were aware about the initiative for removal of *Prosopis juliflora* implemented by UBL in all 4 project villages.
- 66% respondents interacted with stated that there was a need for removal of *Prosopis juliflora* (n=207). Out of those, 82% of the respondents (n=207) stated the *Prosopis juliflora* absorbs more water from the ground so there was a need for removal of *Prosopis juliflora*.
- The beneficiaries highlighted that before the UBL intervention and the awareness sessions, respondents were not aware about the adverse effects of *Prosopis juliflora* on groundwater level, local plant species, crops, etc. and that was the reason the farmers did not try to remove *Prosopis juliflora* from their farmlands.
- 45% of the respondents (n=207) opined that the removal of *Prosopis juliflora* has **impacted their agricultural activities**. Out of these, majority 78% and 20% of the respondents (n=93) stated more groundwater level and **availability of more common land respectively** as an impact of removal of *Prosopis juliflora*.
- Some of the beneficiaries stated that earlier they used to face water scarcity issues due to rapid growth of juliflora because it absorbs more ground water and were not able to cultivate even once during the entire year. However, post the removal of juliflora the **water level has increased** and now they **cultivate 2 or 3 times in a year** which has led to more availability of cultivable land and higher productivity.

- The result of qualitative survey reflects community perception indicating increase in groundwater levels as attributed to removal of Juliflora. However, community perception is generic in nature, as it does not account for individual influence of subjective variable factors such as lake restoration, variation in precipitation, groundwater withdrawal rates, as compared to the removal of Juliflora.

Impact of plantation around lakes:

- 39% respondents interacted with stated that there was a need for plantation around the lakes (n=154).
- Majority, 62% of the respondents (n=60) stated that plantation around lakes prevents soil erosion so there was a need for plantation. 22% of the respondents stated requirement for plantation around the lakes for horticulture, making it aesthetically pleasing, strengthening of lake border, provision of space for animal resting and grazing, shade, and good air quality within the area.
- 62% of the beneficiaries (n=154) were aware and stated that the plantation activity was done of the waste lands. Saplings consisting of five (5) species were planted in the intervention villages.
- The beneficiaries stated that many of them were not aware about the plantation activities and those who were aware mentioned that the survival rate was low. Community mobilizer also mentioned during the interaction that less than 50% of the plants survived.
- The tree plantation activity was limited to the bunds on the periphery of the lakes and ponds. Additionally, considering the low survival rate and the age of the saplings, plantation intervention is not expected to have significant beneficial impact on reducing run-off, increase in infiltration, and/or reduction in soil erosion within the catchment. Hence, the volumetric water benefits from this intervention are not estimated.

Impact of awareness & capacity building sessions on water conservation conducted:

- 90% (n=44) of the respondents stated that the **awareness sessions were beneficial to them** and **increased their awareness level** to some extent on water conservation and effective water management. Beneficiaries mentioned about their increased awareness level due to the sessions
- 95% of the respondents stated that topics covered in the sessions included importance of water conservation, minimal usage and wastage of water was covered as stated by 30% of the respondents. Water supply was covered as stated by 30% of the respondents.
- Detailed discussion with the beneficiaries revealed that Dilasa had conducted one awareness session in each village on the water supply, minimal usage and wastage of water and importance of water conservation.
- 84% of the beneficiaries (n=44) stated that these sessions had led to an **increase in awareness regarding water conservation** and 23% of the respondents stated positive behavioural changes like minimum water wastage and usage.

Recommendations:

Greater ownership & accountability of the villagers & Gram Panchayat: There is a need to ensure greater ownership & accountability of the villagers as well. Only about 1/3rd of the respondents stated to have been the part of planning process for rejuvenation of lakes and other initiatives undertaken within the village.

Strengthening monitoring of the implementation partner: Strengthening the monitoring mechanism during covid 19 and post through local field facilitators and validating more rigorously could have resulted in addressing the gaps through oversight of the project activities.

Protection of saplings planted: Fencing could have been done around the plantation site to avert the damage due to livestock and help in the long-term conservation of the saplings and the villagers will be able to derive benefits of the same.

Identification & convergence with government schemes and departments: There could have been a possible convergence with the respective government departments and the scheme for better overall convergence and sustainability of the programme.

Define, map, and characterize the study area: 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 centred over the Site. The study area should be characterized for natural and anthropogenic features such as topography, hydrology, hydrogeology, geology, land use pattern, water usage etc.

Stakeholder identification and mapping: Stakeholder identification and mapping should be aimed at identification of synergies and reducing the risks in the project which includes identification of all the potential and relevant stakeholders who are impacted by the shared water challenges, benefit from the interventions.

Prioritize shared challenges, identify cause, and set targets: In order to develop appropriate mitigation plan, it is important to identify shared challenges and their causes and prioritize them based on their severity and urgency. Then set targets/objectives to address these challenges on short-medium-and long-term time horizons.

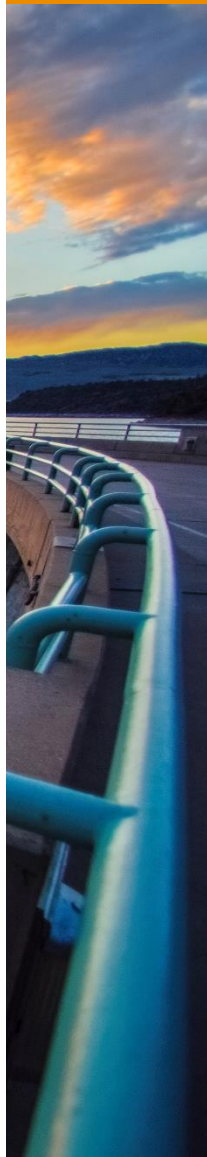
Identification, and mapping of intervention area: The intervention areas should be identified clearly and mapped using appropriate tools such as GIS software, revenue maps, topo-sheets, or other appropriate method, to show point location as well as areal extents of the target intervention.

Monitoring and evaluation of quantifiable indicators: Quantifiable indicators with respect to implemented interventions are not monitored and documented. Hence it is recommended to identify and monitor the quantifiable indicators under pre and post implementation stages of the project.

Record keeping and documentation: Assumptions, claims, objectives, steps, methodology, quantifiable data, and outcomes among aspects of the project at both pre and post implementation stage of the project need to be documented.

A detailed analysis of the assessed impact of all the interventions can be found in the [Findings of the Study](#) section, and recommendations can be found in the section titled [Recommendations](#) in the report.

1. About the Study



1.1. About United Breweries Limited (UBL)

United Breweries Limited (UBL) is an Indian company headquartered in UB City Bangalore Karnataka. Its core business includes social beverages (alcoholic and non-alcoholic). It promotes responsible consumption of Alcohol. Through its CSR interventions, UBL intends to contribute to the preservation of environment & create social capital. 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. UBL has the following focus areas for CSR¹:

- Water (including water conservation and safe drinking water)
- Women Empowerment
- Responsible Consumption of Alcohol
- Community Development

As part of its CSR initiative, United Breweries Limited has worked towards the participatory water conservation through rejuvenation of water bodies project in 4 villages in Thiruvallur district, Tamil Nadu in association with its implementing partner, Dilasa Janvikas Pratishthan.

1.2. About Dilasa Janvikas Pratishthan

Dilasa Janvikas Pratishthan (Dilasa) is a Civil Society organization, engaged in implementing sustainable rural development programs by focusing on natural resource management, climate resilient agriculture, model village development includes health/education initiatives, livelihood enhancement and women empowerment. It has treated over 7.26 lakh ha of land under different watershed programs apart from working in water supply, irrigation, and aquifer management. Dilasa has created a strong foundation in water management as means to sustainable natural resource management. It has a strong connect with rural community specially the farmers through its various projects, therefore, well understands their needs and requirements.²

1.3. About the project- Participatory Water Conservation through rejuvenation of water bodies

Thiruvallur district near Chennai, Tamil Nadu is a semitropical region. Agriculture is a major occupation and farmers are reliant on rain to irrigate their crops. During the non-monsoon months, they use wells and borewells to irrigate their crops. Farmers have insufficient water for irrigation and wells have dried up due to heavy siltation in the existing water resources in the villages³.

To address these issues, UBL decided to implement a CSR project in this area. The first phase of this project was successfully implemented in FY 19 -21 where 7 lakes were rejuvenated in 4 villages of Thiruvallur district. The CSR project support included rejuvenation of lakes & ponds, removal of *Prosopis juliflora* (Juliflora), tree plantation around the lakes and awareness sessions on water conservation to the villagers and Gram Panchayat (GP) members as well.

¹ Source: <https://www.unitedbreweries.com/csr>

² Source: <http://www.dilasango.org/about-Dilasa-Janvikas-Pratishthan.aspx>

³ Source: https://www.unitedbreweries.com/Pdf/CSR/UB_CSR_Annual_Report_2021-2022.pdf (page 20)

The overall objective of the intervention/project was to improve surface water storage and groundwater recharge level by facilitating water conservation through rejuvenation of lakes & ponds and participatory engagement in 4 villages (**Aranvoyal, Murukancherry, Kuthambakkam North & Kuthambakkam South**) near UBL Chennai and Empee plants in Tamil Nadu (Refer below for snapshot of project):

- 1 Project implemented from September 2019 – March 2021 in 4 villages
- 2 Dilasa Janvikas Pratishthan was the implementing partner
- 3 Plantation of 2000 trees
- 4 Rejuvenation of 7 lakes; branding was also done across each lake
- 5 Removal of *Prosopis juliflora* from 100 acres of land
- 6 4 awareness sessions on water conservation for the villagers; 4 sessions for GP member sensitization

1.4. Scope of Work for the assessment

PW has been engaged to conduct an independent Impact Assessment study of water conservation project of United Breweries Limited (UBL) in 4 villages in Thiruvallur district, Tamil Nadu. The scope of work 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 Project for the outputs, outcomes, and impact of the Project. 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 for providing recommendations for managements consideration:
 - Undertake review of all the activities implemented under UBL's project titled 'Participatory water conservation through rejuvenation of waterbodies.
 - Assess the quality of the infrastructure created through the project
 - Evaluate the status and usage of the structures created
 - Assess community awareness around water conservation - Undertake site visits for review of the data and conduct one on one meetings with the Non-Government Organizations (NGO), Gram Panchayat, and community to assess the effectiveness, efficiency & sustainability of the project.
 - Derive the standard framework basis national and international guidelines on calculations for measuring water recharge and rainwater harnessed
 - Review of water recharge and conservation data provided by NGOs against this framework - Prepare Gap assessment report based on 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.

1.5. Study Limitations

- Out of the two Community Mobilizers, one of the community mobilisers was out of state because of some exigency, the PW team could not meet and interact with him.
- Out of the 2 land parcels from where *Prosopis Juliflora* was removed, PW team could only observe the site which was of 20 acres from the entry area as the complete site was not accessible due to dense vegetation and water-logging at the site.
- In the absence of local information in the open source on 'uptake rate' and actual area cleared-off of *Juliflora* and understanding of the exact impacts of *Prosopis juliflora* on depletion of groundwater, potential saving in groundwater were not estimated.
- Quality certification or attestation post review & analyses of quality of water infrastructure to the client was not part of the scope of work.
- Withdrawal data from the ponds is unavailable and therefore not considered in calculating Volumetric Water Benefit Accounting (VWBA). Based on community consultations, direct withdrawal from the lakes/ponds is assumed to be negligible. In case direct withdrawal occurs, volume available in the lake for ground water recharge may reduce corresponding to the volume withdrawn.
- For volumetric estimation, ponds are assumed to undergo two (2) full cycles of completely emptying and refilling within a single year. However, this has not been validated nor documented in the reports accessed by PW.
- The total volume of the lake is assumed to be available for storage of water. However, in reality, for ponds/lakes that have inlet-outlet structures, the crest level of that structure influences the maximum water storage level. If these structures are at ground level, then the pond or lake can only store water up to ground level. Presence of such structures has not been documented for any of the lakes/ponds and the same could not be validated. Based on community consultations, only one of the lakes/ponds has provision for overflow (Thangal Eri-1, Murukancherry). For activities of a similar nature, dimensions and locations of such structures need to be clearly marked along with accurate lake dimensions in order to calculate the storage capacity. Additionally, the Maximum Water Level (MWL) in a lake must be known and depth available for storage must be calculated based on MWL.
- Erosion is a natural and continuous process which is challenging to prevent completely. Unless verifiable measures are taken to prevent silt from entering the lakes, siltation / sedimentation in the lakes are bound to recur over a period of time. As such, desilting interventions are likely to return maximum groundwater replenishment benefits only for the first year or two post-interventions. Beyond that the benefits are likely to depreciate with passing time subject to the sedimentation rate. Therefore, volumetric benefits estimated may be subject to vary depending on sedimentation rate at individual lakes/ponds.

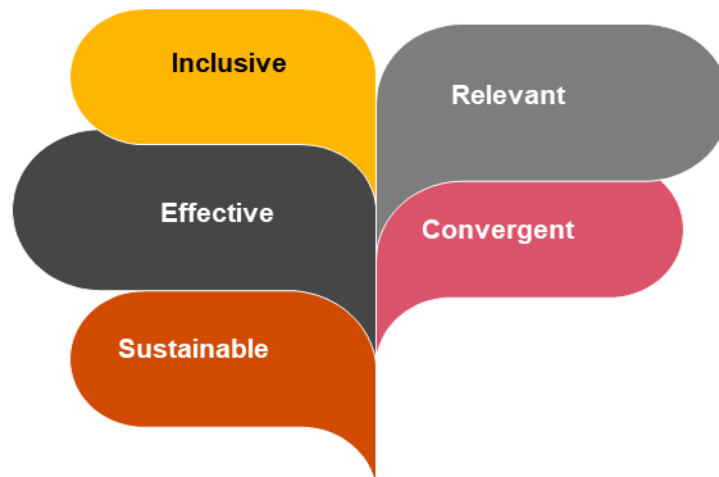
2. Approach and Methodology



2.1. IRECS Framework

The impact of the programme was assessed using the IRECS framework. IRECS is geared to provide overall feedback on the efficacy of implementation as well, as its efficiency in terms of achievement of the desired project outputs with reference to inputs. IRECS framework measured the performance of programme on five parameters – Inclusiveness, Relevance, Effectiveness, Convergence and Sustainability. Overview of areas assessed under each of these five parameters is provided below:

Figure 1: IRECS Framework



Key Evaluation Parameters under IRECS				
Inclusiveness	Relevance	Effectiveness	Convergence	Sustainability
Ability of different stakeholders (particularly poorest and most marginalised) to access the benefits of activities and derive equitable benefits from assets created.	Are the services /inputs /institutions facilitated in the project able to meet community priorities? Are the services provided needed by beneficiaries?	How effectively the activities have been able to manage/ mitigate community expectations? How efficiently have the resources been deployed, monitored and utilized?	Degree of convergence with government/other partnerships; relationship between individuals, community, institutions and other stakeholders	How will the projects help beneficiaries sustain in the long run?

2.2. Approach and Methodology

Guided by the overall IRECS framework as presented earlier, the study took a cohesive and integrated approach to assess the socio-economic impact of CSR project implemented by UBL and assessed its impact on the lives of communities or beneficiaries. The approach is divided into 5 phases, as depicted below:

Plan

As part of the planning phase, the PW and the UBL teams agreed and finalised the scope of work for impact assessment as per specific requirements for the intervention. Thereafter, desk review of the project documents as shared by UBL and Dilasa was carried out by the team. This was done to gauge the status of current situation on ground before starting the actual process.

Process

After the planning phase, the next step was the identification of the key stakeholders for data collection, such as beneficiaries, Gram Panchayat members, community mobilisers, amongst others. This was followed by a detailed secondary data collection and research on the geographical spread which would help in preparing a sampling plan and field visits.

Prepare

The data collection plan was prepared and finalized in consultation with UBL, and field plan confirmed with Dilasa team. This was followed by development of stakeholder specific data collection tools such as Focus Group Discussion (FGD) / In Depth Interview (IDI) guides and the quantitative survey tool. Samples were finalised for the identification of respondents in the 4 villages for water conservation support.

Perform

The field team was trained on the tools to collect data through quantitative survey, post which the team was deployed on ground for data collection. This included the quantitative survey, along with the interactions with Gram Panchayat members, community mobilisers, beneficiaries, and Dilasa team. Apart from this, the team also carried out assessment of the impact of each intervention implemented by UBL on ground based on the following steps as well. The below graph depicts the steps undertaken for each of the project intervention.

Rejuvenation of Lakes	Removal of <i>Prosopis juliflora</i>	Tree Plantation around lakes
<ul style="list-style-type: none">• Visited 7 rejuvenated lakes and ponds sites• Geo tagged locations• Discussed with the implementation partner on understanding how they operate and maintain the lakes• Reviewed Lakes' functionality status• Gained understanding on source of water, groundwater level in different seasons, usage of lake water, wastewater dumping (if any), inundation, maintenance requirements, impact on beneficiaries	<ul style="list-style-type: none">• Visited the removal of <i>Prosopis juliflora</i> locations• Geo tagged locations• Discussion with community, Gram Panchayat• In depth discussion with beneficiaries who have been impacted by the removal	<ul style="list-style-type: none">• Visited the tree plantation location• Geo tagged locations• Discussion with Gram Panchayat members on the benefits and impact of the farm pond

The data thus collected was further collated, cleaned, and analysed.

Additionally, as part of the impact assessment, benchmarking and gap assessment against best practice and the Volumetric Benefit Accounting (VBA) was also carried out. The details of the approach are provided in the below sub sections.

2.2.1. Benchmarking and gap assessment against best practice

For the purpose of assessing alignment of the approach and methodology adopted by the implementing partner with best practices, a gaps assessment was carried out. 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 methodology appropriate for both gaps assessment and cross-validation of beneficial impact accounting done by Dilasa. Approach for the gaps assessment of intervention was divided and evaluated in two (2) phases as: Pre-implementation and Post implementation phase.

Benchmarking and gap assessment for pre-implementation and post-implementation stages of the interventions was carried out using pre-defined set of criteria developed by PW for evaluation based on selected national and international guidelines as well as contextual interpretation of the research publication where relevant and was deemed necessary.

The below graphic depicts the primary reference material used for this purpose.

Rejuvenation of Lakes	Removal of <i>Prosopis juliflora</i>	Tree Plantation around lakes
<ul style="list-style-type: none"> • 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 Resource Institute (WRI) • Manual on Artificial Groundwater Recharge, developed by Central Ground Water Board • International Water Stewardship Standard, developed by Alliance for Water Stewardship 	<ul style="list-style-type: none"> • Tamil Nadu policy on invasive alien plant species and ecological restoration 	<ul style="list-style-type: none"> • The gold standard for afforestation/ reforestation requirements, developed by The Gold Standard Foundation • Guidebook for formulation of afforestation and reforestation projects under the clean development mechanism, developed by International Tropical Timber Organization • Project performance audit report on the participatory forestry project in Sri Lanka, prepared by Asian Development Bank

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

- Report on Needs Assessment Study
- Project Completion Report of Participatory Water Conservation through Rejuvenation of Water Bodies
- Memorandum of Understanding between UBL and Dilasa, dated 25th September 2019
- Beneficiary Data File
- Vendor invoices

- Queries response file
- Pre-implementation and Post-implementation stage photographs

2.2.2. Volumetric water benefit accounting

For benchmarking potential volumetric water benefits estimated by the implementing partner, methodology prescribed in the document titled “Volumetric Water Benefit Accounting (VWBA): A Practical Guide to Implementing Water Replenishment Targets developed by CEO Water Mandate in association with Bluerisk and valuing nature and “Volumetric Water Benefit Accounting (VWBA): A Method for Implementing and Valuing Water Stewardship Activities”⁴ has been used as basis. VWBA provides water stewardship practitioners with standardized methods for implementing stewardship actions as well as quantifying benefits of various water stewardship activities.

The VWBA methodology has been applied to quantify the volumetric water benefit of the lake restoration activity. Under the lake restoration activity, 7 lakes were selected from the target villages of Aranvoyal, Murukancherry and Kuthambakkam for rejuvenation as described in the earlier sections.

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

For the purpose of current assessment, capture and infiltration method was used to calculate volume of groundwater recharge as a result of the intervention. The capture and infiltration method estimates the groundwater recharge based on three parameters as given below:

- Available water supply is the volume of water draining from a catchment (runoff) corresponding to the intervention under consideration
- Volume of water actually captured by the intervention under consideration
- Losses due to evaporation and usage (i.e., withdrawal)

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

a. $\text{Recharge volume} = \text{Volume captured} - [\text{Evaporation} + \text{Withdrawal}]$

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 below.

b. $\text{Volume captured} = \text{Min} [\text{Available supply}, \text{Storage potential}]$

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 (in this case volume of the lake) multiplied by the number of times the lakes is filled to its capacity during the assessment period (Equation C).

c. $\text{Storage potential} = \text{Design storage capacity} \times \text{Number of times filled to capacity}$

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.

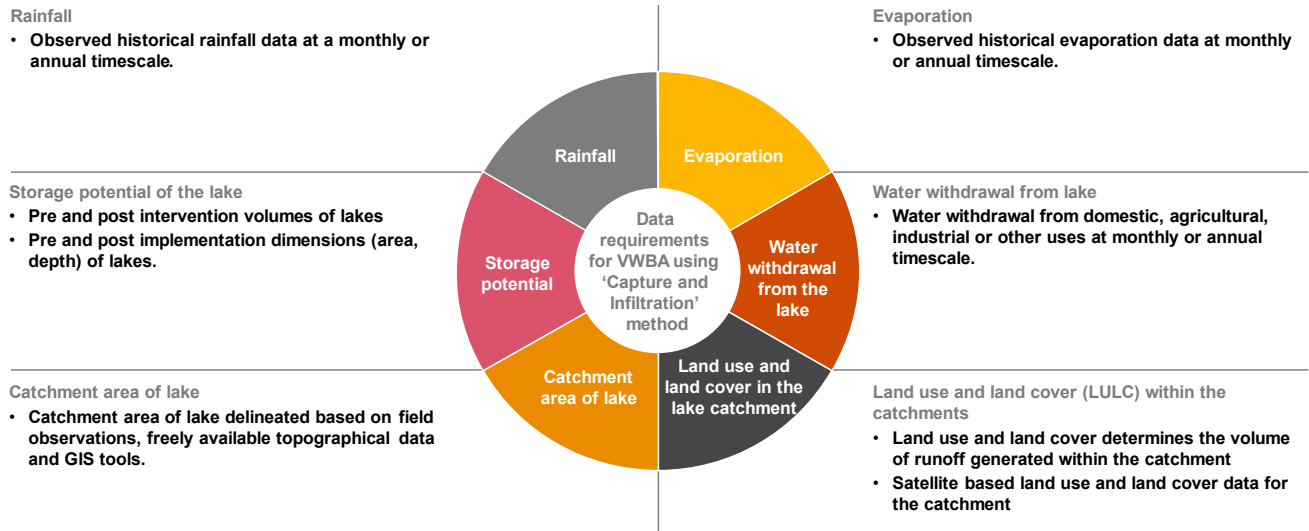
d. $\text{Available supply (aka runoff)} = \text{Catchment area} \times \text{Runoff coefficient} \times \text{Annual rainfall}$

⁴ 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>

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 2.

Figure 2: Data requirement for VWBA for lake/pond restoration activities



The detailed analyses done with each of these datasets and how they are used for calculation of beneficial impacts of the activity are presented in Annexure 2.

Publish

A report on the findings of the study has been prepared for UBL’s consideration and feedback based on the analysis from the above stage.

2.3. Coverage of the Study

Selection of Villages

All 4 intervention villages where project support was provided were selected and visited for the study.

Simple random sampling was deployed for selection of sample households (HHs) keeping in mind distribution across the villages. Sample is drawn in consultation with UBL at 90% Confidence level & 5% margin of error. Out of total 2,325 HHs across 4 villages, **266 HHs** were covered in the quantitative survey.

Table 1: Village wise number of households and sample size

S.no.	Village name	No. of households (HHs)	Sample covered
1	Aranvoyal	1265	132
2	Kuthambakkam North	360	44
3	Kuthambakkam South	450	55
4	Murukancherry	250	35
Total		2325⁵	266⁶

Interaction with stakeholders (Qualitative)

The interactions with the stakeholders comprised of Key Informant Interviews (KIIs) and FGDs which were conducted with beneficiaries, community mobilisers, Gram Panchayat officials, opinion leaders and Dilasa team.

- Seven (7) FGDs were conducted with the beneficiaries and opinion leaders covering 50 beneficiaries.
- One (1) KII each was conducted with the Dilasa team member and Community Mobiliser.
- Two (2) KIIs covering all the 4 villages were conducted with the Gram Panchayat presidents.

⁵ As per details shared by UBL

⁶ Sample size as agreed with UBL

3. Findings of the study



3.1. Profile of the Respondents

The majority (59%) of the respondents were females, and 75% of them belonged to the Scheduled Caste category. Majority of the respondents (91%, n=266) reported to belong to Below Poverty Line (BPL) category. Refer below a snapshot of the distribution of respondents based on gender and social category.

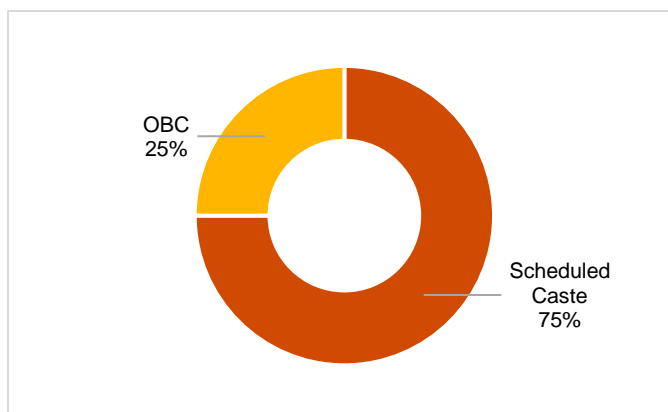


41%



59%

Figure 3: Social category wise distribution of Respondents (n=266)



The respondents reported to be engaged in the following occupations as presented in the table below.

Table 2: % distribution of respondents as per their occupation (n=266)

Occupation	Percentage
Agricultural labourers	18%
Agriculture (Own farm)	15%
Animal husbandry	4%
Currently not employed / No Occupation	1%
Non-Agricultural labour	41%
Other, please specify	11% ⁷
Shop/Business/Trade	9%

Majority 41% of the respondents(n=266) in the intervention villages primarily work as non-agricultural labour. The average monthly income of the respondents was in the range of INR 5,001 - 10,000.

⁷ Others: Driver - 4, Watchman - 1, Private Job -23

The following sub sections highlights the key findings of the impact assessment study as per each of the programmatic activities and interventions. In this section, the impact of the project activities, benchmarking & gap assessment and volumetric benefits have been assessed based on the approach & methodology (refer section 2) followed for the study. It provides a basis for recommendations for the programme.

3.2. Rejuvenation of Lakes and Ponds

About the intervention

Rejuvenation of 7 lakes & ponds was done in 4 project villages through de-siltation, rejuvenation and deepening of water bodies. All the project villages had water bodies available but due to high amount of silt the water bodies were not able to store the water.

100% (N=266) of the respondents were aware about the rejuvenation of lakes and ponds initiative implemented by UBL. 86% of the respondents highlighted that they contributed as a labour in the implementation of the activities for rejuvenation of lakes & ponds whereas remaining respondents could not contribute due to lack of awareness about the process. Beneficiaries mentioned that some of them contributed as a labour under Mahatma Gandhi National Rural Employment Act (MNREGA) in the project activities. It was also shared by the beneficiaries that major work was done through machines especially for digging/deepening of the ponds and cleaning.

3.2.1. Challenges faced by the community before the intervention:

56% (n=266) of the respondents agreed facing water availability issues due to low groundwater recharge level and 39% responded to have less agricultural activities due to lack of water for irrigation. Beneficiaries shared that due to low ground water recharge level, community people faced a lot of issues for drinking water and for irrigation as well. In Murukancherry village, 3 borewells installed by Panchayat could not suffice the water requirement for the entire village. On the other hand, in Aranvoyal village, beneficiaries opined that due to water scarcity especially for the irrigation purposes, community stopped engaging in the agricultural activities on the farmlands which were closer or within the village.

Figure 4: % of respondents on challenges faced before intervention

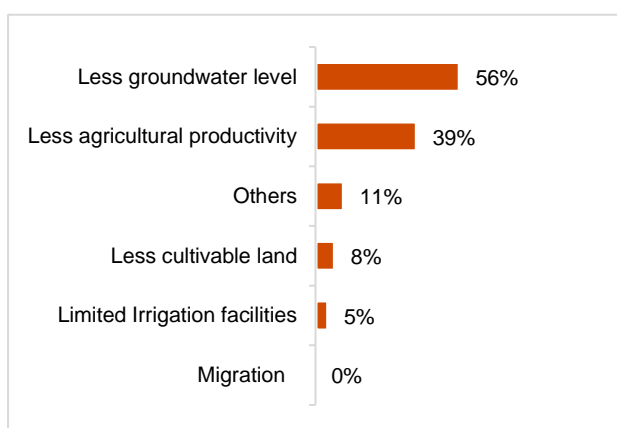
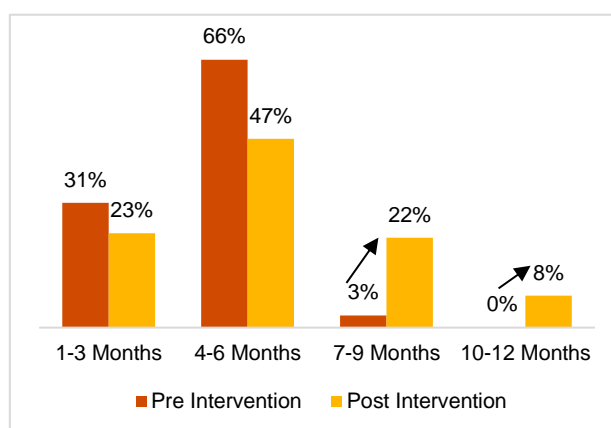


Figure 5: Availability of water in a year (n=266)



During the **pre-intervention stage**, none of the respondents stated that water is available for 10-12 months whereas 3% confirmed the availability for 7-9 months and 66% of the respondents said the availability of water was for just 4-6 months. **Post the intervention**, 8% respondents reported that water is available throughout the year after the intervention and 22% respondents confirmed availability of water for 7-9 months post intervention reflecting the improvement of water availability overtime.

3.2.2. Sources & availability of water for irrigation and drinking facilities

Pre-Intervention Scenario:

Irrigation Purposes: 43% of the respondents were using traditional wells as a major source of irrigation in their farmland followed by 18% who were using water tanks. Beneficiaries of Murukancherry and Kuthambakkam village stated that villagers were majorly dependent on traditional wells and water tanks prior to the intervention for irrigation purposes. Due to the limited availability of water, very few crops used to be cultivated during Rabi season.

Drinking Purposes: 18% of the respondents were using traditional wells, 31% were relying on handpumps and 36% were dependent on water tank service provided by the Gram Panchayat as the major sources of drinking water. The beneficiaries highlighted that in Murukancherry village, 3 borewells were installed for the entire village however the water supply was limited to only 3 hours per day.

Figure 6: Sources of irrigation (n=266)⁸

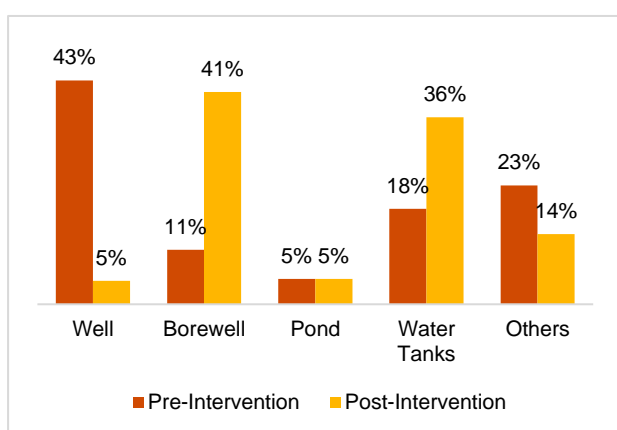
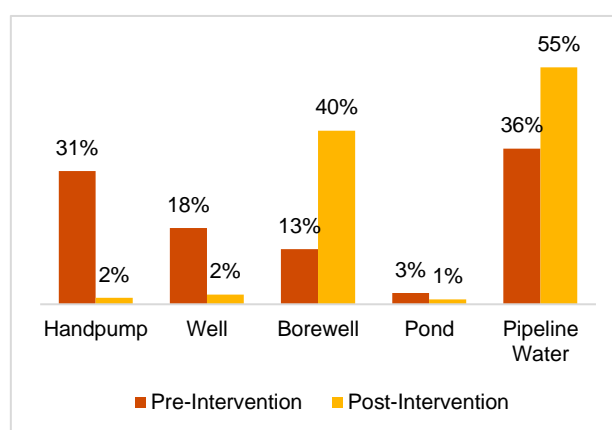


Figure 7: Sources of drinking water



Post-Intervention Scenario:

Irrigation Purposes: After the intervention, use of borewells was reported by additional 30% respondents than the pre-intervention phase followed by additional 18% respondents who reported water tanks also as sources of irrigation. Beneficiaries stated that the usage of borewells has been increased due to improved groundwater recharge level and beneficiaries also used borewells to dig out the water from wells because these wells had water availability throughout the year post intervention.

Drinking Purposes: The usage of handpump was reduced by 29% of respondents whereas 40% beneficiaries reported to have started using borewells from 13% who reported usage during pre-intervention stage as the sources of drinking water. The availability of pipeline water was highlighted by 55% of respondents which increased from pre-intervention phase. Beneficiaries highlighted that in Murukancherry village, earlier 3 borewells were being used to supply drinking water but as an impact of intervention only one borewell was now sufficient to provide water to entire village and for longer duration due to the availability of water based on improved ground water levels.

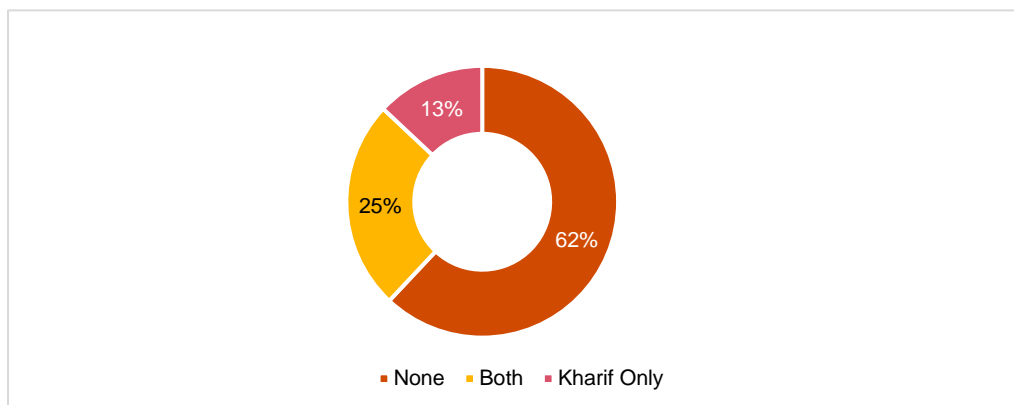
⁸ Here others mean- common pipe, Lake, own motor pipes

3.2.3. Crops productivity during different cultivation seasons:

Pre-Intervention Scenario:

Out of 4 villages, people from 3 villages were reported to be involved in various agricultural activities. Beneficiaries shared that prior to the intervention they were not growing any crops during Rabi season due to scarcity of water in the area for irrigation. Before the intervention, villagers in Aranvoyal stopped engaging in agricultural activities due to lack of water within the village and converted entire land into private residential lands or were left unused; Post intervention, 25% respondents reported to cultivating during both the seasons while 13% reported to cultivating during only Kharif season in project villages.⁹

Figure 8: % of respondents cultivating during different seasons



Post-Intervention Scenario:

Beneficiaries in Murukancherry and Aranvoyal village highlighted about the positive impact of the UBL intervention with regards to agricultural productivity, cultivable land, and yield. Post the intervention, there has been an increase in cultivable land & yield. Post the lake rejuvenation, there has been substantial increase in the ground water level and now they are able to irrigate the farmlands. Now, most of them cultivate 2 or 3 times a year and are able to get higher productivity, yield, and income.

Beneficiaries who are cultivating either in one or both seasons responded that their cultivable area have increased post the UBL intervention, and it was possible due to availability of water within the village. Beneficiaries also opined that earlier some of their land was not in use due to scarcity of water, but they have again started cultivating. The following table highlights the average improvement in cultivable land and yield produced annually.

Table 3: Landholding & Yield Overview and improvement (Annually)

	Pre-Intervention	Post-Intervention	Improved by
Average cultivable land	3.29 Acres	10.73 Acres	7.44 Acres
Avg. yield	7,857 Kg	22,538 Kg	14,681 Kg

⁹ Only 25% of respondents were found cultivating during both seasons because maximum sample was covered from Aranvoyal village (where people have stopped any agricultural activities and converted their land in private lands) due to which the percentage for people not cultivating is higher.

3.2.4. Equitable access and usage of rejuvenation of Lakes and Ponds:

Majority of the respondents (85%) highlighted that the equitable accessibility of water to the community has increased **post the intervention**. Beneficiaries shared that in terms of direct usage, maximum lakes were being used for fishing and bathing purposes. In Murukancherry village, beneficiaries highlighted that one out of the two lakes are being used for the fishing purpose and the Gram Panchayat have issued the tender for annual leasing of the lake based on lowest bid. The benefitted person requires to provide 10% of total income generated from the fishing done through lake to the Gram Panchayat which will be contributed for the maintenance of lakes & ponds within the village.

It was highlighted by the respondents that some of the people were using lake for agricultural purposes and religious purposes such as during festivals, cleaning of temple premises (for example in Kuthambakkam North they were primarily using the lake for religious purposes as it was closer to the temple), immersion of idols etc

Figure 9: % of respondents having equitable access of water

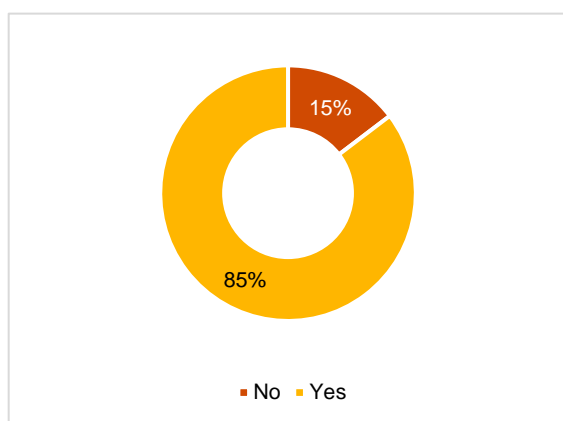
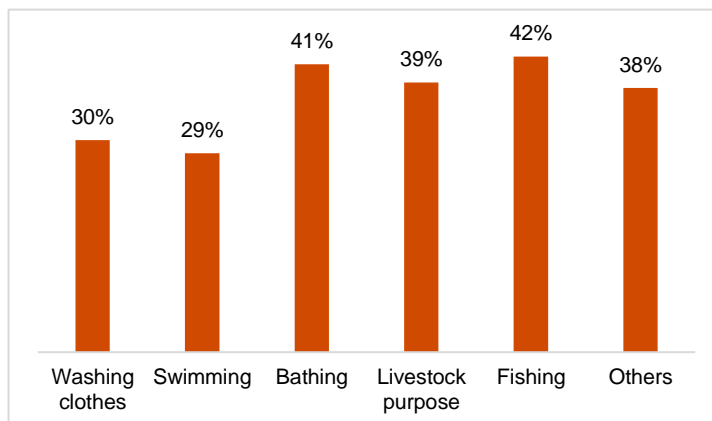


Figure 10: % of respondents reporting on various usage of lakes (Post the intervention)



51% respondents shared that their farmland is less than 1 km away from the rejuvenated lakes & ponds that has helped a lot in improving the ground water level and availability of water which has led to improved agricultural productivity. 28% respondents mentioned that their land parcel was more than 2 km away and 21% had within the range of 1 km to 2 km due to which the groundwater level has increased which resulted in increased productivity. The Gram Panchayat Presidents of both the panchayats shared that the villagers were using the lake majorly for fishing and religious purposes (fetching water for rituals, funerals etc.). Gram Panchayat also supported them by ensuring availability of fishes in the ponds & lakes so that people can use it for domestic purposes as well as their source of additional income by selling it in local markets.

3.2.5. Benchmarking and gaps assessment

As per initial information received from implementation partner, seven lakes/ponds had been part of the desilting and restoration intervention. These included three (3) lakes/ponds in Aranvoyal, two (2) in Murukancherry, and two (2) in Kuthambakkam village (1 each in Kuthambakkam North and Kuthambakkam South). The field facilitator guided the PW team inclusive of hydrologist and water expert to seven lakes which were stated to be part of Phase 1 implementation. One of the lakes visited (Perumalkovil kulam, Kuthambakkam South) did not have coordinates or dimensions mentioned in the shared documents. However, an alternate lake (Elthani Kuttai) in Aranvoyal was observed to be part of the list in the shared documents basis clarifications provided by Dilasa. Team was informed at the time of field visit that Elthani Kuttai in Aranvoyal was not accessible as it had been engulfed by water from a neighbouring larger lake and hence did not have distinct identifiable features. During the visit visual observations were made with respect to the quality and current status of the infrastructure and the surrounding areas based on pre-defined criteria developed as part of gaps assessment. Details on field observations can be found in Table 12 and Table 13 in Annexure 2.

3.2.5.1. Observations on pre and post implementation documentation

Number of gaps in the current methodology/procedure adopted for the implementation of the intervention against the standard methodology were identified as presented in Table 12 and Table 13 in the Annexure 2.

Some of the prominent aspects which were observed to have evident gaps and may need further action, documentation, and/or validation are as given below.

- Inconsistencies in documented details of the target lakes/ponds
 - None of the coordinates of the 7 lakes are mentioned in the MoU or Needs Assessment Report.
 - In the pre-implementation documents, the lakes are referred to by a serial number and village name, rather than a specific lake name. In the post-implementation documents (Project Completion Report), the lakes are referred to by a serial number and photo only. This creates ambiguity between the pre and post implementation documents as there are insufficient unique identifiers used to match the corresponding lakes.
 - The Project Completion Report documents the coordinates of only 3 out of the 7 lakes. Out of these, there is an error corresponding to one set of coordinates (Lake-6) by ~2100 m.
 - As per documented information in MoU and Needs Assessment Report, there are 3 lakes in Aranvoyal, 1 in Kuthambakkam North, 1 in Kuthambakkam South and 2 in Murukancherry. However, as per the clarifications provided by Dilasa at a later time, there are 3 lakes in Aranvoyal, 3 in Murukancherry and 1 in Kuthambakkam South.
- Unstructured documentation of various steps, activities, plans, and technical considerations followed in the project including:
 - identification and selection of shared challenges
 - cause evaluation and rationale for conclusive assertions
 - setting of objectives, targets, outcomes, and success factors
 - establishing baseline condition
 - intervention methodology.
- Precluded measurable qualitative and/or quantitative indicators that are essential to scientifically quantify the beneficial impacts
- Exclusion of short-, medium-, and long-term sustainability drivers for post-intervention management

Further notable gaps were also observed in the assumptions and method adopted by Dilasa in the accounting of increase in storage capacity of the ponds post-intervention. The gaps in accounting of the benefits as documented are summarized below:

- **Depth consideration:** Contributions from the interventions are reflected by the surplus capacity created as a direct result of the project. This would exclude any pre-existing storage capacity of the target pond (if any), prior to project intervention under baseline condition. For this purpose, depth as well as surface area (submergence area) of the pond under baseline condition would have to be deducted from the new dimensions post-intervention to arrive at surplus volume of storage. Whereas documented figures reflect total storage capacity that is inclusive of both historical storage capacity and additional capacity created through the intervention.
- **Water level consideration:** In the case of the lakes/ponds, water from surrounding areas (catchment) flows into the lakes/ponds under gravity. Hence, considering the near flat/gentle slope topography of the area, water in the lake/ponds cannot exceed the ground level at banks under no overflow condition. Therefore, volume of lake/pond which is below the ground level can only be considered to be effectively available for storage of water. Any volume in the form of embankments/ bunds above the ground level will not contribute to the storage volume of the lake/ponds.

- **Pond re-filling cycle consideration:** Lakes/ponds in the target region typically receive water only during monsoon which generally extends over 4 months per year. Based on community consultations, lakes/ponds in the area, particularly the target water bodies retain water for up to 9-12 months in a year. In order to assume all of the storage volume of a selected lake/pond to be considered as beneficial contribution to groundwater replenishment (excluding any losses), water level in the lake/pond must recede completely. Such a scenario would be considered as 1 complete cycle of groundwater replenishment. In order for the assumption to be valid, selected lakes/ponds must be undergoing 2 complete cycles of filling and receding within a given year. Therefore, basis for the assumption needs to be validated in order to reflect estimated replenishment volumes to be closer to actual case.

Further, rationale and assumptions for the unit water requirement as considered for calculation of population benefitted and total areas which can be irrigated through augmented storage capacity (Table 4) were not documented.

Table 4: Estimated benefit from lake restoration as presented in MoU document

Village	Lake	Augmented volume (KL) L x W x D	Total augmented volume (KL)	Estimated population	Estimated irrigation (acre)
Aranvoyal	1	200 x 150 x 2	130,000	5,380	35
	2	200 x 100 x 1.5			0
	3	200 x 100 x 2			50
Murukancherry	1	200 x 150 x 2	69,000	1,420	130
	2	100 x 90 x 1			0
Kuthambakkam south	1	200 x 200 x 1	40,000	2,250	70
Kuthambakkam north	2	150 x 100 x 1.5	22,500	1,820	80

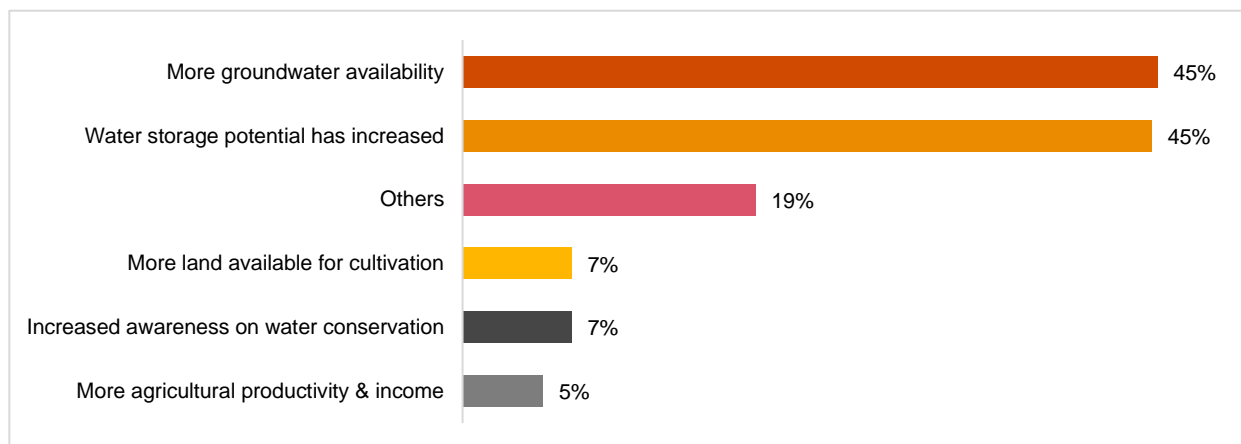
(Source: MoU Document between implementation partner and UBL)

3.2.6. Impact of the intervention

Groundwater Recharge Level:

Majority of the respondents (73%) noticed the visible change in groundwater recharge level as an impact of the intervention and 83% of the total respondents (n=266) highlighted that they have seen the lake reach its full storage level for the first time after the intervention. During the interaction community people have opined that it has created a great impact on improving the ground water level due to which agricultural activities have increased in the village which has also increased their family income.

Figure 11: % of respondents on impact of rejuvenation of Lakes (n=266)



Crop Productivity and overall impact:

Beneficiaries stated that the area of cultivation has been expanded post the intervention in all project villages due to availability of water within the village. Beneficiaries also opined that earlier some of their land was not in use due to scarcity of water which is now being used for various agricultural activities during both the seasons as a result of increased groundwater level and water storage potential.

Beneficiaries stated that few of them started growing additional crops such as ground nuts, vegetables, and paddy especially after the intervention due to the regular availability of water in the region. Only 7% beneficiaries highlighted that their awareness on water conservation has increased after the intervention. Beneficiaries mentioned that only one session was organized at the inception of the programme in the project.

Beneficiaries were asked to rank the activities implemented under the project on a rating scale of one to five (1-5, with 1 being the least & 5 being the highest) to assess the aspect of the programme which has impacted the most.

Table 5: Ranking of Activities under the programme

Activities Implemented	1	2	3	4	5
Rejuvenation of lakes and ponds	0%	12%	39%	12%	36%
Removal of <i>Prosopis juliflora</i>	1%	21%	25%	30%	23%
Plantation around lakes	3%	23%	22%	23%	29%
Awareness & capacity building on water conservation	12%	20%	19%	22%	26%

36% respondents ranked the rejuvenation of lakes & ponds as the most impactful activity of the project followed by plantation around lakes with reporting from 29% of respondents. Majority of the beneficiaries were aware about the rejuvenation of lakes and ponds and highlighted that the village and its people have received maximum benefits from the rejuvenation of lakes & ponds through improved groundwater level and availability of water for longer period in a year followed by plantation of trees around the lakes as it has enhanced the beauty of their village. 12% respondents ranked the awareness & capacity building on water conservation as lowest whereas 26% of the respondents have ranked it as highest as well.

3.2.7. Volumetric water benefits from lake rejuvenation/restoration

Increase in water storage potential and groundwater recharge was reported to be one of the objectives/outcomes of the interventions. Hence to quantify the storage/groundwater recharge potential generated, a volumetric water benefit accounting approach was used.

The volumetric water benefits were calculated based on the methodology discussed in Section 2.2.2. For the purpose of this assessment, the volumetric water benefits were estimated for three distinct scenarios as mentioned below.

- **Scenario 1:** The figures documented in MoU reflect gross storage capacity of the target lakes assuming negligible losses and the lakes fill up twice a year. For computational purpose, area of the lakes/ponds have been estimated based on maximum length and width of the water bodies as reported in the MOU. It should be noted that the storage volumes presented in the MOU are only the storage capacities of the lakes and does not present the Volumetric Water Benefit due to following reasons.
 - The storage capacities calculated are for total storage volume of the lakes, and not the volume of the lake which was made available as a result of the intervention.
 - Limitations in availability of water i.e., whether the sufficient runoff is available to fill these lakes are not considered (or documented)
 - Evaporative losses are not considered
- **Scenario 2:** Surface area of the lakes has been incorporated to reflect actual submergence area based on satellite imagery using Google Earth software. Evaporation losses have been incorporated. Direct water withdrawal from the lakes is assumed to be negligible (if any). Loss of storage capacity due to siltation is assumed to be negligible, and lakes are assumed to fill twice in a given year. Excavated depths considered for computational purpose are unchanged from the MoU document and reflects excavation volumes per documented records. Baseline recharge has been considered to arrive at beneficial impacts. The VWBA approach was adopted to quantify benefits.
- **Scenario 3:** Surface area of the lakes visited have been incorporated to reflect actual submergence area based on satellite imagery. Evaporation losses have been incorporated. Direct water withdrawal from the lakes is assumed to be negligible (if any). Loss of storage capacity due to siltation is assumed to be negligible, and lakes are assumed to fill twice in a given year. Excavated depths considered for computational purpose is 1m based on information shared by the field facilitator of Dilasa during field visit. Baseline recharge has been considered to arrive at beneficial impacts. The VWBA approach was adopted to quantify benefits.

These three distinct scenarios were considered to incorporate variations between the dimensions reported in the various project related documents shared by Dilasa and the information collected during the Site visits.

Accordingly, the storage volumes and potential Volumetric Water Benefit created by the intervention as compared to the total water withdrawals from the Empee and Chennai plants are presented in Table 6 below. The detailed calculations for the estimates of Volumetric Water Benefit can be found in Annexure 3.

Table 6: Volumetric water benefits under various scenarios relative to the total annual water withdrawal from operational units of UBL

Year	Annual storage volume created as per MoU (KL)	Potential annual volumetric water benefit (KL) (Recharge volume generated in scenario – Baseline recharge volume)	
		Scenario-1 (KL)	Scenario-2 (KL)
FY19-20	957,000	195,719	114,300

Year	Annual storage volume created as per MoU (KL)	Potential annual volumetric water benefit (KL) (Recharge volume generated in scenario – Baseline recharge volume)	
		Scenario-1 (KL)	Scenario-2 (KL)
FY20-21	957,000	228,132	114,300
FY21-22	957,000	263,955	114,300

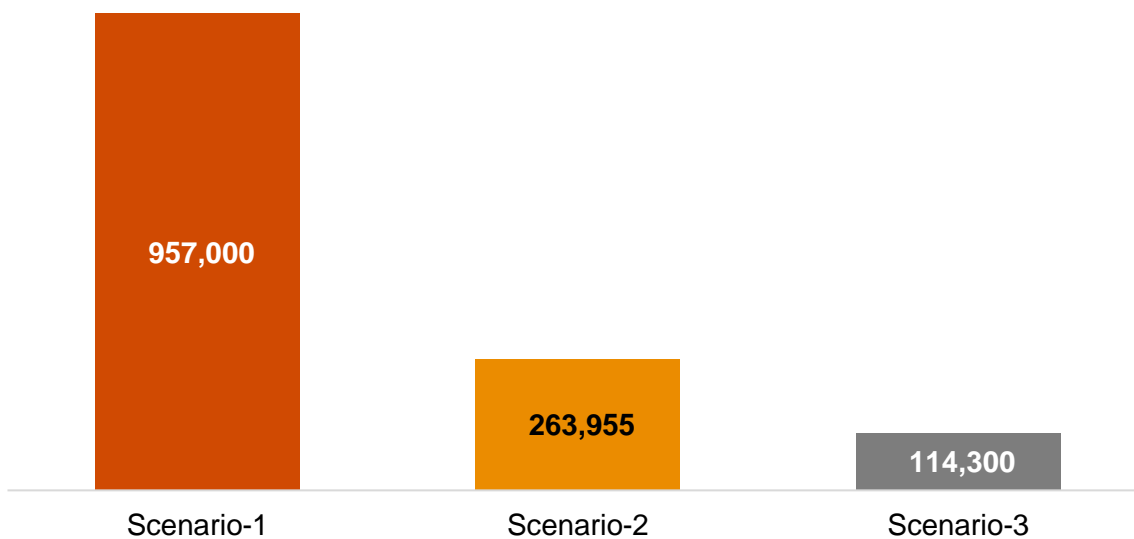
KL: Kilo litre

Note: Volumetric benefits computed under all three scenarios may not be reflecting actual groundwater replenishment considering subjective variables pertaining to ground conditions. As such, estimated figures are subject to limitations as presented in Section 1.5.

Accordingly, as presented in Figure 12 the storage volume as per Scenario 1 is 957,000 KL. Potential volumetric benefits as estimated under Scenario 2 is 263,955 KL, whereas potential volumetric benefits as estimated under Scenario 3 is 114,300 KL.

Figure 12: Volumetric water benefits under various scenarios

Volumetric water benefits in each scenario for FY21-22 (KL)



3.3. Removal of *Prosopis juliflora*

About the intervention

Prosopis juliflora is an invasive plant species in India¹⁰ and it grows rapidly. Literature review indicates that it has potential to uptake large quantum of water which may lead to reduction in growth of other plant species in nearby areas. According to documents shared by Dilasa, *Prosopis juliflora* removal activities were conducted in 4 villages across 100 acres of land with an aim to protect local species, increase cultivable area and facilitate additional income generation from the reclaimed land use by the villagers.

Review of no objection certificates (NOCs) received from the Gram Panchayat indicated that the NOC was obtained for clearance of 105 acres of land, including 26.16 acres from Kuthambakkam, 60.6 acres of land from

¹⁰ <https://krishi.icar.gov.in/jspui/bitstream/123456789/39857/1/aridland.pdf>

Aranvoyal and 18.9 acre of land from Murukancherry. However, the same were not clearly defined and mapped. Out of the 105 acres of land 47.91 acres of land was reported to be under or nearest to the agriculture land. About 10.05 acre of the land indicated mixed land use including lake, residential, and agriculture purposes. No information was available for land use of about 45.11 acres of land in Kuthambakkam and Murukancherry. Following observations were made from the available documents shared by implementing partner as relevant to removal of *Prosopis juliflora*:

- The presentation document on 'Participatory water conservation through rejuvenation of water bodies' indicated that out of 100 acres of land cleared-off of *Prosopis juliflora*, 60 acres of land will be used for cultivation.
- Based on the reported historical land use in the land parcels cleared-off of Juliflora, 47.91 acres of land may be suitable for agriculture.
- The needs assessment report communities in the area were reported to have shifted to alternate source of income other than agriculture due to issues related to availability of water for irrigation, high input costs, and low revenue.

Based on community survey, 78% (n=207¹¹) of the respondents were aware about the initiative related to removal of *Prosopis juliflora* implemented by UBL in all 4 project villages. 66% respondents interacted with stated that there was a need for removal of *Prosopis juliflora* (n=207) because it occupies a lot of cultivable land. Some of the beneficiaries mentioned about their involvement in the removal of *Prosopis juliflora* and were paid under the MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) scheme. The beneficiaries highlighted that before the UBL intervention and the awareness sessions, respondents were not aware about the adverse effects of *Prosopis juliflora* on groundwater level, local plant species, crops, etc. and did not try to remove them from their farmlands. The below graphical representation demonstrates the need for removal of *Prosopis juliflora* as reported by the respondents.

Figure 13: % of respondents on need of removal of juliflora (n=207)

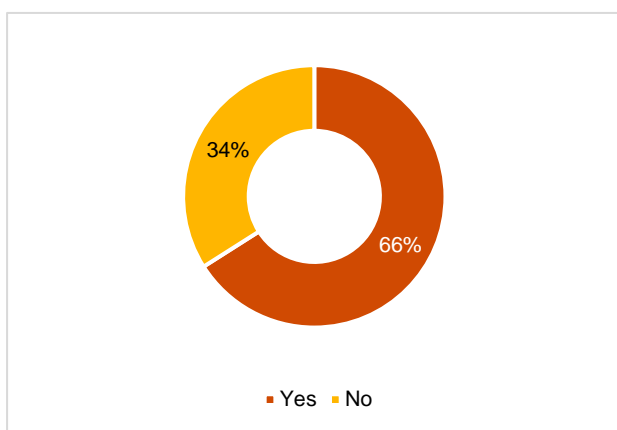
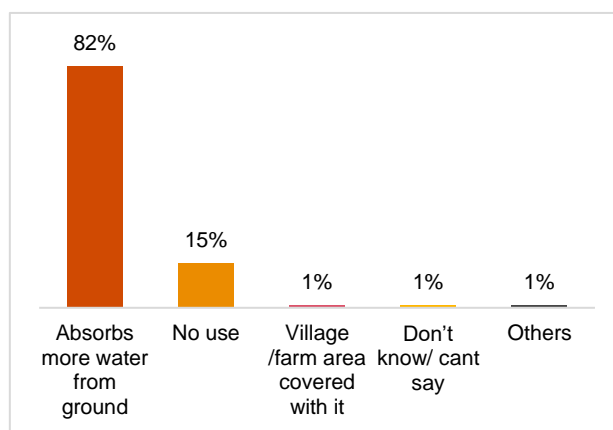


Figure 14: Why was the need for removal of Prosopis juliflora? (n=207)



Majority, 82% of the respondents (n=207) stated that *Prosopis juliflora* absorbs more water from the ground and hence needed to be removed from the land stretches. According to 15% of the respondents, the *Prosopis juliflora* needed to be removed from the land parcels as it was of no use for the community while another 1% of the respondents stated that they used the removed *Prosopis juliflora* for firewood purpose.

¹¹ Here, N is 207 because this section covers only those respondents (78%) who have said to be aware of the removal of juliflora intervention made by UBL.

Table 7: Village wise land use as per NoC**

Village	Land use (acre)							Total
	Agriculture (Agri)	Residential (Res)	Lake (lake)	Res + Agri	Lake + agri	Res + lake	Unknown	
Aranvoyal	47.91	N.A.	2.71	3.08	0.74	6.23	N.A.	60.67
Kuthambakkam	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	26.16*	26.16
Murukancherry	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	18.95*	18.95
Total	47.91	N.A.	2.71	3.08	0.74	6.23	45.11	105.78

* Coordinates were not available for these locations. Hence, beneficial impacts in term of reclamation for agriculture purpose could not be reviewed.

** Details shared by Dilasa.

PW was informed by Dilasa team at the time of site visit that there were only two locations where invasive species interventions were implemented. He same was confirmed based on coordinates shared by the Dilasa team at a later time. Areal extents of the area that was cleared-off of *Prosopis juliflora* could not be confirmed on the ground or based on coordinates shared by the implementing partner.

PW team reviewed two of the sites (21.4- and 42.7-acres land parcels in Aranvoyal), which were largely vacant and undeveloped with signs of potential regrowth of the *Prosopis juliflora*.

According to the field facilitator from Dilasa, one of the land parcels (42.7 acre, hereinafter referred to as Land Parcel 1) in Aranvoyal, located near the Panchayat office, has been converted to non-agricultural land intended to be developed into a medical institution. The second land parcel (21.4 acre, hereinafter referred to as Land Parcel 2) was observed to be vacant and undeveloped. Based on field consultations, this land parcel would be converted into residential plots as informed by field facilitator of Dilasa and local residents.

Two (2) small land parcels located within the 42.7 acres land parcel were reported to have been reclaimed for agriculture as a result of intervention. The landowner of one of the smaller agricultural land parcels (~1.66 acres) confirmed the same during field consultations. Further details are presented in Annexure 5.

3.3.1. Benchmarking and gap assessment

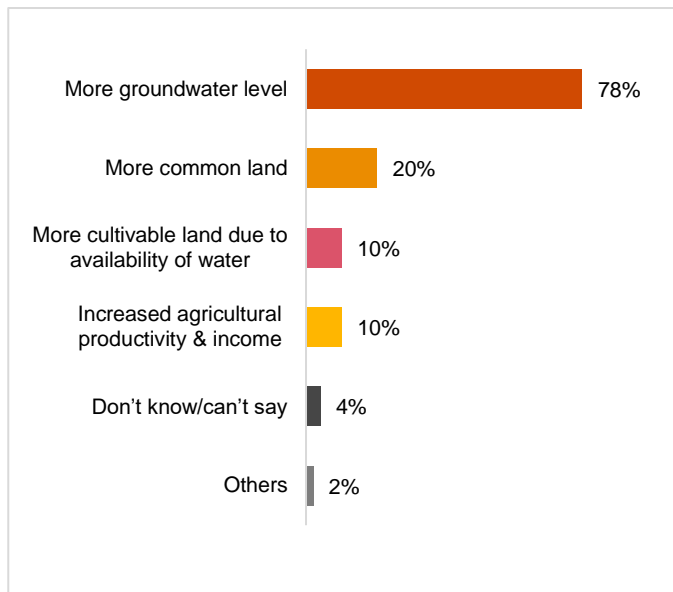
Number of gaps in the current methodology/procedure adopted for the implementation of the intervention against the standard methodology were identified as presented in Table 14 and Table 15 in Annexure 2.

However, some of the prominent aspects which were observed to have evident gaps and may need further action, documentation, and/or validation are as given below

- Areas cleared-off of *Prosopis juliflora* are not clearly mapped
- Dependency of neighbouring communities on *Prosopis juliflora* is not clearly established (It should be noted that the needs assessment report assumes that the *Prosopis juliflora* has no use. However, the community survey indicated that the communities in the vicinity used to consider the Juliflora to be a good crop and were not aware about its adverse effects and also used as firewood. Further ecological, environmental, and socio-economic service provided by *Prosopis juliflora* have not been given due consideration).
- The areas cleared-off of *Prosopis juliflora* are not ecologically restored or revegetated with native vegetation.
- Quantifiable data on ground water levels during pre and post intervention scenarios is not collected/ monitored.

3.3.2. Impact of removal of *Prosopis juliflora* and volumetric benefits

Figure 15: Impact of removal of *Prosopis juliflora* (n=93)



45% of the respondents (n=207) opined that the removal of *Prosopis juliflora* has created an impact in the lives of the community by solving the water scarcity issues within the villages. Out of these, majority 78% (n=93) highlighted that the intervention helped in increasing the ground water level and 20% of the respondents stated availability of more common land as an impact of removal of *Prosopis juliflora*. 2% of the respondents stated that they used the wood from juliflora in brick chambers.

The beneficiaries reported that earlier they used to face water scarcity issues and less land for cultivation due to rapid growth of juliflora and were not able to cultivate even once for the entire year. However, post the removal of juliflora, the availability of more cultivated land increased and now they are able to cultivate their farmland 2 or 3 times in a year which has led to more availability of cultivable land with higher productivity.

Some of the beneficiaries mentioned, that the gram panchayat should assign one person to keep a check at juliflora growth in the village land areas so that Panchayat can be informed on the growth. Subsequently, community members could be mobilized and can work collectively for its removal which will result in complete eradication and provide alternate livelihood to the villagers. The average rating provided by the beneficiaries based on the satisfaction level for removal of *Prosopis juliflora* support stands at 3.57/5 on a scale of 1-5 (with 1 being the least and 5 being the highest).

Land reclamation for agriculture

Based on the coordinates shared by Dilasa team and information shared by the field facilitator with respect to physical boundary of the target land parcels for this intervention, PW delineated areal extents for the asserted areas of intervention (Annexure 5).

Review of the satellite imagery indicated that historically the land parcel had sparse growth of the *Prosopis juliflora*, and the land was used for agricultural purposes. Satellite imagery also indicated that the growth of *Prosopis juliflora* has varied (presence and absence) historically.

Further review of the satellite imagery for the two sites indicated that these sites were not entirely covered by vegetation (possibly *Prosopis juliflora*) historically. However, sparse clusters of the vegetation were observed within these sites. Hence, for the purpose of this assessment the major cluster of such vegetative **growth prior to the intervention (i.e., May 2020)** were marked and measured using GIS tool - Google earth (Annexure 5). All such vegetative growth within the delineated clusters were assumed to be *Prosopis Juliflora* due to limitation in differentiating between differences of species from available satellite imagery. Accordingly, **~3.21 acres of land was observed to be covered by vegetation within claimed land area¹² of 42.7 acre** of Land Parcel 1, and **~4.21 acres of land was observed to be covered by vegetation within claimed area of 21.4 acre** of Land parcel 2. As such, **effective area with respect to land reclamation from *Prosopis juliflora* would be ~7.42 acres**. Annexure 6 presents the cluster wise areas of vegetation as on May 2020.

It should also be noted that considering the dynamicity with respect to changes in land use and visual indications of regrowth of *Prosopis juliflora*, the benefits from the reclamation of land for agricultural purpose may be subjective.

¹² Claimed land areas are the area as claimed by the implementation partner

Conservation of ground water

Due to the characteristic nature of rooting system of *Prosopis juliflora* including its tap root extending up to or more than 30 m, it is said to uptake water from groundwater during dry season, which may lead to depletion of groundwater. Studies conducted elsewhere (Ethiopia, North India) to assess water uptake by *Prosopis juliflora* indicated that the water uptake by the plant may range between 2333-7548 L/day/ha depending on the region^{13,14}. The environmental factors that impact water uptake rate of Juliflora are latent heat, pressure, relative humidity, vapor pressure deficit, and soil moisture. Further, water abstraction of individual trees was also found to be significantly related to the diameter of the stem.

Further, based on the available literature in the open source it is observed that the negative impacts of the *Prosopis juliflora* on groundwater in the region of interest have not been scientifically established. Hon'ble Madras High Court has directed appointment of a seven (7) member expert committee in its passed order W.P.No. 10614 of 2017 to undertake a comprehensive study on Seemai Karuvelam (*Prosopis juliflora*) trees with regard to its ill effects on environment as well as its utility¹⁵. The report developed by expert committee formed by State Government of Tamil Nadu is not readily available in public domain for review. Based on unverified media coverage on the committee's report, the committee is understood to have concluded that Seemai Karuvelam trees are not directly responsible for the depletion of ground water in the State. Further, that the *Juliflora* has xerophytic adaptation, and the root system does not penetrate great depths, and it can grow in regions with scanty rainfall. Whereas Tamilnadu draft policy on invasive alien plant species and ecological restoration of habitats (TN PIPER)¹⁶ considers the invasive tree has significant depleting impacts on the groundwater particularly water scarce regions (e.g.: arid, semi-arid and desert regions). As a consequence, has high potential to influence regional ecosystem health and functionality.

The result of qualitative survey reflects community perception (Section 3.3.2) indicating increase in groundwater levels as attributed to removal of Juliflora. However, community perception is generic in nature, as it does not account for individual influence of lake restoration, variation in precipitation, groundwater withdrawal rates, and removal of Juliflora.

In the absence of local information in the open source on 'uptake rate', actual area cleared-off of Juliflora and understanding of the exact impacts of *Prosopis juliflora* on depletion of groundwater, estimating potential beneficial impact with respect to conservation of groundwater as attributable to removal of *Prosopis juliflora* would be abstract. Hence, considering the limitations and subjective variables specific to the geography are not available, non-contextual volume of water uptake by *Prosopis juliflora* for the given intervention has been computed based on research work carried out in other geographies (Ethiopia) as presented below.

Table 8: Estimated potential water uptake by *Prosopis juliflora*

Land parcel	Estimated water uptake L/acre/day		Area cleared-off of <i>Prosopis juliflora</i>	Estimated potential uptake by <i>Prosopis juliflora</i> under baseline condition (L/ year) *	
	Minimum	Maximum		Minimum	Maximum
Land Parcel 1	944.53	3055.8	3.21	11,06,659	35,80,328
Land Parcel 2	944.53	3055.8	4.21	14,51,412	46,95,695

(*Note: The estimated potential uptake quantities are not actual on field uptake quantities, and these will vary based on the field conditions)

¹³ Shiferaw, H., Alamirew, T., Dzikiti, S., Bewket, W., Zeleke, G., Teketay, D. and Schaffner, U., 2023. Water abstraction of invasive *Prosopis juliflora* and native *Senegalia senegal* trees: A comparative study in the Great Rift Valley Area, Ethiopia. *Science of The Total Environment*, 862, p.160833. <https://www.sciencedirect.com/science/article/pii/S0048969722079360>

¹⁴ <http://www.ijpab.com/form/2018%20Volume%206.%20issue%201/IJPAB-2018-6-1-1088-1092.pdf>

¹⁵ G.Raja vs Principal Secretary to Government, Env. & Forest Department, Hon'ble Madras High Court, judgement order W.P.No. 10044 & 10045 of 2017

<https://www.mhc.tn.gov.in/judis/index.php/casestatus/viewpdf/616101>

¹⁶ https://www.forests.tn.gov.in/app/webroot/img/document/news/news/TNPIPER_plants-1.pdf

The land cleared-off of *Prosopis juliflora* was not assessed from the objective of ecological restoration since this was not documented to be one of the anticipated outcomes of the intervention. The intervention may offer considerable complimentary benefits through ecological services vis-a-vis restoration / re-vegetation of native species. Such holistic intervention aligned with catchment health preservation objectives may result in reduced surface run-off, prevention of soil erosion in the catchment, and minimizing silt build-up in the lakes/ponds in the area.

Further, implemented intervention to remove *P. Juliflora* may be considered to be aligned with the Tamil Nadu state Policy on Invasive Alien Plant Species in Tamil Nadu and their Control, Removal and Ecological Restoration of Habitats. As such, best practice for planning and undertaking such interventions would also involve consultation and collaboration with concerned stakeholders in State agencies along with other entities with similar interest.

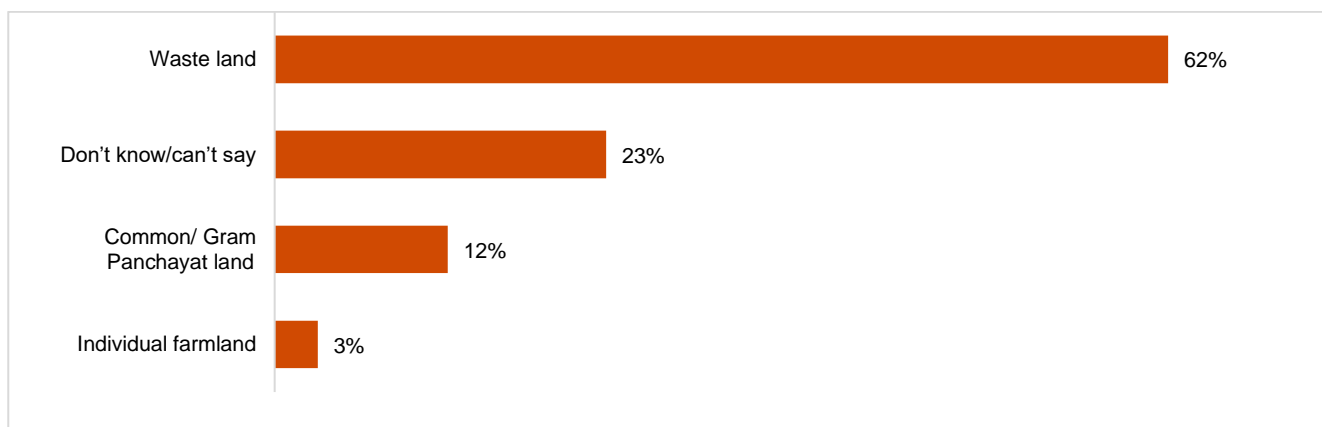
3.4. Tree Plantation around lakes

About the intervention

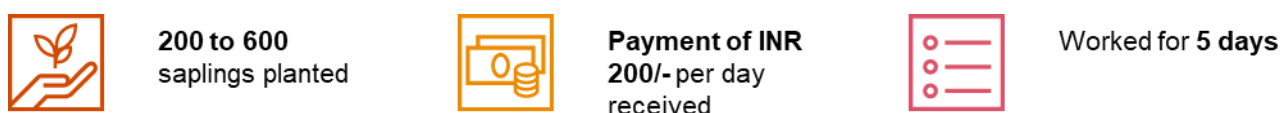
Tree plantation was done around the lakes to contribute to promotion of the local plant species and create bunding around the lakes. Tree plantation has been done in all the 4 intervention villages around all 7 rejuvenated lakes & ponds. As reported by Dilasa, total 2000 trees comprising of 5 species has been planted in different locations. Some of the beneficiaries stated that the plantation was done in a scattered manner (i.e., plantation around the lakes and in different land parcels). Beneficiaries reported that the plantation done are far from their homes due to which they didn't find it much relevant and felt that there was limited need for plantation of trees around the lakes.

It was reported that highest level of unawareness was for the tree plantation activities because only 58% (n=154) were aware about the initiative undertaken for plantation of trees around the lakes. Since, respondents were not involved in the process of planning & implementation, hence respondents were not aware about it. Most of the beneficiaries 62% were aware and reported that the plantation activity was done on the waste lands whereas 23% of them were not aware about the category of land where plantation was done.

Figure 16: Awareness of plantation activity done on what category of land by ownership (n=154)



25% of the beneficiaries were involved in the plantation activity (n=154). The beneficiaries stated that 5 local variety of plants have been planted namely Neem (*Azadirachta indica*), Jamun (*Syzygium cumini*), Peepal (*Ficus religiosa*), Palasa (*Butea monosperma*) and Karanj (*Pongamia pinnata*). The beneficiaries were engaged in the labour work for plantation activity and were paid under MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) scheme and were also involved in digging pits, planting, and watering the plants from June 2021 to December 2021. The range of saplings planted, payment and number of days worked by the villagers involved in the plantation activity as reported by the respondents is given in the infographic below:



The beneficiaries reported that most of the saplings planted were grazed by the livestock as there was no fencing provided around the plantation area. There was lack of maintenance mechanism either by the community or the panchayat to ensure protection of the plantation initiative. The beneficiaries suggested for more plantation of species like Karanj as the livestock does not eat them.

As per the quantitative survey, 84% of the villagers involved in the plantation activity stated that some of the plants have survived since the plantation.

3.4.1. Bench marking and gap assessment

According to the field facilitator, the plantation activity has been carried out along the periphery of the lakes, typically on the earthen bunds. Dilasa reported that the 2000 saplings in total were planted around all seven lakes. Plantation work was done by two different contractors. During the visit, some of the plantation around the lake was evident, but few were observed to have survived.

Table 9: Field observations: Plantation project

Particulars of Consideration	Document with Corresponding Information	Whether Incorporated	Conformance Status*	Remarks based on Observations on Documentation / Record / Reported Information
Field Observation Intended to assess conformance of implemented action with the conceptual and designed plans, and alignment of the intervention with project objectives				
Location of the implemented actions match the documented / reported coordinate(s)	Memorandum of understanding, Pg. 19	Yes	Partially Addressed	MoU indicates that only the areas around the target lakes/ponds were selected for plantation activity. Sporadically located saplings were observed along periphery of 5 of the 7 target lakes/ponds (except Pillaiyarkulam kovil pond in Kuthambakkam and pond in Murukancherry) largely limited to the bunds/embankments created from deposition of excavated soil from lake/pond beds.
Description of project type documented / reported matches the implemented action	Needs Assessment Report. Pg 13, 27, and 29. Memorandum of understanding, Pg. 19	Yes	Completely Addressed	MoU document states the project type as Plantation around lakes, which corresponds to implemented action
Species of saplings planted are the same as those documented in conceptual plan	Project completion report. Pg. 10 Invoice for tree plantation around lakes Dt. 19/12/2020	Yes	Partially Addressed	Based on community feedback, inputs shared by field facilitator of implementation partner, and visual observations, about 5 species of saplings were recognized (compared to 13 species as per documented information) namely Neem (Azadirachta indica), Jamun (Syzygium cumini), Peepal (Ficus religiosa), Palasa (Butea

Particulars of Consideration	Document with Corresponding Information	Whether Incorporated	Conformance Status*	Remarks based on Observations on Documentation / Record / Reported Information
				monosperma) and Karanj (Pongamia pinnata).
Health, condition, and physical appearance of saplings were satisfactory	No information available	No	No baseline	Most of the saplings planted were observed to have perished except for saplings planted on embankment of Sengaranthangal pond in Aranvoyal village.
Total number of saplings planted reflect the numbers documented in conceptual plan	MoU document, Pg. 20 Project completion report. Pg. 10 Invoice for tree plantation around lakes Dt. 19/12/2020	No	Inconsistencies observed	Based on input from field facilitator of implementation partner and feedback from communities, poor survival rate was largely due to livestock grazing and lack of maintenance mechanism (e.g., lack of periodic watering). Broad estimates (unaccounted) for current survival were deemed to be only ~25%. Total number of surviving saplings in actuality could not be validated. An accounting exercise need to be undertaken to quantify survival rate.
Designated stakeholders and individuals have been engaged to overtake ownership and management of saplings post implementation stage	Not available	No	No baseline	Chain of command or designated roles for stewardship of the plantation for periodic maintenance and long-term sustainability were not established or documented
Fencing for the protection of saplings have been provided at all locations	No information available	Other	Has not been considered in intervention	No documented information was available to review. However, during the Site visit it was reported that no fencing was provided to the plants. This was reported to have resulted into the plants getting grazed by the livestock.

* 1. Yes/ Completely addressed: It indicates that the requirements presented in column 1 (i.e., Particulars of Consideration) have been incorporated in the implemented action and is aligned with the conceptual plan.

2. Yes/ partially addressed: It indicates that the requirements presented in column 1 (i.e., Particulars of Consideration) have been incorporated partially in the implemented action and is aligned with the conceptual plan

3.No/ Not implemented: It indicates that the requirements presented in column 1 (i.e., Particulars of Consideration) have not been incorporated in the implemented action and/or not (aligned with the conceptual plan.

4.Other: Lack of information or documentation, inconsistencies in the data documentation or not applicable

3.4.2. Observations on pre and post implementation documentation

Number of gaps in the current methodology/procedure adopted for the implementation of the intervention against the standard methodology were identified as presented in Table 16 and Table 17 in Annexure 2.

However, some of the prominent aspects which were observed to have evident gaps and may need further action, documentation, and/or validation are as given below

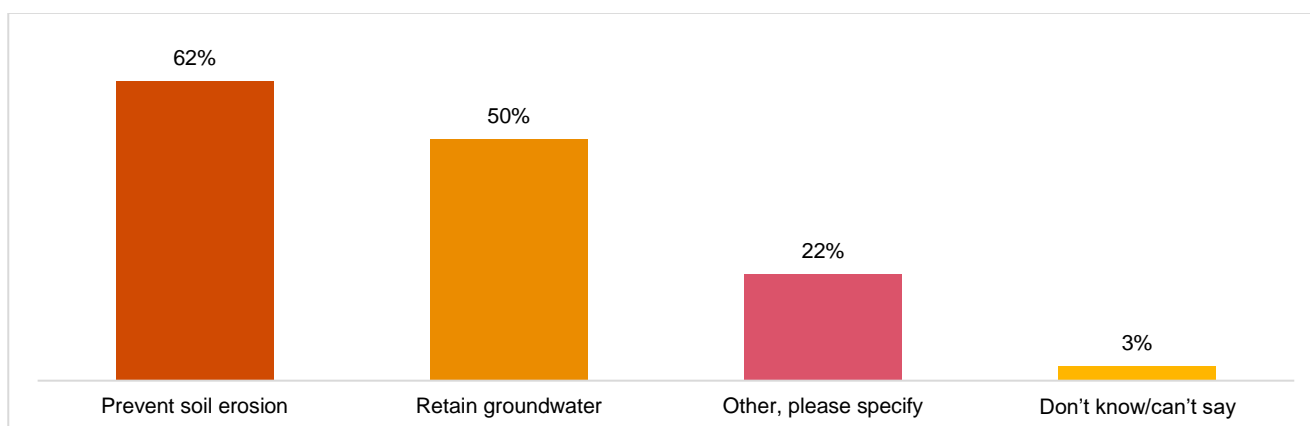
- Objective of the plantation activity was not clearly defined
- Survival rate/ need for replantation are not documented
- The saplings were not fenced to protect them from being grazed by the animals.

3.4.3. Impact of the intervention and Volumetric water benefit

Impact of tree plantation around the lakes

39% respondents stated that there was a need for plantation around the lakes (n=154). Majority of the respondents were of the opinion that plantation of trees helped in beautification of the village due to which need for the tree plantation was felt by the respondents. The below graphical representation demonstrates the reasons for the need for plantation around the lakes, as reported by these 39% respondents.

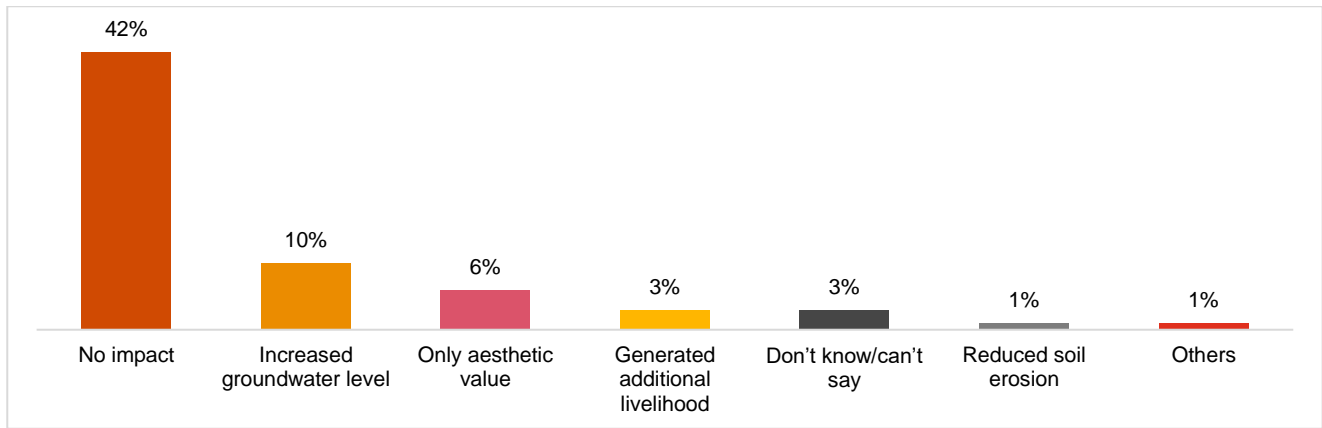
Figure 17: Need for plantation around the lakes (n=60)



Majority (62%) of the respondents (n=60) stated prevention of soil erosion as the prime need for tree plantation around the rejuvenated lakes while 50% of the respondents opined that it was needed to retain the groundwater in the region. 22% of the respondents stated requirement for plantation around the lakes for horticulture, making it aesthetically pleasing, strengthening of lake border, provision of space for animal resting and grazing, shade, and good air quality within the area.

Some of the beneficiaries suggested for plantation of more trees around the lakes for aesthetic purposes. The below graph illustrates the impact of plantation activity on the villagers as reported by the beneficiaries:

Figure 18: Impact of plantation activity on villagers (n=266)



The average rating provided by the beneficiaries based on the satisfaction level for plantation around the lakes support stands at 2.53/5 on a scale of 1-5 (with 1 being the least and 5 being the highest). The beneficiaries stated that many of them were not aware about the plantation activities and the survival rate was low. Community mobilizer also mentioned during the interaction that less than 50% of the plants survived.

Considering the low survival rate, age of the saplings, and since the plantation activity is limited to the bunds on the periphery of lakes & ponds, plantation intervention is not expected to have significant beneficial impact on reduction of run-off, increase in infiltration, and/or reduction in soil erosion within the catchment. Hence, the volumetric water benefits from this intervention are not estimated.

Moreover, benefits in the form of reduction in erosion of the bunds due to plantation may be limited as root system of the larger trees may weaken the bunds from the inside which may lead to instability of bunds in future.

Further, based on review of historical satellite imagery, considerable green cover and vegetation was observed to have been cleared as part of the embankment construction for lake restoration. Same has not been accounted nor documented.

Considering low survival rate of the planted saplings, their age relative to the loss of older trees, and unfavourable odds of surviving saplings to reach their prime, adverse impacts for collective interventions may outweigh limited beneficial impacts (if any) from the plantation intervention.

3.5. Awareness & Capacity Building on Water Conservation

About the intervention:

Dilasa had approached the Gram Panchayat of the villages as part of the project & conducted a need assessment survey to know the ground water recharge level in the area. The Gram Panchayat members also provided their suggestions post which the intervention was planned. The below graph summarizes the nature of awareness sessions and the topics covered as part of those awareness sessions conducted as part of the programme as stated by the beneficiaries.

Figure 19: Were awareness sessions conducted by Dilasa (n=158)

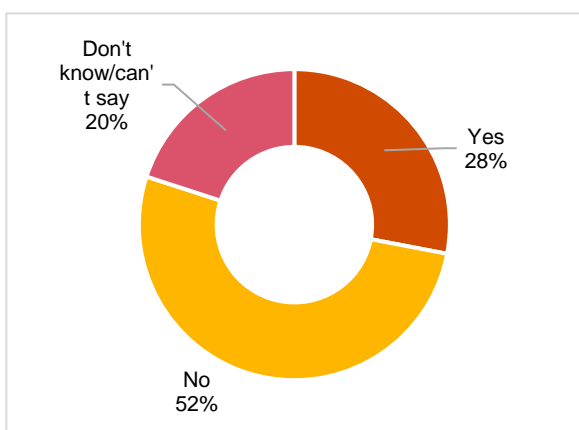
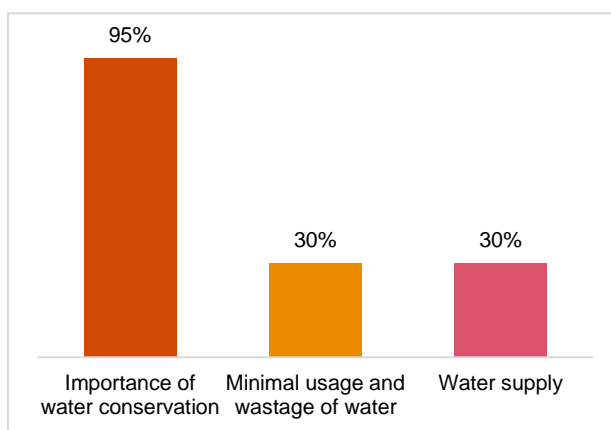


Figure 20: Topics covered during awareness sessions (n=44)



59% (n=158) of the respondents were aware about the initiative undertaken by the UBL for generating awareness around water conservation among community people and Gram Panchayat members. A majority of the respondents were not aware about the awareness sessions conducted by Dilasa because respondents participated in quantitative survey were mainly women and were not part of these sessions as stated by the respondents during interactions. Female respondents mentioned that the male members of the family had participated in meetings/sessions. 28% of the respondents agreed that Dilasa had conducted awareness sessions on the water supply, minimal usage and wastage of water and importance of water conservation.

Out of all the respondents who have been a part of awareness sessions, 95% (n=44) of the respondents could recall the topics covered in those sessions which included importance of water conservation whereas 30% of the respondents mentioned minimal usage and wastage of water as the topic of awareness sessions. Remaining 30% of the respondents attended the session on Water supply. Beneficiaries mentioned that awareness session was conducted where a presentation was made by UBL & Dilasa team and posters were displayed on the topics of awareness sessions.

Detailed discussion with the beneficiaries revealed that Dilasa had conducted one awareness session in each village on the water supply, minimal usage and wastage of water and importance of water conservation. Some beneficiaries also opined that the sessions were not in a structured awareness session mode, however the information of the activities were provided in initial community meetings.

Impact of the intervention:

Majority of the respondents who participated in awareness sessions stated that the awareness sessions were beneficial to them and increased their awareness level to some extent. During the interaction, beneficiaries mentioned about their increased awareness level due to the sessions.

Figure 21: What has been the change in awareness sessions (n=44)

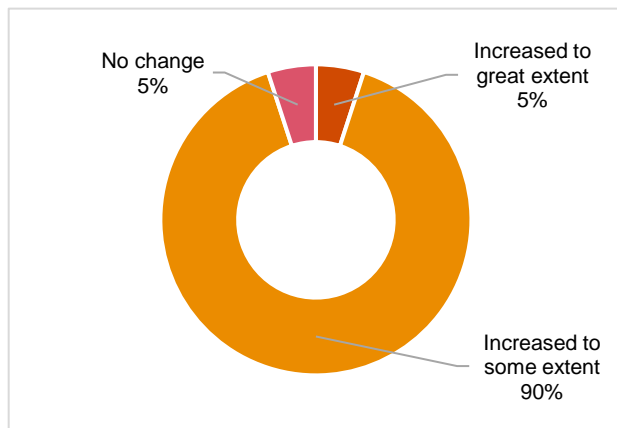
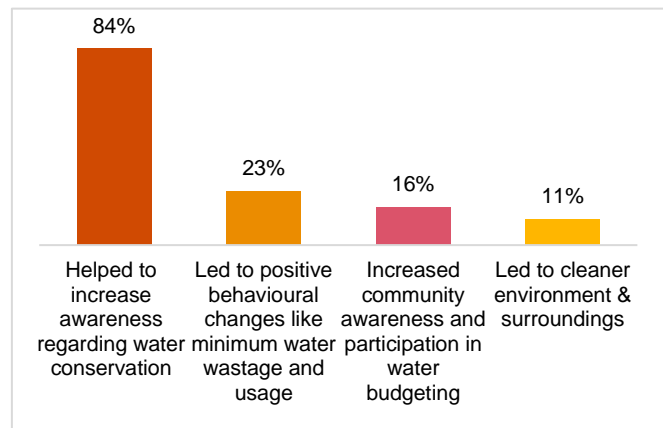


Figure 22: Benefits of the awareness sessions (n=44)



84% of the beneficiaries (n=44) stated that these sessions had led to an increase in awareness regarding water conservation and 23% of the respondents stated positive behavioural changes like minimum water wastage and usage. Beneficiaries could recall that the sessions were about water conservation and saving water as there is scarcity of water in the area. Respondents agreed that the programme has increased the awareness level among community to some extent which earlier they did not have knowledge about.

3.6. IRECS Analysis

Following is an assessment of the project implemented by UBL as per the IRECS framework.

Table 10: IRECS Analysis

Parameter	Assessment from the study
Inclusiveness	<ul style="list-style-type: none"> The support provided by United Breweries Limited to the intervention villages is inclusive in nature as all the households of the intervention villages benefitted with regards to water infrastructure in terms of rejuvenation of lakes; removal of <i>Prosopis juliflora</i> and tree plantation activities. The beneficiaries are impacted either directly or indirectly by the interventions and the benefits of the support provided by UBL are being utilized without any discrimination by all the villagers irrespective of their social community or gender or economics status.

Parameter	Assessment from the study
Relevance	<p>The project support with reference to Water bodies in terms of rejuvenation of lakes, removal of <i>Prosopis juliflora</i> and tree plantation around lakes was relevant for the intervention villages as there was a scarcity of water for agriculture as well as for drinking purposes and low groundwater availability in these villages. Detailed discussion with respondents revealed that prior to the intervention the water was only available for 4 to 6 months and people had to fetch water from neighbouring villages and ground water was very low from March to June.</p> <ul style="list-style-type: none"> 66% respondents interacted with stated that there was a need for removal of <i>Prosopis juliflora</i> (n=207). 39% respondents interacted with stated that there was a need for plantation around the lakes (n=154) <p>Respondents stated that the programme was particularly relevant to them as they were fighting with scarcity of water and had no other sources of water.</p>
Effectiveness	<ul style="list-style-type: none"> A moderate degree of effectiveness has been observed in the support provided as most of the respondents have benefited from the programme. 99% of the respondents (n=194) stated that the UBL's initiative has helped to a greater extent in improving the groundwater level in past 2-3 years. Detailed discussion with beneficiaries highlighted that the impact of removal of <i>Juliflora</i> & tree plantation has not been as effective as it had been envisaged because <i>Prosopis juliflora</i> has grown again and plantation couldn't survive, hence, direct impact of both the activities could not be observed.
Convergence	<ul style="list-style-type: none"> The project has collaborated and taken support from Gram Panchayat members for convergence at the ground level. The beneficiaries were engaged in labour work and were paid under MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) scheme. Detailed discussion on the field revealed that current role of the Gram Panchayat was limited with regards to maintenance of the water infrastructure. There could have been better convergence with the Village Development Committees regarding the maintenance of provided structures, hence moderate convergence is noted. However, future convergence of this initiative with Tamil Nadu Government scheme for removal of <i>Prosopis juliflora</i> wherein the policy aims at the prevention of unintentional or deliberate introduction of invasive alien plant species and the identification, prevention of spread, appropriate control, and eradication of all invasive alien plant species in terrestrial and wetland ecosystems of Tamil Nadu state can be done.
Sustainability	<ul style="list-style-type: none"> The current model under the initiative restricts long-term sustainability on its own. The maintenance of the rejuvenated lakes, tree plantation done around the lakes and removal of <i>Prosopis juliflora</i> requires a constant inflow of funds & the Panchayat should ensure proper availability of the funds in order to ensure that the same are being used for maintenance of the assets created by the project. Currently, the Gram Panchayat is only using the MGNREGA funds which are not sufficient for the same. Greater community ownership & accountability of the Gram Panchayat is required to leverage more funds/support from other alternative sources, be it Government or other corporates is required to ensure long term sustainability of the project.

4. Recommendations



1. Greater ownership & accountability of the villagers & Gram Panchayat

It was observed that currently the involvement of the Gram Panchayat was limited with regards to ensuring the maintenance of the rejuvenated lakes & ponds, removal of *Prosopis juliflora* and trees planted in the villages. In some of the villages, the lakes need maintenance for sedimentation & growth of plants. There has been regrowth of *Prosopis juliflora* & saplings planted have been grazed by the livestock.

There is a need to ensure greater ownership & accountability of the villagers as well. Only about 1/3rd of the respondents stated to have been the part of planning process for rejuvenation of lakes and other initiatives undertaken within the village.

2. Strengthening monitoring of the implementation partner

For the project, Dilasa, a Maharashtra based organization provided support in the project implementation. During covid 19 exigency, due to travel restriction the implementation partner could not visit & monitor the field for a major period of time and had to rope in a vendor to carry out the activities in the intervention villages. As a result, there were gaps observed in the documentation and implementation vis-à-vis in the MoU requirements. Strengthening the monitoring mechanism during covid 19 and post through local field facilitators and validating more rigorously could have resulted in addressing the gaps through oversight of the project activities.

3. Protection of saplings planted

Detailed discussion with the beneficiaries & other stakeholders revealed that in majority of the villages, most of the saplings are grazed by the livestock due to lack of fencing and maintenance mechanism. Hence, there could have been fencing done around the plantation site to avert the damage due to livestock and help in the long-term conservation of the saplings and the villagers will be able to derive benefits of the same. Alternatively, community members suggested plantation of local plants which animals do not graze.

4. Identification & convergence with government schemes and departments

It was understood that there is an existing Tamil Nadu government scheme in place for removal of *Prosopis juliflora* "Tamil Nadu Policy on Invasive Alien Plant Species and Ecological Restoration of Habitats". There could have been a possible convergence with the respective government departments and the scheme for better overall convergence and sustainability of the programme.

5. 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.

At present the study area considered for identification of needs and interventions is not formally defined, mapped, and documented in the context of site operations.

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 centred over 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 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 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.

6. Stakeholder identification and mapping

- Stakeholder identification, mapping, and profiling is one of the important steps, as it helps to include the affected/ interested parties in the project, gain insight into expectations, benefit from collective knowledge, obtain their consent and buy-in, share or plan ownership transfer of the project post implementation, among other aspects. At present the potential stakeholders are not clearly identified, evaluated, and documented for their interests and influence on the project
- Stakeholder identification and mapping should be aimed at identification of synergies and reducing the risks in the project
- Stakeholder identification includes identification of all the potential and relevant stakeholders who are impacted by the shared water challenges, benefit from the interventions and who contribute to the project or pose challenges in the successful completion of the project.
- Stakeholder mapping aims at evaluation of stakeholder's interest in particular shared water challenges and planned intervention, and their power to influence or contribute to the intervention project.

7. Prioritize shared challenges, identify cause, and set short-, medium-, and long- term targets/objectives

Formally identify and prioritise shared challenges reported by the stakeholders, based on severity/ significance and sense of urgency. Guidance on the prioritisation of the shared challenges for further action are not prescriptive but the judgement can be made on case-to-case basis. For example, unavailability of water for drinking need to be prioritised over shortage of water for other uses (agriculture, industrial or commercial).

Further, in order to develop appropriate mitigation plan, it is important to identify causes of the shared challenge and then prioritise the targets/ objectives on short-, medium- and long-term time horizons. At present although the shared challenges have been identified the causes of these challenges are not scientifically evaluated and documented. Further, planned actions are limited to short-term interventions. As such following approach may be adopted at a broad level:

Short-term: Planning, preparation, and implementation of target interventions

Medium-term:

- Periodic O&M, planned ownership transfer/transition, monitoring of current interventions
- Planning, preparation, and implementation of complementary interventions

Long-term: Planning, preparation, and implementation of collaborative and collective interventions

Few such examples are provided below as reference:

1. Desilting of lakes/ponds

Based on the cause of the sedimentation mitigation measures may change as presented in table below

Time horizon	Natural sedimentation	Anthropogenic (Dumping of waste)
Short term	Periodic desilting	Desilting
Medium term	Creation of sedimentation basins or silt traps at the inlet of the lake	Community awareness program
Long term	Plantation and catchment treatment within the catchment area to reduce the soil erosion	Regulatory interventions and oversight to restrict recurrence in future

Note: The above interventions are indicative and for the purpose of illustration only. For field implementation detailed assessment of the causes is required.

2. Declining water availability

Time horizon	High abstraction rates	Declining rainfall (climatic variations)
Short term	Augment/ restore/rejuvenate existing water sources	Restore/ rejuvenate existing water sources
Medium term	Community awareness, behavioural change, optimisation/ reduction of water use (collective water use efficiency)	Community awareness, Behavioural change, and Optimisation/ reduction of water use
Long term	Augmentation and development of new water sources, reclamation of used water (wastewater), transition to alternate crop cultivation or irrigation method	Long term planning for future development in the area

Therefore, it is recommended to identify shared challenges, their causes and prioritise based on their severity and urgency.

8. Ecological restoration of areas cleared up of *Prosopis juliflora*

Land cleared up of *Prosopis juliflora* may be ecologically restored (revegetated) by plantation of native species.

9. 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.

10. Monitoring and evaluation of quantifiable indicators

The quantifiable indicators are those indicator parameters which can be measured and associated with the particular intervention. Monitoring and evaluation of quantifiable indicators facilitates in the estimation of volumetric benefits of the implemented interventions.

At present quantifiable indicators with respect to implemented interventions are not monitored and documented. Hence it is recommended to identify and monitor the quantifiable indicators under pre and post implementation stages of the project.

Some the indicative quantifiable indicators for various interventions are presented below.

- Following indicators may be used for lake desilting interventions
 - Water levels in lake and seasonal variations thereof
 - Depth to groundwater levels and seasonal variation
 - Water withdrawal
 - Depth of sediment
 - Actual area irrigated (with the help of water from the target lake)
 - Number of beneficiaries dependent on the lake
 - Estimated storage volumes are influenced by various factors including depth of the pond or maximum water head that can be accommodated in the pond. Since the baseline depth of the ponds is not

documented, hence, depth of the ponds may need to be validated. It is recommended to install level gauges at all the lakes & ponds to monitor water level and depth post implementation.

- Following indicators may be used for removal of invasive species (*Prosopis juliflora*)
 - Actual land area cleared-off of the invasive species
 - Area under cultivation (out of the land areas actually cleared-off of *Prosopis juliflora*) under pre and post intervention scenarios
 - Estimates on groundwater withdrawal under pre and post interventions scenarios
 - Depth to groundwater table under pre and post intervention scenarios
 - Changes in density/ abundance of invasive species
 - Change in area covered under invasive species
- Following indicators may be used for plantation related initiative
 - Change in abundance/ composition/ density of native species
 - Change in area under native vegetation

Further, since such interventions may have synergies with local or regional policies and/or schemes, best practice would be to coordinate with concerned agencies at the planning stage. This would involve:

- Identification of appropriate policies and/or schemes, and understanding related provisions
- Identification and mapping of relevant stakeholders
- Understanding program details, physical extent of programs, components of programs suitable for participation and collaboration
- Defining contribution and level of engagement
- Engaging with concerned stakeholders and arriving at consensus on collaborative action
- Participation in collective intervention basis pre-defined MoU

11. Record keeping and documentation

Assumptions, claims, objectives, steps, methodology, quantifiable data, and outcomes among aspects of the project at both pre and post implementation stage of the project need to be documented.

5. Annexures



5.1. Annexure - 1: Case Studies from the Field

5.1.1. Rejuvenation of lakes

7 lakes were rejuvenated as part of the project support from UBL which has been a beneficial to the villagers for irrigation, fishing, domestic purposes, and livestock drinking purposes, etc.

The beneficiaries Vysak Devarkonda and Sanath Vijayan of Kuthambakkam North village stated that the rejuvenation of lakes and introduction of fishes in the lake by the gram panchayat have been beneficial to them. They use the rejuvenated lake for fishing for personal consumption along with religious and recreational purposes. They also opined that the rejuvenation of lake has led to an increase in the ground water level. Earlier, they were using borewell for irrigation but post the intervention, open well is enough and suffices for irrigation saving them time and cost associated with borewell operation.



Sajith, one of the beneficiaries from Murukancherry village was of the opinion that the rejuvenated lake has been highly beneficial for his family of 4.

He uses the lake regularly for domestic purposes and also helps livestock who can drink water here. Before the lake rejuvenation, he had to travel far distances to other villages with the livestock due to unavailability of water for them, but the lake rejuvenation support by UBL have led him in saving time and energy. He spends his free time he saves now with family.

5.1.2. Benefits of *Prosopis juliflora* removal

Beneficiary **Mohan** of Murukancherry village has been impacted by the removal of *Prosopis juliflora* from his 5-acre farmland support as part of the project from UBL.

Before the project, he was not using this farmland at all and was surviving by cultivating the other farmland. The project has led to increase in cultivable land & additional income generation for him.

Mohan stated that the removal of *Prosopis juliflora* has been very helpful to him. Earlier he could not cultivate his farmland as the area did not have enough ground water for irrigation. But post the Juliflora removal there has been substantial increase in the ground water level and now he is able to irrigate his farmland. Now, he cultivates his farmland 3 times a year and is able to get higher productivity and income.



5.2. Annexure - 2: Gaps Assessment

Table 11: Field observations: lake restoration (de-silting) project

Particulars of Consideration	Document with Corresponding Information	Whether Incorporated	Vannan Kulam, Aranvoyal	Elthani Kuttai, Aranvoyal	Sengaranthangal, Aranvoyal	Thankgal Eri-1, Murukancherry	Parikarakulam, Kuthambakkam North	Thangal Eri-2, Murukancherry	Pillaiyarkulam Kovil, Kuthambakkam South
Location of selected lakes/ponds match the documented / reported coordinate(s)	Relevant information available in Needs Assessment Report, Pg.16, MoU document, Pg. 15, and additional responses to queries shared by implementation partner	Yes	Completely Addressed	Completely Addressed	Completely Addressed	Completely Addressed	Completely Addressed	Completely Addressed	Completely Addressed
Description of project type documented / reported matches the implemented action (Annexure 4)	Relevant information available in MoU document, Pg.15-30	Yes	Completely Addressed Lakes/ponds to be rejuvenated through de-silting and stabilization of embankment	Physical assessment could not be carried out [#]	Completely Addressed Lakes/ponds to be rejuvenated through de-silting and stabilization of embankment	Completely Addressed Lakes/ponds to be rejuvenated through de-silting and stabilization of embankment	Completely Addressed Lakes/ponds to be rejuvenated through de-silting and stabilization of embankment	Completely Addressed Lakes/ponds to be rejuvenated through de-silting and stabilization of embankment	Completely Addressed Lakes/ponds to be rejuvenated through de-silting and stabilization of embankment
Physical features of the implemented project are evident and match the description of the project as documented / reported (Annexure 4)	Relevant information available in MoU document, Pg.15-30	Yes	Completely Addressed Activities pertaining to soil excavation from lake beds, embankment stabilization/development were reflective of the intended objective.						
Implemented project is per the intended conceptual and detailed design specifications	Relevant information available in MoU document, Pg.15-30	Other	Inconsistencies observed Per information shared by field facilitator, all excavations/de-silting activities were limited to just 1m from the baseline depth (pre-implementation stage level). This could not be validated during field. However, documented depths vary considerably across all the lakes/ponds. Additional storage capacity created through this intervention is greatly subjective to the depth of the lake/pond. As such, actual impact from the intervention with respect depth of excavation needs to be validated.						
Physical infrastructure is in good condition per visual observation and is serving its intended purpose (Annexure 6)	Based on field observation independent of documentation	Yes	Completely Addressed Siltation and erosion of bund was observed	Was not assessed	Completely Addressed Erosion of the bund was observed. Siltation in pond is likely	Completely Addressed	Completely Addressed	Completely Addressed. Heavy silt build-up, vegetation growth within pond, erosion of bund were observed.	Completely addressed. Heavy siltation and sediment build up long with thick vegetation covering considerable portion of the pond was observed
Created infrastructure can be considered as functioning effectively based on visual	Based on field observation independent of documentation	Yes	Completely Addressed	Was not assessed	Completely Addressed	Completely Addressed	Completely Addressed	Completely Addressed	Considering the heavy sedimentation, storage capacity may have reduced

Particulars of Consideration	Document with Corresponding Information	Whether Incorporated	Vannan Kulam, Aranvoyal	Elthani Kuttai, Aranvoyal	Sengaranthangal, Aranvoyal	Thankgal Eri-1, Murukancherry	Parikarakulam, Kuthambakkam North	Thangal Eri-2, Murukancherry	Pillaiyarkulam Kovil, Kuthambakkam South
observations (Annexure 4)									relative to the restored capacity
Use of the pond/lake by local community members was observed during field visit	Based on field observation independent of documentation	Yes	No baseline for comparison. Direct use by community members was not observed	No recall by the community as this pond is adjoining a large lake which engulfs the pond during and post-monsoon	No baseline for comparison. Direct use of the pond was not observed	No baseline for comparison. Direct use of the pond by community was not observed	No baseline for comparison. Recreational use as well as fishing for domestic consumption was observed	No baseline for comparison. Livestock feeding and fishing for commercial purpose were observed	No baseline for comparison. Direct use of the pond by community members was not observed
Beneficial impact from pond/lake restoration reported by neighbouring land users during consultation	Based on field observation independent of documentation	Other	No recall from the communities. Neighbouring land parcels are vacant and undeveloped	Validation of beneficial impacts specifically attributable to this pond may be technically complex considering its proximity to larger lake	Neighbouring agricultural landowners reported increase in groundwater in open wells and higher yield from borewell(s) located in their private property	Community attributed pond restoration for increase in groundwater level around the pond, increase in yield in Gram Panchayat borewell located 100m from the pond, and reduction in local inundation/waterlogging	Increase in groundwater level reported by farming community in the area	Neighboring land parcels are largely vacant undeveloped residential plots and commercial plots	Beneficial impact on groundwater level perceived by community members. Not validated through measurements
Groundwater monitoring well(s) identified as part of post-implementation monitoring plan are present at the location documented / reported	No information available	Other	No baseline. Nearest well is a borewell located ~200m downstream. Groundwater level not monitored	Was not assessed	No baseline. Nearest open well is ~200m downstream, and nearest bore well is 250m downstream. Groundwater level is visually monitored by private landowner from open well	Had not been considered. Nearest borewell is ~100m upstream and ~100m downstream. Groundwater level not monitored	Had not been considered. Nearest borewell is ~150m downstream	Had not been considered	Had not been considered
Measurement/data logger device(s) are located at designated places as documented / reported (if any)	Not implemented	No	Not implemented	Not implemented	Not implemented	Not implemented	Not implemented	Not implemented	Not implemented
Catchment area land use matches the document / reported details	No information available	No	No baseline for comparison. Largely open vacant and undeveloped land reported by locals to be residential plots	Mostly agricultural land	Mostly agricultural land	No baseline for comparison. Mixed land use includes residential use, agricultural use, vacant undeveloped land, and commercial use	No baseline for comparison. Mostly agricultural land	No baseline for comparison. Largely vacant undeveloped residential plots and commercial plots	No baseline for comparison. Mixed land use including commercial, institutional, and residential uses within 150m upstream from the pond

Particulars of Consideration	Document with Corresponding Information	Whether Incorporated	Vannan Kulam, Aranvoyal	Elthani Kuttai, Aranvoyal	Sengaranthangal, Aranvoyal	Thankgal Eri-1, Murukancherry	Parikarakulam, Kuthambakkam North	Thangal Eri-2, Murukancherry	Pillaiyarkulam Kovil, Kuthambakkam South
Wastewater from local communities does not enter the pond / lake based on visual survey of its periphery	Based on field observation independent of documentation	Yes	No baseline for comparison No inflow observed. Future residential use growth near the pond may influence this factor	Was not assessed	No baseline for comparison Wastewater discharge channels were not observed near the pond.	No baseline for comparison Stormwater drainage channel from the village is connected to the pond. Likely to be vulnerable to water quality impact	No baseline for comparison. Wastewater discharge channels were not observed near the pond	No baseline for comparison. Wastewater discharge channels were not observed upstream of the pond. However, illegal dumping of wastewater in vacant land parcel upstream of the pond was observed. Likely to impact water quality of the pond.	No baseline for comparison. Storm water drain observed to be connected to the pond. Poor quality water, likely to be untreated wastewater from upstream reaches was observed in the storm water drain.
Mitigation actions and/or interventions to prevent potential elements of concern and risks identified during pre-implementation stage have been implemented	No information available	No	Not addressed. Silt trap or sedimentation basin may be required to prevent siltation in the pond	No baseline	No baseline to compare. Silt trap or sedimentation basin may be required to prevent siltation in the pond	No baseline to compare. Water quality testing may be carried out to assess impact from wastewater discharge (if any)	No baseline.	No baseline. Water quality testing may be carried out to assess impact from wastewater inflow (if any)	No baseline. Wastewater treatment system ideally up to secondary level may have to be developed upstream of the pond to prevent untreated wastewater from deteriorating pond health further
Zone of influence with respect to increase in groundwater levels around the target lake/ponds that can be attributed to the project intervention has been delineated or established through scientific approach	No information available	Other	No baseline. Need to establish monitoring network	No baseline.	No baseline. Need to establish monitoring network	No baseline. Need to establish monitoring network	No baseline	No baseline. Need to establish monitoring network	No baseline
Individual beneficiary located within the zone of influence of target lakes/ponds and the means through which impacts are being realized have been qualitatively or quantitatively established using a scientific approach	No information available	Other	No baseline. No residential or agricultural use within 100m from the pond	No baseline. No recall of the interventions at this pond by the community	No baseline. Agricultural activities around the pond are dependent on groundwater. Likely to reflect beneficial impact if quantified through scientific approach	No baseline. Residential and agricultural communities located in close proximity. Likely to reflect quantifiable beneficial impact.	No baseline. Temple located on the bank of the pond and adjoining agricultural landowner's dependent on groundwater. Likely to reflect beneficial impact if quantified through scientific approach	No baseline. Commercial establishments and residential community located downstream are dependent on groundwater. Likely to reflect quantifiable beneficial impact	No baseline

#: During field visit one of the lakes/ponds (Elthani Kuttai) in Aranvoyal was not accessible as it had been engulfed by water from neighbouring larger lake. Further at the time of field visit PW was informed that this lake was part of phase 2 of the intervention and hence not the part of the current assessment.

Yes/ Completely addressed: It indicates that the requirements presented in column 1 (i.e., Particulars of Consideration) have been incorporated in the implemented action and is aligned with the conceptual plan.
 No/ Not implemented: It indicates that the requirements presented in column 1 (i.e., Particulars of Consideration) have not been incorporated in the implemented action and/or not (aligned with the conceptual plan).
 Other: Lack of information or documentation, inconsistencies in the data documentation or not applicable

Table 12: Benchmarking and Gaps Assessment of Rejuvenation of lakes and ponds: Pre-Implementation Stage

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
1	Define the physical scope 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.					
1.a	Location of the subject Site where business has its operational unit is identified clearly and mapped	High	Yes	Partially Addressed	Relevant information available in Needs Assessment Report, Pg.6	Needs assessment report has identified UB Chennai and Empee plants to be the target plants for the planned interventions. However, the exact locations of the plants were not mapped
1.b	A physical boundary representative of the focus area for intervention such as study area of defined areal extent (e.g.: 10 km radius around operational unit) or the micro-watershed/catchment (hydrological boundary of the area contributing surface water flow to the nearest stream/river), has been clearly defined and presented on a map relative to the operational unit's location	High	Yes	Partially Addressed	Relevant information available in Needs Assessment Report, Pg.10	The needs assessment reports mentions that the villages Aranvoyal and Murukancherry are near to Aranvoyal plant and village Kuthambakkam, is near to the UB Empee plant. At present village administrative limits / catchment boundary / contextual study area is not defined. Further, relevance of villages selected for intervention with respect to Site operations is not evidently documented.

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
2	Technical considerations for baselining catchment (study area) status Understanding of the catchment / study area and its physical surface and subterranean attributes. These include environmental factors that influence the selected water intervention. Some of the important catchment related parameters include local/regional climate, land profile, soil and subsurface characteristics, surface, and groundwater features, among other parameters.					
2.a	Land use and land cover within the study area, particularly of the area surrounding the target location selected for intervention has been characterized and mapped	High	No	Had not been considered	No information available	No information available for review
2.b	Topography and slope of the study area / catchment have been considered and incorporated into conceptualization and design of the selected intervention	High	No	Had not been considered	No information available	No information available for review
2.c	Drainage pattern of the study area / catchment has been considered and incorporated into conceptualization and design of the selected intervention	High	No	Had not been considered	No information available	No information available for review
2.d	Geology and hydrogeology of the study area / catchment has been considered and incorporated into conceptualization and design of the selected intervention	High	No	Not documented or recorded	No information available	No information available for review
2.e	Major water sources such as rivers, lakes, reservoirs etc. within the study area/ catchment are identified, mapped, and considered during the conceptualization and design of the selected intervention	High	Yes	Partially Addressed	Relevant information is available in Needs Assessment Report, Pg. 15, 16	Information related community water supply, agricultural water source, and existing ponds/lakes in the selected villages have been documented. Location of these lakes, natural drainage channels and network in the area have not been mapped
2.f	Trends in groundwater availability (groundwater levels) in the study area / catchment have been considered and incorporated into conceptualization and design of the selected intervention	High	Yes	Partially Addressed	Relevant information available in Needs Assessment Report, Pg.11, 12, 15, 19, 21, and 24	Based on the focused group discussion conducted by Dilasa, groundwater levels were reported to have depleted in all the villages. However, the quantitative information (groundwater levels) on the trends in water levels over the past 3-5 years in the vicinity of the selected lakes were not documented.

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3	Assess or review catchment/ study area water balance To understand the gaps in water demand and supply water balance for the study area/ catchment, establish water stress, and the need for intervention w.r.t. water conservation and replenishment projects.					
3.a	Hydrometeorological parameters such as rainfall, temperature, evaporation, and runoff were evaluated for historically (5-10 years).	High	Yes	Partially Addressed	Relevant information pertaining to rainfall is available in MoU document, Pg. 17.	Historical hydro-meteorological data and local weather pattern including temperature variations and evaporation
3.b	Water demand for agriculture, domestic, and industrial users have been reviewed based on available primary and/or secondary data sources	Moderate	Yes	Partially Addressed	Relevant information available in Needs Assessment Report, Pg.11, 12, 15, 19, 21, and 24	The needs assessment provides the information on the population, cropping pattern, and sources of water for irrigation and drinking purpose. The needs assessment report also provides qualitative information on the availability of water in terms of number months in year for which the water is available source of water. However, water demand from various users such as agriculture, domestic, and industrial within the study area was not taken into consideration
3.c	Water availability in the study area/catchment including surface water and groundwater sources is reviewed based on available primary and/or secondary data sources	High	Yes	Partially Addressed	Relevant information available in Needs Assessment Report, Pg.11, 12, 15, 19, 21, and 24	The needs assessment provides the information on the population, cropping pattern, and sources of water for irrigation and drinking purpose. The needs assessment report also provides qualitative information on the availability of water in terms of number months in year for which the water is available source of water. However, water availability from various water sources within the study area was not taken into consideration
4	Stakeholder identification, mapping, and profiling Stakeholder identification is one of the important steps as it helps to include the affected/ interested parties in the project, gain insight into expectations, benefit from collective knowledge, obtain their consent and buy-in, share or plan ownership transfer of the project post implementation, among other aspects.					
4.a	Potential stakeholders (e.g., landowners, farmers, residential communities, gram panchayats, government agencies/departments/boards responsible for water related infrastructure, and management etc.) have been identified	High	Yes	Partially Addressed	Relevant information available in Project completion report, Pg. 6	The project completion report indicates that Gram Panchayat and concerned government departments were involved in the overall process for getting NoCs. No information on the various government departments involved in the process is available in the report.

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
4.b	Stakeholder's interests with respect to the water related interventions have been identified and evaluated	Moderate	Yes	Partially Addressed	Relevant information available in Project completion report, Pg. 5, and 6	Interests of the stakeholders were not identified. Gram Panchayat and concerned government departments were reported to be engaged for getting NOC for the proposed interventions. However, based on the available information the involvement of the government departments appears to be limited to regulatory compliances (i.e., for getting NoCs) only, and no further information on how they were included (if included) in overall decision-making process is not documented. Further, the gram panchayats appear to have been involved in the project after the interventions were selected. However, no information whether the views from the Gram Panchayat were considered while deciding the intervention measures is available in the report.
4.c	Stakeholder's power to influence or contribute to the potential interventions was identified and evaluated, and stakeholder engagement plan is developed considering key roles of identified stakeholders for successful completion of the project interventions	Moderate	Other	Not documented or recorded	No information available	Stakeholder's influence and capacity to contribute are not evaluated
4.d	Stakeholder's opinion, perspective, and feedback on targeted interventions, intervention's potential benefits and/or adverse impacts, have been collected	Moderate	Yes	Not documented or recorded	Relevant information available in Need Assessment Report, Pg. 4	Reference to stakeholder consultation has been provided in the Need Assessment Report. Based on input from Dilasa team, selected lakes are finalized based on input provided by the Gram Panchayat and key members of the village(s). However, details of the consultations including subjects covered, outcome of the consultations, key items of consideration have not been documented.

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
5	Identify the shared water challenges and their impact within the catchment Shared water challenges are those that are common between the operational Site of UBL and one or more of the relevant stakeholders. Identification of shared water challenges provides an opportunity for collective action in the catchment.					
5.a	Baseline status and potential challenges with respect to availability of sufficient quantity of water or water stress have been taken into consideration	High	Yes	Completely Addressed	Relevant information available in Needs Assessment Report, Pg. 16, 17, 19, and 21	Recurring droughts in recent years, declining groundwater levels and reduction of availability of water (in terms of number of months the water is available in the ponds/lakes) are identified as challenges with respect to water availability within the study area.
5.b	Baseline status and potential challenges with respect to availability of good quality of water for consumption have been taken into consideration	Moderate	No	Had not been considered	No information available	No information on the water quality related challenges within the catchment/study area is available in any of the documents shared with PW at the time of assessment.
5.c	Baseline status and potential challenges with respect to Water, Sanitation, and Hygiene (WASH) as relevant to the communities in the area have been taken into consideration	Moderate	Yes	Partially Addressed	Relevant information available in Needs Assessment Report, Pg. 11, 22, and 15	Issues with respect to unavailability of toilets and practice of open defecation were identified as WASH related challenges. However, observation regarding access to safe drinking water and healthcare were not documented.
5.d	Baseline status of water features in the area and challenges with respect to deterioration of water bodies have been taken into consideration	High	Yes	Partially Addressed	Relevant information available in Needs Assessment Report, Pg. 16, 17, 19, and 21	Reduction in storage capacity of the ponds/lakes due to sedimentation were identified as water availability related challenge. However, its implications on overall health of the lake/pond ecosystem, and challenges with respect to quality of water and sediments in the lakes/ ponds were not identified and evaluated. Further, status of natural drainage channels that feed into the target lakes have not been reviewed.
5.e	Historical challenges posed by water related extreme weather events such as droughts and floods have been considered	High	Yes	Partially Addressed	Relevant information available in Needs Assessment Report, Pg. 16, 17, 19, and 21	Recurring droughts in recent years, declining groundwater levels and reduction of availability of water (in terms of number of months the water is available in the ponds/lakes) are identified as challenges with respect to water availability within the study area. However, issues pertaining to flood, inundation, and waterlogging have not been taken into consideration

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
5.f	Water quality of target lakes/ponds, natural or artificial drainage channels that feed into the target lakes/ponds, and groundwater in the area have been taken into consideration	High	No	Had not been considered	No information available	No information on the water quality within the catchment/study area is available in any of the documents shared with PW at the time of assessment.
5.g	Shared water challenges identified above are evaluated and prioritized	High	Yes	Partially Addressed	Relevant information is available in Needs Assessment Report, Pg. 26 and MoU document, Pg. 13	Shared challenge(s) in the area have been identified and water related challenges have been prioritized. However, rationale for prioritizing these over other identified challenges, specific interventions, selection of specific lakes, selection of particular locations, among other aspects have not been documented
6	Root cause(s) of the shared water challenges have been identified Interventions intended to be mitigation measures implemented without identification of the root cause that is triggering the challenge may fail to effectively provide sustainable solution in the long term and result in misalignment of effort and resources. Further, objective of intended actions may not be effectively achieved.					
6.a	Abstraction (if any), and changes (increase/decrease) in abstraction of water from lakes/ponds have been taken into consideration.	High	No	Had not been considered	No information available	Historical change in water demand and abstraction of various sources of water within the study area are not documented
6.b	Historical dependency and changes (increase/decrease) in abstraction of water from groundwater have been taken into consideration.	High	Yes	Not documented or recorded	Relevant information available in Needs Assessment Report, Pg.11, 12, 15, 19, 21, and 24	Historical change in water demand and abstraction of various sources of water within the study area are not documented
6.c	Historical precipitation rate, changes (increase/decrease) in precipitation pattern and its implication on water availability, particularly groundwater have been taken into consideration.	High	Yes	Partially Addressed	Relevant information pertaining to rainfall is available in MoU document, Pg. 17.	Historical hydro-meteorological data and local weather pattern including temperature variations and evaporation
6.d	Historical and projected changes in land use and its implications on water availability have been taken into consideration.	Moderate	Other	Had not been considered	No information available	Changes in historical land use pattern and its implications on the water availability are not evaluated
6.e	Changes in physical characteristics of water bodies and streams feeding to the lakes/ponds (e.g.: encroachment, solid waste dumping, denotification and land use change) have been taken into consideration.	Moderate	Other	Not documented or recorded	No information available	Issue with respect to encroachment in water bodies/ streams feeding to water bodies restricting the flow of water in the lakes/ponds are not evaluated/ documented

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
6.f	Wastewater management practices in the area, particularly whether municipal or industrial wastewater is discharged (treated or untreated) into any surface water bodies or groundwater have been taken into consideration.	High	Other	Had not been considered	No information available	No information available for review
7	Catchment water programs & schemes Identify and understand other water stewardship activities being undertaken within the catchment to work synchronously, plan & benefit from synergies, avoid duplication of effort, align with larger scheme of things, among other productive engagement					
7.a	Ongoing water-related initiatives being undertaken by other stakeholders within the catchment/study area have been taken into consideration.	Moderate	Yes	Not documented or recorded	No information available	According to Cipla's implementation partner, information on ongoing interventions, project activities by other stakeholders (Gram Panchayat) have been collected. However, these are not documented.
7.b	Planned water-related initiatives by other stakeholders within the catchment/study area have been taken into consideration.	Moderate	No	Not documented or recorded	No information available	Information on planned interventions project activities by other stakeholders is not available in the report
8	Prepare implantation plan Set short-, medium-, and long- term objective which will form the basis for execution of the envisioned activities					
8.a	Prioritize stakeholder challenges and plan initiatives on the short-, medium-, and long-term time scales.	Moderate	Yes	Not documented or recorded	No information available	
8.a	Prioritise stakeholder challenges and plan initiatives on the short-, medium-, and long-term time scales.	Moderate	Yes	Not documented or recorded	No information available	According to Cipla's implementation partner, water-related interventions were prioritized considering the recurring drought faced by the communities over the preceding 3 years, in order to address circumstantial water stress faced by communities. However, the same along with rationale and process adopted during this decision stage have not been documented

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
8.b	Identify intervention activities based on the short-, medium-, and long- term objectives	Moderate	Yes	Not documented or recorded	No information available	The project activities selected are waterbody rejuvenation, plantation of native species and removal of invasive species. However, these are observed to have been executed as standalone activities with limited synergies. Also, the activities are not planned in short-, medium-, and long-term time horizons. Further, rationale for the selection of target lakes and the process adopted during decision stage have not been documented
8.c	Implementation partner(s) has been identified and selected based on capabilities relevant to the project, formal association has been established for targeted interventions	Moderate	Yes	Completely Addressed	Relevant information available in Needs assessment report, Pg. 5, and MoU for Water Conservation Chennai Dilasa	Implementation partner chosen was Dilasa which has worked with Client before on other social sector projects at different sites in the country. Dilasa projects itself as an organization dedicated towards its vision to uplift the environmental, social, and economic status of rural people by implementing sustainable natural resource management and women empowerment. The organization has reported to have experience of working on water and livelihood related projects in 27 districts across 115 blocks and 5558 villages in Maharashtra
8.d	Conceptual plan and design of the planned interventions have been developed and key parameters for detailed design, execution, and monitoring of success factors have been documented	High	Yes	Partially Addressed	Relevant information available in MoU document, Pg.15-30	Planned interventions and activities, steps involved, relevant stakeholders, project timeline, estimated resource requirement have been documented. However, key parameters for assessing success of the initiative, monitoring quantitative indicators to measure post-implementation impacts, and ownership transfer roadmap have not been documented.
8.e	Detailed designs and task level descriptions (such as engineering drawings, geo-technical aspects, excavation and hauling details, critical considerations, site specific considerations) have been documented.	High	No	Not addressed	No information available	No information available for review

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
8.f	Expected outcome of the intended intervention are clearly defined and documented	High	Yes	Completely Addressed	Relevant information is available in MoU document, Pg. 22	7 lakes/ponds to be rejuvenated through de-silting and stabilization of embankment 365 hectares of land to be converted for water conservation Create 957,000 KL water potential on annual basis Enable access to water for 10,870 individuals Enable stabilization of 365 hectares land area through improved availability of water
8.g	Key indicators to measure and quantify success of the intervention have been defined and documented	High	No	Not addressed	No information available	No information available for review
9	Documentation of the project site condition Status and condition of the selected project site prior to active intervention as a baselining exercise to define key parameters that will help assess contribution from the intervention post-implementation through comparison of pre-intervention and post-intervention scenario					
9.a	Specific details of the selected lakes/ponds have been documented (e.g.: Geolocations, identifiers, administrative / governance attributes), and have been mapped relative to the operational Site location	High	Yes	Inconsistencies observed	Relevant information available in Needs Assessment Report, Pg.16, MoU document, Pg. 15, and additional responses to queries shared by implementation partner	Selected individual lake/ponds have been listed and tabulated. However, there are inconsistencies between documented information in different files. Further, inconsistencies were observed with the geolocations.
9.b	Dimensions and surface area of the lakes/ponds have been measured physically or estimated based on secondary sources and documented	High	Yes	Inconsistencies observed	Relevant information available in Needs Assessment Report, Pg.16	Individual lake/pond areas have been estimated on the basis of maximum length and width. However, based on the review of satellite imagery the lakes/ponds are observed to be of irregular shape and do not correspond to the dimensions documented.
9.c	Bed level and maximum water level of the lakes/ponds, ground level around the lake, and embankment crest level is documented.	High	Yes	Partially Addressed	Relevant information available in Needs Assessment Report, Pg.16	Depth of the target lake/pond has been documented. However, basis for the same has not been documented. Further, other key aspects related to maximum water level, ground level, inlet and outlet, weir height (if any), embankment details, have not been documented

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
9.d	List of potential beneficiaries, their relative location wrt target lake/pond, purpose of usage of water from lake have been identified and documented.	High	Yes	Partially Addressed	Relevant information available in MoU with Dilasa. Pg. 15	Individual beneficiaries have not been identified. Population of each village is presumed to be collective beneficiaries from the target interventions Assumptions on the unit water requirement considered for calculation of population benefitted and total areas which can be irrigated through augmented storage capacity are not documented
9.e	Water withdrawal from the lakes/ ponds including quantity and methods of withdrawal (if any) have been documented	High	No	Not addressed	No information available	Existing water withdrawal from the lakes/pond for domestic, agriculture, or other uses along with the method of water withdrawal are not estimated and documented
9.f	Groundwater levels in the neighbouring areas around the target lake/pond during different times in the year have been documented.	High	No	Not addressed	No information available	Ground water levels and their seasonal variations in the neighbouring areas are not monitored
9.g	Surplus water inflow into the target lake/pond from its catchment has been estimated/established and documented	High	Other	Had not been considered	No information available	No information available
9.h	Groundwater monitoring plan to monitor impact on groundwater level post-implementation has been developed and documented with specific details of monitoring well location (relative to the target lake/pond), frequency and method of monitoring	High	No	Not addressed	No information available	No information available
9.i	Wastewater management practices in the area, particularly whether municipal or industrial wastewater is currently being discharged (treated or untreated) or is likely to be discharged into the target lake/pond has been documented	High	Other	Had not been considered	No information available	No information available
9.j	Physical attributes of the target lake/pond and its immediate surroundings have been documented	Moderate	No	Not addressed	No information available	No information available
9.k	Ecological attributes of the target lake/pond and its surroundings have been documented	Moderate	Other	Had not been considered	No information available	No information available

SI. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
9.l	Socio-economic attributes associated with the target lake/pond (if any) have been documented	Moderate	Other	Had not been considered	No information available	No information available
9.m	Cultural attributes associated with the target lake/pond (if any) have been documented	Moderate	Other	Had not been considered	No information available	No information available
9.n	Water level in the target lake/pond has been measured or recorded to capture historical variations	High	No	Not addressed	No information available	No information available
9.o	Potential elements of concern and risks have been identified and mitigation measures have been planned and documented	High	No	Not addressed	No information available	No information available
9.p	Need for clearance of vegetation (if any), trees, or other natural features as part of project intervention has been assessed, alternate approach to avoid such clearance has been evaluated. Area of clearance, natural features that may get impacted, and number of trees to be felled have been documented clearly in case unavoidable.	Low	Other	Had not been considered	No information available	No information available

Table 13: Benchmarking and Gaps Assessment of Rejuvenation of lakes and ponds: Post-Implementation Stage

SI. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
1	Continuous monitoring Post implementation monitoring program facilitates in keeping track of health of the infrastructure, observe and record quantifiable beneficial impacts of the project, intended objectives are achieved over long-term, and effective management and maintenance at appropriate time.					
1.a	Water level in the target pond/lakes are monitored at pre-defined intervals, including number of times the lake/pond has depleted completely in one season and the duration of water storage in the lake/pond in a year	Low	No	Had not been Considered	No information available	Water levels in the ponds/lakes are not recorded
1.b	Groundwater levels in the vicinity of the lakes/ponds are monitored and are aligned with the monitoring plan developed at pre-implementation stage	High	No	Had not been Considered	No information available	Groundwater levels in the vicinity of the lakes/ponds are not recorded

Sl. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
1.c	Quality of water in the ponds/lakes in monitored periodically	Moderate	No	Had not been Considered	No information available	Quality of water in the ponds/lakes in monitored
1.d	Water withdrawals from the ponds/lakes are monitored	Low	No	Had not been Considered	No information available	Water withdrawals from the lakes/ponds are not monitored
1.e	Physical conditions of the infrastructure are monitored. A checklist of key aspects for periodic inspection and maintenance is available with relevant stakeholder(s)	High	No	Had not been Considered	No information available	The infrastructure is not monitored for physical deterioration. During the Site visit the bunds built along the periphery of some of the lakes were observed to have eroded. Erosion of bunds may add silt back to the lakes
1.f	In case ownership or management responsibilities of the target lake/pond has been transferred to other stakeholders, their involvement and commitment to sustainability of the project intervention is being tracked and documented	Moderate	No	Not documented or recorded	No information available	Water withdrawals from the lakes/ponds are not monitored
1.g	Bed level of the target lake/pond is measured or monitored on an annual basis to document sedimentation and loss of storage volume created through the intervention	Low	No	Had not been Considered	No information available	Water withdrawals from the lakes/ponds are not monitored
2	Field Observations Intended to assess conformance of implemented actions with the conceptual and designed plans, and alignment of the intervention with project objectives.					
2.a	Location of selected lakes/ponds match the documented / reported coordinate(s)	High	Other	Inconsistencies observed	Relevant information available in Needs Assessment Report, Pg.16, MoU document, Pg. 15, and additional responses to queries shared by implementation partner	Selected individual lake/ponds have been listed and tabulated. However, there are inconsistencies between documented information in different files. Further, inconsistencies were observed with the geolocations as well as between the lakes/ponds that were part of field assessment and those documented in different files.
2.b	Description of project type documented / reported matches the implemented action	High	Yes	Completely Addressed	Relevant information available in MoU document, Pg.15-30	Lakes/ponds to be rejuvenated through de-silting and stabilization of embankment

Sl. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
2.c	Physical features of the implemented project are evident and match the description of the project as documented / reported	High	Yes	Completely Addressed	Relevant information available in MoU document, Pg.15-30	Activities pertaining to soil excavation from lake beds, embankment stabilization/development were reflective of the intended objective.
2.d	Implemented project is per the intended conceptual and detailed design specifications	High	Other	Inconsistencies observed	Relevant information available in MoU document, Pg.15-30	Conceptual plans are available in the prepared documents. However, detailed design specifications pertaining to planned desilting, embankment construction, land clearance needed for depositing excavated earth, overflow weirs, inflow channels, among other relevant aspects have not been documented. Further, per information shared by field facilitator, all excavations/de-silting activities were limited to just 1m from the baseline depth (pre-implementation stage level). This could not be validated during field visits considering constraints to undertake measurement tasks. However, documented depths vary considerably across all the lakes/ponds. Additional storage capacity created through this intervention is greatly subjective to the depth of the lake/pond. As such, actual impact from the intervention with respect depth of excavation needs to be validated from field assessment.
2.e	Physical infrastructure is in good condition per visual observation and is serving its intended purpose	High	Yes	Completely Addressed	Based on field observation independent of documentation	Siltation, erosion of embankment, vegetation growth on lakebed were observed. However, intervention was considered to be serving its intended purpose in the short-term (up to 2 years).
2.f	Created infrastructure can be considered as functioning effectively based on visual observations	High	Yes	Completely Addressed	Based on field observation independent of documentation	Considering the rate of siltation within span of 1 year, need for recurring intervention will have to be assessed for continued realization of beneficial impact(s).
2.g	Use of the pond/lake by local community members was observed during field visit	Moderate	Yes	No baseline for comparison	Based on field observation independent of documentation	Recreational use including fishing and leisure activities (Murukancherry), livestock feeding (Aranvoyal), and sporadic use of water for cultural activities (use at temple, Kuthambakkam) were observed.

Sl. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
2.h	Beneficial impact from pond/lake restoration reported by neighbouring land users during consultation	Moderate	Yes	Completely Addressed	Based on field observation independent of documentation	Increase in groundwater level and yield from agricultural borewells were reported by agricultural landowners and residential community members in Aranvoyal and Murukancherry villages
2.i	Groundwater monitoring well(s) identified as part of post-implementation monitoring plan are present at the location documented / reported	High	Other	Had not been Considered	No information available	No information available for review
2.j	Flow measurement device(s) are located at designated places as documented / reported (if any)	Low	No	Not applicable	Not applicable	Not applicable
2.k	Catchment area land use matches the document / reported details	Moderate	No	No baseline for comparison	No information available	Catchment area of lakes in all three villages are likely to experience land use change in the near future considering that the land parcels in Aranvoyal and Murukancherry have been converted into residential plots, and industrial plots in Kuthambakkam as per information shared by local residents.
2.l	Wastewater from local communities does not enter the pond / lake based on visual survey of its periphery	High	Yes	No baseline for comparison	Based on field observation independent of documentation	Although wastewater inflow was not observed at any of the lakes/ponds, scenario is likely to change subject to impending change in land use. Mitigation measures need to be evaluated and adopted to prevent treated or untreated wastewater from reaching the lakes/ponds
2.m	Mitigation actions and/or interventions to prevent potential elements of concern and risks identified during pre-implementation stage have been implemented	High	No	Not addressed	No information available	No information available for review
3	Beneficiary Validation Effort to qualitatively and/or quantitatively validate beneficial impacts including direct benefits and complementary benefits from the project intervention					
3.a	Zone of influence with respect to increase in groundwater levels around the target lake/ponds that can be attributed to the project intervention has been delineated or established through scientific approach	Moderate	Other	Had not been Considered	No information available	No information available for review

SI. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
3.b	Individual beneficiary located within the zone of influence of target lakes/ponds and the means through which impacts are being realized have been qualitatively or quantitatively established using a scientific approach	Moderate	Other	Had not been Considered	No information available	No information available for review
3.c	Clearance of vegetation (if any), trees, or other natural features as part of project intervention has been assessed, accounted, and documented. Area of clearance, natural features that have got impacted, and number of trees felled have been documented clearly and potential detrimental impacts (if any) from the same have been evaluated and documented.	Moderate	Other	Had not been Considered	No information available	Based on input received from the implementation partner, <i>Prosopis juliflora</i> trees in the vicinity of the lakes/ponds had been cleared. Details of the same have not been documented. Further, detrimental impacts of the vegetation clearance have not been assessed.

Table 14: Benchmarking and Gaps Assessment of Removal of *Prosopis juliflora*: Pre-Implementation

SI. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Observations on Documentation / Record / Reported Information
1	Mapping of invasive species / Transect Survey The areas affected by invasive plants should be identified and mapped using onsite survey (ground truthing) and GIS mapping techniques. Transect survey is a tool for describing the location and distribution of resources, features, landscapes, and land use along a given transect. It can be used to compare discussions of different stakeholders. In addition, transect walks can provide a good cross-section of information that can be used for specific purposes of verification and appraisal.					
1.a	Survey transects are clearly identified and mapped	Moderate	Yes	Partially Addressed	Relevant information is available in Needs Assessment Report Pg. 6, and 8.	The needs assessment report mentions that the transect walk was conducted to develop a clear understanding of the village area. However, the survey transects are not clearly defined and mapped. Details pertaining to the alignment and locations of the transect are not available for review.
1.a	Various plant species observed in the study area are identified during the survey	Moderate	Other	Has not been considered	No information available	Needs assessment report has identified <i>Prosopis juliflora</i> as the invasive species present in the area of interest. However, other species observed in the study area are not documented

Sl. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Observations on Documentation / Record / Reported Information
1.b	Abundance and density of the identified species is estimated	Moderate	No	Not addressed	No information available	Report mentions that 100 Acres of land was cleared off of <i>Prosopis juliflora</i> . However, details on the density of the plant or the number of plants removed are not available
1.c	Any birds/ animals observed in the area in general and dependent on the target species (e.g., for shelter or as food) in particular are identified	Moderate	Other	Has not been considered	No information available	Bird and animal species, particularly dependent on <i>Prosopis juliflora</i> (if any) in the study area are not documented
2	Demarcation of treatment area Mapping of invasive species, and information on density of the invasive species in different areas will facilitate identification of treatment area.					
2.a	Treatment area is clearly identified and mapped	High	Yes	Partially Addressed	Photographs with site coordinates	Only the point locations of some of the sites cleared-off of Juliflora were shared. However, exact treatment areas (areas which were cleared-off of Juliflora) have not been mapped or documented.
2.b	Land use categorization of the target site selected for invasive species removal has been assessed with due consideration to government owned land, privately owned land, forest land, grazing land, natural grasslands, suitability of the land for cultivation, among other relevant aspects	High	No	Not addressed	No information available	The areas cleared-off of <i>Prosopis juliflora</i> are reported to be made available for agriculture and no ecological restoration is planned. Also, the site representative reported that one of the land parcels cleared-off of <i>Prosopis juliflora</i> in Aranvoyal has been converted into residential plots and another land parcel in Aranvoyal has been converted into non-agricultural land intended to be developed into a medical institution. As such, land ownership of target locations has not been documented and needs validation.
3	Identification of Benchmark site Appropriate site/area with relatively undisturbed natural ecosystem should be identified which can serve as a reference site for ecological restoration. Preferably, such area should be from similar habitat/region as of the treatment area.					
3.a	Benchmark site with relatively undisturbed natural ecosystem in the region has been identified and documented	High	Other	Has not been considered	No information available	The areas cleared-off of <i>Prosopis juliflora</i> are reported to be made available for agriculture and no ecological restoration is planned.
3.b	Native plant species to be used for revegetation are identified	High	Other	Has not been considered	No information available	The area cleared-off of <i>Prosopis juliflora</i> is not planned to be ecologically restored.

Sl. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Observations on Documentation / Record / Reported Information
4	Revegetation strategy Aims at development of plan for revegetation of an area infested by invasive species					
4.a	Native plant communities and composition for plantation is defined	Moderate	Other	Has not been considered	No information available	The area cleared-off of <i>Prosopis juliflora</i> is not planned to be ecologically restored.
4.b	Native soil and seed bank of desired species are developed	Moderate	Other	Has not been considered	No information available	The area cleared-off of <i>Prosopis juliflora</i> is not planned to be ecologically restored.
4.c	The land cleared-off of <i>Prosopis juliflora</i> is revegetated with native plant species	High	Other	Has not been considered	No information available	The area cleared-off of <i>Prosopis juliflora</i> is not planned to be ecologically restored.
5	Stakeholder identification Stakeholder identification is one of the important steps as it helps to include the affected/ interested parties in the project, gain insight into expectations, benefit from collective knowledge, obtain their consent and buy-in, share or plan ownership transfer of the project post implementation, among other aspects.					
4.a	Potential stakeholders (e.g., landowners, farmers, gram panchayats, government agencies/departments/boards responsible for water related infrastructure, and management etc.) were identified	High	Yes	Partially Addressed	No information available	Potential stakeholders are not identified and documented in the needs assessment or project completion report. However, the NOC documents indicating land areas sanctioned for the activity received from gram panchayat were available for review.
4.b	Stakeholder's interests with respect to the ecology, forest, and invasive species management interventions were identified and evaluated	Moderate	No	Inconsistencies observed	No information available	Stakeholder's interests with respect to ecology, forests, and invasive species are not identified and evaluated
4.c	Stakeholder's power to influence or contribute to the potential interventions was identified and evaluated	Moderate	Other	Has not been considered	No information available	Stakeholder's power to influence or contribute to the potential interventions is not evaluated. Based on the available information the involvement of the government departments appears to be limited to regulatory compliances (i.e., for getting NoCs) only, and no further information on how they were engaged (if included) in overall decision-making process is not documented.

SI. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Observations on Documentation / Record / Reported Information
4.d	Awareness creation sessions/ workshops involving interested stakeholders are conducted to increase the community's knowledge on impact of <i>Prosopis juliflora</i> on groundwater and its management.	Moderate	Yes	Partially Addressed	Relevant information is available in Needs Assessment Report Pg. 21, and Project completion report Pg. 7, and 11	Needs assessment report mentions that the communities were not aware of the disadvantages of the <i>Prosopis juliflora</i> , and they used to consider the <i>Prosopis juliflora</i> to be useful for the crops. The report mentions 4 community awareness programs and 4 sensitization programs for GP members for the sustainability of interventions were conducted. However, based on available information these programs appear to be limited to water conservation and lake rejuvenation activities only.
5.b	Designated stakeholders and individuals have been engaged to overtake ownership and management of post implementation stage activities in short-, medium, and long-term	High	No	No baseline	Not available	Chain of command or designated roles for stewardship of the cleared areas, for periodic maintenance and long-term sustainability of implemented action were not established or documented
6	Cost-benefit analysis It allows an organization to evaluate potential projects free of biases. It shows a clear picture of how the community would fare under interventions for achieving particular goals. It is critical to analyse if any part of the local community is dependent on the invasive species, and how its removal might impact that community.					
6.a	Current uses of the target species in the study area have been identified, evaluated, and documented	Moderate	No	Inconsistencies observed	Relevant information is available in Needs Assessment Report Pg. 21	The needs assessment report mentions that the <i>Prosopis juliflora</i> has no use. However, responses from the communities on the use of Juliflora are not documented. It should be noted that the community perception survey indicated that the communities believed that the <i>Prosopis juliflora</i> is good for the crops, and they never tried to remove it.
6.b	Potential socio-economic impacts of the removal of target species have been identified, evaluated, and documented	Moderate	Other	Has not been considered	No information available	Potential socioeconomic impacts of the removal of <i>Prosopis juliflora</i> are not evaluated
6.c	Scientific basis for the benefits from removal of the target invasive species have been taken into consideration and documented	Moderate	No	Not addressed	Relevant information is available in Project Completion Report, Pg. 9 MoU document, Pg. 30	No information available for review

SI. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Observations on Documentation / Record / Reported Information
6.d	Benefits from the removal of the invasive species have been taken into consideration, have been compared against the socio-economic impacts, and results of evaluation have been documented	Moderate	Other	Inconsistencies observed	Relevant information is available in Project Completion Report, Pg. 9 MoU document, Pg. 30	Available information refers to larger objective of clearing 100acres of land to reduce groundwater uptake by invasive species. However, beneficial impacts of these have not been compared with value being realized by the community through its socio-economic services under present condition and weighed against considered detrimental attributes.
7	Prepare Implementation Plan Set short-, medium-, and long- term objective which will form the basis for execution of the envisioned activities					
8.d	Conceptual plan and design of the planned interventions have been developed, detailed execution plan and monitoring of success factors have been developed and documented	High	Yes	Partially Addressed	Relevant information available in MoU document, Pg.15-30	Planned interventions and activities, steps involved, relevant stakeholders, project timeline, estimated resource requirement have been documented. However, post-implementation stage actions and activities have not been incorporated and documented.
8.f	Expected outcome of the intended intervention are clearly defined and documented	High	Yes	Completely Addressed	Relevant information is available in MoU document, Pg. 22	Following outcomes are envisioned from the target intervention - 100 acres of land to be cleared of <i>Prosopis juliflora</i> - Cleared land parcel reclaimed for other use - Increase cultivable land area through this intervention - Increase income generation of local communities as an outcome of reclamation of land through this intervention
8.g	Key indicators to measure and quantify success of the intervention have been defined and documented	High	No	Not addressed	No information available	No information available for review

Table 15: Benchmarking and Gaps Assessment of Removal of *Prosopis juliflora*: post-Implementation

Sl. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Observations on Documentation / Record / Reported Information
1	Continuous monitoring Invasive species management requires long-term efforts. Hence, interventions are required to be followed by systematic monitoring.					
1.a	Continuous monitoring has been done after removal of the invasive trees using one of the following methodologies: - Periodic monitoring of implementation areas at predetermined photo-documentation points. - Invasive species journal/ record keeping - Perambulation and removal of newly growing plants etc.	High	No	Not addressed	No information available	Continuous monitoring after intervention was not conducted.
2	Impact assessment After implementation of planned interventions (removal of trees and restoration), impact assessment should be conducted scientifically using quantifiable indicators.					
2.a	Land use categorization of the target site selected for invasive species removal has been assessed with due consideration to government owned land, privately owned land, forest land, grazing land, natural grasslands, suitability of the land for cultivation, among other relevant aspects	High	No	Not addressed	No information available	The areas cleared-off of <i>Prosopis juliflora</i> are reported to be with the intent of making it available for agriculture and reduce groundwater abstraction by the invasive species. However, information pertaining to historical use of the land and current ownership are not available. Also, the field coordinator reported that one of the land parcels cleared-off of <i>Prosopis juliflora</i> in Aranvoyal has been converted into residential plots and another land parcel in Aranvoyal has been converted into non-agricultural land intended to be developed into a medical institution. As such, land ownership of target locations has not been documented and needs validation.
2.b	Change in species diversity and composition in the area after removal of invasive trees is documented	High	Other	Has not been considered	No information available	Change in species diversity and composition after implementation of the intervention activity is not assessed
2.c	Reduction or absence of invasive species over time has been assessed	High	No	Not addressed	No information available	Reduction in abundance of invasive species after intervention is not assessed. Further, re-emergence of <i>Prosopis juliflora</i> trees was observed at several locations during field visit

Sl. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Observations on Documentation / Record / Reported Information
2.d	Improvement in water availability is assessed and quantified	High	No	Not addressed	No information available	Improvement in groundwater levels after intervention in not assessed
2.e	Improvement in livelihood of the communities with respect to defined objectives of increase in cultivable area and increase in income generation of the communities directly or indirectly attributable to the target intervention has been assessed and documented	High	Other	Inconsistencies observed	Relevant information is available in Project completion presentation. Pg. 9 MoU document, Pg. 30 Invoice for <i>Prosopis juliflora</i> removal, dated 02/05/2020	Increase in the area available for agriculture (60 acre) is claimed to be benefit of removal of <i>Prosopis juliflora</i> . In contrast as reported in the needs assessment report, the communities are shifting from agriculture to other source of incomes due to issues related to irrigation, low productivity, and high input costs. Hence, unless other issues are resolved the land cleared-off of the <i>Prosopis juliflora</i> may not be beneficially brought under agriculture as claimed. Impact on cultivable area, income generation of agricultural community needs to be validated.

Table 16: Benchmarking and Gaps Assessment of Tree Plantation: Pre-Implementation

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
1	Set objective ad outcome of the plantation project Plantation and afforestation activities may be undertaken as standalone initiatives or planned to provide complementary beneficial services that may include carbon capture, ecological restoration, soil, and water conservation, improve hydrological functions, provide wildlife habitat, among others					
1.a	Objective(s) of the plantation exercise are clearly defined	Moderate	Yes	Partially Addressed	Needs assessment report. Pg 13.	The needs assessment report mentions that plantation activity is targeted to be undertaken on wastelands in all three villages. Further, objective of the plantation activity undertaken on the embankments developed along the periphery of the ponds was not clearly defined.
1.b	Intended outcome with details of desired future condition of the item envisioned is clearly defined	Moderate	No	Not addressed	No information available	No information available
2	Identification of area for plantation Poor planning prior to undertaking plantation programmes may lead to ineffective outcome including low survival rate					

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
2.a	Area selected for plantation activity is identified and mapped clearly	Moderate	Yes	Partially Addressed	Needs Assessment Report. Pg 13, 27, and 29. Memorandum of understanding, Pg. 19	Needs Assessment Report has identified waste lands in all 3 villages and periphery of selected lakes are target locations for plantation action. MoU indicates that only the areas around the lakes were selected for plantation activity. However, designated locations and mapping of the selected locations has not been documented.
2.b	Planned activities are not within designated forest and wetland areas	High	Yes	Partially Addressed	Needs Assessment Report. Pg 13, 27, and 29.	Although waste land composition in individual village has been documented, their locations have not been mapped or documented. As such, whether the selected land parcels are outside designated forest area and wetland area need to be validated.
2.c	Planned activities are not in areas which were deforested in last 10 years	Moderate	Other	Has not been considered	No information available	No information available
2.d	Land use of the target site selected for plantation has been assessed with due consideration to grazing land, natural grasslands, suitability of the land for plantation, among other relevant aspects	Moderate	Yes	Partially Addressed	Needs assessment report. Pg 13.	Although waste land composition in individual village has been documented, historical use of the land, relationship of the communities with the land, suitability of land for plantation, among other relevant aspects have not been documented
3	Site characterization It is desirable to collate information on the site conditions before selecting the species for plantation					
3.a	Physical characteristics of the Site such as slope, aspect, and position in the landscape (e.g., ridge/hilltop, mid slope, or valley) are identified and mapped	Moderate	Other	Has not been considered	Not available	Site's physical characteristics are not evaluated and mapped
3.b	Local meteorological characteristics such as rainfall, temperature, humidity have been taken into consideration	Moderate	Yes	Partially Addressed	Not available	Sites' meteorological characteristics are not evaluated and documented
3.c	Soil characteristics (physical, chemical, and biological properties) in the plantation area have been taken into consideration	Moderate	Other	Has not been considered	Not available	The soil in the plantation area was not characterized for physical, chemical, and biological properties.

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
3.d	Native/local species commonly found in the area in and around the plantation area have been identified and documented	High	No	Not addressed	Not available	Native species found in the area are not identified and documented
4	Project Plan Selection of tree species may be defined by the objective of the plantation or intended use of the trees, soil characteristics, and weather conditions.					
4.a	Selected species and the basis for their selection have been documented	High	Yes	Partially Addressed	Project completion report. Pg. 10 Invoice for tree plantation around lakes Dt. 19/12/2020	Local tress species were reported to be promoted for plantation activity. Following tree species were reported to have been planted as per invoice Karanja/ Pongamia Jamun Neem Royal poinciana (Gulmohar) Banyan- (Bargad) Orchid/Bauhaniania Kino Peepal/ ficus Castor/ Ricinus Rain/ samanea Portia Amla Luppai (Mahua) Among these species Royal poinciana (Gulmohar) is an exotic species.
4.b	Age, health, condition, and physical appearance of saplings at the time of procurement has been taken into consideration and documented	High	No	Not addressed	No information available	No information available for review
4.c	Total number of saplings procured, total number of saplings delivered at the target location, and condition of saplings at the delivery location have been documented	High	Yes	Partially Addressed	Project completion report. Pg. 10 Invoice for tree plantation around lakes Dt. 19/12/2020	Total number of saplings procured is available from the invoice. However, number of saplings delivered at project site location, condition of saplings at the delivery location, and validation of species delivered have not been documented
4.d	Spacing requirement and root growth provisions for selected species have been taken into consideration and documented	Moderate	Other	Has not been considered	No information available	No information available for review

Sl. No.	Particulars Of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
4.e	Periodic maintenance, inspection and monitoring mechanism/schedule have been developed and documented	High	No	Not addressed	No information available	No information available for review
4.f	Expected outcomes of the intended intervention have been clearly defined and documented	High	Yes	Completely Addressed	Relevant information available in Needs Assessment Report, Pg. 22	Planting of 2000 saplings and survival rate on annual basis have been considered as outcomes.
4.g	Key indicators to measure and quantify success of the intervention have been defined and documented	High	No	Not addressed	No information available	No information available for review
5	Stakeholder identification An essential step to enable inclusion of relevant stakeholders and interested parties in the project and facilitate the identification of potential risk and opportunities for collaboration.					
5.a	Potential stakeholders are identified and mapped for their interests and power to influence or contribute to the project	Moderate	No	Not documented or recorded	Not available	Stakeholders are not systematically identified and mapped against their interests and power to influence or contribute.
5.b	Designated stakeholders and individuals have been engaged to overtake ownership and management of saplings post implementation stage	Moderate	No	Not documented or recorded	Not available	Chain of command or designated roles for stewardship of the plantation for periodic maintenance and long-term sustainability have not been documented

Table 17: Benchmarking and Gaps Assessment of Tree Plantation- Post Implementation

Sl. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
1	Continuous care and monitoring The plantation initiative is a long-term exercise as plants require longer time to mature and become self-sufficient in terms of nutrient and water requirement.					
1.a	Periodic watering of the saplings/seedlings is done. Record of completed activity is maintained by relevant stakeholder(s)	High	Yes	Not documented or recorded	No information available	According to information shared by field coordinator of implementation partner, tankers are used to water the saplings. However, no records or documentation is available to validate the same. Procedure adopted for continuous monitoring is not documented.
1.b	Periodic inspection records for the plantation site are maintained to keep track of sapling health, carry out survival count, ensure fences are in place for protection of saplings, and conduct replantation as required	High	No	Not documented or recorded	No information available	Procedure adopted for continuous monitoring is not reported. However, during the site visit only 20-25% of the saplings planted were reported to have survived.
1.c.	Watering schedule has been developed for all seasons of the year including specific measures for dry season watering and has been documented. The same has been shared with relevant stakeholders	High	No	Not addressed	No information available	No information available to review
1.d	Monitoring mechanism for watering of the seedlings during 1st and 2nd year of plantation is developed and a designated steward is engaged to take ownership of the monitoring.	High	Other	Has not been considered	No information available	No information available to review
1.e	Periodic inspection to monitor unauthorized cutting or removal of plant	Moderate	No	Not documented or recorded	No information available	Procedure adopted for continuous monitoring is not reported.
2	Impact assessment After implementation of planned interventions (plantation), impact assessment should be conducted scientifically using quantifiable indicators.					
2.a	Change in abundance of plants of native species is recorded	High	Yes	Partially Addressed	Project completion report. Pg. 10	Total of 2000 plants were reported to have been planted
2.b	Change in area under green cover/ vegetation/ trees is recorded	High	No	Not addressed	No information available	Total area brought under plantation is not recorded

Sl. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
2.c	Survival count records and casualty replacement records are documented	High	No	Not addressed	No information available	No information available to review
3	Field Observation Intended to assess conformance of implemented action with the conceptual and designed plans, and alignment of the intervention with project objectives					
3.a	Location of the implemented actions match the documented / reported coordinate(s)	High	Yes	Partially Addressed	Memorandum of understanding, Pg. 19	MoU indicates that the only the areas around the target lakes/ponds were selected for plantation activity. Sporadically located saplings were observed along periphery of 5 of the 7 target lakes/ponds (except Pillaiyarkulam kovil pond in Kuthambakkam and pond in Murukancherry) largely limited to the bunds/embankments created from deposition of excavated soil from lake/pond beds.
3.b	Description of project type documented / reported matches the implemented action	High	Yes	Completely Addressed	Needs Assessment Report. Pg 13, 27, and 29. Memorandum of understanding, Pg. 19	MoU document states the project type as Plantation around lakes, which corresponds to implemented action
3.c	Species of saplings planted are the same as those documented in conceptual plan	High	Yes	Partially Addressed	Project completion report. Pg. 10 Invoice for tree plantation around lakes Dt. 19/12/2020	Based on community feedback, input shared by field facilitator of implementation partner, and visual observations, about 5 species of saplings were recognized (compared to 13 species as per documented information) namely Neem (Azadirachta indica), Jamun (Syzygium cumini), Peepal (Ficus religiosa), Palasa (Butea monosperma) and Karanj (Pongamia pinnata).
3.d	Health, condition, and physical appearance of saplings were satisfactory	High	No	No baseline	No information available	No information available to review

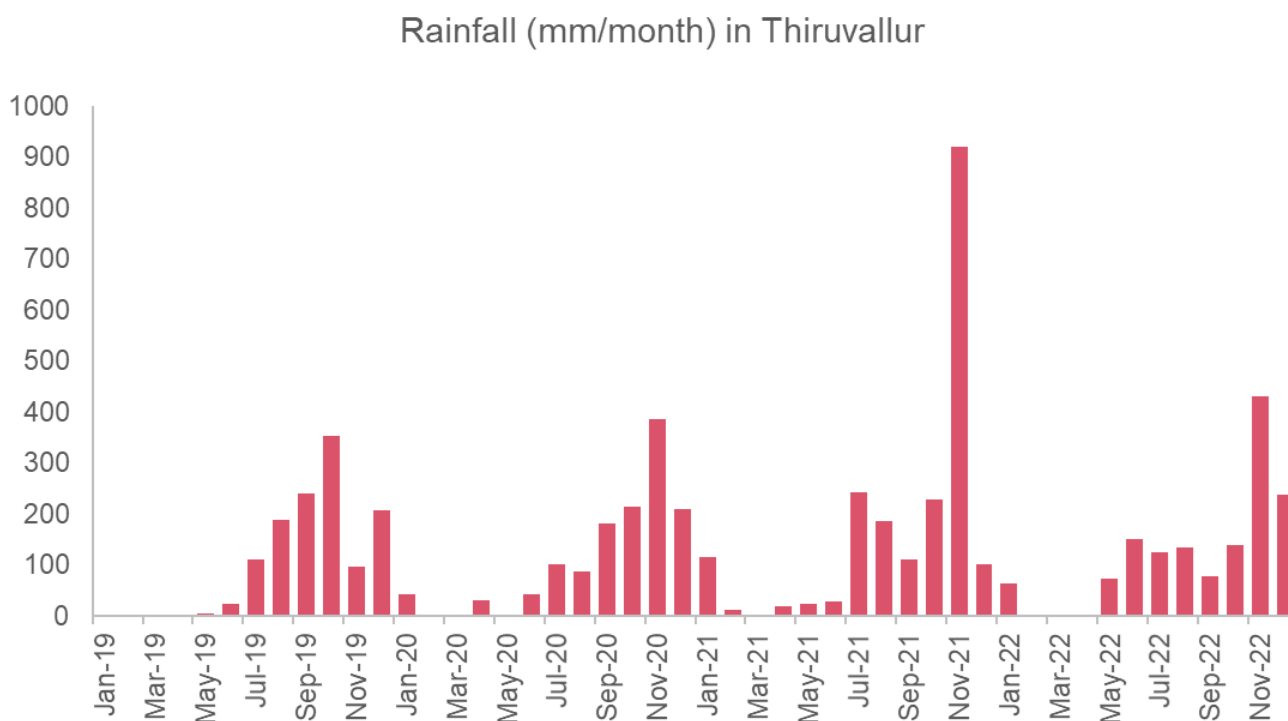
Sl. No.	Particulars of Consideration	Significance of the Particular Consideration	Whether Incorporated	Conformance Status	Document with Corresponding Information	Remarks based on Observations on Documentation / Record / Reported Information
3.e	Total number of saplings planted reflect the numbers documented in conceptual plan	High	No	Inconsistencies observed	MoU document, Pg. 20 Project completion report. Pg. 10 Invoice for tree plantation around lakes Dt. 19/12/2020	Most of the saplings planted were observed to have perished except for saplings planted on embankment of Sengaranthangal pong in Aranvoyal village. Based on input from field facilitator of implementation partner and feedback from communities, poor survival rate was largely due to livestock grazing followed by lack of periodic watering. Broad estimates (unaccounted) for current survival were deemed to be only 10 to 20%. Total number of surviving saplings in actuality could not be validated. An accounting exercise need to be undertaken to quantify survival rate.
3.f	Fencing for the protection of saplings have been provided at all locations	High	Other	Has not been considered	No information available	No information available to review

5.3. Annexure - 3: Estimation of Volumetric Water Benefit

5.3.1. Rainfall

Monthly rainfall data from January 2019 to December 2022 was collected from IndiaWRIS for Thiruvallur district and is presented in Figure 23.¹⁷

Figure 23: Monthly rainfall data for Thiruvallur district from January 2019 to December 2022 (Source: IndiaWRIS)



5.3.2. Evaporation

Evaporation rate over this district is 9.56 mm/day.¹⁸ The annual evaporation from a lake is the product of the evaporation rate, the lake surface area, and the number of days in a year.

5.3.3. Storage potential of the lakes/ponds

Dimensions of the lakes and ponds were provided as per Table 18 in the MoU (between Dilasa and UBL). Assuming that all the lakes get filled twice in a given year, the storage capacity created is said to be 957000 KL.

¹⁷ <https://indiawris.gov.in/wris/#/rainfall>

¹⁸ Balaguru, M., Sankaran, S., & Ilavarasan, N. (2019). Estimation of Evaporation Loss in Red hills Lake at Thiruvallur District, Tamil Nadu. International Research Journal of Multidisciplinary Technovation, 1(6), 569-581.

Table 18: Calculated holding capacities of the waterbodies using dimensions claimed in the MoU

Lake name	Village name	Length (m)	Width (m)	Baseline Depth (m)	Final depth (m)	Additional depth (m)	Final volume (KL)
Vannan Kulam	Aranvoyal	200	150	1.2	3.2	2.0	96,000
Elthani Kuttai	Aranvoyal	200	100	1.0	2.5	1.5	50,000
Sengaranthangal	Aranvoyal	200	100	1.6	3.6	2.0	72,000
Thangal Eri -1	Murukancherry	100	90	0.5	1.5	1.0	13,500
Parikarakulam	Kuthambakkam North*	150	100	1.5	3.0	1.5	45,000
Thangal Eri-2	Murukancherry	200	150	1.4	3.4	2.0	102,000
Pillaiyarkulamkovil	Kuthambakkam South	200	200	1.5	2.5	1.0	100,000

* As per the MoU, this lake was mentioned to be in Kuthambakkam North, however the location was verified to be in Murukancherry following further communications with the implementation partner. In further tables the village name for this lake will be listed as Murukancherry.

To validate the surface areas claimed, satellite imagery and QGIS were used, and the surface areas of the 7 lakes post rejuvenation were delineated. It was found that the dimensions stated in the MoU were overestimated when compared with the satellite images. The surface areas of the 6 lakes determined from satellite images are presented in Table 20.

Further, according to input shared by implementing partner's field facilitator, all the lakes were excavated by approximately 1m to remove silt from the pond beds. However, the reported depth excavated as per MoU differs from this information gathered.

Since lake holding capacities are a key component of VWBA, in order to cover all the range of potential volumetric benefits, 2 different scenarios were considered which are described below and summarized in Table 19:

- Scenario 1: Surface area of the lakes has been incorporated to reflect actual submergence area based on satellite imagery. Evaporation losses have been incorporated. Direct water withdrawal from the lakes is assumed to be negligible (if any). Loss of storage capacity due to siltation is assumed to be negligible, and lakes are assumed to fill twice in a given year. Excavated depths considered for computational purpose are unchanged from the MoU document and reflects excavation volumes per documented records. Baseline recharge has been considered to arrive at beneficial impacts. The VWBA approach was adopted to quantify benefits. The lake dimensions considered for Scenario 1 are presented in Table 20.
- Scenario 2: Surface area of the lakes has been incorporated to reflect actual submergence area based on satellite imagery. Evaporation losses have been incorporated. Direct water withdrawal from the lakes is assumed to be negligible (if any). Loss of storage capacity due to siltation is assumed to be negligible, and lakes are assumed to fill twice in a given year. Excavated depths considered for computational purpose is 1m based on information shared by the field facilitator during field visit. Baseline recharge has been considered to arrive at beneficial impacts. The VWBA approach was adopted to quantify benefits.

The final depth and volume are presented in Table 21.

Table 19: Summary of computational considerations adopted for various scenarios

Scenario	Basis for Surface Area	Basis for lakes included in calculation	Basis for Excavated Depth	Evaporation Losses	Water withdrawal from lake	Loss of Storage due to Siltation	Baseline Condition	VWBA
Scenario 1	Maximum length and width of subject water body	MoU	MoU	X	X	X	X	X
Scenario 2	Satellite imagery	MoU	MoU	✓	X	X	✓	✓
Scenario 3	Satellite imagery	Field visit	1m	✓	X	X	✓	✓

The baseline¹⁹ depths of the ponds are taken from the MoU as presented in Table 20 in the absence of any other available data but surface area is obtained using satellite imagery.

Table 20: Calculated holding capacities of the waterbodies using baseline and Scenario-1

Lake name	Village name	Surface area from GIS (acre)	Baseline depth (m)	Scenario 1 depth (m)	Baseline volume (KL)	Scenario 1 volume (KL)
Vannan Kulam	Aranvoyal	3.92	1.2	3.2	19,044	50,784
Elthani Kuttai	Aranvoyal	0.82	1.0	2.5	3,300	8,250
Sengaranthangal	Aranvoyal	1.96	1.6	3.6	12,659	28,482
Thangal Eri -1	Murukancherry	2.48	0.5	1.5	5,021	15,062
Parikarakulam	Murukancherry	1.56	1.5	3.0	9,453	18,906
Thangal Eri-2	Murukancherry	12.00	1.4	3.4	67,974	165,079
Pillaiyarkulamkovil	Kuthambakkam South	0.88	1.5	2.5	5,354	8,923

During community consultations, the PW team was informed that all the lakes were excavated by just 1m due to some local restrictions. Thus, another scenario calculation was carried out assuming final depth to be 1m more than baseline depth as presented in Table 21.

¹⁹ Baseline refers to the condition of the lakes/ponds before carrying out any of the project activities.

Table 21: Calculated holding capacities of the waterbodies for Scenario-2

Lake name	Village name	Surface area from GIS (acre)	Baseline depth (m)	Scenario-2 depth (m)	Scenario-2 volume (KL)
Vannan Kulam	Aranvoyal	3.92	1.2	2.2	34,914
Sengaranthangal	Aranvoyal	1.96	1.6	2.6	20,570
Thangal Eri -1	Murukancherry	0.02	0.5	1.5	15,062
Parikarakulam	Murukancherry	1.56	1.5	2.5	15,755
Thangal Eri-2	Murukancherry	12.00	1.4	2.4	116,526
Pillaiyarkulamkovil	Kuthambakkam South	0.88	1.5	2.5	8,923
Perumalkovil kulam*	Kuthambakkam	1.27	NA	1	5,120

* Documents provided by Dilasa did not contain coordinates and dimensions of this lake. This lake was part of the field review and has been considered for Scenario-2 calculations which reflects observations made on the field.

5.3.4. Catchment area of each lake/pond

To determine the runoff that can be captured by a particular waterbody, its catchment area needs to be known. A catchment is the area that contributes runoff to a particular outlet point when rain falls over that area. Catchment boundaries are determined by topography, including natural topography and man-made barriers which alter/obstruct natural flow of water. To determine the catchments of these waterbodies, topographical data with 30-m was downloaded²⁰ and processed in QGIS along with some manual alternations to account for field observations. Table 22 presents the catchment for each lake in acres and Figure 24 shows the catchment boundaries of each lake/pond (red lines around the pond).

The area of the catchments for each of the lakes (this includes the surface area of the lake) is as follows:

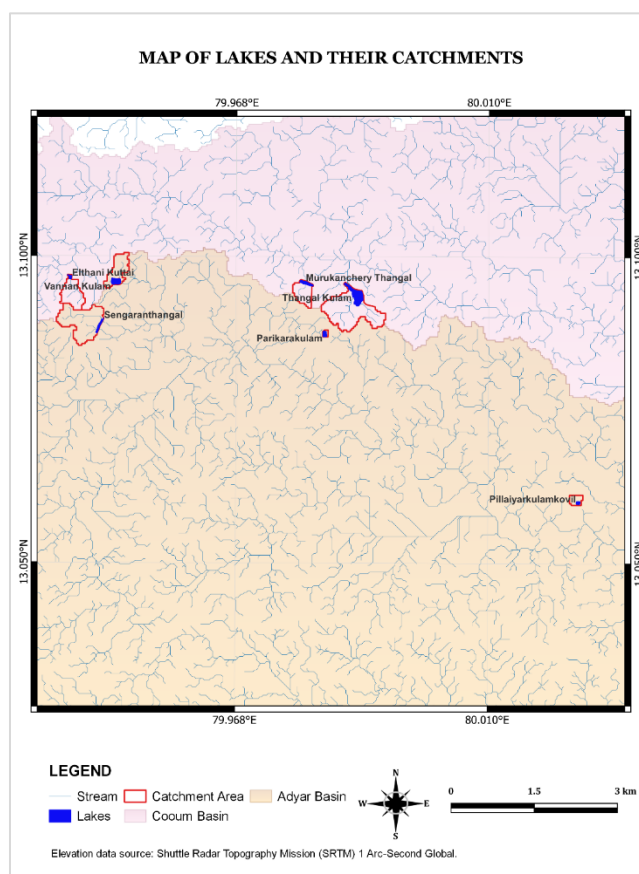
Table 22: Catchment areas (acre) of each of the lakes/ponds

Lake name	Catchment area (acre)
Vannan Kulam	40
Elthani Kuttai	42
Sengaranthangal	94
Thangal Eri -1	31

²⁰ Shuttle Radar Topography Mission 1 Arc-Second Global (Digital Object Identifier (DOI) number: /10.5066/F7PR7TFT

Lake name	Catchment area (acre)
Parikarakulam	2
Thangal Eri-2	128
Pillaiyarkulamkovil	10
Perumalkovil kulam	7

Figure 24: Catchments of the lakes/ponds



5.3.5. Land use and land cover (LULC) in each catchment

In order to calculate available supply of water to a lake (as described in equation d), we require a value called runoff coefficient, denoted as C . Runoff coefficient is a dimensionless number ranging from 0 – 1 which indicates the proportion of rainfall which generates runoff from a particular surface. For example, if runoff coefficient = 1 for a particular surface, it means that all the rain which falls on this surface will flow as runoff, and nothing will be infiltrated or held. Similarly, if runoff coefficient is 0.5, it means half the rainfall will generate runoff and the other half will be either infiltrated or held at that location.

Runoff coefficients are mainly determined by the land cover/land use of a particular area, and standard values are available for different types of land covers. Using LULC data from ESRI for the year 2021²¹, it was observed

²¹ LULC 2021: Impact Observatory, Microsoft, and Esri (https://ic.imagery1.arcgis.com/arcgis/rest/services/Sentinel2_10m_LandCover/ImageServer)

that the catchment areas of all the lakes consist of 5 main types of land cover – Built-up area, croplands, trees, rangeland, and waterbodies.

The following runoff coefficients have been considered for each of the land cover types seen in the project areas:

- Built-up area – 0.8
- Trees – 0.3
- Croplands – 0.4
- Rangeland – 0.35
- Waterbodies – 1

The values have been selected from literature assuming that the area has soil type of average infiltration rate and is a rural area²². The runoff coefficient for areas covered by waterbodies is considered as 1 because the rainfall over this area is immediately retained.

Based on the percentage area of each land cover type in a particular catchment, a weight value of c is calculated. The weighted runoff coefficient for each lake catchment is presented in Table 23.

Table 23: Weighted runoff coefficients for each lake catchment

Lake name	Weighted runoff coefficient, c
Vannan Kulam	0.42
Elthani Kuttai	0.39
Sengaranthangal	0.34
Thangal Eri -1	0.33
Parikarakulam	0.81
Thangal Eri-2	0.42
Pillaiyarkulamkovil	0.45
Perumalkovil kulam	0.34

²² <https://www.in.gov/dot/div/contracts/standards/dm-Archived/10Metric/Part4/Ch29/DCh29.pdf>

5.3.6. Calculation of available supply, volume captured and recharge volume

The available supply of runoff to each lake is calculated using formula d for FY19-20, FY20-21 and FY21-22 as presented in Table 24.

Table 24: Available supply of runoff for each of the lakes during FY19-20, FY20-21, and FY21-22

Year	Lake name	Weighted runoff coefficient, c	Catchment area, A (m ²)	Annual Rainfall, I (m)	Available supply (KL) $c \times A \times I$
FY2019-2020	Vannan Kulam	0.42	162,770	1.27362	87,068.99
FY2020-2021				1.38719	94,833.02
FY2021-2022				1.93395	132,211.40
FY2019-2020	Elthani Kuttai	0.39	170,800	1.27362	35,167.20
FY2020-2021				1.38719	38,303.09
FY2021-2022				1.93395	53,400.23
FY2019-2020	Sengaranthangal	0.34	379,411	1.27362	164,296.65
FY2020-2021				1.38719	178,947.15
FY2021-2022				1.93395	249,479.05
FY2019-2020	Thangal Eri -1	0.33	126,041	1.27362	52,974.41
FY2020-2021				1.38719	57,698.19
FY2021-2022				1.93395	80,439.89
FY2019-2020	Parikarakulam	0.81	9,202	1.27362	9,493.07
FY2020-2021				1.38719	10,339.57
FY2021-2022				1.93395	14,414.91
FY2019-2020	Thangal Eri-2	0.42	516,753	1.27362	276,421.54
FY2020-2021				1.38719	301,070.33

Year	Lake name	Weighted runoff coefficient, c	Catchment area, A (m ²)	Annual Rainfall, I (m)	Available supply (KL) c x A x I
FY2021-2022				1.93395	419,737.00
FY2019-2020	Pillaiyarkulamkovil	0.45	40,699	1.27362	23,325.78
FY2020-2021				1.38719	25,405.76
FY2021-2022				1.93395	35,419.42
FY2019-2020	Perumalkovil kulam*	0.34	28,320	1.27362	12430.53
FY2020-2021				1.38719	13538.97
FY2021-2022				1.93395	18875.35

*Perumalkovil kulam is only considered for Scenario 3 calculations. Elthani kuttai is only considered for Scenario 1 and Scenario 2 calculations

Available supply represents the maximum quantity of water than can get accumulated at the lake location not considering the storage potential of the lake as a limited factor. Thus, the volume actually captured by the lakes will be (equation b) the minimum value among the storage capacity and available supply. Assuming that each lake gets completely filled twice a year, volume captured in each scenario is presented in Table 25. Recharge volume for each obtained after subtracting evaporation losses and annual withdrawal from the volume captured. In this case since water withdrawal data is unavailable, it has not been considered. If evaporation losses exceed the volume captured, then recharge volume is considered to be zero. The annual recharge volume for each of the lakes is presented in Table 25.

Table 25: Calculation of volume captured and recharge volume for FY19-20, FY20-21, and FY21-22

Year	Lake name	Available supply (m ³ or KL)	Storage Potential (m ³)			Annual evaporation loss (m ³)	Volume captured (m ³) Min (Available supply, Storage Potential)			Recharge volume (m ³) Volume captured - evaporation			MoU Volume (m ³)
			Baseline	Scenario-2	Scenario-3		Baseline	Scenario-2	Scenario-3	Baseline	Scenario-2	Scenario-3	
FY2019-2020	Vannan Kulam	87,068.99	38,088	101,568	69,828	21,990	38,088	87,069	69,828	16,098	65,079	47,838	192,000
FY2020-2021		94,833.02	38,088	101,568	69,828	21,990	38,088	94,833	69,828	16,098	72,843	47,838	192,000
FY2021-2022		132,211.40	38,088	101,568	69,828	21,990	38,088	101,568	69,828	16,098	79,578	47,838	192,000
FY2019-2020	Elthani Kuttai	35,167.20	3,300	8,250	6,600	11,515	3,300	8,250	6,600	-	-	-	100,000
FY2020-2021		38,303.09	3,300	8,250	6,600	11,515	3,300	8,250	6,600	-	-	-	100,000
FY2021-2022		53,400.23	3,300	8,250	6,600	11,515	3,300	8,250	6,600	-	-	-	100,000
FY2019-2020	Sengaranthangal	164,296.65	25,318	56,964	41,140	27,605	25,318	56,964	41,140	-	29,359	13,535	144,000
FY2020-2021		178,947.15	25,318	56,964	41,140	27,605	25,318	56,964	41,140	-	29,359	13,535	144,000
FY2021-2022		249,479.05	25,318	56,964	41,140	27,605	25,318	56,964	41,140	-	29,359	13,535	144,000
FY2019-2020	Thangal Eri -1	52,974.41	10,042	30,124	30,124	35,038	10,042	30,124	30,124	-	-	-	27,000
FY2020-2021		57,698.19	10,042	30,124	30,124	35,038	10,042	30,124	30,124	-	-	-	27,000
FY2021-2022		80,439.89	10,042	30,124	30,124	35,038	10,042	30,124	30,124	-	-	-	27,000

Year	Lake name	Available supply (m ³ or KL)	Storage Potential (m ³)			Annual evaporation loss (m ³)	Volume captured (m ³) Min (Available supply, Storage Potential)			Recharge volume (m ³) Volume captured - evaporation			MoU Volume (m ³)
			Baseline	Scenario-2	Scenario-3		Baseline	Scenario-2	Scenario-3	Baseline	Scenario-2	Scenario-3	
FY2019-2020	Parikarakulam	9,493.07	18,906	37,812	31,510	21,990	9,493	9,493	9,493	-	-	-	90,000
FY2020-2021		10,339.57	18,906	37,812	31,510	21,990	10,340	10,340	10,340	-	-	-	90,000
FY2021-2022		14,414.91	18,906	37,812	31,510	21,990	14,415	14,415	14,415	-	-	-	90,000
FY2019-2020	Thangal Eri-2	276,421.54	135,948	330,158	233,052	169,420	135,948	276,422	233,052	-	107,002	63,632	204,000
FY2020-2021		301,070.33	135,948	330,158	233,052	169,420	135,948	301,070	233,052	-	131,651	63,632	204,000
FY2021-2022		419,737.00	135,948	330,158	233,052	169,420	135,948	330,158	233,052	-	160,738	63,632	204,000
FY2019-2020	Pillaiyarkulamkovil	23,325.78	10,708	17,846	17,846	12,454	10,708	17,846	17,846	-	5,392	5,392	200,000
FY2020-2021		25,405.76	10,708	17,846	17,846	12,454	10,708	17,846	17,846	-	5,392	5,392	200,000
FY2021-2022		35,419.42	10,708	17,846	17,846	12,454	10,708	17,846	17,846	-	5,392	5,392	200,000
FY2019-2020	Perumalkovil kulam	12,430.53			10240	17866			10240	-		-	NA
FY2020-2021		13,538.97			10240	17866			10240	-		-	NA
FY2021-2022		18,875.35			10240	17866			10240	-		-	NA

The total recharge volume for each scenario in FY19-20, FY20-21 and FY21-22 was calculated (cumulative of all 7 lakes from Table 25) and is compared with the site water withdrawal in Table 26.

It was found that Scenario 1 and the lake volumes claimed in MoU indicate potential recharge volumes to be more than the current site water withdrawal. The potential water withdrawal in scenario-2 is estimated to be less than the current water withdrawal. The assumptions made in the calculations are important to consider here:

- a) No water withdrawal from the ponds by community
- b) The ponds get filled to capacity twice a year as mentioned in the MoU

Table 26: Total recharge volume compared with site withdrawal

Year	Baseline (m ³)	Scenario 2 (m ³)	Scenario 3(m ³)	Scenario 1 dimensions (m ³)	
FY19-20	16,098	211,817	130,398	250,578	
FY20-21	16,098	244,230	130,398	263,558	
FY21-22	16,098	280,052	130,398	326,047	

The difference between total recharge volume of each scenario and the baseline represents the potential volumetric water benefit of the lake rejuvenation activity for a particular year. This table is presented in Section 3.2.7.

5.4. Annexure - 4: Changes in condition of lakes from 2019 to present








5.4.1. Elthanni Kuttai, Aranvoyal

 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Maxar Technologies</p>
<p>Elthani Kuttai : March 2019</p>	<p>Elthani Kuttai : March 2020</p>	<p>Elthani Kuttai: May 2020</p>
 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Maxar Technologies</p>
<p>Elthani Kuttai: Feb 2021</p>	<p>Elthani Kuttai: August 2021</p>	<p>Elthani Kuttai: March 2022</p>
 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Airbus</p>
<p>Elthani Kuttai: October 2022</p>	<p>Elthani Kuttai: Jan 2023</p>	<p>Elthani Kuttai: Jan 2023 zoomed out</p>









5.4.2. Sengaranthangal, Aranvoyal

 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>
<p>Sengaranthangal: March 2019</p>	<p>Sengaranthangal: March 2020</p>	<p>Sengaranthangal: April 2020</p>
 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>
<p>Sengaranthangal : Feb 2021</p>	<p>Sengaranthangal : August 2021</p>	<p>Sengaranthangal : March 2022</p>
 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Airbus</p>
<p>Sengaranthangal : October 2022</p>	<p>Sengaranthangal : Jan 2023</p>	<p>Sengaranthangal : Jan 2023 zoomed out</p>










5.4.3. Vannan Kulam, Aranvoyal

 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>
<p>Vannan Kulam : March 2019</p>	<p>Vannan Kulam : March 2020</p>	<p>Vannan Kulam : May 2020</p>
 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>
<p>Vannan Kulam : Feb 2021</p>	<p>Vannan Kulam : August 2021</p>	<p>Vannan Kulam : March 2022</p>
 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>
<p>Vannan Kulam : October 2022</p>	<p>Vannan Kulam: Jan 2023</p>	<p>Vannan Kulam: Jan 2023 zoomed out</p>

5.4.4. Thangal Eri -1, Murukancherry

 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>
<p>Thangal Eri 1 : March 2019</p>	<p>Thangal Eri 1: Feb 2020</p>	<p>Thangal Eri 1: March 2020</p>
 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>
<p>Thangal Eri 1 : May 2020</p>	<p>Thangal Eri 1 : Feb 2021</p>	<p>Thangal Eri 1 : August 2021</p>
 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Airbus</p>
<p>Thangal Eri 1 : March 2022</p>	<p>Thangal Eri 1 : Jan 2023</p>	<p>Thangal Eri 1 : Jan 2023 zoomed out</p>









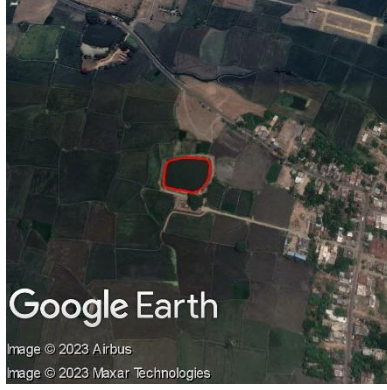
5.4.5. Thangal Eri -2, Murukancherry

 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>
<p>Thangal Eri 2 : March 2019</p>	<p>Thangal Eri 2: March 2020</p>	<p>Thangal Eri 2 : May 2020</p>
 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>
<p>Thangal Eri 2 : Feb 2021</p>	<p>Thangal Eri 2 : July 2021</p>	<p>Thangal Eri 2 : August 2021</p>
 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>	 <p>Google Earth image © 2023 Airbus</p>
<p>Thangal Eri 2 : March 2022</p>	<p>Thangal Eri 2 : Jan 2023</p>	<p>Thangal Eri 2 : Jan 2023 zoomed out</p>

5.4.6. Parikarakulam, Murukancherry

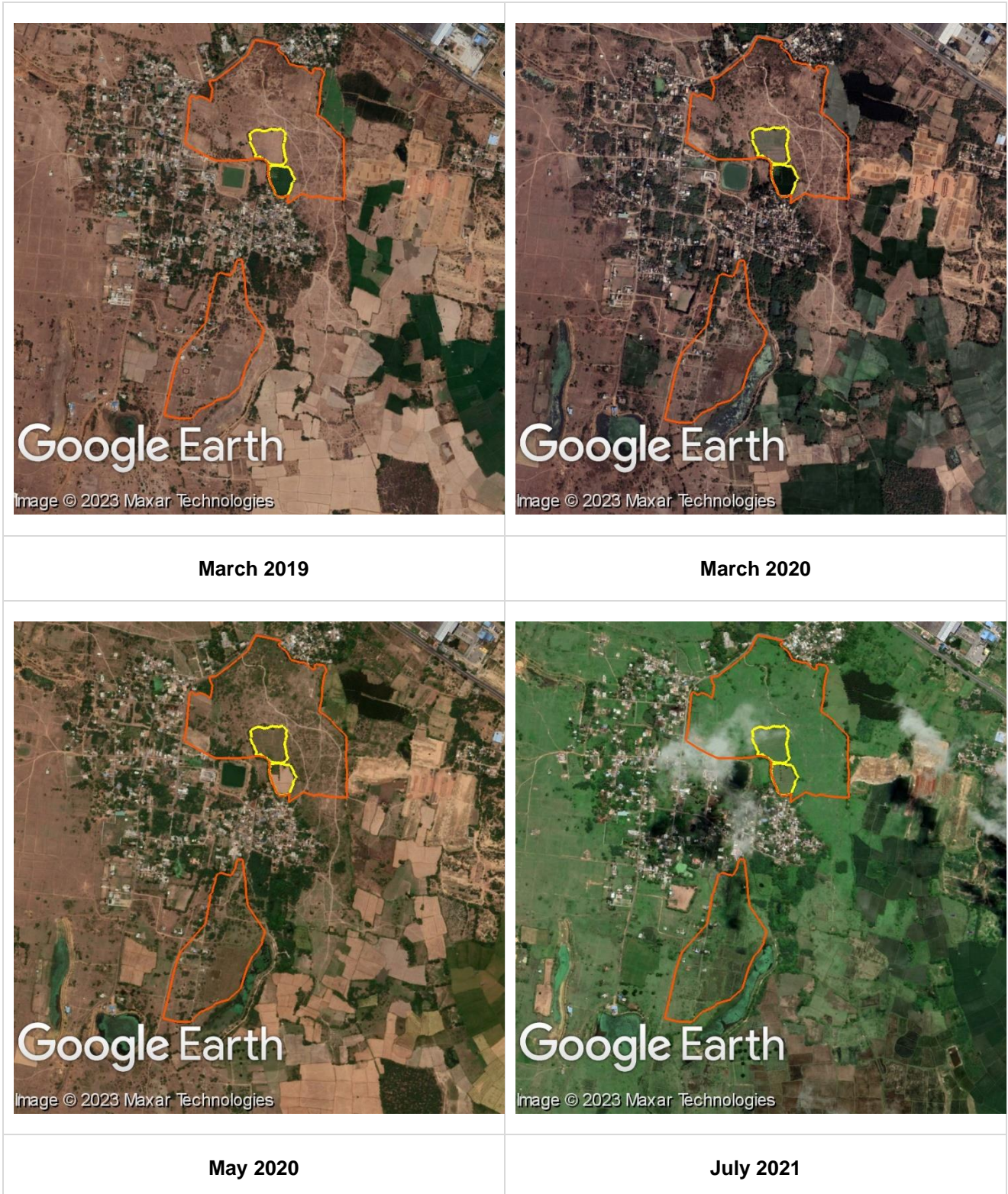
 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>
<p>Parikarakulam : March 2019</p>	<p>Parikarakulam: March 2020</p>	<p>Parikarakulam: May 2020</p>
 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>
<p>Parikarakulam: Feb 2021</p>	<p>Parikarakulam: July 2021</p>	<p>Parikarakulam : August 2021</p>
 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Maxar Technologies</p>	 <p>Google Earth image © 2023 Airbus</p>
<p>Parikarakulam : March 2022</p>	<p>Parikarakulam : Jan 2023</p>	<p>Parikarakulam: Jan 2023 zoomed out</p>

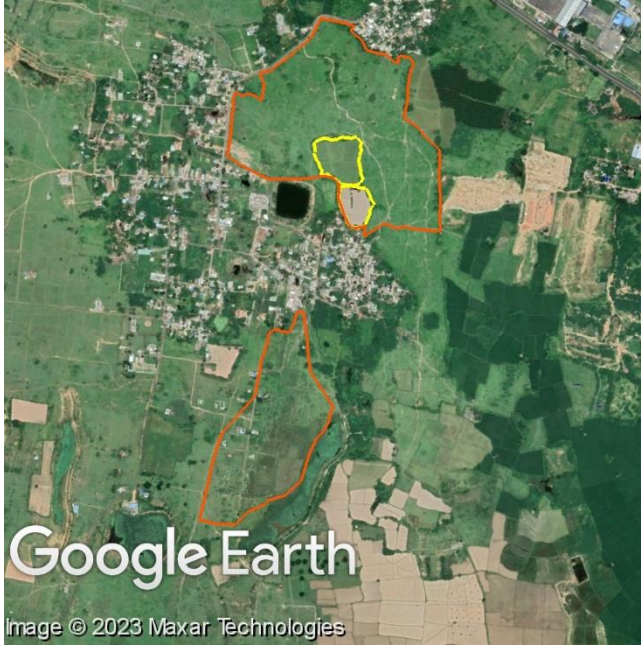
5.4.7. Pillaiyarkovilkulam, Kuthumbakkam

 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Maxar Technologies</p>
<p>Pillaiyarkulamkovil :March 2019</p>	<p>Pillaiyarkulamkovil : March 2020</p>	<p>Pillaiyarkulamkovil : May 2020</p>
 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Maxar Technologies</p>
<p>Pillaiyarkulamkovil: Feb 2021</p>	<p>Pillaiyarkulamkovil: July 2021</p>	<p>Pillaiyarkulamkovil: August 2021</p>
 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Maxar Technologies</p>	 <p>Google Earth Image © 2023 Airbus Image © 2023 Maxar Technologies</p>
<p>Pillaiyarkulamkovil: February 2022</p>	<p>Pillaiyarkulamkovil: June 2022</p>	<p>Pillaiyarkulamkovil: June 2022 zoomed out</p>

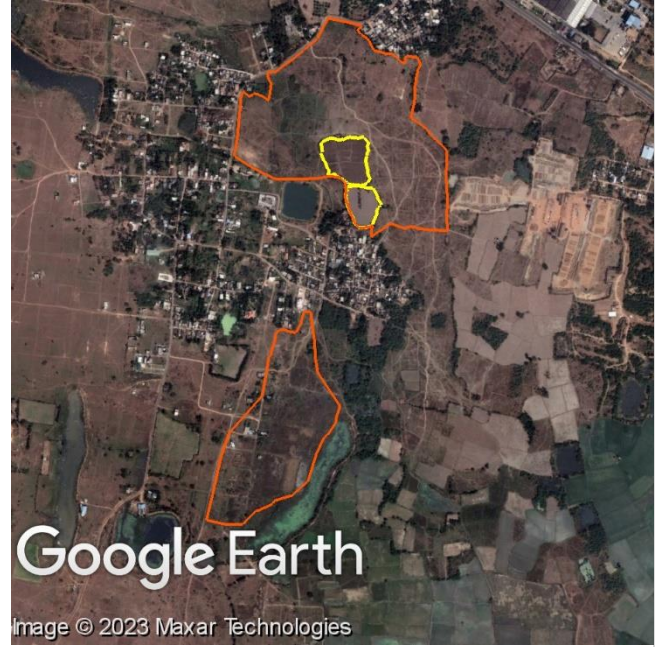
5.5. Annexure - 5: Changes in the areas where *Prosopis juliflora* was removed

The red boundaries denote private lands, and the yellow boundaries denote private agricultural land that was reclaimed by the activities. The exact plots from where *Prosopis juliflora* was removed were not marked in the report.





August 2021



March 2022

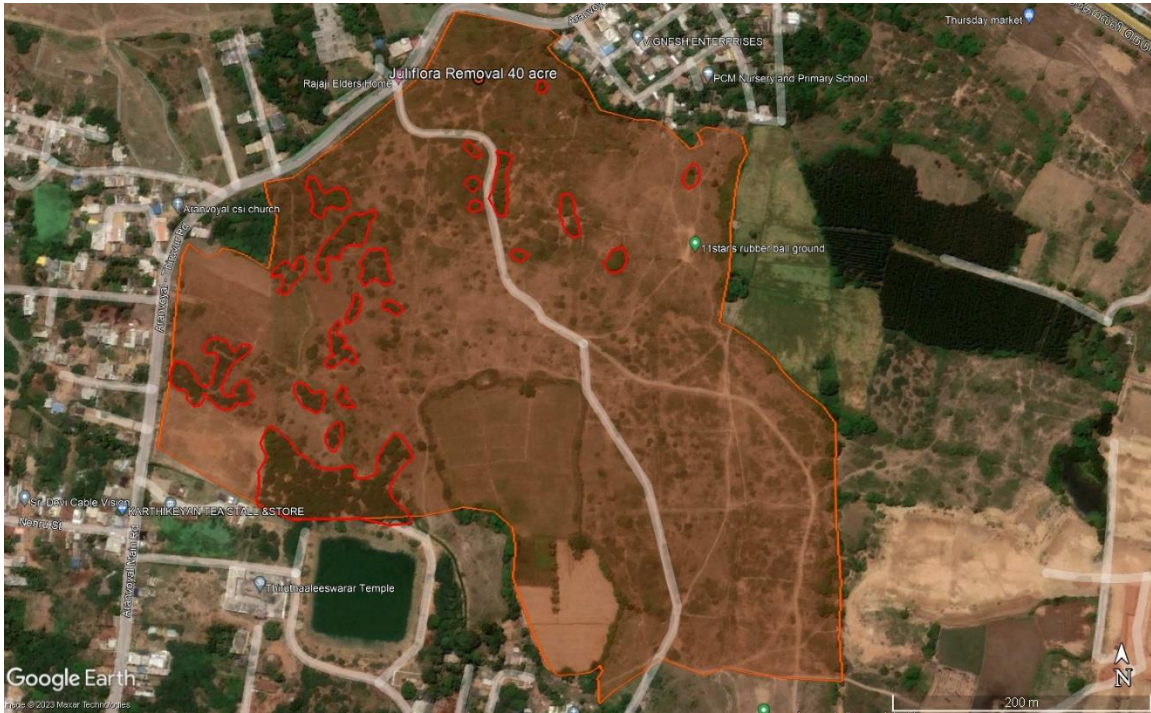


October 2022

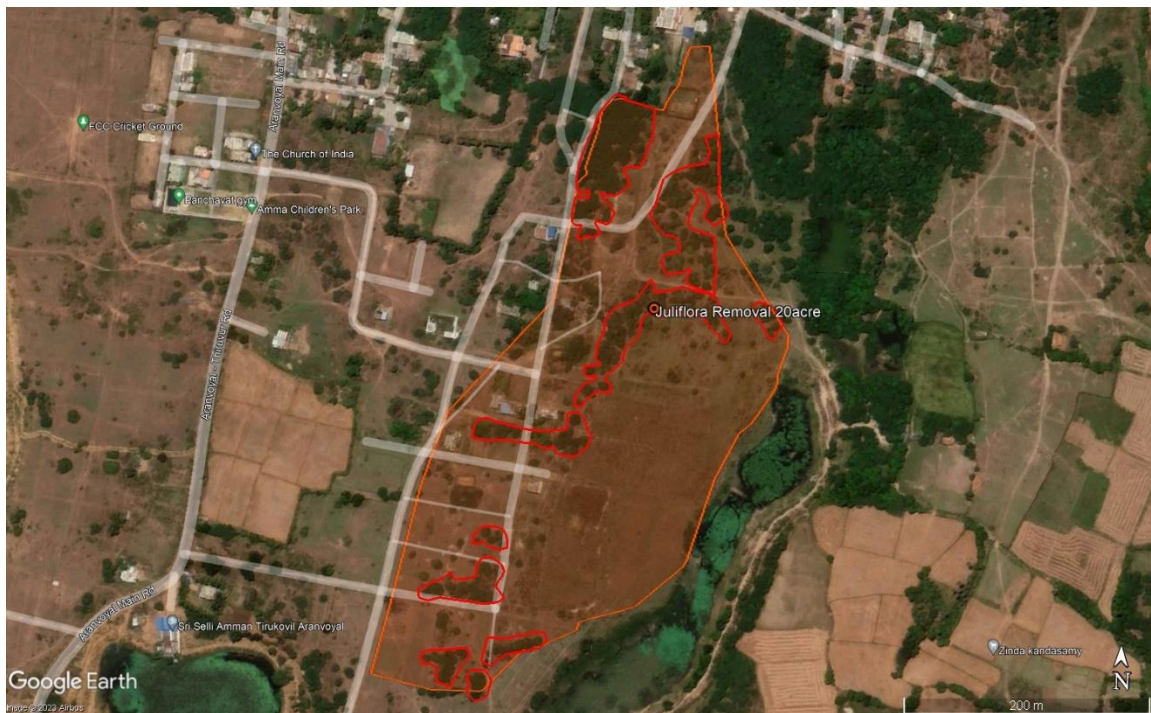


January 2021

5.5.1. Major cluster of Juliflora within Land Parcel 1 and 2 before intervention



Land Parcel 1



Land Parcel 2



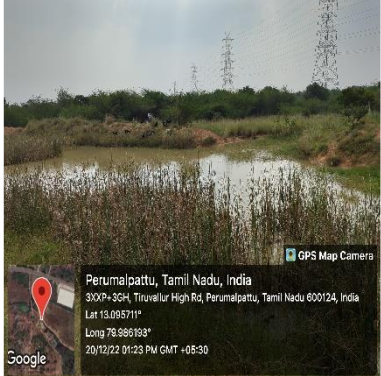
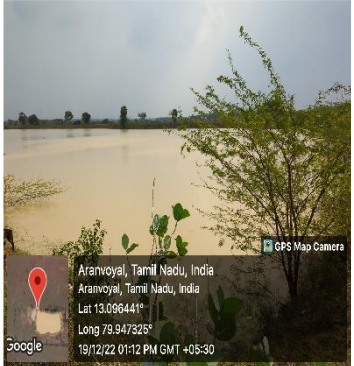

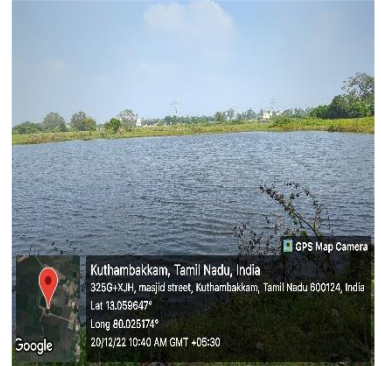



Source: Google Earth



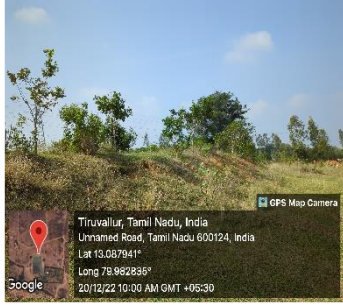



5.6. Annexure -6: Areas of major clusters of P. Juliflora

Table 27: Actual area under vegetation on 40 acre and 20 acre land parcels as of May 2020

Cluster	Actual Area under Vegetation on Land Parcel 1 (in Acre)	Actual Area under Vegetation on Land Parcel 2 (in Acre)
1	1.34	1.00
2	0.40	0.97
3	0.10	0.10
4	0.10	0.82
5	0.10	0.40
6	0.10	0.36
7	0.04	0.18
8	0.23	0.10
9	0.13	0.18
10	0.14	0.10
11	0.03	
12	0.02	
13	0.02	
14	0.02	
15	0.13	
16	0.02	
17	0.10	
18	0.02	
19	0.10	
20	0.05	
21	0.03	
Total	3.21	4.21

5.7. Annexure - 7: Snapshots from the Field

		
<p>Tree plantation site</p>	<p>UBL branding on rejuvenated lake</p>	<p>Vegetation and sedimentation in lake</p>
		
<p>Aranvoyal lake</p>	<p>Borewell</p>	<p>Kuthambakkam north lake</p>
		
<p>Removal of <i>Prosopis juliflora</i> from site 2</p>	<p>Kuthambakkam south lake</p>	<p>Plantation around lake site 1</p>

		
<p>Livestock drinking water from rejuvenated lake</p>	<p>KII with panchayat president in Aranvoyal</p>	<p>Plantation around lake site 2</p>
		
<p>Murukancherry lake</p>	<p>Removal of <i>Prosopis juliflora</i> from site 1</p>	<p><i>Prosopis juliflora</i> in lake</p>

Data Classification: DC2 (Confidential)

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