FINDINGS REPORT

IMPACT ASSESSMENT

of Focused Development Program (FDP) P0392 of HDFC Bank CSR

NGO Partner: Deshpande Foundation
Project Location: 8 districts of Northern Karnataka

Submitted by:

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EXECUTIVE SUMMARY

About the FDP: HDFC bank carries out its CSR activities under the umbrella of '*Parivartan*', through which it tries to reach out to communities and enable them to shift from poverty to growth. The Focused Development Program (FDP) of HDFC Bank CSR is one among its many important programs, where the Bank chooses an implementing partner with expertise in one of the focus areas and tries to improve the lives of the target beneficiaries around that particular focus area.

The proposed research was hence commissioned to conduct an Impact Assessment of the FDP project P0392, which supported the NGO partner Deshpande Foundation in the creation of 1,000 farm ponds in 8 drought-prone districts of North Karnataka. HDFC Bank supported Deshpande Foundation in accelerating its farm pond project through establishment of the Rural Transformation Technology Centre (RTTC), between January 2021 to March 2022. The RTTC has been instrumental in elevating the farm pond construction process with a customised software leveraging Artificial Intelligence (AI) and Machine Learning (ML) technology, optimising site selection, execution, monitoring, and evaluation through high-tech solutions. The RTTC operates like a hub, equipped with display and communication tools, and computing power to process and visualize data from diverse sources including weather, government records, IoT, and drones.

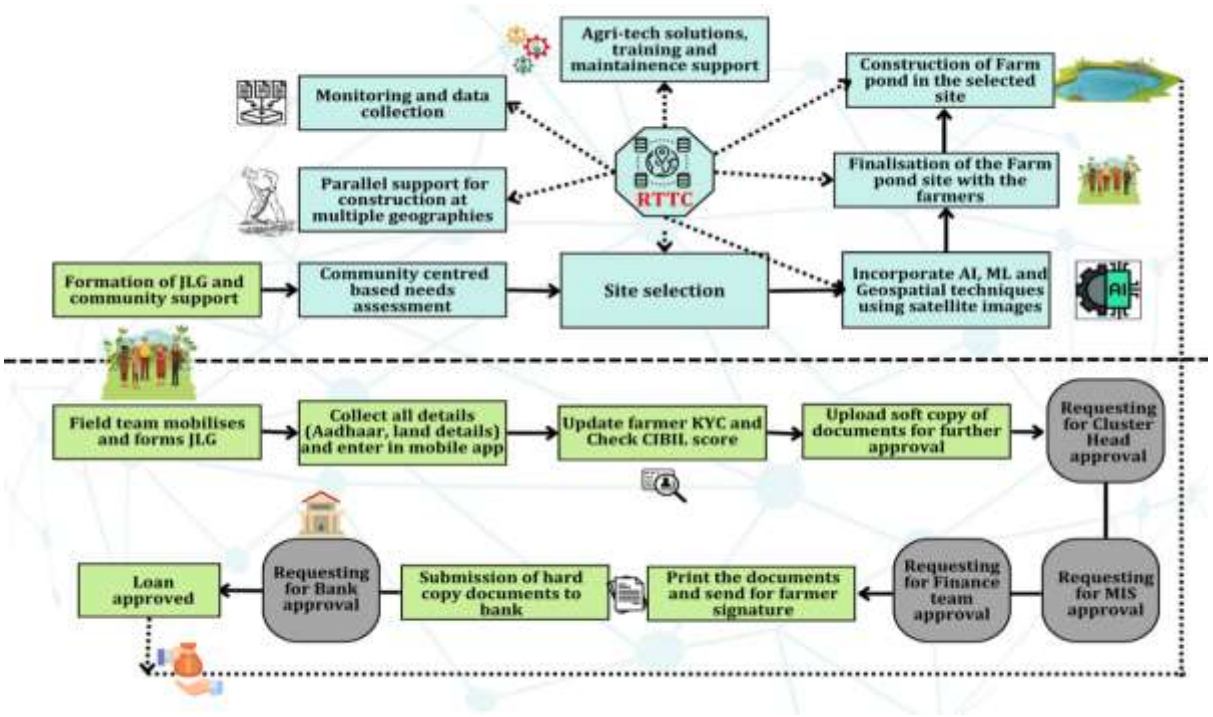
About the Impact Assessment: The key overall objective of this Impact Assessment was to understand how the establishment of the RTTC helped Deshpande Foundation in scaling up and efficiently accelerating its intervention of 1000 farm pond construction in Northern Karnataka. The Assessment also sought to evaluate the efficacy, effectiveness of the project interventions and sustainability of the project's outcomes. A *quasi-experimental Post-Test Only Control Group Design* was followed for this study. Data collection methods primarily involved Key Informant Interviews (KIIs) (10 numbers) with Implementing Partner personnel/ manager; RTTC Technical Staff and Farm Pond personnel, to understand the process flow of the intervention led by the technology-driven RTTC. Structured quantitative interviews with farm pond owners in treatment and control group were conducted to gather data directly from farm pond owners. A total quantitative sample size of **525** comprising of 350 in treatment group and 175 in control group (50% of treatment) were targeted. Focus group discussion (FGDs) were also conducted with beneficiaries in the treatment villages to gain qualitative insights. Sample size was achieved across all data collection methods. Fieldwork for the study was done between 6th – 22nd October, 2023. The study used the OECD DAC criteria as an analytical framework for assessing the overall impact of the FDP.

Key Study Findings:

- **The Rural Transformation Technology Centre (RTTC)**

The RTTC in Karnataka exemplifies how technological innovation, when aligned with community-based approaches and sustainable financial models, can significantly enhance rural development. Its success in the construction of farm ponds and the integration of advanced technologies like AI and ML heralds a new era in agricultural and rural transformation, setting a replicable model for other regions to follow. The adoption of technology in the construction of farm ponds has transformed the operational model from one that is paper-based and reactive to a dynamic, data-driven approach. This technological leap has not only enhanced the effectiveness of farm pond construction but also empowered farmers with better decision-making tools and resources. The benefits span from enhanced data security and integrity to increased operational efficiency and the ability to scale up operations significantly.

Process flow of implementation of Rural Technology Transformation Centres (RTTC)



RTTC's field implementation strategy is a dual approach, involving both field and technical teams. The field facilitators act as the primary interface with the community, mobilizing farmers and aiding in the formation of Joint Liability Groups (JLGs). The technical team, on the other hand, provides crucial support in data visualization, processing, and decision-making. They utilize the mobile Farm Pond application for site assessment, leveraging land elevation data and AI methodologies to determine the feasibility of farm pond construction.

Additionally, the Farm Pond program employs a financial model for farm pond construction that is rooted in community engagement and cooperative effort. Central to this approach is the establishment of JLGs. These groups are supported by RTTC's field team, which guides them through the process of securing financial support, including the preparation and submission of bank loan applications. A distinctive feature of this model is the partnership with the Deshpande Foundation, which contributes 70% of the required funding for each pond while the farmers collectively cover the remaining 30%. This cost-sharing setup is facilitated by Deshpande Foundation's assistance in acquiring bank loans, which the farmers then repay in manageable instalments.

Before and after implementation of RTTC: A snapshot

Key features	Before RTTC	After RTTC
Technological Innovation	Lacks advanced technological tools; relies on traditional methods.	Uses AI, ML, and geospatial analysis for precision and forecasting.
Resource Utilization	Resource management may not be optimized due to lack of precise data.	More efficient resource management through informed decision-making.
Community Empowerment	Less empowerment due to reliance on conventional practices.	Empowers farmers with decision-making tools and resources.
Optimal site selection	Potential for suboptimal water conservation due to less precise citing.	Technology aids in optimal farm pond placement for water conservation.

Strategic Decision Making	Limited data analysis capability, leading to less informed decision-making.	Data aggregation supports strategic planning and pattern analysis.
Data Management and Integrity	Data often kept in physical records; higher risk of errors and loss.	Centralized data repository; secure and less prone to errors.
Real-Time Monitoring and Accountability	Monitoring dependent on manual updates; slower response to issues.	Allows for instant monitoring and quicker intervention.
Productivity and Scale	Slower pace, typically 100 ponds per month due to manual processes.	Potential to construct 100 ponds daily due to technological efficiency.
Security and Continuity	Data security and continuity at risk with staff turnover.	Improved data security and continuity regardless of personnel changes.

- **Farm Pond and Beneficiaries**

The key findings of the study, highlighting the impact of the RTTC in farm pond construction are as follows:

- A *significantly* higher proportion of treatment group (98%) farm pond owners affirmed that the agency[1] (here, RTTC) helped in suggesting an ideal spot for farm pond construction in their land, as compared to 76% in control group.
- Almost all beneficiaries in the treatment group reported full participation in the site selection process with the agency at 96%, which is *significantly* higher than the control group's 70%. This indicates a more participative approach in the RTTC method.
- Guidance for technical aspects of the farm pond, like dimensions and inlet and outlet placement, was provided to 81% of the treatment group, which is notably higher than the 65% in the control group, reflecting a more comprehensive support model in the RTTC method.
- Satisfaction ('very satisfied') with quality of RTTC-constructed ponds was acknowledged by 54% in treatment group, *significantly* higher than the 36% in the control group.
- Satisfaction ('very satisfied') among beneficiaries in treatment group (43%) was *significantly* higher with respect to water availability in farm ponds, as compared to control group (27%).
- Post pond construction, reliance on only pond water for irrigation is high in both groups, at 76 percent for each, reinforcing the importance of farm ponds in local irrigation practices.
- A clear shift from traditional irrigation methods towards adoption of micro-irrigation systems seen in both the treatment and control groups post farm pond construction.
- That construction of farm ponds helped considerably in water harvesting and improving the ground-water level in their village or region, was affirmed by 47% treatment and 43% control group.
-
- Marked increase in total irrigated land in the 6-10 acre bracket from 30% before to 38% after pond construction, and in the 11-20 acre bracket from 11% to 21%, indicating a potential expansion in irrigation coverage due to the RTTC method.
- Duration of land under cultivation increased significantly post-farm pond construction for periods exceeding 8 months, rising from a mere 1% to 30% in the treatment group. For the control group, increase was to a lesser extent, from 1% to 18%. This suggests that the farm ponds have extended the agricultural window, allowing for longer cultivation periods.

[1] Deshpande Foundation, through RTTC has anchored the construction of farm pond for the treatment group, whereas control group has farm pond anchored by non-RTTC i.e. Government/ Other NGOs / Privately financed. The word 'agency' has been used in the questionnaire, referring to RTTC for treatment group and non-RTTC for control group.

- Post-construction, the diversity of crops cultivated in the treatment group increased dramatically, with 86% of farmers growing 2-3 different crops, a substantial increase from 36% before farm pond construction. The control group also saw a similar trend, indicating that farm ponds might be encouraging farmers to diversify their crops.
- Both groups benefited from increased volume of production post-farm pond construction, though to a comparative greater extent in treatment group.
- A host of agro-advisory services through training were received by the treatment group. This included enhancement of soil health and fertility, better cropping patterns, the adoption of innovative agricultural practices that bolster resilience to climate changes, improved irrigation techniques, and water management, as well as post-harvest management. The RTTC method therefore not only focuses on the technological aspects of farm pond construction but also emphasizes capacity-building among farmers. This approach likely contributes to more sustainable and effective agricultural practices, as evidenced by the broader uptake of training and advice in the treatment group.
- A significant majority of the treatment group (88%) were members of a JLG, compared to only 30% in the control group. Farmers in the treatment group had a *significantly* higher rate of loan acquisition for farm pond construction at 89%, close to double the rate of the control group at 50%, Being a JLG member also assisted *significantly* in faster loan approval (96% treatment group vs 85% control group). The treatment group's repayment progress is evenly spread, suggesting a steady commitment to fulfilling financial obligations.

Overall, the RTTC model has brought about a transformative change in the way agricultural development is approached at the community level. It has led to a more informed and efficient process of farm pond construction, which is vital for irrigation and water conservation in rural areas. In addition to the innovations in farm ponds and agriculture, the RTTC has also been valuable in scaling up diverse domains, such as – education, skilling, and entrepreneurship. The use of technology has not only provided immediate advantages but also laid the foundation for continuous improvement and adaptation, which is key to maintaining the gains made by the RTTC.

INTRODUCTION

Chapter 1

HDFC Bank's corporate social responsibility initiative, 'Parivartan,' seeks to address poverty and promote growth across communities. By focusing on key areas like rural development, education, skill training, healthcare, and financial literacy, Parivartan strives for sustainable community empowerment and national socio-economic progress.

Within this broader framework, the Bank's Focused Development Program (FDP) is pivotal. HDFC Bank CSR collaborates with specialised partners to target specific developmental areas, rigorously monitoring and evaluating to gauge success and effectiveness of projects under their programs.

The proposed research was hence commissioned to conduct an Impact Assessment of the FDP project P0392, which supported the NGO partner Deshpande Foundation in the creation of 1,000 farm ponds in Karnataka. This widespread intervention reached 8 districts, 171 villages, and 1,000 farmers, particularly in drought-prone areas of North Karnataka.

The Deshpande Foundation launched the *'Neer Sinchana'* program in 2014 to facilitate water harvesting for crop cultivation in semi-arid zones of North Karnataka. With 6,000 ponds built across several districts and a goal to construct 100,000 more in five years, scaling operations was a challenge, which was in turn met by employing advanced technologies like AI for operational and real-time monitoring. HDFC Bank CSR has contributed significantly to this endeavour by backing the Rural Transformation Technology Centre (RTTC) establishment, particularly from January 2021 to March 2022. The RTTC has been instrumental in elevating the farm pond construction process with a customised software leveraging Artificial Intelligence (AI) and Machine Learning (ML) technology, optimising site selection, execution, monitoring, and evaluation through high-tech solutions. The RTTC operates like a hub, equipped with display and communication tools, and computing power to process and visualize data from diverse sources including weather, government records, IoT, and drones.

The processes adopted during the intervention included:

- Mobilising farmers
- Selecting sites with geospatial analytics
- Excavating using heavy machinery
- Constructing ponds with appropriate bunding and inlet-outlet channels
- Geo-mapping the structures
- Assessing water storage after monsoon
- Increasing the irrigated land coverage
- Enhancing crop production

STUDY METHODOLOGY

Chapter 2

This chapter describes the research methodology adopted for conducting the said Impact Assessment.

2.1. RESEARCH DESIGN

A **quasi-experimental Post-Test Only Control Group Design** was followed for this study. The assessment focussed on process documenting the intervention led by the technology-driven Rural Transformation Technology Centre (RTTC) especially in the construction of the 1000 farm ponds along with collecting data from project beneficiaries.

In the absence of baseline information, data from the treatment group was collected through a *retrospective recall approach*. In addition, for parameters or indicators where retrospective recall approach was not appropriate, data from the control group was sought to be collected.

The ***key overall objective*** of the Assessment was:

> ***to understand how the establishment of the RTTC helped Deshpande Foundation in scaling up and efficiently accelerating its intervention of 1000 farm pond construction in Northern Karnataka***

While assessing this, the study also intended to understand the process for farm pond selection through technology and integration of Artificial Intelligence (AI) and Machine Learnings (ML); the effectiveness of the program on beneficiaries in terms of adopting innovative farm practices to increase the production and income from farming; and the support provided through Agri Advisory services powered by Rural Transformation Technology Centre (RTTC) to FPOs and farmers.

Overarchingly, the assessment sought to evaluate the efficacy, effectiveness of the project interventions, and sustainability of the project's outcomes.

2.2. SAMPLE SIZE AND SAMPLING APPROACH

Considering a coverage of a known population of 1000 farmers, a statistically significant sample size at 95% confidence interval, 5% margin of error and 15% non-response rate works out to be 319.

The formula used to calculate the sample size is:

Where, N = population size
z = z-score
e = margin of error
p = standard of deviation

$$\text{Sample size} = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 N}\right)}$$

However, given the spread of the intervention villages in the 8 study districts, and ensuring optimal spread of interviews across each, a sample size of 350 beneficiaries in the treatment group was planned to be

covered. For the control group, 50% of the treatment group sample size, that is, 175 was sought to be covered.

Hence, a total quantitative sample size of **525** comprising of 350 in treatment group and 175 in control group were planned.

Control Group Selection*:* For selection of control group, those farmers were considered who have farm ponds in the same village but which had not been constructed under the RTTC support. Thus, non-RTTC constructed farm ponds formed the control group. Being in the same village ensured comparability with the treatment and help assess the impact of the RTTC.

Sampling Approach*:* A two-stage sampling approach was adopted for the impact assessment, as follows:

Stage 1: Selection of villages: HDFC Bank CSR had provided 8 districts in which the intervention was done, and the corresponding number of villages where the FDP was implemented. A total of 171 villages formed part of the intervention. For the purpose of sampling for the assessment, 25 percent of the project villages in each district, which comes to 44 villages in total was planned to be covered.

With regard to the number of control villages, half the number of treatment villages sampled were sought to be covered.

Stage 2: Selection of beneficiary farmers: From among the 1000 beneficiary farmers across districts, the sample of beneficiaries covered in each district for the assessment was in proportion to the total. This sample of beneficiaries were sought to be spread equally across each of the sampled villages covered in that district. Within each village, simple random sampling was followed for selection of beneficiaries.

Table 2.1: Target and Achieved sample size

	Treatment		Control	
Districts	**Target**	**Achieved**	**Target**	**Achieved**
Bagalkot	15	15	8	8
Ballari	94	102	47	51
Belagavi	33	34	17	17
Dharwad	55	60	28	29
Gadag	50	50	25	25
Koppal	1	4	1	1
Raichur	20	21	10	11
Vijayapura	82	81	41	39
Total	**350**	**367**	**175**	**181**

For the qualitative component, Focus Group Discussions (FGD) and Key Informant Interviews (KII) were conducted for gaining deeper insights assessing program impact. These were conducted in treatment villages only. Selection if respondents for the qualitative component will be purposive. The sample for the qualitative sample across different stakeholder is as under:

Table 2.2: Distribution of achieved Qualitative Sample Size

Respondent category	Sample size
FGD with Beneficiaries	12
Key Informant Interviews (KII) • Implementing Partner personnel/ manager x 2 • RTTC staff x 4 • Farm Pond Personnel x 4	10

FGDs were covered, 2 each in the 4 districts of Ballari, Dharwad[2], Gadag and Vijaypura which have greater coverage of project villages and farmers; 1 each in the rest 3 districts except Koppal. For Koppal, with only 4 farmers, FGDs were not conducted here.

2.3. STUDY TOOLS

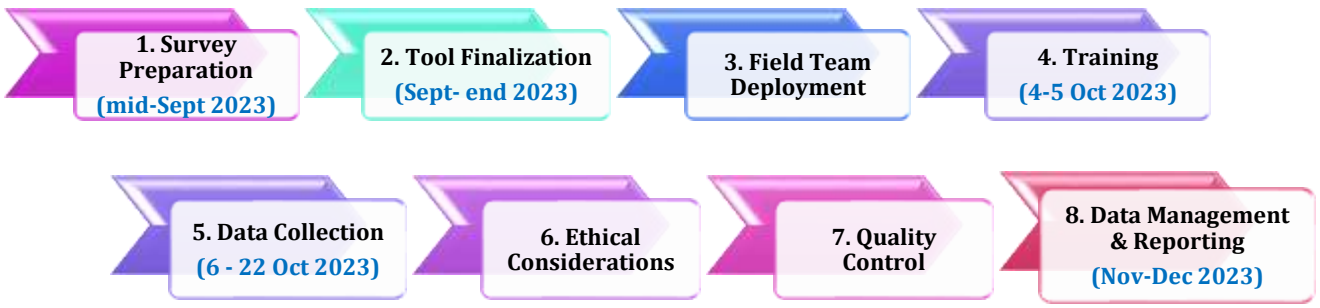
The research tool developed was in alignment with the intervention done under the FDP, with the aim to arrive at quantifiable impact indicators and assessing the project's efficacy, effectiveness and sustainability of outcome. Project related documents as obtained for HDFC Bank CSR were studies to get detailed understanding of the project and hence develop the tools. The tools developed as part of this Assessment included the following:

- Quantitative questionnaire for project beneficiaries
- Key Informant Interviews (KII) Guide
    - Implementing Partner personnel/ manager
    - RTTC staff
    - Farm Pond Personnel
- Focus group discussions (FGD)
    - With Beneficiaries

The quantitative research instrument was a structured questionnaire with mainly close-ended questions, enabling capture of responses through pre-defined set of (multiple) response choices and will be finalized in consultation with HDFC Bank CSR. The qualitative KII and FGD Guide had questions to help draw qualitative insights in keeping with the scope of the Assessment, with special attention to assessing the project's efficacy, effectiveness and sustainability of outcome. Each of the qualitative guides were prepared and customized for the respective respondent type.

2.4. STUDY IMPLEMENTATION

The preparation for the Impact Assessment after commissioning from HDFC Bank CSR began in mid-September 2023. One of the important initial tasks was to study the project documents shared by HDFC Bank CSR, for developing an understanding of the project. The study tools were then developed and shared with HDFC team for approval. The CAPI digital scripting was also undertaken in preparation for the field launch in addition to other field level preparation. Field Team Training was held on 4th- 5th October, 2023 at Hubli for orienting and training the teams on the study protocols and tools. Soon after, data collection was launched from 6th October onwards and completed by the third week of October. This was followed by data processing, management, analysis and preparation of Report which was completed in the month of November-December.



[2] One additional FGD done in Dharwad


Field Team Training at Hubli


A beneficiary farm pond


An interview in progress


A beneficiary farm pond


FGD with beneficiaries, Bellary

2.5. DATA MANAGEMENT, ANALYSIS AND REPORTING

After completion of data collection, final data collation, checking and cleaning of the completed quantitative interviews were done. Like-wise, transcription and further content analysis was undertaken for the qualitative capsule. Once the data was cleaned, it was analysed and Draft Findings Report prepared on its basis.

Data analysis for the study highlighted the impact of the intervention through a pre-post analysis for the treatment group where applicable (retrospective approach) along with comparison with control group. Descriptive statistical analysis using SPSS was conducted, in addition to test of significance between the treatment and control group for key indicators of interest. Qualitative data analysis helped to supplement the overall findings and data trends reported.

2.5.1. ANALYTICAL FRAMEWORK

This Report on the Impact Assessment of FDP P0377 has made use of the OECD DAC[3] criteria as an analytical framework. This framework defines six evaluation criteria – relevance, coherence, effectiveness, efficiency, impact and sustainability – and two principles for their use. These criteria provide a normative framework used to determine the merit or worth of an intervention (policy, strategy, programme, project or activity). They serve as the basis upon which evaluative judgements are made. This framework recommends adapting this framework, wherever feasible and applicable. Application of this framework to the present Impact Assessment study is discussed in detail in the chapter on Discussion, Chapter 5.

[3] https://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm

The OECD DAC Framework

2.6. FIELDWORK CHALLENGES

The data collection teams for the study did face certain challenges during the fieldwork period. The period for data collection was extended owing to field level difficulties, mainly due to beneficiary unavailability on the ground – owing to reasons such as beneficiary currently out of town/ staying in different city now/ leased farmland and staying elsewhere/ beneficiary away in field which is far off from the main village. Moreover, team also faced challenges in reaching out to the respondents as their phone numbers were inactive or went unanswered. The spread of beneficiaries was scattered across villages sometimes only 3-6 in a single village (especially Dharwad); and the inter-village distance within a block being greater, thus causing lesser productivity each day and requirement of coverage of more villages to achieve the desired sample size in a district. The field work was initially scheduled to be completed in 10 days, starting from 6th October, till 16th October. However, due to various challenges, the field work extended till 22nd October.

STUDY FINDINGS

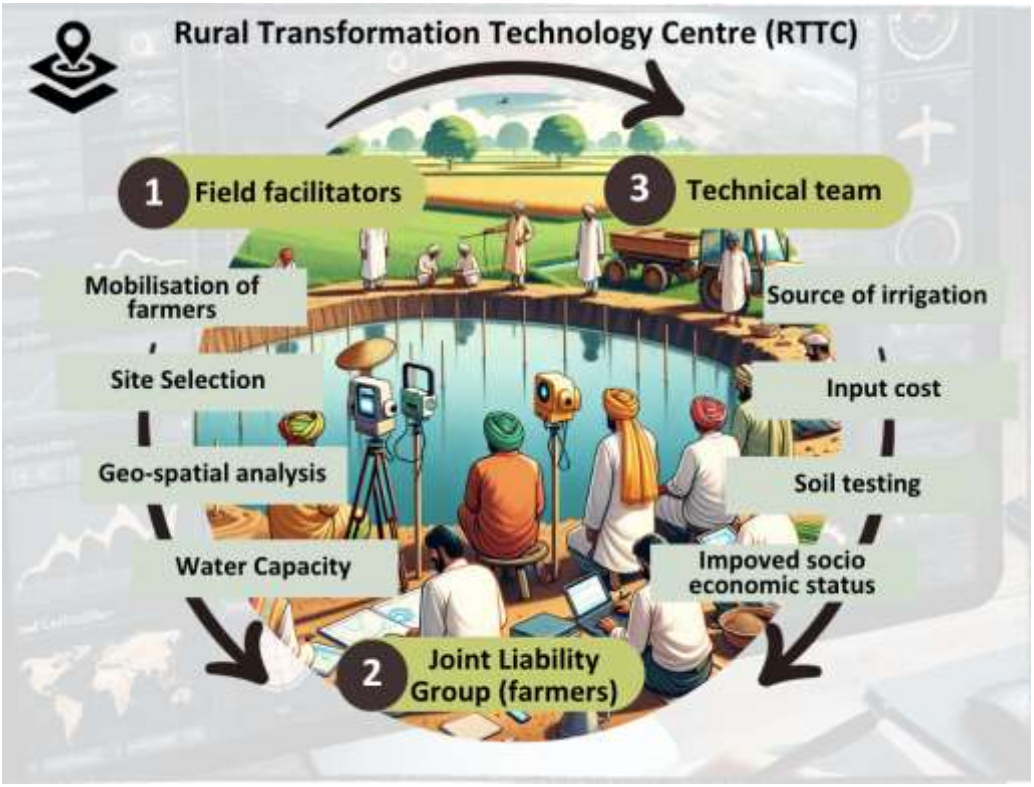
IMPLEMENTATION OF RURAL TRANSFORMATION TECHNOLOGY CENTRE (RTTC) IN HUBLI, KARNATAKA

Chapter 3

The Rural Transformation Technology Centre (RTTC) represents a significant leap in agricultural and rural development in Karnataka. Its primary aim is to utilize technological innovations for enhancing service delivery in the agricultural sector, particularly through the construction of farm ponds. The RTTC has successfully constructed 3,262 farm ponds across eight districts in Karnataka, demonstrating its substantial impact on rural transformation.

This chapter discusses about the RTTC, seeking to document key features of the Centre, its processes towards farm pond construction and thereby the impact. Data in this chapter is collated from Key Informant Interviews (KIIs) conducted with Deshpande Foundation Manager/ Key Personnel and RTTC technical staff.

Figure 3.1: Features of Rural Technology Transformation Centres (RTTC)

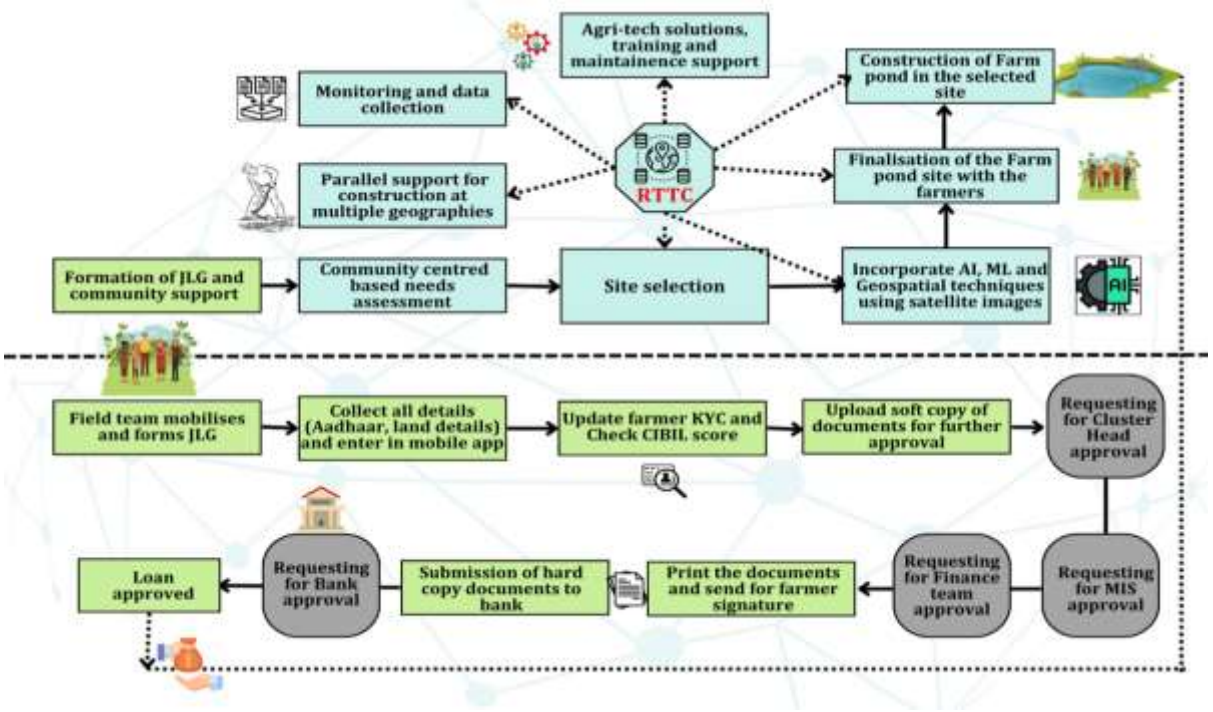


3.1. TECHNOLOGICAL INNOVATIONS AT RTTC

RTTC's approach integrates advanced technologies such as Artificial Intelligence (AI) and Machine Learning (ML) to improve program efficiency and sustainability. This integration has enabled the centre to offer near real-time visibility of on-ground situations through satellite imagery, facilitating informed decision-making and efficient monitoring. The centre is equipped with customised software designed to extract geospatial intelligence, which plays a crucial role in guiding and monitoring rural activities. This software aggregates data from various sources, including satellites, photorealistic 3D tiles purchased from Google, government data, IoT sensors, and drones, enabling a comprehensive and dynamic view of rural

agricultural landscapes. Innovative technologies are tested, at the inception of implementation at a farm based in Hulgur.

Figure *3.2: Process flow of implementation of Rural Technology Transformation Centres (RTTC)*



> *"Initially, we used to do the construction manually by visiting the sites. Now through the RTTC technology, we can suggest the farmer about the good water storage location. So that whenever it rains the storage will be good and they can use for irrigation, and ultimately improve their income."*
>
> *- Sandeep Kumar Naik, Deputy Director - Farm Pond Program*

> *"Earlier, it used to be 10 or 15 ponds per day; but now last season it was 100 per day, next season we want to do 300-400 per day. With the help of technology, 400 machines at a time in a 2000 sq.kms. will help scale up the selection of the pond location. Each field personnel has an app and the data is fed in real time. At every 15 minutes you can see the live update."*
>
> *- Mohammad Innus Khan, Senior Director – DF Agriculture Initiatives*

> *"The integrity of the data will ensure that the data will be available for the admins or the monitoring team, where ever or whichever location of the world they are in. Our data is safe and secured through this common centralized approach. Secondly, it also helps in monitoring the on goings of the ground, at a real-time pace. So one can take the action or decision by monitoring the data. Earlier we used to do 100 ponds a month, now I can do weekly 100 ponds. If it goes in the same speed, everyday 100 ponds can be constructed."*
>
> *- Raghavendra Chikkalkar, Delivery Head Technology*

3.2. FINANCIAL MODEL FOR FARM POND CONSTRUCTION

The Rural Transformation Technology Centre (RTTC) employs a financial model for farm pond construction that is rooted in community engagement and cooperative effort. Central to this approach is the establishment of Joint Liability Groups (JLGs), typically consisting of six to seven local farmers. These groups are supported by RTTC's field team, which guides them through the process of securing financial support, including the preparation and submission of bank loan applications. A distinctive feature of this model is the partnership with the Deshpande Foundation, which contributes 70% of the required funding for each pond while the farmers collectively cover the remaining 30%. This cost-sharing setup is facilitated by Deshpande Foundation's assistance in acquiring bank loans, which the farmers then repay in manageable instalments. This strategy not only lessens the immediate financial load for farmers but also fosters a sense of investment and ownership, leading to more sustainable development and an increased rate of participation.

> *"We also tackle the farmers' financial concerns, clarifying the loan process and how the farm ponds will be a worthwhile investment for storing rainwater for crops. Farmer's encounter scepticism, particularly when farmers compare the Foundation's assistance with government offerings which they perceive as free or delayed. Our response is to highlight the timely and efficient help we offer, emphasizing that the Foundation's support can ultimately save the farmers money and time. Despite these issues, many farmers are receptive and agree to the terms once they understand the long-term benefits and technological support involved."*
>
> *- Farm Pond Personnel, Asuti*

Figure 3.3: Snapshots from RTTC Hub

3.3. FIELD IMPLEMENTATION: A DUAL APPROACH

RTTC's field implementation strategy is a dual approach, involving both field and technical teams. The field facilitators act as the primary interface with the community, mobilizing farmers and aiding in the formation of JLGs. The technical team, on the other hand, provides crucial support in data visualization, processing, and decision-making. They utilize the mobile Farm Pond application for site assessment, leveraging land elevation data and AI methodologies to determine the feasibility of farm pond construction. The key challenges faced in mobilizing farmers for farm pond construction, are addressing the concerns of both educated and uneducated farmers, explaining the benefits and the financial aspects of farm ponds, and overcoming scepticism about the support versus government aid.

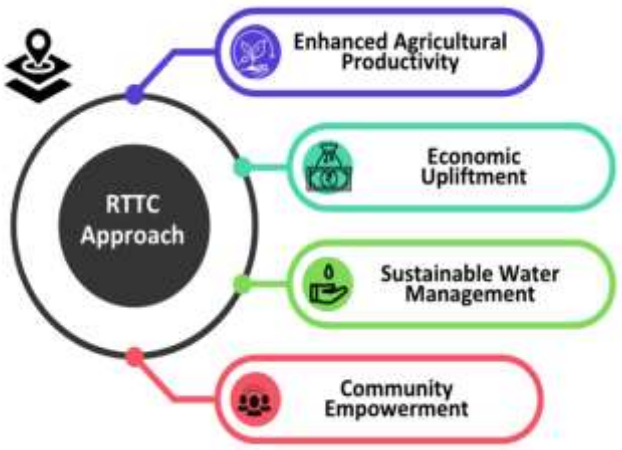
> *"We work with both educated and uneducated farmers, explaining the benefits of farm ponds and how these can positively impact their farming, especially during times of inconsistent rainfall. We assure farmers that they know the best locations for farm ponds based on water flow and stock up, using technology like satellite images to select the optimal sites."*
>
> *- Farm Pond Personnel, Asuti*

3.4. RTTC'S APPROACH

The RTTC's approach has had a multi-dimensional impact, including:

- **Enhanced Agricultural Productivity:** The construction of farm ponds has directly contributed to improved irrigation, leading to increased agricultural productivity and crop diversity.
- **Economic Upliftment:** Financial support structures and technological interventions have facilitated economic growth and stability among the farming communities.
- **Sustainable Water Management:** The farm ponds have played a crucial role in water management practices in the region. Conservation, ensuring sustainable water
- **Community Empowerment:** The collaborative and participatory model of RTTC has fostered a sense of community ownership and empowerment, crucial for sustainable rural development.

Figure 3.4. Multi-tier approach of Rural Transformative Technological Centre (RTTC)



> *"Before farm pond construction the farmer was completely dependent on the rain or the facility of the bore well. Now with this farm pond during rainy season, the water gets stored and an extra crop can be cultivated for extra income."*
>
> *- Wasim, Developer, RTTC Staff*

> *"We can track everything in the system. After the intervention we can see the water capacity; we can see the crop type, we can see the income difference after the farm pond and before the farm pond."*
>
> *- Johnson, Developer, RTTC Staff*

3.5. BENEFITS AND TRANSFORMATIVE IMPACT

The RTTC model has brought about a transformative change in the way agricultural development is approached at the community level. It has led to a more informed and efficient process of farm pond construction, which is vital for irrigation and water conservation in rural areas. The use of AI and ML technologies has replaced manual, less efficient methods, enabling precise geospatial analysis and forecasting. This technological leap has not only enhanced the effectiveness of farm pond construction but also empowered farmers with better decision-making tools and resources.

The table below shows that the RTTC method is superior in several key areas, particularly in data management, scalability, and the application of technology for strategic benefits. While the traditional method has been effective to a certain extent, RTTC's use of modern tools and techniques offers a more advanced, efficient, and empowering approach to farm pond construction and the broader scope of agricultural development.

> *"Through a survey done by the government last year, it was reported that the ground water level had increased automatically. It is not essentially that farm ponds are the reason for it. However, in the past 10 years we have constructed many numbers of farm ponds, which collect the rain because of which the ground water is increasing. This can be understood as a non-planned impact which is benefiting to the whole society."*
>
> *- Raghavendra Chikkalkar, Delivery Head Technology*

Table 3.1 Before and after implementation of RTTC: A snapshot

Key features	Before RTTC	After RTTC
Technological Innovation	Lacks advanced technological tools; relies on traditional methods.	Uses AI, ML, and geospatial analysis for precision and forecasting.
Resource Utilization	Resource management may not be optimized due to lack of precise data.	More efficient resource management through informed decision-making.
Community Empowerment	Less empowerment due to reliance on conventional practices.	Empowers farmers with decision-making tools and resources.
Optimal site selection	Potential for suboptimal water conservation due to less precise siting.	Technology aids in optimal farm pond placement for water conservation.
Strategic Decision Making	Limited data analysis capability, leading to less informed decision-making.	Data aggregation supports strategic planning and pattern analysis.

Data Management and Integrity	Data often kept in physical records; higher risk of errors and loss.	Centralized data repository; secure and less prone to errors.
Real-Time Monitoring and Accountability	Monitoring dependent on manual updates; slower response to issues.	Allows for instant monitoring and quicker intervention.
Productivity and Scale	Slower pace, typically 100 ponds per month due to manual processes.	Potential to construct 100 ponds daily due to technological efficiency.
Security and Continuity	Data security and continuity at risk with staff turnover.	Improved data security and continuity regardless of personnel changes.

FARM POND AND BENEFICIARIES

Chapter 4

The present chapter collates findings from the quantitative household interviews conducted with farm pond owners in both treatment and control villages, comparing data from the two groups, thereby helping to assess impact on beneficiaries in the project villages.

4.1. SOCIO-DEMOGRAPHIC PROFILE

A total of 548 households were interviewed, of which 367 were farm pond owners from Treatment households while remaining 181 were from Control households. Overall, respondents interviewed included 89 percent males and 11 percent females. Social category representation shows a considerable proportion of General category households at 62 percent, with Other Backward Classes (OBC) at 21 per cent, Scheduled Tribes (ST) at 11 percent and Scheduled Castes (SC) at 6 percent.

Almost all the respondents (97 percent) were farmers or cultivators. In terms of housing, two-fifth respondents live in pucca houses. A considerable majority of the beneficiaries are classified as Below Poverty Line (BPL), emphasising the RTTC's target demographic of economically disadvantaged populations. The landholding data reveals a spectrum of farm sizes among beneficiaries, with a comparatively higher proportion of medium farmers in the treatment group and semi-medium farmers in the control group.

Table 4.1: Percentage Distribution of Socio-economic profile of farmers

Socio-economic profile	Treatment	Control	Total
Gender			
Male	87	93	89
Female	13	7	11
Social category			
Scheduled Caste	3	10	5
Scheduled Tribe	11	11	11
Other Backward classes	24	15	21
General	61	63	62
Occupation			
Farmer/ cultivator	97	98	97
Wage labour	3	2	2
Small business	0	<1	<1
Salaried govt service	<1	0	<1
Type of house			
Kacha	16	3	12
Semi pucca	38	51	42
Pucca	46	46	46
Social entitlements			
Above Poverty Line	22	17	20
Below Poverty Line	72	77	74
Antodaya Card	2	2	2
No Card	4	4	4
Type of farmer			
Marginal farmer	4	3	3
Small farmers	14	18	16
Semi-medium farmers	34	45	38
Medium farmers	40	23	34
Large farmers	8	11	9

4.2. CHARACTERISTICS OF THE FARM POND

The data presented outlines various aspects of farm pond characteristics and their impact on agricultural practices post-construction, comparing the RTTC method (treatment) with other traditional methods (control).

4.2.1. FARM POND CONSTRUCTION SUPPORT

As per the study design, all farm ponds in treatment group were constructed by Deshpande Foundation through the HDFC Bank CSR supported RTTC. In the control group, 8 in 10 farm ponds were constructed by farmers with government support, followed by 16 percent who financed it on their own while another 4 percent through another NGO.

Table 4.2: Percentage distribution of Farm Pond Construction Support

Farm pond construction supported by	Treatment	Control
Deshpande Foundation	100	0
Government	0	80
Other NGO's	0	4
Privately financed	0	16

4.2.2. CONSISTENCY IN FARM POND EXCAVATION

Both groups have a universal adoption of fully excavated farm ponds. This indicates a common preference for fully excavated ponds over partially dug ones.

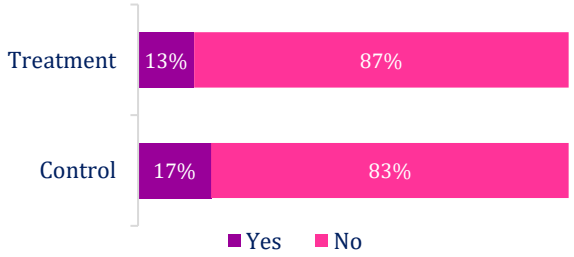
4.2.3. STANDARDISED WATER MANAGEMENT STRUCTURES

The majority of both treatment (91%) and control (88%) groups' farm ponds, though marginally higher for treatment, have both inlet and outlet structures, which is essential for effective water management and indicates a high standard of construction.

4.2.4. LOW ADOPTION OF POND LINING

A minority of farm ponds are lined, with 13 percent in the treatment group and a slightly higher 17 percent in the control group. This may reflect cost considerations or the perceived necessity of pond lining for water retention. The lining material used by farmers for lining was plastic.

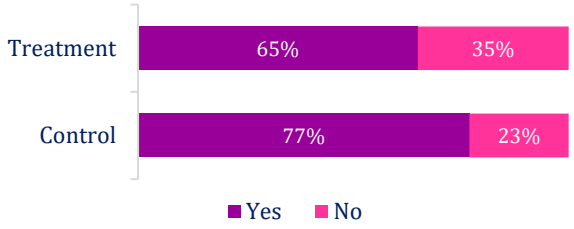
Figure 4.1: Percentage distribution of Adoption of Pond Lining



4.2.5. POND RECHARGE PRACTICES

Among farm pond households that do have a farm pond lining (N: Treatment=49, Control: 30), recharging of farm ponds with external water sources is reported by 65 percent of the treatment group, whereas the control group is higher at 77 percent. This suggests a comparatively higher dependency of the treatment group on natural water recharge methods.

Figure 4.2: Percentage distribution of Pond Recharge Practices



The primary source of water for recharging farm ponds, among households that do depend on external water sources for pond recharge, is canal water, with a high reliance observed in both treatment (84 percent) and control (75 percent) groups. Wells are less used, especially in the treatment group (10 percent), compared to the control group (17 percent).

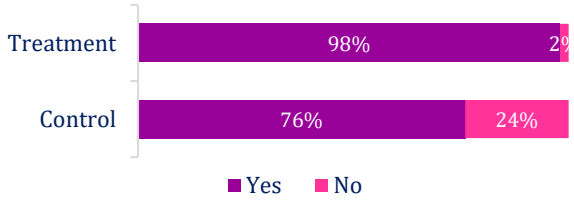
4.3. OPTIMIZING FARM POND EFFICACY: LEVERAGING ADVANCED TECHNOLOGY AND EXPERT GUIDANCE IN CONSTRUCTION

The data provided offers insights into the utilization of advanced technology and agencies' involvement in the farm pond construction process, highlighting the differences between the treatment group, supported by the RTTC, and the control group, following traditional methods.

4.3.1. HIGHER AGENCY (RTTC) INVOLVEMENT IN TREATMENT GROUP

The agency's involvement in suggesting the ideal spot for farm pond construction, as opined by farm pond owners, is notably high in the treatment group at 98 percent, compared to 76 percent in the control group. The difference between the two groups is *statistically significant.* This suggests that the RTTC's approach has a more hands-on role in guiding site selection compared to traditional methods of farm pond construction.

Figure 4.3: Percentage distribution of opinion of farm pond owners on agency suggesting ideal spot for Pond



4.3.2. INCREASED BENEFICIARY PARTICIPATION WITH RTTC

Almost all beneficiaries in the treatment group reported full participation in the site selection process with the agency at 96 percent, which is *significantly* higher than the control group's 70 percent. This indicates a more participative approach in the RTTC method.

Table 4.3: Percentage distribution of Beneficiary Participation in the site selection process

Beneficiary participation in the site selection process with the agency	Treatment	Control
Full participation	96	70
Moderate level participation	4	29
Some participation	<1	1

4.3.3. GREATER SATISFACTION WITH SITE SELECTION IN RTTC METHOD

Beneficiary satisfaction with the site suggestion for farm ponds is higher in the treatment group, with 63 percent feeling 'very satisfied' (*statistically significant*), against 38 percent in the control group. A greater number of beneficiaries in the control group, 60 percent, felt 'satisfied', pointing to a more nuanced perception of satisfaction.

Table 4.4: Percentage distribution of satisfaction of beneficiary with Farm Pond site suggestion

Satisfaction of beneficiary with Farm Pond site suggestion	Treatment	Control
Very satisfied	63	37
Satisfied	32	61
Neither satisfied nor dissatisfied	5	2

4.3.4. CONSISTENT CONSTRUCTION LOCATION FOLLOWING AGENCY ADVICE

The construction of farm ponds in the location, as suggested by the agency is almost universally followed in both groups, with almost all (99% each) in the treatment and control group adhering to the agency's guidance.

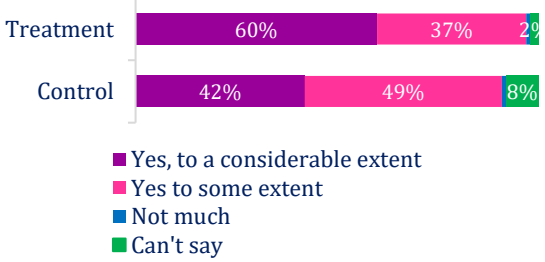
4.3.5. SUBSTANTIAL USE OF TECHNOLOGY BY TREATMENT GROUP

On being asked whether the agency's (RTTC's) use of technology like satellite images, drones, GPS, mobile apps, etc, has helped in the construction of your farm pond in a more efficient and time bound manner, majority (57%) treatment group beneficiaries affirmed it as being to a 'to a very large extent' followed by 34 percent consider 'to a large extent'.

Table 4.5: Percentage distribution of Use of technology by agency helping in farm pond construction in a more efficient and time bound manner

Use of technology by the agency	Treatment
To a very large extent	57
To a large extent	34
To some extent	7
To a small extent	2

Figure 4.4: Percentage distribution of pond owners by whether agency's intervention helped them in saving their time and effort in the entire pond construction process



In fact, *significantly* higher proportion of pond owners in the treatment group (60%) expressed that the agency's (RTTC) intervention helped them 'to a considerable extent' in saving their time and effort in the entire pond construction process. The corresponding data for the control group was 42 percent.

4.3.6. RTTC PROVIDES MORE TECHNICAL GUIDANCE

Guidance for technical aspects of the farm pond, like dimensions and inlet and outlet placement, was provided to 81 percent of the treatment group, which is notably higher than the 65 percent in the control group, reflecting a more comprehensive support model in the RTTC method.

4.3.7. PERCEIVED HIGHER QUALITY OF RTTC-CONSTRUCTED PONDS

When it comes to the quality of the farm pond construction, 54 percent of the treatment group felt 'very satisfied' (*statistically significant*) compared to 36 percent in the control group. However, the control group had a higher percentage of 'satisfied' responses at 60 percent.

Table 4.6: Percentage Distribution of Quality of the Construction of Farm Ponds

Quality of the construction of Farm Pond	Treatment	Control
Very satisfied	54	36
Satisfied	41	60
Neither satisfied nor dissatisfied	5	4

The data reflects a more engaged and technology-driven approach in the treatment group associated with the RTTC, which corresponds with higher rates of satisfaction and adherence to suggested practices, potentially leading to better construction quality and enhanced farm pond efficacy.

4.4. EMPOWERING FARMERS THROUGH JOINT LIABILITY GROUPS

The data outlines the effectiveness of Joint Liability Groups (JLGs) in the context of farm pond construction, contrasting the treatment group supported by RTTC with the control group that did not receive guidance. JLGs are critical in facilitating access to financial resources and support for farmers, and the analysis highlights the benefits of being part of a JLG.

4.4.1. HIGHER JLG MEMBERSHIP IN RTTC SUPPORTED GROUP

A significant majority of the treatment group (88%) were members of a JLG, compared to only 30 percent in the control group. This suggests that RTTC's efforts have successfully promoted JLG formation. Participation in JLG meetings over the last year was higher in the treatment group with 20 percent always attending meetings, versus 4 percent in the control group, indicating a more active and engaged community within RTTC supported groups.

Figure 4.5: Percentage distribution of member of JLG group

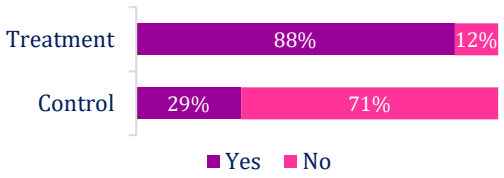


Table 4.7: Percentage distribution of participation in JLG Meeting in the last one year

Participation in JLG meeting in the last one year	Treatment	Control
Always/ Whenever meeting was held	20	4
Often	59	56
Occasionally	19	36
Rarely	2	4

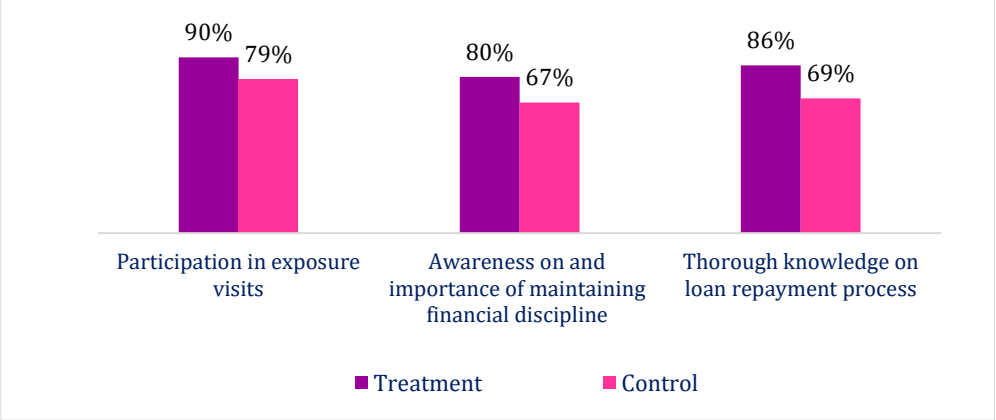
"First, they put together small groups of around 6 to 8 folks. Then they used GPS to figure out how big the land was. Next, they used a mobile app to help collect all the papers they needed. Once they had all that sorted, they started building the pond. They checked the place with the GPS when they started digging, then again while they were making the pond, and one more time after they finished. If there was anything else to do after that, the higher-up people took care of it."

- Beneficiary, FGD, Gosabalu

4.4.2. TRAINING THROUGH JLG GROUP

The treatment group has benefited from participation in exposure visits, awareness on maintaining financial discipline, and gaining thorough knowledge on the loan repayment process, which is attributable to the support and training provided though the JLG.

Figure 4.6: Percentage distribution of knowledge/ training/ benefits being part of a JLG group



4.4.3. LOAN ACCESSIBILITY BOOSTED BY JLG MEMBERSHIP

Farmers in the treatment group had a higher rate of loan acquisition for farm pond construction at 89 percent, close to double the rate of the control group at 50 percent, and this was found to be *statistically significant*. Being a JLG member also assisted significantly in faster loan approval, with 96 percent (*statistically significant*) in the treatment group affirming this, compared to 85 percent in the control group.

Figure 4.7: Percentage distribution of loan taken for construction for Farm Pond

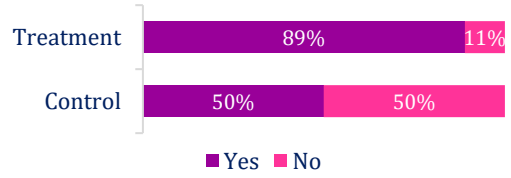
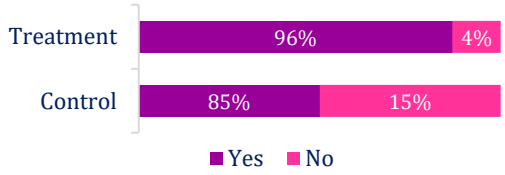


Figure 4.8: Percentage distribution of being JLG member helped in loan approval in a faster manner



4.4.4. LOAN REPAYMENT

Overall, among farm pond owners who did take loans for the construction of the pond, 58 percent in the treatment group and 77 percent in the control group have so far repaid the entire loan amount.

Figure 4.9: Percentage distribution of farmers who have repaid the entire loan amount

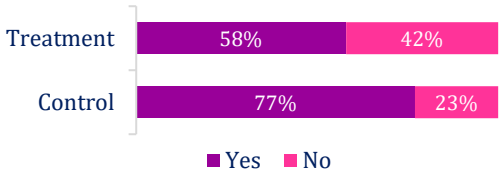


Table 4.8: Percentage distribution of proportion of loan repaid till date of study

Participation in JLG meeting in the last one year	Treatment	Control
0 percent	1	9
1-25 percent	31	54
26-50 percent	32	18
51-75 percent	15	14
76-95 percent	21	5

However, when examining the extent of loan repayment among those who have not yet repaid their loan amount, the treatment group had a more balanced distribution across repayment brackets. In contrast, the control group had a higher concentration in the 1-25 percent repayment bracket (54 percent). This suggests that while the control group may start repaying loans, they do so at a slower pace than the treatment group.

"Deshpande Foundation helps groups of farmers to get together, usually about six to eight in a group, to take a loan for building farm ponds. They have half a year to start paying back the loan which helps because sometimes they don't know how much money they'll make from their crops by the end of the year. The money from the loan goes into one account for the whole group, not into individual accounts. This way, everyone in the group shares the responsibility of paying the loan back.

If the farmers don't make enough money from their crops to pay the loan on time, they find it tough. Sometimes they have to borrow more money from other people or sell something from their homes to pay off the loan. But because they are in a group, they help each other out and try their best to pay the loan back together"

- Program Manager, Hubli

"No one's had trouble paying back the loan. Sometimes we might be late, but we always catch up. If we can't make a payment one month, we just do it the next. With less rain this year, things are a bit tight, but more rain means better crops, and then we can pay a bit extra. For example, if we can't pay in October, we'll definitely clear it by November. Our instalments usually last six months, so at most it might stretch to seven, but we make sure to pay it all. Everyone's working really hard, and the system they've set up for us is very easy to work with."

- Beneficiary, FGD Raravi

Overall, it was found that being part of a JLG, especially within the treatment group, is associated with higher participation rates, knowledge acquisition, and loan approval for farm pond construction. While the control group shows higher immediate loan repayment rates, the treatment group displays a steadier progression in loan repayment over time, possibly reflecting the benefits of the comprehensive support provided by RTTC.

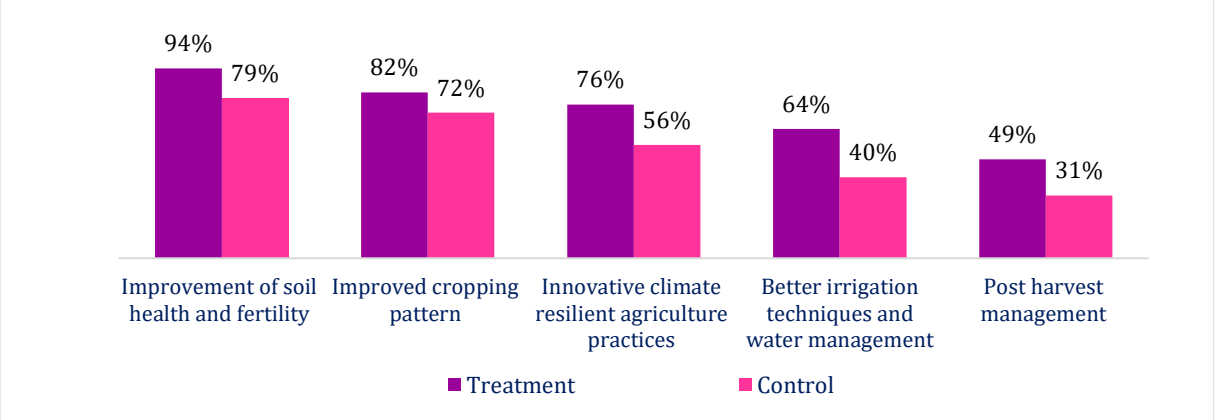
4.5. ENHANCED TRAINING ENGAGEMENT WITH RTTC

A significant majority of the treatment group (86%) received training or advice on maintaining their farm ponds, suggesting that RTTC's approach includes a strong extension or educational component. This figure is notably higher than the control group's 71 percent, indicating that the RTTC's integration of modern technology may be coupled with more comprehensive support and guidance.

4.5.1. BENEFITS FROM AGRO-ADVISORY SERVICES THROUGH TRAINING / ORIENTATION

The treatment group reports improvements from the training sessions that span various aspects of agricultural practices. These include enhancement of soil health and fertility, better cropping patterns, the adoption of innovative agricultural practices that bolster resilience to climate changes, improved irrigation techniques, and water management, as well as post-harvest management.

Figure 4.10: Percentage Distribution of various agro-advisory services received through agency that helped construct farm pond



They taught us how to manage the farm pond with a training. They set up a projector and explained everything. It was really helpful. They taught us about things we didn't know, like how to deal with the green worms that attack chilli plants. These worms are tiny, but they showed us pictures and explained how to look after our crops to stop the worms from ruining them."

- Beneficiary, FGD Gosabalu

The data suggests that the RTTC method not only focuses on the technological aspects of farm pond construction but also emphasizes capacity-building among farmers. This approach likely contributes to more sustainable and effective agricultural practices, as evidenced by the broader uptake of training and advice in the treatment group. The inclusion of post-harvest management in the training underscores the comprehensive nature of the RTTC's support, which extends beyond immediate agricultural production to encompass the entire crop cycle.

4.6. WATER AVAILABILITY, IRRIGATION, PUMPING SYSTEMS AND IRRIGATION COST

The data presents an insightful view into the impact of farm pond construction on water availability, irrigation, and associated costs.

4.6.1. SATISFACTION WITH WATER AVAILABILITY POST-CONSTRUCTION

Beneficiaries showed significant level of satisfaction with water availability in farm ponds, with 43 percent in the treatment group and 26 percent in the control group reporting they were very satisfied. The duration of water fullness in farm ponds was similar across both groups, with most ponds retaining water for 6-8 months annually.

Table 4.9: Percentage Distribution of satisfaction with availability of water in the farm pond

Availability of water in the farm pond	Treatment	Control
Very satisfied	43	26
Satisfied	51	68
Neither satisfied not dissatisfied	5	5
Dissatisfied	0	1
Very dissatisfied	1	0

4.6.2. SHIFT IN IRRIGATION COVERAGE

Irrigated land shows a shift in the treatment group post-construction, with a marked increase in the 6-10 acre bracket from 30 percent to 38 percent, and in the 11-20 acre bracket from 11 percent to 21 percent, indicating a potential expansion in irrigation coverage due to the RTTC method. Contrastingly, smaller land holdings up to 5 acres saw a decrease in irrigation, which might reflect a strategic choice to focus resources on more extensive land plots.

Table 4.10: Percentage distribution of duration of water fully filled in farm pond

Water fully filled in farm pond	Treatment	Control
3-5 months	10	9
6-8 months	65	66
> 8 months	25	25

Table 4.11: Percentage distribution of Total Irrigated land

Total Irrigated land	Before Farm Pond		Post Farm Pond	
	Treatment	Control	Treatment	Control
< 2 acres	5	5	0	1
2-5 acres	46	48	31	40
6-10 acres	30	29	38	33
11-20 acres	11	11	21	18
> 20 acres	8	7	10	8

4.6.3.STABLE RELIANCE ON FARM PONDS

Prior to construction of farm pond, households in both treatment and control groups primarily depended on canals (treatment: 71%; control: 72%) and tubewells (treatment:40%; control: 27%) as a source of irrigation.

Post pond construction, reliance on only pond water for irrigation is high in both groups, at 76 percent for each, reinforcing the importance of farm ponds in local irrigation practices. Among those who do not completely depend on farm pond water, additional sources of irrigation include water from canal, rain water followed by tubewells.

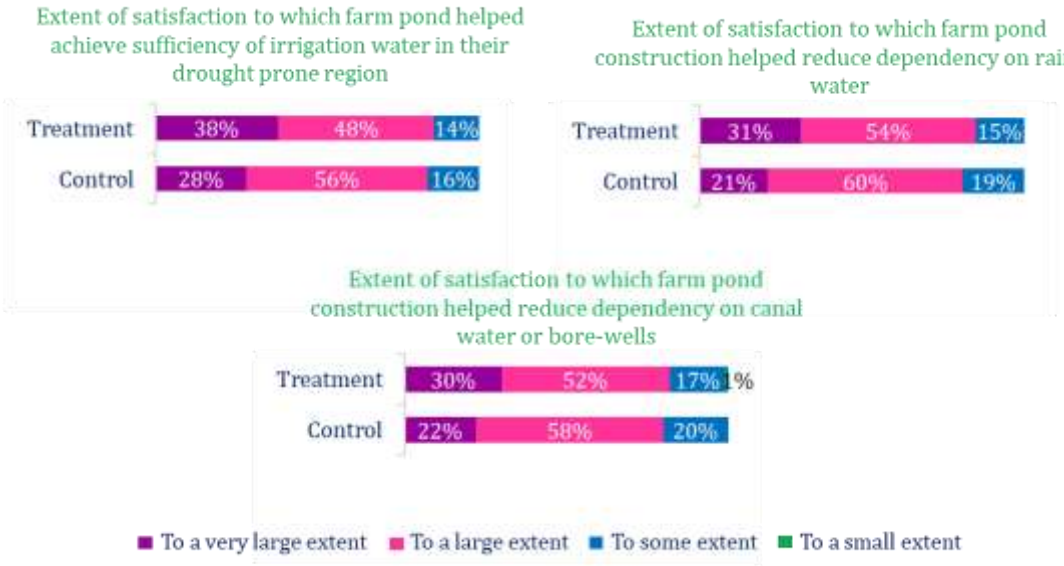
Table 4.12: Percentage distribution of those who depend only on farm pond water

Depend only on farm pond water	Treatment	Control
Yes	76	76
No	24	24

4.6.4.SATISFACTION WITH SUFFICIENCY OF IRRIGATION WATER AND REDUCED DEPENDENCY ON OTHER IRRIGATION SOURCES

An assessment of households' satisfaction across different irrigation water related parameters is depicted in the figure below. Questions were asked around satisfaction with whether farm pond has helped households to achieve sufficiency of irrigation water, given their context of being a drought prone region; whether construction of the farm pond helped in reducing your dependency on rain-water; and whether construction of the farm pond helped in reducing your dependency on canal water or bore-wells. In all these three cases, greater proportion of treatment households as compared to control households responded their satisfaction to be 'to a very large extent'.

Figure 4.11: Percentage distribution of extent of satisfaction with sufficieny of irrigation water and reduced dependency on other irrigation sources



4.6.5.SUBSTANTIAL SHIFT TOWARDS MICRO IRRIGATION TECHNIQUES

Prior to farm pond construction, the 2 main types of irrigation adopted by the treatment group were well/tube well and canal irrigation, constituting 53 percent, each. The control group relied more heavily on canal irrigation at 67 percent, with well/tube well irrigation at 32 percent. After the construction of farm ponds, there was a substantial shift towards micro-irrigation techniques. Drip irrigation usage surged to 88 percent in the treatment group and 76 percent in the control group, from a modest 6 percent and 5 percent respectively before the construction. Similarly, sprinkler irrigation also saw a significant increase post pond construction, from 11 percent before to 85 percent after for treatment group and 13 percent before to 75 percent after for control groups. These changes indicate a move towards more efficient water-saving irrigation methods following the introduction of farm ponds.

The data highlights a clear pivot from traditional irrigation methods towards more sustainable practices in both the treatment and control groups post farm pond construction, suggesting that the farm ponds may have facilitated or encouraged the adoption of micro-irrigation systems.

Table 4.14: Percentage Distribution of Main source of irrigation

Main source of irrigation	Before Farm Pond		Post Farm Pond	
	Treatment	Control	Treatment	Control
Well/Tube well irrigation	53	32	20	19
Canal irrigation	53	67	40	35
Tank irrigation	27	7	6	4
Drip irrigation	6	5	88	76
Sprinkler irrigation	11	13	85	75
Furrow irrigation	3	6	27	27

4.6.6.INCREASED OWNERSHIP OF WATER PUMPS FOR IRRIGATION

Pumping systems are a significant investment for the majority, as evidenced by 85 percent of the treatment group and 90 percent of the control group purchasing water pumps, predominantly diesel-operated (treatment – 73%; control – 80%). This preference suggests the necessity of reliable water pumping solutions in irrigation practices, though it also indicates a potential area for cost and energy-efficiency improvements.

Figure 4.12: Percentage distribution of purchase of water pump for irrigation post pond construction

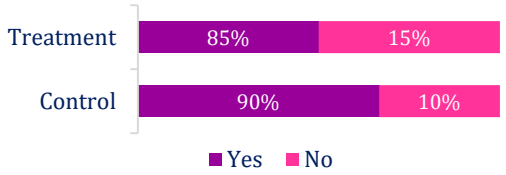


Table 4.9: Percentage distribution of type of water pump

Type of water pump	Treatment	Control
Electricity	25	16
Diesel	73	80
Petrol	2	4

4.6.7.INCREASED IRRIGATION COSTS WITH SCALING UP

The cost of irrigation reflects a substantial post-construction increase, a 40 percent increase for the treatment group from an average Rs. 10,156 to Rs. 14,249. For the control group, this increase was 33 percent, from Rs.9,284 to Rs.12,379.

The rise in costs can be linked to 98 percent of the treatment group confirming expansion of their area under cultivation after farm pond construction, and 76 percent cultivating more crop types, leading to a higher utilization of resources and, consequently, increased expenses.

Table 4.16: Percentage distribution of cost of irrigation incurred

Cost of irrigation	Before Farm Pond		Post Farm Pond	
	Treatment	Control	Treatment	Control
< Rs 5000	29	47	4	3
Rs 5000-10000	44	29	44	58
Rs 10000-25000	22	20	44	33
Rs 25000-50000	4	3	7	6
>Rs 50000	1	2	<1	0
Average	Rs. 10,156/-	Rs. 9,284/-	Rs. 14,249/-	Rs. 12,379/-

"The farm pond has been a big help. It's even made it possible for us to send our kids to better schools. We're doing better financially now, and we've been able to move our kids from government schools to private ones. Everyone's talking about how much things have improved."

- Beneficiary, Gosabalu

4.7. CROP CULTIVATION, DIVERSIFICATION AND PRODUCTION

4.7.1. LAND UNDER CULTIVATION

In the treatment group, the duration of land under cultivation increased significantly post-farm pond construction for periods exceeding 8 months, rising from a mere 1 percent to 30 percent. This was mirrored by the control group, although to a lesser extent, increasing to 18 percent. This suggests that the farm ponds have extended the agricultural window, allowing for longer cultivation periods.

Table 4.17: Percentage distribution of land under cultivation (in months)

Land under cultivation (in months)	Before Farm Pond		Post Farm Pond	
	Treatment	Control	Treatment	Control
< 3months	5	3	3	0
3-5 months	32	22	3	4
6-8 months	62	74	64	78
> 8 months	1	1	30	18

4.7.2. CROP DIVERSIFICATION

Post-construction, the diversity of crops cultivated in the treatment group increased dramatically, with 86 percent of farmers growing 2-3 different crops, a substantial increase from 36 percent before farm pond construction. The control group also saw a similar trend, indicating that farm ponds might be encouraging farmers to diversify their crops.

Table 4.18: Percentage Distribution of Crop diversification

Crop diversification	Before Farm Pond		Post Farm Pond	
	Treatment	Control	Treatment	Control
< 2 crops	54	48	0	1
2-3 crops	36	40	86	84
4-5 crops	9	8	12	11
>5 crops	1	4	2	4

After farm pond construction, the treatment group saw an increase in the cultivation of paddy, vegetables, and horticulture crops, suggesting that water availability from the ponds may have allowed farmers to expand into crops requiring more water. Other cereals remained the top additional crop in the control group, possibly reflecting existing farming practices or market demands.

> *"I have to say, I own a 6-acre and 72-cent farm. Before the construction of the farm pond, I used to grow sunflower. We would grow guralla in one acre, yielding about 3 to 5 harvests. The total income would be between 50 to 60 thousand. After the farm pond, we started planting chili, and that year, we made 12 lakhs. The good soil is up to 3 feet deep. The pond was dug 12 feet deep, and if we use a JCB and a tractor to dig deeper, it can be utilized 3 to 4 times for the 6 acres. So, this farm pond is very useful for farmers."*
>
> *- Beneficiary, FGD Gosabalu*

4.7.3. ENHANCING HORTICULTURE CROP CULTIVATION THROUGH IMPROVED WATER ACCESS FROM FARM PONDS

The treatment group reported a 29 percent 'to a very large extent' helpfulness between increase in cultivation of horticulture or cash crops and water availability through farm pond, which was higher than the control group's 18 percent. This indicates that the treatment group perceives a stronger connection between the farm pond construction and water availability for growing horticulture or cash crops.

Table 4.19: Percentage distribution of crop cultivation versus water availability

Crop cultivation Vs water availability	Treatment	Control
To a very large extent	29	18
To a large extent	54	65
To some extent	17	17
To a small extent	0	0

4.7.4. VOLUME OF CROP PRODUCTION

The data showed that a larger percentage of the treatment group (29%) reported an increase 'to a very large extent' in crop production volume post-farm pond construction compared to 19 percent in the control

group. Similarly, though on an opposite trend, 63 percent control group reported 'to a large extent' increase in volume of production as compared to 53 percent treatment group. This suggests that both groups benefited from increased production, though to a comparative greater extent in treatment group.

Table 4.20: Percentage Distribution of Volume of Crop production

Volume of Crop production	Treatment	Control
To a very large extent	29	19
To a large extent	53	63
To some extent	18	18

"Everyone's noticing that there are a lot more crops these days. We're planting different kinds of millets like pearl and foxtail, and we've also got chilli plants growing. Things are definitely better now. Before, our growth was just 5%, but it's shot up by 95%. Our earnings have jumped from thousands to lakhs."

- Beneficiary, FGD Gosabalu

4.7.5. WATER RETENTION CAPACITY

A quarter of the treatment group (25%) reported that the farm ponds retained water 'to a considerable extent,' compared to 19 percent in the control group, indicating a perceived improvement in water retention due to the RTTC method.

Table 4.21: Percentage distribution of water retention capacity

Water retention capacity	Treatment	Control
Yes, to a considerable extent	25	19
Yes, to some extent	68	75
Not much	6	5
Same as other ponds	1	1

"During the dry summer months, our pond runs out of water, so we plant crops in the rainy season. When it rains, the pond fills up, and we use that water. Right now, we're using water stored from the last rainfall, which lets us grow thirsty crops like cotton. Even if there's no rain for a month, the water in the pond can be used. When it does rain again, the pond collects all the water, so the crops don't need any extra. After the rain stops, we use the pond water for the crops. This way, we can grow better, and our cotton yield has increased from 2 quintals to 15 quintals."

- Beneficiary, FGD Raravi

Overall, the data suggests that the construction of farm ponds has had a positive impact on extending the cultivation period, encouraging crop diversification, and improving water retention capacity, in both the groups. However, the positive impact is seen to a slightly greater extent in the treatment group than the control group.

4.8. BENEFITS OF FARM POND

4.8.1. IMMEDIATE AGRICULTURAL BENEFITS OF FARM POND

Both the treatment and control groups report similar percentages across all immediate agricultural benefits gained as a result of farm pond construction. These improvements, reported by about 9 in 10 households, include consistent water availability during both the rabi and kharif seasons, protective irrigation during periods of delayed rainfall, increased irrigated area, enhanced cropping intensity, crop diversification, shift towards horticulture crops, improvement in productivity on irrigated land, increase in income and availability of drinking water for animals. This demonstrates that farm ponds, in general, are perceived as beneficial for improving agricultural outputs and livelihoods.

Table 4.22: Percentage distribution of agricultural benefits of Farm Pond

Agricultural benefits of Farm Pond	Treatment	Control
Availability of water in both rabi and Kharif season	89	94
Protective irrigation ensured during delay or absence of rainfall	95	94
Increase in irrigated area	97	98
Increase in cropping intensity or multiple cropping in the irrigated land	96	96
Crop diversification	86	86
A shift towards more horticulture crops	82	85
Improvement in productivity in the irrigated land	96	97
Increase in income	99	99
Availability of drinking water for animals	98	99

4.8.2. OTHER NON-AGRICULTURAL BENEFITS

In the non-agricultural benefits category, the treatment group perceives a higher benefit in terms of the farm pond being a source of drinking water for the household (21%) compared to the control group (16%). The control group places slightly more importance on the pond for household-related water usage (18% vs. 14% in the treatment group) and for recreational or bathing purposes (16% vs. 12% in the treatment group). Livestock bathing or drinking is highlighted more in the treatment group (42%) against the control group (36%). These benefits point to the multi-dimensional value of farm ponds beyond agriculture.

Table 4.23: Percentage distribution of Non agricultural benefits of Farm Pond

Non-agricultural benefits of farm pond	Treatment	Control
Source of drinking water for household	21	16
Water usage in household related work	14	18
Recreation or bathing purpose	12	16
Bathing or drinking purpose for livestock	42	36
Usage of religious festivals	11	14

4.8.3. FISH REARING:

Fish rearing in farm ponds is a less common practice, with only a small percentage of both groups engaging in it (3% in the treatment group and 7% percent in the control group).

In the treatment households that do engage in fish rearing (N=11), commonly reared type of fish includes Catla, Mrigal, Rohu and lesser common ones being Common Carp, Grass Carp, Silver Carp, Tilapia and Pangasius. Those rearing fish mostly used it both for sale and household consumption. Sale of fish mainly happened through traders/ middlemen and the farm gate/ door step of the farmers. Treatment households harvested approximately 9000 (number) fishes in their pond in a year. The average input cost incurred in fish rearing in the last one year was Rs.18,636/- and net income earned through fish rearing in the last one year was Rs.86,800/-.

4.9. CLIMATE RESILIENCE, BIODIVERSITY AND ECOSYSTEM

4.9.1. ACKNOWLEDGEMENT OF CLIMATE RESILIENCE

In the treatment group, 44 percent believe that farm ponds contribute 'to a considerable extent' to climate resilience, while the control group is slightly lower at 36 percent. This may indicate that the RTTC's use of advanced technology in farm pond construction is perceived as more effective in combating the effects of climate change and drought. Very few respondents are unsure of the impact, with only 1 percent in both groups unable to state the farm ponds' effectiveness against climate challenges, indicating that the majority of participants have a clear perception of the benefits.

Table 4.24: Percentage Distribution of Farm Pond Vs drought and climate change scenario

Farm Pond Vs drought and climate change scenario	Treatment	Control
Yes, to a considerable extent	44	36
Yes, to some extent	51	60
Not much	4	3
Don’t know/Can't say	1	1

4.9.2. PERCEIVED BIODIVERSITY OR ECOSYSTEM IMPROVEMENT

A significant portion of the treatment group believes that farm ponds have improved biodiversity or the ecosystem to a considerable extent (38%), with an even larger segment (57%) noting improvement to some extent. The control group, however, has a higher percentage seeing some extent of improvement (65%) but less in the way of considerable impact (32%). In terms of specific biodiversity improvements, both groups noticed more greenery around farm ponds (41% in treatment vs. 38% in control) and an increase in wildlife presence (39% in treatment vs. 40% in control).

Table 4.25: Percentage distribution of Farm pond to improve the biodiversity or ecosystem

Farm pond to improve the biodiversity or ecosystem	Treatment	Control
Yes, to a considerable extent	38	32
Yes, to some extent	57	65
Not much	4	3
Don’t know/Can't say	1	

4.9.3. GROUNDWATER LEVEL INCREASE AND POST-MONSOON WATER STORAGE

When assessing the effect on groundwater, 47 percent of the treatment group reported a considerable increase, which is slightly higher than the control group at 43 percent.

Table 4.26: Percentage distribution of Farm Pond construction helping in water harvesting and improving the ground-water level

Farm pond to helping in water harvesting and improving the ground-water level	Treatment	Control
Yes, to a considerable extent	47	43
Yes, to some extent	40	51
Not much	12	7
Don't know/Can't say	1	0

Further, 38 percent in treatment group and 34 percent in control group agreed to be engaging in water harvesting or post-monsoon water storage with the pond that has been constructed.

In summary, farm ponds, are seen to contribute to environmental sustainability by enhancing biodiversity and ecosystem health, as well as aiding in groundwater replenishment. The data also reflects a shared perception between the treatment and control groups on the benefits, with slight variations in the degree to which these benefits are felt.

DISCUSSION

Chapter 5

This chapter discusses the overall outcome and impact of the RTTC intervention in the light of the larger analytical OECD DAC Framework, assessing the FDP around the pillars of Relevance, Effectiveness, Impact, Coherence and Sustainability.

5.1. RELEVANCE: TAILORING TECHNOLOGY TO RURAL NEEDS

The RTTC's approach to integrating advanced technologies like AI, ML, and geospatial tools directly aligns with the critical needs of Karnataka's agricultural landscape. By replacing outdated, manual methods with data-driven practices, RTTC addresses the immediate and long-term requirements of water conservation and farm productivity. The construction of farm ponds has facilitated better irrigation and enhanced water availability for households and livestock, proving the relevance of RTTC's initiatives in the current climate-conscious era. The approach resonates the predominantly Below Poverty Line population (72%), accessing economically viable solutions through technology.

5.2. EFFECTIVENESS: STREAMLINING OPERATIONS AND EMPOWERING FARMERS

The RTTC's strategies have proven effective, in the treatment group supported by the Deshpande Foundation. The effectiveness of the RTTC approach is also evident from the high percentage of beneficiaries reporting satisfaction with the site selection for farm pond construction (63% very satisfied) and the quality of the constructed ponds (54% very satisfied). With nearly all farm ponds in the treatment group being constructed at locations advised by the agency, RTTC's effectiveness in site finalization is underscored. This is further reinforced by the treatment group's satisfaction with water availability in farm ponds, significantly higher for the treatment than for the control group along with three-fourths now relying only on farm pond water for irrigation. The RTTC's method has effectively improved crop diversification and productivity, as well as provided a more secure and centralized system for data management, which is crucial for the long-term effectiveness of rural development projects.

5.3. IMPACT: FACILITATING ECONOMIC GROWTH AND ENVIRONMENTAL IMPROVEMENT

The RTTC's impact extends to agricultural productivity and environmental betterment. The higher satisfaction rates in farm pond site selection and construction quality among the treatment group indicate a positive direct impact. The treatment group's adoption of technology has been impactful, with an extended cultivation period post-construction for over 8 months (30 per cent) and enhanced crop diversification (86 per cent cultivating 2-3 crop types), leading to increased agricultural productivity. The environmental benefits are notable, with 38 per cent of the treatment group recognizing ecosystem improvements and a 47 per cent increase in groundwater levels 'to a considerable extent', indicating a significant contribution to environmental sustainability and climate resilience. The technological interventions have made a tangible difference, achieving a notable scale of operations with potential daily construction of 100 ponds.

5.4. COHERENCE: A CONSISTENT APPROACH TO RURAL TRANSFORMATION

The RTTC, under the Deshpande Foundation, has significantly advanced the foundation's mission by integrating scalable AI and ML technologies into farm pond construction. These technological enhancements have revolutionized agricultural practices in semi-arid regions, empowering farmers to

increase crop cycles, yields, and subsequently their incomes. As a result, RTTC has not only contributed to a marked improvement in rural livelihoods but has also positioned Indian agriculture at the vanguard of the global shift towards a more sustainable, technologically-driven future. This modern approach to farming underscores the potential for replicable and scalable agricultural models that leverage technology for data-driven decision-making, risk mitigation, and optimal resource use.

In addition to the innovations in farm ponds and agriculture, the RTTC has also been valuable in scaling up diverse domains, such as – education, skilling, and entrepreneurship. Through the established living laboratory called Sandbox, Deshpande Foundation facilitated a skilling programme for the technical and vocational skill enhancement of individuals. Skill training programmes held at the 3 levels – with young children below the age of 6, residential programmes for young adults, and college programs; Deshpande Foundation is able to equip the youth. The materials utilized at the skilling programmes have been designed through the use of innovative technology.

As Deshpande Foundation works towards fostering social entrepreneurship through technology, incubating and nurturing start-ups and ideas, is a notable initiative. The Sandbox at Hubli, provides a platform for start-ups, social enterprises, and innovators to collaborate, receive mentorship, and access resources to grow their ventures. In addition to this, they also provide physical spaces where startups and entrepreneurs can work collaboratively. Moreover, along with guidance, they also offer funding support in the form of grants, seed funding, or connections to potential investors which is crucial for start-ups to scale their operations. Through this venture, Deshpande aims to foster ideas that can ultimately address various economic and social challenges.

5.5. SUSTAINABILITY: ENSURING LONG-TERM BENEFITS AND COMMUNITY OWNERSHIP

Sustainability is a cornerstone of the RTTC's work, reflected in the high JLG membership (88%) which encourages community empowerment and collective management of resources. The RTTC's interventions are designed to offer sustainable solutions, as shown by the stable reliance on farm ponds for irrigation (76%) and the notable use of canal water for recharging (84%). The approach ensures that farm ponds are not only a source of immediate agricultural enhancement but also a means for long-term water resource management, where post-monsoon water storage is also encouraged. The use of technology has not only provided immediate advantages but also laid the foundation for continuous improvement and adaptation, which is key to maintaining the gains made by the RTTC.

The goal of the establishment of the RTTC was to ensure that the usage of technology to become easily replicable and scalable. In addition to the technology used for the establishment of the farm ponds, Deshpande Foundation also believes that the integration and organization of data, is a visionary model that can be easily replicated in similar interventions. Through the RTTC, Deshpande Foundation is also striving to make the technological innovations more accessible through seamless interfaces of mobile applications.

To further illustrate the sustainability of the model taken up by Deshpande Foundation for the construction of farm ponds, they have also steered towards the cash and carry model. Differing from the existing CSR and JLG model, the cash and carry model would require the farmers to provide the fund for the construction of the pond by themselves. This will mitigate the hassle of procuring loans and its cumbersome paperwork, with the objective of increasing more beneficiaries. However, its limitations being that it will be able to cater to mostly large farmers. For ensuring the continued linkage with small and medium farmers, the JLG model shall continue to prevail.

CONCLUSION

Chapter 6

The adoption of technology in the construction of farm ponds has transformed the operational model from one that is paper-based and reactive to a dynamic, data-driven approach. The benefits span from enhanced data security and integrity to increased operational efficiency and the ability to scale up operations significantly. This technological shift is not merely an improvement but a necessary evolution to meet the growing demands and complexities of rural development projects.

The Rural Transformation Technology Centre in Karnataka exemplifies how technological innovation, when aligned with community-based approaches and sustainable financial models, can significantly enhance rural development. Its success in the construction of farm ponds and the integration of advanced technologies like AI and ML heralds a new era in agricultural and rural transformation, setting a replicable model for other regions to follow.

The Impact Assessment conducted bears testimony to the benefits derived from the setting up of the RTTC at Hubli. Findings from the study are summarised below:

6.1. FARM POND CONSTRUCTION: THE RTTC'S IMPACT THROUGH TECHNOLOGY AND ENGAGEMENT

The RTTC has significantly influenced the construction and management of farm ponds through a comprehensive approach that combines advanced technology with expert guidance. With an overwhelming 98 percent of the treatment group benefiting from heightened agency involvement, there is a clear indication of a more participatory and satisfying process in site selection for farm ponds compared to the 76 percent in the control group. This has led to 96 percent of the treatment group being fully engaged in the site selection process, which is significantly higher than the 70 percent in the control group, reflecting a more inclusive and collaborative model of operation under the RTTC. The treatment group has also reported a higher satisfaction rate, with 63 percent feeling 'very satisfied' with the site selection (versus 37% in control group), and nearly all farm ponds in the treatment group were constructed at locations advised by the agency, underscoring the RTTC’s effectiveness in site finalization.

Moreover, beneficiaries in the treatment group have perceived a superior quality of farm pond construction, with 54 percent expressing high satisfaction, surpassing the 36 percent in the control group. In addition, the treatment group has benefited from more extensive technical guidance, like dimensions and inlet and outlet placement, with 81 percent receiving support for farm pond construction, far exceeding the 65 percent in the control group, demonstrating RTTC's dedicated approach to enhancing the efficiency and quality of farm pond projects.

6.2. CAPACITATING BENEFICIARIES: RTTC'S HOLISTIC EMPOWERMENT OF FARMING COMMUNITIES

The RTTC has made significant strides in empowering farmers through the formation and support of Joint Liability Groups (JLGs), with treatment group members showing an 88 percent participation rate, much higher than the control group's 29 percent. This active involvement extends to JLG meetings, with 20 percent of the treatment group always present whenever meetings are held and another 59 percent being present often, underscoring the enhanced community engagement fostered by the RTTC. Furthermore, the RTTC's comprehensive training programs on financial discipline and loan management have led to 89 percent of the treatment group obtaining loans for farm pond construction, with a remarkable 96 percent reporting that JLG membership expedited the loan approval process. The treatment group's repayment

progress is evenly spread, suggesting a steady commitment to fulfilling financial obligations. Additionally, the treatment group benefits from a broad spectrum of agricultural training, ranging from soil health to post-harvest management, showcasing the RTTC's holistic approach to agricultural support. This integrated support system by the RTTC demonstrates a strong dedication to building capacity, enhancing financial acumen, and ensuring sustainable farming practices among the rural farming communities.

6.3. IRRIGATION EFFICIENCY MANAGEMENT IN RTTC-ENHANCED FARM PONDS

Post-construction of farm ponds by the RTTC has led to a notable satisfaction in water availability, with 43 percent of the treatment group feeling very satisfied, compared to 27 percent in the control group. This increased satisfaction correlates with a shift in irrigation practices, where larger land areas are now being irrigated, especially in the 6-10 acre bracket, which saw an increase from 30 percent before to 38 percent after, within the treatment group. With 76 percent treatment households depending only on farm pond eater on irrigation, indicates the ponds' essential role in consistent irrigation. In fact, 85 percent treatment group households even purchased water pumps for enhanced efficiency in irrigating their field, post pond construction. Additionally, the scaling up of operations is reflected in the increased costs of irrigation, with a rise in expenses by 40 percent, pointing towards greater resource use and investment as farming activities expand.

6.4. ADVANCEMENTS IN AGRICULTURAL SUSTAINABILITY POST-RTTC FARM POND CONSTRUCTION

The RTTC's implementation of farm ponds has significantly enhanced the agricultural landscape for the treatment group, notably extending the cultivation period to over 8 months for 30 percent of the group, a considerable increase from the mere 1 percent pre-construction. This intervention has also led to a remarkable rise in crop diversification, with 86 percent of the treatment group engaging in cultivating 2-3 different crop types post-intervention, up from 36 percent. The adoption of various crops, including staples like paddy and high-value crops like vegetables, has been observed, underscoring a shift towards a diversified agricultural approach. In fact, enhanced water availability further helped farmers to take up cultivation of more of horticulture and cash crops. Further, both groups acknowledged greater volume of crop production owing to the farm pond construction, a comparative greater extent of benefit was reported by the treatment group. The treatment group also perceived a comparatively greater improvement in water retention capabilities post-construction, highlighting the multifaceted benefits of the RTTC's farm pond projects in bolstering sustainable agricultural practices.

6.5. ENHANCED DRINKING WATER SECURITY (FOR HOUSEHOLDS AND LIVESTOCK) THROUGH RTTC FARM PONDS

The construction of farm ponds has brought similar agricultural benefits to both the treatment and control groups, with a reported 9 in 10 households reporting benefits across various agricultural aspects. However, the treatment group, supported by RTTC, has observed more pronounced non-agricultural benefits especially for drinking purposes, both for households and livestock. They have a higher reliance on farm ponds as a household water source, with 21 percent of the group utilizing it for domestic needs, a noticeable improvement over the control group's 16 percent. Moreover, the treatment group has significantly capitalized on this water source for livestock upkeep, with 42 percent using it for drinking or bathing their animals, compared to 36 percent in the control group. These figures underscore the added value RTTC's farm ponds provide in enhancing not just agricultural productivity but also contributing to the well-being of rural households and their livestock.

6.6. FOSTERING ENVIRONMENTAL SUSTAINABILITY AND RESILIENCE WITH RTTC FARM PONDS

The RTTC's approach to building farm ponds has significantly reinforced the climate resilience of agricultural practices in the treatment group, with 44 percent of farmers affirming 'to a considerable extent' the ponds' substantial role in combating drought and climate change. The positive perception extends to the ecosystems around these water bodies, where 38 percent of the treatment group have observed enhancements 'to a considerable extent', reflecting RTTC's effective strategies in ecological conservation. The similar upticks in greenery and wildlife presence reported by both treatment and control groups showcase the farm ponds as a boon to local biodiversity. Furthermore, the treatment group reports an encouraging rise in groundwater levels, indicating that the farm ponds are instrumental not only in immediate water conservation but also in contributing to long-term groundwater replenishment. These findings underscore the dual environmental and agricultural benefits realized through the RTTC's farm pond initiatives.

Based on overall study findings and analysis, the following **recommendations** emerge:

- **Establish Continuous Impact Assessment Mechanisms**: Setting up mechanisms for ongoing assessment of the economic, environmental, and social impacts of farm pond construction. This will help in making data-driven adjustments to the programs and in documenting best practices for replication in other regions.
- **Invest in Renewable Energy**: Given the high use of diesel water pumps (73 percent in the treatment group), there is an opportunity to explore and invest in renewable energy sources to power irrigation systems, which could reduce costs and environmental impact.
- **Policy Advocacy for Scale-Up**: Advocate for policies that support the scale-up of RTTC initiatives, leveraging public-private partnerships and government support to replicate the model in other regions.