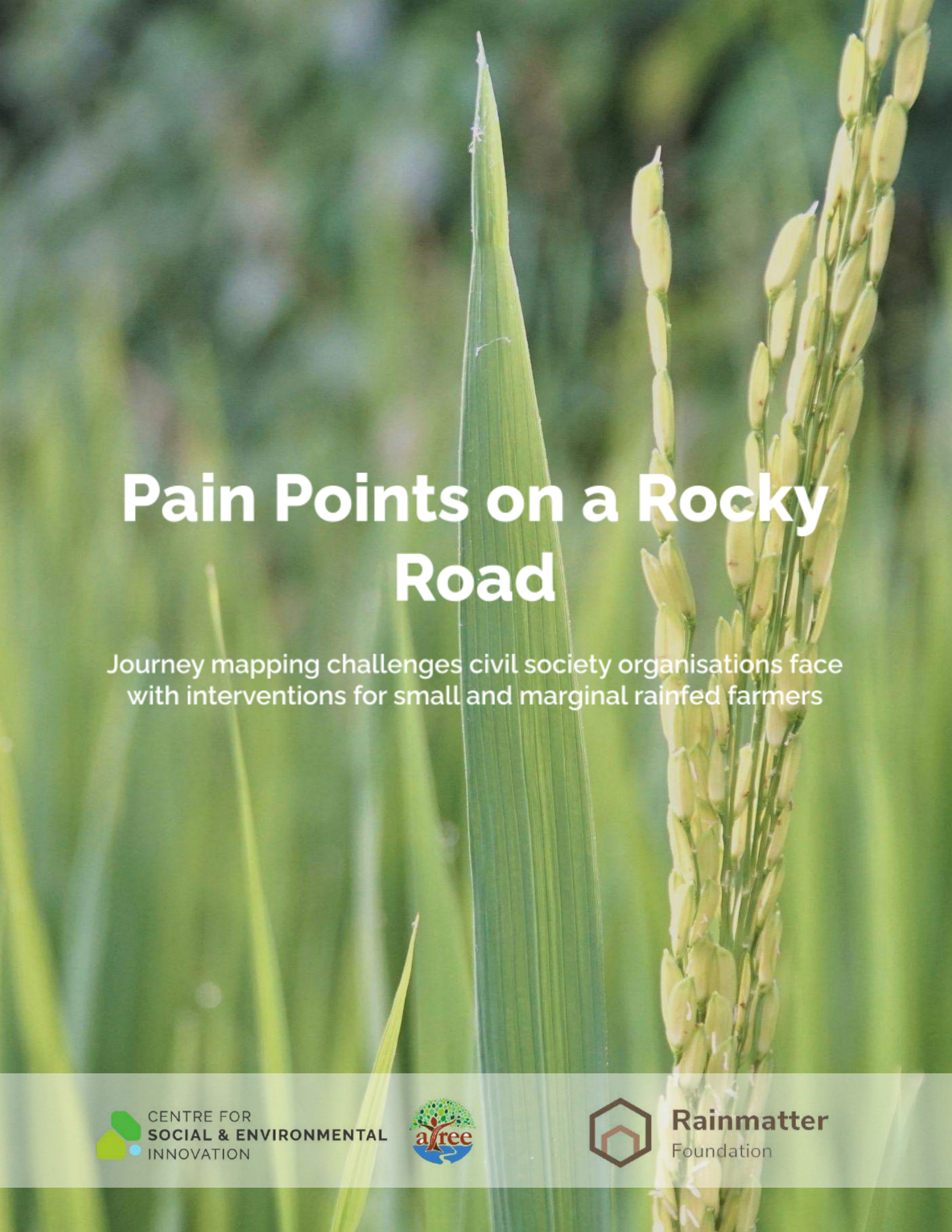

Pain Points on a Rocky Road

Journey mapping challenges civil society organisations face with interventions for small and marginal rainfed farmers

CENTRE FOR SOCIAL & ENVIRONMENTAL INNOVATION

atree

Rainmatter Foundation

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About ATREE

The Ashoka Trust for Research in Ecology and the Environment (ATREE) is a global non-profit organisation which generates interdisciplinary knowledge to inform policy and practice in the areas of conservation and sustainability.

ATREE envisions a society committed to environmental conservation, and sustainable and socially just development.

For over two decades, ATREE has worked on issues like biodiversity and conservation, climate change mitigation and development, land and water resources, forests and governance, and ecosystem services and human wellbeing. ATREE has consistently ranked in the top 20 Environment and Water Security think-tanks in the world.

About CSEI

ATREE's Centre for Social and Environmental Innovation (CSEI) aims to translate research to enhance human well-being, while also conserving the natural environment. CSEI aims to co-create scalable solutions working with partners. We hope to build impact ecosystems to address the problems we work on.

Our solutions are rooted in scientific research. CSEI currently focuses on three problems: water & foods, invasive plant species, and climate resilient/green cities.

The Centre's focus is on empowering the 'first mile'- in their role as citizens, producers, or consumers. Our goal is to enable a transition to a more sustainable and fair system.

About Rainmatter Foundation

Rainmatter Foundation is an initiative by the team behind Zerodha, India's largest stock broking firm. The foundation supports fellowships and organisations working for the environment, with a focus on afforestation, ecological regeneration and livelihoods.

This is only the first of many outputs that we have planned as part of this project. While this report records all the interventions and challenges we documented during fieldwork, we plan to distill them into separate, more public-facing outputs such as blogs, media articles, posters, videos and more. These are vitally important issues that need to be communicated and engaged with a wider audience.

Acknowledgements

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Karnataka

Farmers	CSOs	Other institutions
• Prakash • Govindappa • Veda • Bhootaraju • Anjan, Chandrashekar • Shivakumar • Surendra, Chetan • Subramhanya • Janardhan • Kumar	• Radhamani, Bhaskar, Aradhya, Paramesh - **MOTHER** • Gayatri Lal, Arvind Risbud, Venkata Reddy, Shivshankar, Sudhama Rao, Kalyan Shetty, Tajuddin - **MYRADA** • Mahantesh - **BIRDS**	• Thukaram - **CAMPCO** • Ramu - Arecanut processor • CK Prakash - Arecanut trader Gubbi

Telangana

Farmers	CSOs	Other institutions
• Raghuveer Reddy. • D. Kistiah • Y Chandramoohan Reddy • Rajendra Reddy • C Sugunamma • Sugunamma • Venkat Reddy • Sujathamma • Krishna Naik • Paresh Naik	• Bakka Reddy - **WASSAN** • Deepthi Reddy - **Samunnati Foundation** • Y V Malla Reddy - **AF Ecology Centre**	• Shalini, Bharath, Vishnu - **Rythu Nestham FPC** • Chalapathy and Krishna - **APWELL project**

Maharashtra

Farmers	CSOs	Other institutions
• Laxuman (Anna) Kamthe • Tulshiram Karkande • Namdev Jhurange	• Prashant Borawake - **GGP** • Sandeep Jadhav - **WOTR** • Ajay Shelke - **WOTR**	• Ramling Khose - **Wadzire, FPO** • Dyaneshwar Bodake - **Abhinav Farmers Club**

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List of Abbreviations

AF Ecology	Accion Fraterna Ecology Centre
AFC	Abhinav Farmer's Club
AGM	Annual General Meeting
AGR	Artificial Groundwater Recharge
AI	Aridity Index
APCBTMP	Andhra Pradesh Community based tank management Programme
APDAI	Andhra Pradesh Drought Adaptation Initiative
APFAMGS	Andhra Pradesh Farmer Managed Groundwater Systems
APMC	Agricultural Produce Marketing Committee
APSIDC	Andhra Pradesh State Irrigation Development Corporation
B2C	Business-to-Consumer
BIRDS	Bijapur Integrated Rural Development Society
BUA	Borehole User Associations
CA	Chartered Accountant
CAS	Crop Adoption Survey
CBO	Community-based Organisation
CCT	Continuous Contour Trenching
CEO	Chief Executive Officer
CRIDA	Central Research Institute for Dryland Agriculture
CRPs	Community Resource Persons
CS	Company Secretary
CSE	Centre for Science and Environment
CSO	Civil Society Organisation
CSR	Corporate Social Responsibility
CWB	Crop Water Budgeting
CWIK	Crop–Water Information Kiosk
DAC&FW	Department of Agriculture, Cooperation and Farmer Welfare
DDP	Desert Development Programme
DFID	Department for International Development
DPAP	Drought Prone Areas Programme
DPR	Detailed Project Report
EAP	Entrepreneurship Awareness Program
EBA	Ecosystems Based Adaptation
EC	Executive Committee
EVA	Environmental Viability Assessment
FGD	Focus Group Discussions
FIG	Farmer Interest Groups
FPC	Farmer Producer Company
FPO	Farmer Producer Organisation
FWS	Farmer Water Schools
GEC	Groundwater Resource Estimation Committee
GGP	Gram Gaurav Pratishthan
GIS	Geographic Information System
GMC	Groundwater Monitoring Committee
GP	Gram Panchayat
GSMS	Grama Sasya Mitra Samakhya
HMR	Hydrological Monitoring Record
HNSS	Handri-Neeva Sujala Sravanthi
HRIS	Habitation Resource Information System
HU	Hydrological Unit

HUN	Hydrological Unit Network
IAT	Institute of Agricultural Technology
ICAR	Indian Council of Agricultural Research
ICFRE	The Indian Council of Forestry Research and Educatio
IFFCO	Indian Farmers Fertiliser Cooperative Limited
IGWDP	Indo-German Watershed Development Programmes
IMD	Indian Meteorological Department
IMFU	Agromet Field Unit
IT	Information Technology
KVK	Krishi Vigyan Kendra
KWD	Karnataka Watershed Development
LRP	Local Resource Person
Mha	Million hectares
MIS	Micro-information system
MOTHER	Multipurpose Organisation for Training, Health, Education and Rehabilitation
MSMS	Mandal Sasya Mitra Samakhya
MYRADA	Mysore Resettlement and Development Agency
NABARD	National Bank for Agriculture and Rural Development
NGHS	National Family Health Survey
NGO	Non-Governmental Organisations
NGRI	National Geophysical Research Institute
NMSA	National Mission on Sustainable Agriculture
NPOF	National Project on Organic Farming
NREGA	National Rural Employment Guarantee Act
NRM	Natural Resources Management
ODK	Open Data Kit

PGM	Participatory Groundwater Management
PGS	Participatory Guarantee System
PHM	Participatory Hydrological Monitoring
PIA	Project Implementing Agency
PRA	Participatory Rural Appraisal
Rs.	Rupees
RSK	Raiyata Sampark Kendra
S3IDF	Small Scale Sustainable Infrastructure Development Fund
SC	Scheduled Caste
SCI	System of Crop Intensification
SFAC	Small Farmers Agribusiness Consortium
SHG	Self-help Group
SMG	Sasya Mitra Group
SOC	Soil Organic Content
SoI	Survey of India
SRI	System of Rice Intensification
ST	Scheduled Tribe
SWAP	Sub-Watershed Action Plan
SWSC	State-level Water Steering Committee
TMC	Thousand Million Cubic feet
UN-FAO	Food and Agriculture Organisation of the United Nations
UTs	Union Territories
VWSC	Village Water and Sanitation Committee
WASSAN	Watershed Support Services and Activities Network
WOTR	Watershed Organisation Trust

Executive Summary

There are a number of challenges in Indian agriculture including degraded land, depleting water resources and falling farmer incomes . To address these challenges, government agencies, civil society organisations (CSOs), philanthropies and bilateral agencies are funding and implementing a number of projects. There are many success stories too; cases where natural resources have been restored, solving for land degradation and water scarcity, while improving farmer incomes.

These successful CSO interventions have not always scaled as they were intended to. Interventions that worked in one place have not worked in another context. Reasons for this include starting from scratch instead of learning from others, disinterest in learning from failures and taking a one-size-fits-all approach to solutions. There is a need to relook at the way CSOs identify problems and approach solutions. What is needed are diagnostic tools that could help communities arrive at the solution more efficiently by learning from others.

In this project, we have developed a framework that maps pain points experienced by CSOs as they implement interventions in the farming process. Using a design thinking approach, we conducted journey mapping exercises with CSOs to understand their implementation challenges. We worked with CSOs and farmer collectives in arid and semi-arid regions of the Deccan Plateau, choosing them based on socioeconomic and biophysical variables.

Through this process, we have collated specific farming process challenges and CSO intervention challenges. For these, we have provided potential actionable solutions that any stakeholder in the ecosystem could implement. We have also collated research questions that need to be answered before solutions can be arrived at. Further, we compiled a subset of solutions that involve digital tools and frameworks, and the creation of a knowledge commons that CSEI has the expertise to further.

At the end of this journey mapping exercise, we propose the development of a paper toolkit that can guide CSOs on solutions to some of these challenges. We will begin the development of the toolkit, and pilot it with these CSOs to understand how effective the toolkit is in overcoming the challenges we identified.

For the pain points that don't have immediate solutions, we have identified a set of research questions that require additional research. We recommend the setting up of a research marketplace where we can provide the questions, for students, particularly masters and PhD candidates, interested in working on relevant and impactful research topics would benefit from this marketplace. This is a win-win for all parties involved, and could unlock key research insights for solutioning for CSOs.

PART I
Setting the Context

Before we present the case for a diagnostic toolkit to address problems in the agriculture sector, it is necessary to first understand the context.

There are a number of challenges in Indian agriculture including degraded land, depleting water resources and stagnating farmers incomes:

Degraded land

In India, 97.85 million hectares (ha) of land, roughly 30% of the country's geographical area, is degraded[1]. Almost 37 million ha, or a third of this land is classified as non-irrigated or rainfed, meaning the crops planted in these regions depend on the monsoons for water.

Unlike irrigated land, where crops are grown for a large part of the year leaving the topsoil covered, the top soil in rainfed regions is mostly exposed. This exposure causes the topsoil to erode over time, resulting in less fertile lands available for cultivation. Causes for degradation could be water erosion, wind erosion, increased salinity and alkalinity in land, and water logging.

Depleting water resources

In terms of water resources, groundwater levels across the country are severely depleted. Several blocks have extraction levels that are higher than the rate of recharge, putting populations that rely on groundwater for drinking purposes and agriculture at risk.

Stagnating incomes

Land and water resources are essential for agriculture, and any changes in the quantity and quality of either can severely impinge upon farm incomes. Land degradation, water scarcity and poor water quality have resulted in poor yields, affecting agrarian livelihoods and the country's food security.

While the average annual income per farm household (from multiple sources like wages, crop cultivation, farming of animals and non-farm business) has increased in the last two decades, there has been a sharp decline in income from crop cultivation during the same period.[2] This means that a large part of the farm income is coming from wages (like the household's participation in government schemes like NREGA), and farm animals.

Also, there are several inter-state and inter-district variations[3] that results in some districts having lower incomes or higher poverty status than others (*annexure 2*).

There are many success stories showing that natural resources can be restored and sustained, solving for land degradation and water scarcity, while improving farmer incomes.

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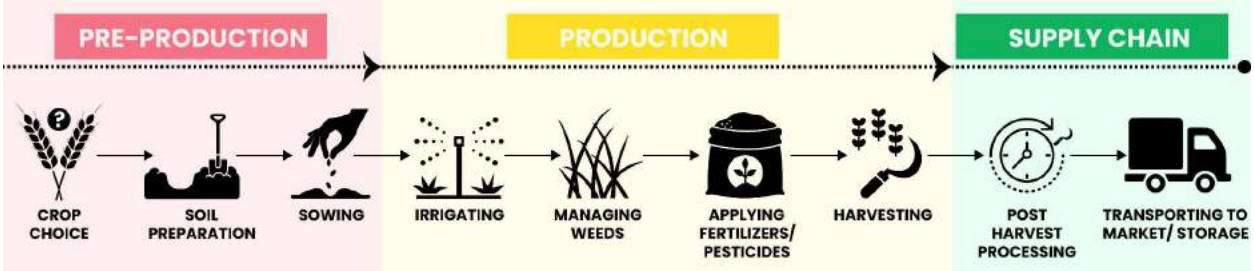
[1] Land degradation is typically defined as decline in productivity of land in terms of biodiversity and economy, resulting from various causes including climate and human induced factors.
[2] Narayanamoorthy, A. 2021. Why farm income in India is so low. *The Hindu Business Line*. Retrieved from: https://www.thehindubusinessline.com/opinion/why-farm-income-in-india-is-so-low/article37075687.ece
[3] The interdistrict variations have been spatially visualised in the annexure.

For example, watershed development activities have been implemented for decades now as a means to improve water availability for farmers. Agroforestry is also being implemented in some other regions to provide farmers with additional sources of income, apart from crop cultivation. We explain both these interventions in detail in the *annexure 4.*

Government agencies, philanthropic organisations, and CSOs have funded and implemented a number of these programmes to improve farmers' incomes, through multiple pathways that address challenges around different parts of the farming process.

The farming process involves a number of steps that farmers undertake to grow and sustain the crops on their farmland.

We have categorised these steps across three broad headings: Pre-production, production, and supply chain. Depending on the crops being grown, there may be minor variations, but most farmers follow most or all of the steps in a typical farming process illustrated below:.



We classified CSO interventions based on which part of the farming process they were attempting to influence.

Most of the CSOs we covered focus on addressing challenges along pre-production, production and supply chain, explained in more detail in *annexure 3.*

Some interventions focus on improving water availability (through the construction of check dams and farm ponds), some on value addition of produce and a few others on improving market linkages.

But there are problems of inefficiency and unintended consequences, which have limited scaling and replication.

These programmes have not always scaled as they were intended to; interventions that have worked in one place do not work in another context. This is because of a number of reasons:

1. **Duplication of effort --** There is a failure to leverage others' efforts because of a bottom-up approach to problem diagnosis. For example, a preliminary literature search on the Cauvery river basin – an area that extends over 80,000 sq.km covering Tamil Nadu, Karnataka, Kerala – revealed that 40 studies were done simultaneously in 2015. The studies covered interrelated themes including rural water security, climate impact, water-soil assessment and agriculture. Every time a CSO starts

working in a new area, they conduct a detailed primary data collection exercise and mapping. This is almost 80% of the project cost. If CSOs could share the data collected on public platforms, then other CSOs who enter these regions can leverage existing datasets instead of starting from scratch.

2. **Unintended consequences --** The intervention first approach to solutioning has prevented CSOs and philanthropic organisations from learning from failure. This has resulted in a repetitive cycle of doing and failing and unintended consequences that perpetuate inequity. Case in point is the intervention of desilting tanks for groundwater recharge. For one, the result of increased water levels could prompt farmers to switch to more water-intensive crops. Second, the benefit of applying silt for improved productivity is overshadowed by an equity implication. Even if the silt is available for free, the cost of transporting it from tanks to farms means that only rich farmers in a region can hire trucks to acquire the silt and improve the fertility of their lands.

This suggests that there is a fundamental need to relook the way we are approaching problem diagnosis and solutioning.

There are two challenges with current approaches to problem diagnosis and solutioning:

1. **The bottom-up approach for problem diagnosis:** Most CSOs arrive at the solution, from first principles, where they approach every problem from the bottom up. CSOs work from scratch and conduct a preliminary analysis of the area every time they enter a new region to work in. For instance, in Karnataka, one of the CSOs we focused on conducts a value chain analysis[4] everytime they want to set up a Farmer Producer Organisation (FPO) in a group of taluks/blocks. They do this to identify parts of the value chain that they can tackle through the FPO. The data for analysing this value chain is spread across multiple sources, and often all it takes is finding easy ways to place them on an open source platform.

2. **The intervention-first approach for solutioning:** Some CSOs and philanthropic organisations treat solutioning as 'intervention-first', meaning they approach a new community with their favoured solution rather than asking what problem needs to be solved. Gram panchayats work in collaboration with CSOs to help farmers collectively plan for crops or irrigate optimally by providing more accurate weather forecasts and so on. But these are not really scalable; they rely on years of deep engagement before the most suitable interventions are arrived at. Where this is not possible, the tendency is to simply replicate solutions that have worked elsewhere. But these often fail because there is no understanding of the conditions for replicability and scalability of solutions -- the so-called 'what works where and why' question.

Both these approaches (intervention-first and bottom-up) have resulted in crores being invested in programmes that often cause unintended consequences -- improving a few aspects of the value chain, while worsening others.

[4] The CSO evaluates each activity in the value chain, in this case, the different stages of the farming process, to understand where there is scope for improvement.

Moreover, problem solving is not efficient. Solutioning is not allowing us to move the needle fast enough -- we still don't know what works best and under what conditions -- there is a lot of trial and error.

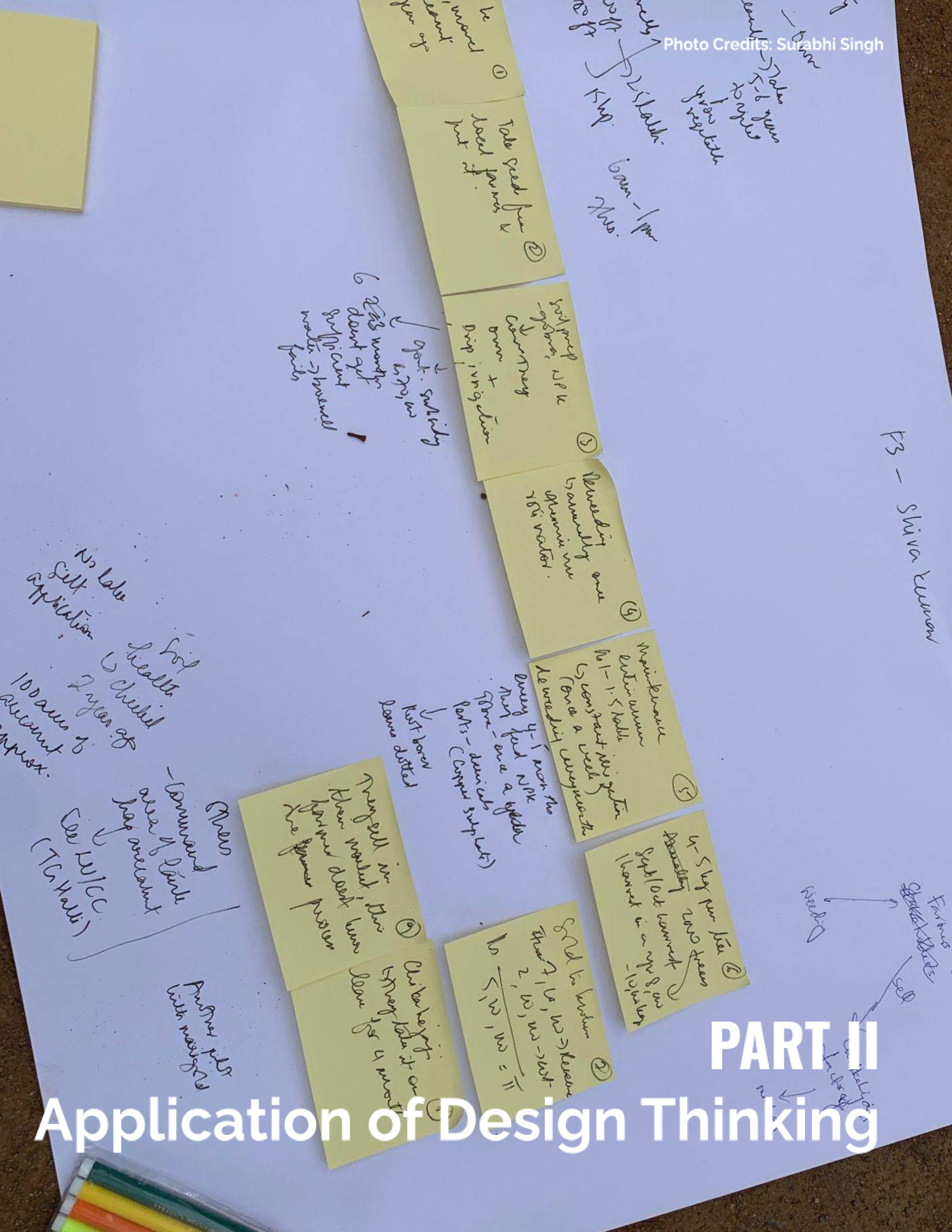
In summary, CSOs engage in a trial and error process leading with solutions that have worked elsewhere when they enter a new area, rather than asking, 'what is the problem here and which solutions might work best', indicating very little cross learning.

What is needed are diagnostic tools that can help communities arrive at the solution more efficiently by learning from others.

In arriving at a problem diagnostic toolkit, the primary challenge is comparability, because CSOs provide solutions for different parts of the farming process.

Decision support tools that build on work done can help identify what options are likely to work based on the geology, rainfall patterns, prevailing cropping practices, culture etc.

In this project, we have developed a comparative framework that mapped processes, actors, pain points and interventions, sampling across diverse geographies to understand what interventions are being implemented to address what challenges, and what the conditions are under which they are succeeding or failing. The next section details the framework we followed.



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PART II
Application of Design Thinking

We developed a comprehensive framework to arrive at the CSO's pain points using design thinking tools.

Design thinking is a problem-solving approach meant to clearly define challenges faced by different stakeholders involved in a project/process and work towards innovative solutions. The advantage of using design thinking tools is that it allows us to adopt a user-centric approach to problem diagnosis and solutioning. It also enables us to be more agile, helping us hypothesise, prototype, pilot and re-do the process quickly.

CSOs work across a range of geographies. They intervene by influencing multiple actors at different points in the farming process. They face different pain points, at different stages of their intervention journey. Because we are developing the guidebook for CSOs, we interviewed them using qualitative methods. Design thinking toolkits were helpful in organising our ideas.

We sampled CSOs across a range of geographies covering socio-economic and biophysical variables of interest in the Deccan Plateau.

The Deccan Plateau covers a large area of peninsular India. Bordered by the mountain ranges of Eastern and Western Ghats on either side and the Narmada river to the North, the Deccan Plateau is largely a hard rock terrain - with basalt terrain on the north-western side and crystalline rocks in most of the other parts. This means that groundwater availability is limited in the Deccan Plateau and its occurrence is confined to fractured and weathered zones.[5] In addition, being in the rain shadow region, the plateau gets far less rainfall than both the Ghats and coastal areas beyond them - making large areas semi-arid and arid.

We focused on four states in the Deccan Plateau - Karnataka, Maharashtra, Andhra Pradesh and Telangana, and within these states we collaborated with CSOs working in arid and semi-arid regions, where a large percentage of farmers practice rainfed agriculture.[6] These regions, owing to their geographic and climatic features described above, are largely water constrained.

We used four key indicators to identify regions of interest/districts:

Indicator	Aridity index (Annual)	Percentage of rainfed cropped area	Landholding size	Multidimensional poverty index
Brief description	To understand the degree of dryness of climate in a region.	To understand the extent to which farmers in a region rely solely on rainfall as a source of water.	To understand farmers' profiles in the study regions.	To understand the levels of deprivation in health, education and living standards
Source	CGIAR-CSI Global Aridity Index (version 2)[7]	Census of India 2011	Census of India 2011	Niti Aayog's Multidimensional Poverty Index Baseline Report based on National Family Health Survey (NFHS) 2015-16

[5] https://www.geospatialworld.net/article/gis-aiding-groundwater-recharge-in-hard-rock-terrain-area/
[6] Since the journey maps involved field work, and there were COVID-related travel restrictions, we focused on states where we had team members.
[7] Trabucco, Antonio; Zomer, Robert (2019): Global Aridity Index and Potential Evapotranspiration (ET0) Climate Database v2.

Due to climate change, depleting groundwater levels, surface water storage and failing irrigation canal infrastructure, these arid and semi-arid regions are frequently affected by drought events, especially in the last two decades. This has severely impacted the livelihoods of small and marginal farmers earning meagre incomes from agriculture. Farmers are trapped in a vicious cycle of debt, forcing them to give up their land and work as migrant labourers in urban areas or else commit suicide. These four indicators allowed us to naturally focus on areas of need.

For more details on how districts in each of the states perform across these indicators, please refer to the *annexure 2*.

We considered key actors that CSOs interact with - farmers, market-facing organisations and government agencies.

We focused on three sets of stakeholders because, early on in our work, we realised that water challenges are only part of the problem. When a farmer makes a water decision, that decision is often driven by many other factors like crop choice, which in turn is determined by the market value of the crop at the time of sowing. So, we cannot study water challenges in isolation. Even in cases where water is not a problem, there are still other challenges related to labour, which is either expensive or unavailable or both; or market price variability, which threatens the income security of farmers.

For instance, in Anantapur district, farmer communities have resolved the water shortage problem through protective irrigation methods.[8] However, they still haven't been able to resolve challenges related to market volatility. In this case, farmers' income is not as impacted by water, as it is by fluctuations in market prices.

We conducted journey mapping exercises[9] with the key actors to map the pain points across the CSO's journey.

A journey map is a visualisation of the processes that an individual/organisation undertakes to accomplish a goal. Here, the goal is to improve farmers' livelihoods while managing water resources sustainably, and the process refers to the interventions that CSOs implement in order to achieve this goal.
We chose this method and these stakeholders because:

1. **The richness of qualitative discussions:** Journey mapping is a qualitative exercise, which means that the maps we develop are based on in-depth conversations with the stakeholders whose journeys we map. The types of challenges we are trying to solve in the water for agriculture space are complex and interconnected. A simple quantitative survey may be insufficient to capture all the information effectively, and in a way in which we can move towards solutioning. Journey mapping can help bridge this gap.

2. **A collaborative approach to problem solving and solutioning:** Through detailed discussions with multiple stakeholders around the same sets of challenges, we have

[8] This will be discussed in detail in the upcoming sections.
[9] For more on journey maps, please refer to annexure 1.

been able to clearly identify the steps that these stakeholders undertake in their daily journey, the key pain points they faced at each of these stages and more importantly, their opinions on effective ways to resolve these challenges so that they can continue to profit from their agricultural activities in the short and long term.

Developing journey maps are highly collaborative processes, which means that the stakeholders are involved in every step and the journey maps are validated with them once they are developed. This collaborative process has helped build a deep sense of empathy in the team that worked with these stakeholders, including farmers, Farmer Producer Organisations and Civil Society Organisations. This process helped us understand how each of these actors make or influence decisions around crop choice and water management, thereby paving the way for innovative solutions.

The CSOs we have included in this report include:

Telangana & Andhra Pradesh

- Watershed Support Services and Activities Network (WASSAN)
- Accion Fraterna Ecology Centre (AF Ecology)

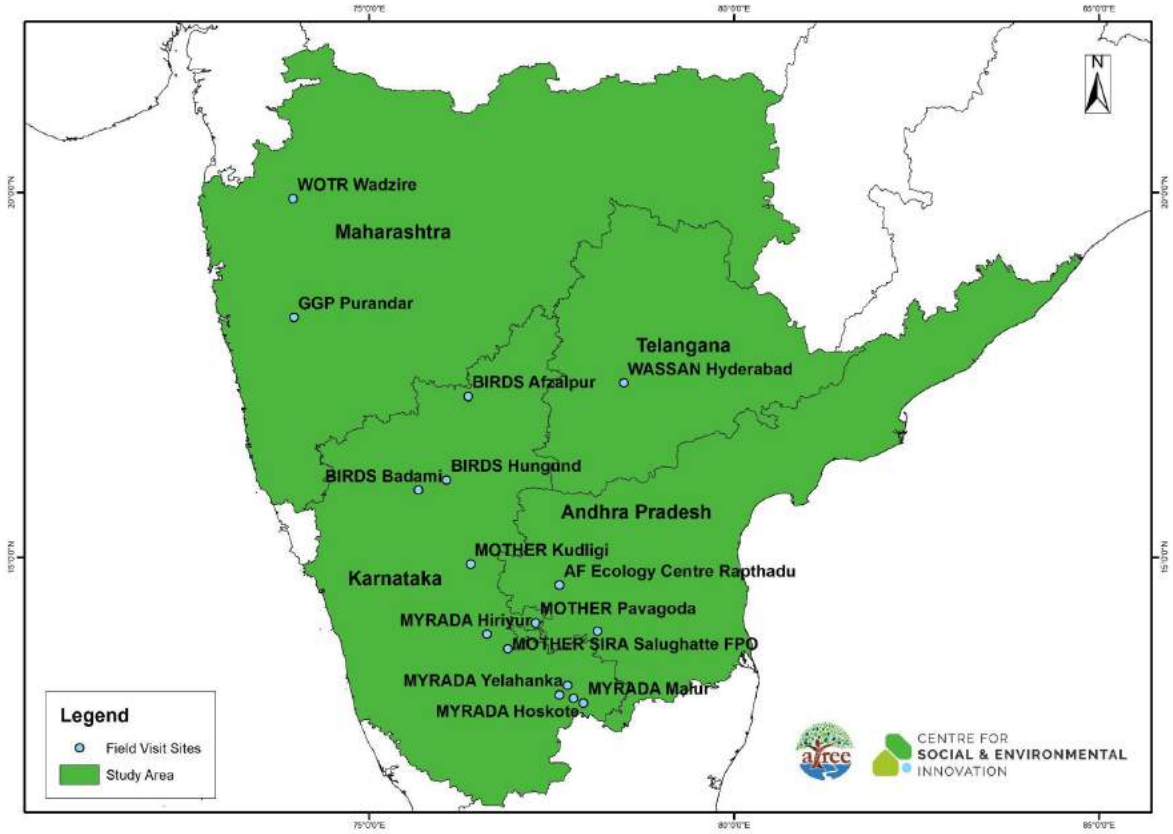
Karnataka

- Multipurpose Organisation for Training, Health, Education and Rehabilitation (MOTHER)
- Bijapur Integrated Rural Development Society (BIRDS)
- Mysore Resettlement and Development Agency (MYRADA)

Maharashtra

- Watershed Organisation Trust (WOTR)
- Gram Gaurav Pratishthan (GGP)

We also included two case studies that shed light on successful interventions: the APWELL project in Andhra Pradesh and the Abhinav Farmers Club in Maharashtra.



Location of CSOs and field visits

For each CSO, we documented the journey map of one or more of their more interventions to understand what are the steps involved in implementing the interventions, who are the stakeholders involved, how much time and money does it take to implement each step of the intervention and what pain points were experienced during implementation at each step.

The interventions we covered through these discussions include:

1. Agroforestry
2. Agromet advisories
3. Crop water budgeting
4. Farmer Producer Organisations
5. Low-input farming methods (SCI and organic)
6. Protective irrigation
7. Watershed management activities (supply-side)

For more details on each of these interventions, please refer to annexure 4.

Photo Credits: Pranuti Choppakatla

PART III
CSO Journey Maps

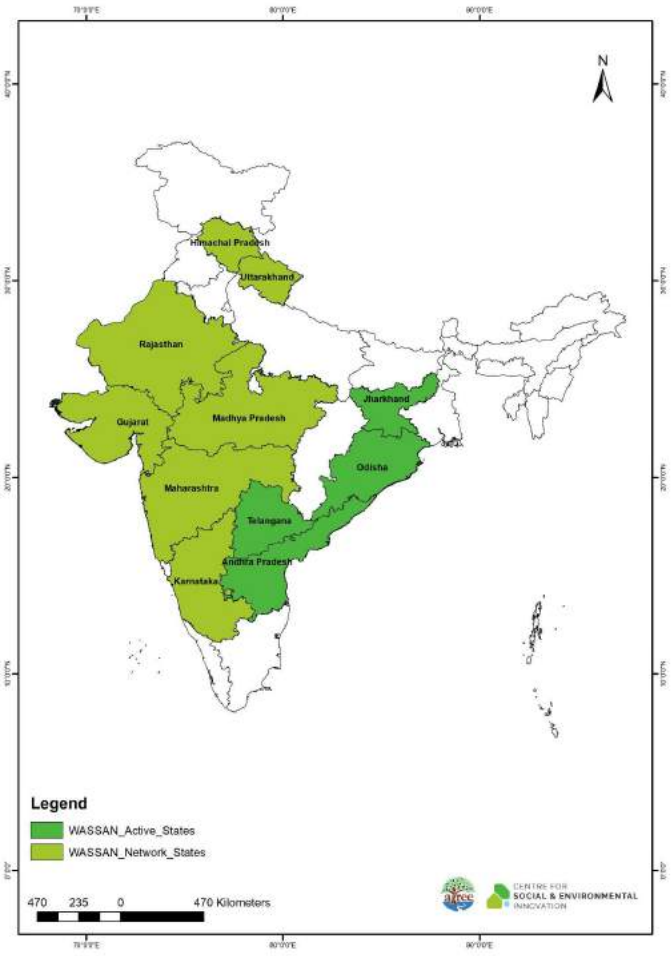
Andhra Pradesh & Telangana

Andhra Pradesh & Telangana

WASSAN

Watershed Support Services and Activities Network

Formed in 1996, WASSAN is a network of different CSOs engaged in participatory watershed development programmes. Their mission is to improve the livelihoods of deprived communities in drought-prone areas, by strengthening Natural Resources Management (NRM). They interface between government agencies and actors on the ground, innovate new processes and build capacity among the stakeholders involved. They have also created networks like Revitalising Rainfed Agriculture Network (RRA Network) and National Coalition on Natural Farming (NCNF) to convene and facilitate cross learning between stakeholders. WASSAN is also involved in WASH, the promotion of solar energy pumps, revival of millet production and consumption, millet processing, promotion of indigenous cattle breeds, community-managed natural farming techniques and seed systems. The focus of WASSAN's journey map is crop water budgeting.



WASSAN and Crop Water Budgeting

WASSAN acts as a knowledge partner for facilitating water budgeting and water security planning. Many government-funded schemes like Jal Jeevan Mission and Atal Bhujal Yojana, as well as watershed interventions helmed by private organisations in the rural sector, prioritise water security planning and water budgets. An understanding of water budgets and underlying hydrologic processes provides a basis for effective water resource management and intervention planning.

WASSAN has designed a process for crop water budgeting and scaled this via 32 projects under the Indo-German Watershed Development Programmes (IGWDP) from 2008 till 2015. These projects were implemented by 12 NGO partners in Medak, Warangal, Adilabad and Karimnagar districts. Acting as an important knowledge partner, they have also published resource materials on water budgeting to share their experience with other CSOs.

About the Journey Map

This first journey map captures how WASSAN carries out water budgeting for a village or group of villages. It documents the stakeholders and resources involved in each activity, the time it takes and the main challenges or pain points they encountered. Detailed primary and secondary data are required to develop accurate crop water budgets. From this journey map, it is evident that the CSO invests maximum time and financial resources in putting this data together from scratch, when they enter a new region of interest. Multiple stakeholders are involved in conducting crop water budgeting with farmers at the helm after undergoing training. Conducting this exercise themselves helps promote transparency and enables farmers to be an active participant.

Journey Map: Crop Water Budgeting

Stage	Step 1: Preparatory			Step 2: Stakeholder engagement
	Training of facilitators	**Data Collection (P+C)**	**Communication**	**Meeting with VWDC**
CSO activities	To identify and train facilitators and watershed supervisors, implementation partners on crop water budgeting	• Map aquifers in the region • Establish a water monitoring network • Assess water levels of borewells, open wells • Document surface water bodies' features including area, depth at different locations during different seasons, frequency of filling up • Track seasonal fluctuations in net groundwater draft • Collate information from secondary sources on rainfall patterns, aquifer features • Estimate groundwater recharge by following the process set by CGWB (refer to 2016 GEC norms).	• Create standard templates and formats for the crop water budgeting process • Prepare and disseminate communication material (flexies, posters or pamphlets) to improve awareness on water management and collective action.	• To cross-check data collected from secondary sources with village leaders. • Transect walk along the village to visit water harvesting structures, identify cropping patterns in the village • Discuss primary data collected about water availability, spread, storage and flows. • Understand trends in water use and agricultural practices in the village.
Stakeholders	• Facilitators • Watershed supervisors • Implementation partners (CSOs, government officials etc.)	• One volunteer to collect data about each watershed (500 ha) • Data analysts	• Communication experts • Translators (regional language) • Designers • Subject-matter experts	• Members of VWDC • Village elders • Community Resource Persons • Facilitators
Timeline	1 week	50 days for 10 watershed (500 ha)	1-2 weeks	4 to 5 hours
Resource	• Funding to organise training sessions • Reference material to distribute among facilitators	• Funding for field visits • ODK forms for data collection	Funding for developing communication material	
Output	Trained facilitators for every watershed	Documentation of primary data necessary for water balance calculation	Communication material to spread awareness among the community	A comprehensive understanding of the hydrology of the region
Pain points	Lack of adequate training material for data collection and crop water budgeting.	It takes up a lot of time and resources to digitise the data collected (such as geotagged plot boundaries, cropping patterns, location of surface water sources)		

Journey Map: Crop Water Budgeting

Stage	Step 2: Stakeholder engagement Meeting with Farmers	Step 3: Awareness Building & Decision Making	Step 4: Implementation
CSO activities	• To capture decadal changes (water availability and use, green cover, cultivated land, crop types, machines used for lifting water - open wells, bore wells, diesel pumps) • To estimate water balance based on secondary and primary data collected • To document cost of cultivating major crops, yield and income This is linked to water consumption patterns for each crop • To map water requirements (pumping hours) against net income • To discuss results of water balance analysis, general beliefs about water, changing market rates, etc. (Farmers are split into 2-3 groups, based on major crops grown in the area, to conduct this discussion. Large posters are used for this exercise.)	Workshop held with all stakeholders at the Gram sabha • To present all the data collected and cross-checked (water balance, trends, crop productivity per unit of water) • To debate findings, methodology to estimate water requirements • Farmers who did the water balance exercise explain the logic or rationale behind each step to the gram sabha. • To discuss potential profits of shifting from intense to critical irrigation (need a footnote explaining this)	Based on the discussions in the Gram sabha • Farmers voluntarily shift from low income-high water use crop (eg: turmeric, onion, brinja, etc.) to high income-low water use crops (eg: red gram, green gram, bengal gram,etc.) • Farmers adopt water management strategies like critical irrigation
Stakeholders	• Farmers • Community Resource Persons • External Facilitators	• Supervisors • Facilitators • VWDC members • Gram panchayat • Farmers • Women's collectives or SHGs	• Farmers • Gram panchayat • Farmer's collectives (like FPOs)
Timeline	1 - 2 Days	1 Day	1 agriculture season (atleast)
Resource	• Flex sheets (large posters to display information) • Funds to conduct the workshop (venue, communication material etc)	Funds to conduct the workshop (venue, communication material etc)	Enabling infrastructure to implement and sustain water management strategies
Output	To prepare communication material and to introduce to farmers that crops that consume more water do not necessarily give higher income.	Underline two messages to inform decisions on water management and crop choices: • Higher water consumption does not mean higher income *(as raised in the workshop in the previous stage)* • There is negative water balance in the village - more water is pumped that allowed to percolate into local aquifers	Improved management of water resources.
Pain points	• Farmer lose trust in the process if the water budget is inaccurate and not serving any purpose to them • Lack of data (rainfall, groundwater and surface water level, etc.) and subject-matter experts for conducting crop water budgeting.	• Resistance to drafting and signing legally-binding agreements on water sharing and cropping patterns • Limited scope of meetings means that farmers are unable to raise other pressing concerns like establishing new market linkages for alternative crops.	Due to a lack of enabling infrastructure such as market linkages for less water-intensive crops, farmers are unable to adhere to promises made.

The CSEI team at Anantapur, Andhra Pradesh. Photo credits: Manjunatha G

Summary of Pain Points

Here, we list the different pain points against the farming issue, list possible solutions and outline future lines of inquiry

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Topics
Pre-Production (Crop Choice, Soil Preparation, Sowing)				
Farmers don't have access to information to decide which crops to grow as per water availability and climatic conditions.	CSO facilitates crop water budgeting exercise before the start of an agricultural season in a village	Crop water budgeting requires lot of data, time and skilled manpower: • CSOs lack access to open source digital tools and skilled personnel to process and archive the data they collect for future use • Lack of data-sharing mechanisms among CSOs and other stakeholders leads to information loss, duplication of efforts	• Open access digital tools to collect primary data and calculate water budgets by analysing primary and secondary data. • Data sharing platforms for CSOs to share data about crop water budgeting exercises they facilitated.	• Data quality standards for publicly/crowd sourced datasets relevant for crop water budgeting
For farmers, financial viability is the sole driver for choosing the crops they grow in a particular season without collectively thinking about long-term sustainability of natural resources	CSO provides farmers with a list of crops that require less water but can ensure higher profits.	• Crop water budgeting alone cannot motivate farmers to grow crops as per water availability and climatic conditions. Farmers also require adequate market linkage for less water-intensive crops. • The panchayat, water user associations and VWDC lack the mandate to put this system in place.	• Include a focused discussion on establishing market linkages for recommended crops in the Gram Sabha. Involve FPOs or FPCs, government mandis officials in the discussion as well. • Collate block/district wise list of less water-intensive and high value (nutritional, etc.) crops to plan for market linkages.	• How can we incentivise or support farmers to grow less water intensive crops? • How to increase the demand for less water intensive crops among consumers?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Topics
Production (Irrigation, Fertilisers, Pesticides, Harvest)				
There is no metering of water used by individual farmers which creates mistrust.	CSOs estimate water consumption at the end of the season using parameters like crops grown, size of the land, total pumping hours etc.	Equipment to measure groundwater levels, agriculture run-off, evapotranspiration and flow sensors are not easily available for farmers. It is also unprofitable for farmers to invest in such water monitoring devices because they hold smaller tracts of land.	• Innovate low-cost solutions for measuring real-time water consumption at farm and village scales. • Establish appropriate communication channels to disseminate this information to farmers.	How can we assess crop water consumption at farm scale using low cost IoT devices?
Farmers don't adhere to budgeted irrigation water requirement due to lack of timely irrigation advisories	CSOs, and the experts they bring in, discuss irrigation requirements of different crops with farmers before the start of an agriculture season.	Farmers need information specific to their farm condition, crop growth stage and weather conditions to optimise their water use pattern.	Issue farm-scale irrigation advisories along with seasonal crop water budgets so that farmers can act upon the information given to them and change their water use pattern.	How to design a bottom up irrigation advisory service where marginal farmers have a say in the advice they need and when they need it?
Failure to comply with new, more sustainable practices.	CSOs facilitate Gram Sabha discussions. The decisions made here are taken based on mutual trust and consent.	Lack of legal water sharing agreements, graduated sanctions for violators, untimely renewal of water budgets and delayed resolution of disputes between farmers affects shifting to new practices.	• CSOs should facilitate legal water sharing agreement between water user groups and plan for timely resolution of disputes. • Since a community's social structure varies across regions, there is a need to consider how government rules and regulations can sustain an intervention.	• How can we enable existing rural institutions like Water User Associations, FPOs, etc. to create rules for water sharing and draft legal water sharing agreements based on them? • Analysis of case studies where water sharing rules and practices, dispute management, legal water sharing agreements have been implemented.

Conclusion

Apart from the pain points mentioned above, CSOs also struggle to adopt a systemic approach for solving the issues in the agriculture value chain. For instance, to establish market linkages for less water-intensive crops, we also need to think about increasing the demand for those crops among consumers. It is critical to consider dependencies and interlinkages across sectors while designing any intervention and devise strategies accordingly.

Another important takeaway is that CSOs also struggle to sustain the practices or activities introduced by them, once they exit a region. This is mainly due to the lack of a clearly defined exit strategy which can facilitate gradual handover of the process to the farmers or other institutions. The expertise of external facilitators and the financial resources to bear the cost of activities like conducting annual water budgeting workshops are limited once the CSO moves out.

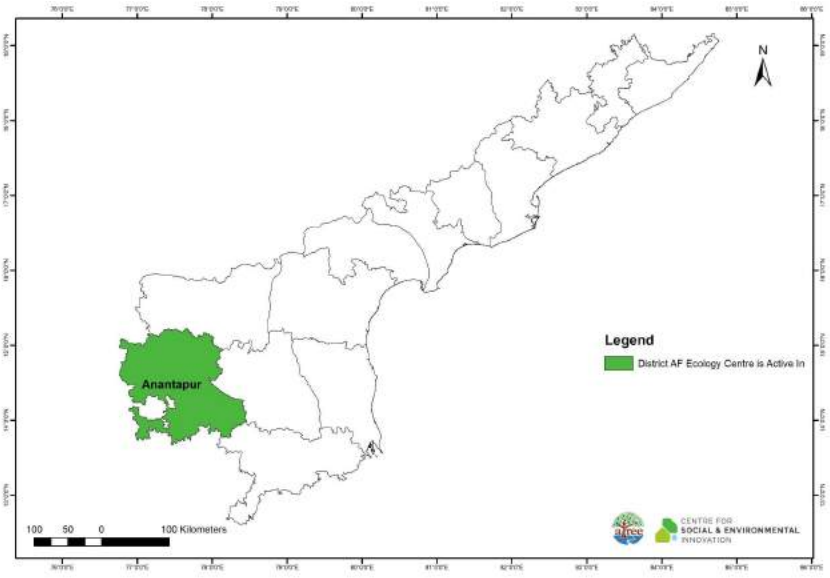
We need to come up with better strategies to sustain the intervention and also facilitate cross-learning between organisations working in regions with similar challenges.

Andhra Pradesh & Telangana

AF Ecology Centre

Accion Fraterna Ecology Centre

Accion Fraterna (AF), also called AF Ecology Centre, aims to empower rural communities through natural resources management (NRM), community-managed natural farming practices, watershed development, policy advocacy and vocational training. Much of their work is concentrated in Anantapur district where, since 1986, they have been implementing one of the largest watershed development programmes in India. Anantapur is an arid, drought-prone and entirely agrarian economy. About 90% of 27.5 lakh acres under cultivation is rainfed and chronically drought-prone. There are also no industrial employment opportunities and the available rural livelihood opportunities here are highly vulnerable. Their solution of protective irrigation, which addresses the crisis of water scarcity faced by rainfed farmers in the region, is the focus of this journey map.



AF Ecology and Protective Irrigation

Studies have shown that even one dry spell, i.e. 20 to 30 consecutive days of no rainfall, can cause a drought. In dry, semi-arid regions like Anantapur, prolonged dry spells during the growing season often leads to crop failure. One way of preventing about 80% of such crop failure is through protective irrigation, a practice by which water is sparingly supplied to fields during a drought, particularly during crucial periods of plant growth (Annual Report 2017-18).

AF Ecology has been promoting protective irrigation in Anantapur, as it provides a safety net for rainfed farmers in drought-prone regions where there isn't sufficient water to ensure all farmers have unfettered access to irrigation. It thus addresses the problem of inequity, as irrigated farmers are successful and rainfed farmers are left with nothing if the rain fails. Protective irrigation involves a package of interventions from choosing less water-intensive crops, farming practices like mulching, etc. to organising transport of water from the source to the fields. We explain this intervention in detail in annexure 4.

About the Journey Map

This journey map illustrates how AF Ecology introduces protective irrigation to a new mandal. The whole process begins with secondary research so that they can identify water-stressed regions that would benefit from this intervention. The journey map shows how a major part of introducing this intervention involves discussions and meetings with stakeholders, including Sasya Mitra Groups (SMG). These are farmers' groups that plan, implement and monitor the project, and so is key to its success. Open forums with early adopters from other mandals are also important because they help inspire the confidence of new farmers. Then, farmers who sign up are provided with protective irrigation for that crop season.

Journey Map: Protective Irrigation

Stage	Step 1: Data collection and analysis	Step 2: Stakeholder engagement	
CSO activities	• Collect and analyse primary and secondary data (groundwater level, rainfall, land use land cover, elevation, soil type, demography, etc.) to assess water stress. • Carry out baseline research to identify water-stressed mandals that would benefit from protective irrigation.	Create or identify existing Sasya Mitra Groups (SMGs)[10] and arrange meetings with the convenors where they introduce the idea of protective irrigation to SMG representatives and ask them to help them communicate it to the farmers in the mandal.	Identify early adopters from other mandals, who have benefited from protective irrigation and are ready to share their experience in an open forum.
Stakeholders	• CSO (mainly technical experts to analyse the primary and secondary data)	• CSO (Facilitators to liaise with SMG representatives) • SMGs	• CSO • FPO • SMG • Farmers (early adopters of protective irrigation)
Timeline	2-3 months	1 week	Half day
Resource	Funding for data collection and analysis		
Output	List of mandals that require protective Irrigation	SMG representatives understand the utility of Protective Irrigation.	Early adopters will act as community resource persons.
Pain points	Lack of data particularly in terms of rainfall and soil quality because there aren't enough rain gauges and soil testing facilities at the mandal level	Creation of SMGs in the mandal, if there are no existing ones, requires additional time and resources.	

[10] SMG (Sasya Mitra Groups): Sasya Mitra Groups are farmers groups who plan, implement and monitor the projects such as the introduction of protective irrigation. Each SMG consists of 25 members representing the families of which 13 are women. In terms of protective irrigation, they identify institutions in the village that can coordinate with the CSO and transport water from the source to the fields. They also coordinate with the farmers to ensure that they can pay for this service.

Journey Map: Protective Irrigation

Stage	Step 3: Awareness Building	Step 4: Implementation
CSO activities	• Organise open forums to discuss the benefits of protective irrigation. • Explain the constraint on crop choice (dry crops, drought resistant varieties) under this method. • Early adopters share their experience of shifting to protective irrigation with the farmers. • Explain the cost sharing process to the farmers interested in adopting protective irrigation.	• Help the farmer in crop choice (dry and drought resistant crop varieties). • Set up protective irrigation for rainfed cropland using different methods, i.e. supplying groundwater or surface water through pipelines or tankers[11] or sprinkler systems) based on farmers' requirements. • Provide the service to farmers through rural institutions like FPOs.
Stakeholders	• CSO • FPO • SMG • Farmers	• CSO • FPO • Farmers • Farm labourers (if necessary) • Workers to set-up and maintain the protective irrigation infrastructure
Timeline	Half day	All through the cropping season (whenever necessary)
Resource	• Communication material including videos to inspire farmers. • Funding for organising open forums, workshops, cover travel expenses etc.	• Tankers • Equipment such as micro irrigation tubes, water pumps
Output	Mutual trust is built among the CSO, FPO, SMGs and farmers.	Protective irrigation given to the farmers in need.
Pain points		• Inadequate water sources: Severe drought year, delayed release of water from reservoirs (in this case, Srisailam reservoir through HNSS project) means there is too little water to draw from. • Labour: One way water is supplied under protective irrigation is through furrows. The labour cost of digging them is high, so farmers are hesitant to adopt this.

[11] In Anantapur some farmers are receiving protective irrigation through Handri-Neeva Sujala Sravanthi project. It periodically fills the village surface water bodies with water supplied through the canal networks and plans to irrigate 6 lakh acres in the 4 districts of Rayalaseema region.

Summary of Pain Points

Here, we list the different pain points against the farming issue, list possible solutions and outline future lines of inquiry

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Topics
Production (Irrigation, Fertilisers, Pesticides, Harvest)				
Inadequate water for rainfed crops in semi-arid areas.	Protective Irrigation (surface water)	• Limited reach of current government inter-basin water transfer projects, like Handri Neeva, to facilitate filling of surface water bodies in villages. • Delays in releasing the water into the canal at the right time, thereby missing the crucial spells of protective irrigation.	• Re-design irrigation canal projects to supply water first to the village tanks and then to the individual farmers in the canal command area. • Plan for releasing excess water to the surface water bodies as per the actual crop water demand in the watershed.	Analyse how water can be equitably distributed in semi-arid areas by supplying water from reservoirs to the shared surface water bodies.
Farmers not adhering to the water sharing practices.	Farmers arrive at a decision to share water in the open forum conducted by CSOs.	• In times of severe drought owners of farm ponds and borewells break the mutual consent to share water. • Water sharing decisions are not being revised in a timely manner creating disputes among water users.	• Create awareness to use groundwater as a common pooled resource. • CSO and FPOs to create a district/mandal/block-wise drought contingency plan. • Plan for timely renewal of water sharing decisions.	How can farmers be encouraged to adhere to water sharing decisions made by them?
Farmers don't switch to less water-intensive crops.	CSO mandates farmers to grow less water-intensive crops to utilise the protective irrigation.	Due to very low market value for most of the less water-intensive crops, it's difficult to get farmers to crop them.	• Campaigns and incentives for advocating less water-intensive crops • Try to set an MSP and ensure an FPO can procure the produce. • Set up a processing unit to create value added products that have higher market value.	How to change behaviours among farmers to adopt less water intensive crops and irrigation methods?

Conclusion

AF Ecology works in one of the most drought-prone regions in the country so their work regarding protective irrigation is vital. But the failure to release water from reservoirs in a timely manner during periods of severe water scarcity can lead to impacts even when prudent water conservation practices like protective irrigation are at play.

This journey map also shows that there are issues in terms of behaviour change as well, calling for better awareness-building campaigns and incentives for farmers to shift to less water-intensive crops. As we mentioned in the previous chapter on WASSAN, system-wide solutions related to market linkages are also key. Going forward, AF Ecology plans to set up processing centres to produce value-added products such as sauces and pickles, as well promote non-farm activities (like livestock rearing, agri-tourism) that can bring in income and improve the livelihoods of the farmers.

Case Study

Participatory Groundwater Management

in Telangana & Andhra Pradesh

Participatory groundwater management in Andhra Pradesh's rainfed areas started with the setting up of **20,000 community borewell irrigation schemes** by the Andhra Pradesh Irrigation Development Corporation (APSDIC) from 1974 to 1994. Buoyed by its success, APSIDC proposed the Andhra Pradesh Borewell Irrigation Scheme (APWELL Project), with funding support from the Netherlands government.

- ***Timeline*:** 1995 - 2003
- ***Area, demography*:** 14,000 ha of irrigated land
    - 370 villages
    - 7 of 8 drought-prone AP districts
    - 14,500 marginal farmers
- ***Activities*:** Watershed conservation, recharge enhancement, community wells and distribution systems, provision of electricity, sustainable agriculture

Community borewell used by farmers in Gorantla Varipalli village in Anantapur district. Photo Credits: Surabhi Singh

Under APWELL, **Participatory Hydrological Monitoring (PHM)** and Artificial Groundwater Recharge (AGR) were launched in 2001 to ensure the sustainability of small-holder wells

- Under PHM, 3,450 Water User Groups, 600 women's Self-Help Groups, 250 Groundwater (Borewell) Users Associations were trained to measure rainfall, well water level and discharge, stream discharge.
- Crop water budgeting was introduced after one year's worth of data (about the above parameters) became available:
    - Methodology developed collaboratively with farmers, district-level functionaries (i.e. of implementation partners such as government department, CSOs, think tanks)
    - Crop–water budgeting spreadsheets were refined and field-tested at eight hydrological units in 2002.

The PHM model was path breaking as it introduced farmer-friendly methods for data analysis and established farmer-scientist partnership to sustainably manage groundwater resources.

After the APWELL project ended, **APFAMGS** was established in 2006 (with UN-FAO funding) to fine-tune APWELL's work regarding PHM, artificial groundwater recharge, crop–water budgeting and field-testing of new approaches through Farmer Water Schools, Habitation Resource Information System and the crop–water information kiosk.

About Jana Jaagriti Foundation, *APWELL's implementation partner*

Even after completion of the APWELL project in 2003, JJF, based in Anantapur district, continued to adopt the standard practices and tools developed by the project team.

According to D.P. Balram, CEO of the foundation, around 500 bore wells were dug in Anantapur district alone as part of APWELL. The process developed[12] by the APWELL team, helps them keep track of the groundwater balance in a region.

He explained the process of implementing participatory groundwater management in a watershed:

- **Water User Groups** (comprised of mostly the youth in an area) formed for well monitoring
- **Water indicator tool** used to measure water levels in each borewell
- **Yield test** done to understand how much water is being pumped
- **Percolation sources**[13] for groundwater recharge are also monitored

Sri D.P. Balaram
CEO, Jana Jaagriti

'Only 11% of rain water infiltrates into groundwater in this region. Based on this assumption, we estimate the amount of percolation. Then, we balance this against actual usage to understand if farmers are over-using a particular borewell. Through this process, we were able to prove to farmers that they are over-exploiting borewells and we come up with demand-side water management strategies like reducing the extent of crop area, cropping less in the summer, switching to drylands crops, etc.

It took us around 4 years to convince the farmers to switch to less water intensive crops. We told farmers, if they don't practice this, they will eventually keep digging wells but not get water out of it.'

The CSEI team at MC Thanda village near Anantapur, Andhra Pradesh. Photo Credits : Tanvi Agrawal

CSEI Field Notes

The CSEI team visited a tribal village, **Mulakala Cheruvu Thanda**, near Anantapur where Jan Jagruti implemented participatory groundwater management through APWELL. Farmers told us that they had no source of groundwater in the village and that they depended solely on rainfall for irrigating their crops. As farming failed due to the lack of water, most villagers were forced to move to cities and seek work.

After the APWELL team thoroughly studied the aquifer here, they suggested ways to tap groundwater from the subsurface zone. They dug many community borewells, constructed a subsurface dam in the village and got electricity connection for the pumps as well.

After this intervention, farmers started growing crops in two agricultural seasons which boosted their income. Farmers were also trained to do the water budgeting exercise collectively, so that they can plan their cropping pattern as per the availability of water in the region. They told us that they still continue to have these discussions before every cropping season. While many community borewells are still functional, the increase in income has prompted some farmers to dig their own borewells. This is a worrying trend that needs to be kept track of.

[12] Using Microsoft Excel, APWELL evolved a process to track crop–water budgeting. The spreadsheet, containing 10 worksheets, was in the local language as the end users were farmers.
[13] Percolation refers to the movement of the water through soil and permeable rocks. The water flows to recharge the groundwater in the water table and aquifers.

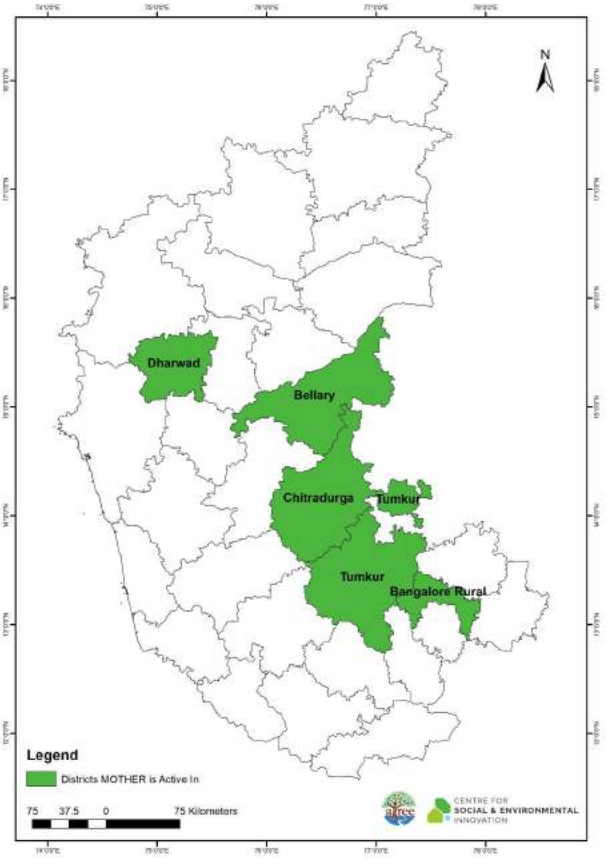
Karnataka

Karnataka

MOTHER

Multipurpose Organisation for Training, Health, Education and Rehabilitation

MOTHER was established in 1995 in Tumkur 'to develop and empower the poorer section of society and bring them to the mainstream.' Their activities focus on ensuring conservation of soil and water, alternative forms of livelihoods and development, assisting local people in empowering themselves to manage their natural resources and social aspects. MOTHER aims to provide end-to-end solutions for the farming communities in the areas they work in, covering agroforestry, FPOs and protective irrigation, the focus of the journey maps in this section. We have also included a case study on the Salughatte FPO. The CSO has carried out watershed interventions in 25,443 ha, supported orchard cultivation in 1,739.5 acres and organic farming in 1,766 acres in the five Karnataka districts they are active in.



MOTHER and FPO Development

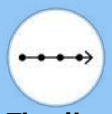
Farmer Producer Organisations are being set up across the country to tackle high input costs, and inability to get a good market price for produce. They buy inputs and sell produce in bulk, thereby creating economies of scale, reducing the cost of cultivation and improving profitability of small and marginal farmers. We describe this intervention in more detail in the annexure.

MOTHER has been setting up and promoting FPOs for over a decade in and around the Tumkur district. In 2006, MOTHER collectivised farmers to grow mangoes and chikoo (sappodilla) on 1,000 acres of land. The FPO procures fruit from its 1,200 member farmers, helps with the ripening, grading and packaging and finally sells them in *taluks* where they get a good price. Since then they have set up four more FPOs in Tumkur and one each in Bellary and Chitradurga. Buoyed by the success of this orchard FPO, MOTHER also set up the Salugatte FPO focused on promoting millets, with NABARD's support, detailed in page 32.

About the Journey Map

The journey map illustrated here depicts the steps MOTHER follows to set up an FPO for a group of villages. From the journey map, it is clear that a bulk of the MOTHER's time and activities are spent on building trust with the community. If they have prior projects running in those areas, this becomes easy to do. If not, this stage typically takes many months, or even years. In terms of the stakeholders involved, it is a highly democratised process that involves both gram panchayat members as well as villagers/farmers from the first step. The biggest pain point that emerged is making the FPO financially independent. MOTHER has to handhold them beyond the first five years they initially plan for, until they are able to move forward on their own.

Journey Map: FPO Development and Support

Stage	Step 1: Identifying regions of interest	Step 2: Getting community leaders' buy-in - Part 1	Step 3: Identifying key village resource leaders- Part 2
 **CSO activities**	Identify areas where existing programmes are being implemented (or) conduct a needs analysis	Conduct gram sabha or explain the project with key village leaders and get their consent for project implementation	Select two community leaders from each village who will liaise with other farmers in the village - these leaders will eventually become FPO board members
 **Stakeholders**	Gram panchayat (GP) members	GP members, other villages	GP members, other villagers
 **Timeline**	4-6 months	A few weeks	4-6 months
 **Resource**	NABARD	NABARD	NABARD
 **Output**	Identification of areas where FPOs could help address income challenges	Consent from GP members to develop an FPO	Selection of community resource points who will spearhead the FPO creation for their villages
 **Pain points**	Can only work in areas where CSO has prior experience implementing projects		Identifying leaders who can be influential in their villages. This is important because influential leaders can convince others in the village to be a part of the FPO, they are more likely to be heard by the larger community. If CSO is new to an area, this process can be time-consuming.

Journey Map: FPO Development and Support

Stage	Step 4: Formally registering the FPO as a legal entity	Step 5: Appointing the FPO CEO	Step 6: Providing ongoing support
CSO activities	• Collect legal documents from nominated board members (aadhaar, pan card and photo). • Register the FPO as a company with the Ministry of Corporate Affairs with the help of an auditor.	Hire an extension officer, who will eventually become the FPO's CEO and manage the day to day running of the FPO.	• Conduct capacity-building programmes for the CEO and other farmers on how to be accountable to the FPO shareholders • Assist with vision building, marketing, procurement, getting business licenses.
Stakeholders	• Gram panchayat members • Auditor		
Timeline	1 year		5 years and ongoing
Resource	Project funding from NABARD	Project funding from NABARD	Project funding from NABARD
Output	Formal company registration	Appointment of CEO	Improved capacity of FPO's CEO, board members and member farmers
Pain points	• Names are often inconsistent across all documents • Women members don't have mobile phones, which makes online registrations through OTP difficult	-	Board members often don't think of FPO's long term growth and so they don't become financially sustainable or independent in 5 years. CSO has to handhold for longer as FPO requires continuous marketing support

Case Study: Salugatte FPO

A Salugatte FPO meeting. Photo credits: Tanvi Agrawal

MOTHER has been promoting and strengthening the Salugatte FPO (S-FPO) since July 2015 through the NABARD fund.

- Based in Tumkur district
- Registered under the Companies Act.
- Total shares are 450
- Total share capital of Rs. 4,50,000.

The S-FPO provides a platform for **bulk marketing of agricultural products**, like minor millets, groundnut, redgram, sunflower, cotton and onions across nine villages in Tumkur. They have successfully sold cowpea, horse gram, sun hemp, dolichos lablab, organic vegetables and fruits.

A few years ago, the S-FPO established a **millet processing mill** to convert millet grain to millet flour, which has **higher market value**. For instance, if millet is sold at Rs. 90/kilo, millet flour is sold at Rs. 240-300/kilo, particularly in urban areas. So, they are working to add value to farmers' produce to improve their income.

Canara Bank provided **the loan** to set up the mill and the Small-Scale Sustainable Infrastructure Development Fund (S3IDF)[14] put up the collateral security required for the loan. The S3IDF grant support also allowed the S-FPO to purchase a Bolero Maxi truck to transport the produce they purchase from their farmer members to the market. This **reduced the cost of transportation** for farmers.

Some of the **challenges the S-FPO face** include, collecting the share amount from members and becoming financially independent in three years. They don't have sufficient working capital and are unable to develop business strategies for the long term especially in terms of marketing their produce. They have also been unable to pay staff salaries for running the FPO successfully. The S-FPO is still active, but these are very difficult challenges to find solutions for.

[14] S3IDF supports FPOs and FPCs (Farmer Producer Companies) in developing a viable business model and provides them with access to needed equipment and finance to strengthen their farmers' livelihoods.

The CSEI team at Sira *taluk*, Tumkur, Karnataka. Photo credits: Manjunatha G

MOTHER and Agroforestry *(with FPO and protective irrigation)*

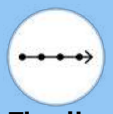
Agroforestry is a land-use system that integrates trees and shrubs on farmlands and rural landscapes to improve the productivity, profitability and ecosystem sustainability of the area. The central government has also adopted a National Agroforestry policy in 2014 as a way to promote socio-economic development, especially for small and marginal rainfed farmers who struggle with low farm productivity and water availability. We explain this in more detail in annexure 4.

MOTHER has been implementing their agroforestry projects for 6 to 7 years in Tumkur and Bellary. Farmers in these areas previously cultivated groundnut/maize in monocultures. MOTHER selected 1,000 families here (small and marginal farmers (< 5 acres) and helped them convert their land areas into agroforestry systems, i.e. a combination of intercropping, horticulture and forestry.

About the Journey Map

This journey map is particularly interesting because MOTHER has implemented an agroforestry intervention, through an FPO, and in conjunction with projective irrigation practices. The following section provides a detailed step-by-step note on how MOTHER implements an agroforestry intervention, along with the pain points that MOTHER experiences at each step. As evident from the map, it is as the CSO begins carrying out agroforestry activities that most pain points emerge.

Journey Map: Agroforestry *(with FPO and protective irrigation)*

Stage	Step 1: Selection of villages, preparation of concept note	Step 2: Preparation of DPR	Step 3: Commencement of project activities
 **CSO activities**	• Select the village based on socio-economic profile and agricultural indicators. • Conduct a sample survey before preparing the concept note and submitting to NABARD	• Collect village history. • Conduct family survey, Participatory Rural Appraisal (PRA). • Hold village-wise gram sabhas for selection of beneficiaries. • Prepare and submit DPR to NABARD	• Conduct field visits and orientation of selected farmers. • Prepare alignment for pit digging, trench cum bund work. • Apply farmyard manure (FYM), green manure, soil in pits • Distribute saplings, plant in June. • Dig a tank in each farm. • In the summer, provide tankers to fill these tanks with borewell water once in 15 days for protective irrigation.
 **Stakeholders**	NABARD	• Farmers • Consultants, NABARD	• Technical persons/other agencies. • Mobilise external labour. • Training/capacity building agencies. • Local KVK for technical guidance.
 **Timeline**	3 months	3 months	2/3 years - phase-wise
 **Resource**	Own funds	Project funding from NABARD	25% contribution from farmers, 75% from project
 **Output**	Villages selected, concept note approved	Beneficiaries selected, DPR prepared and approved	Saplings planted

 **Pain points**	Selection of the right area is essential - should be most in need of support/backward. This is challenging because vulnerability is multidimensional and there is a lack of precise data to capture this information	• Technical report needed, and the CSO often doesn't have the internal capacity to prepare it.
		• Farmers say one thing during DPR preparation and change their minds later - they want some other types of saplings, etc.
			This stage involves the most problems that need to be addressed with continuous training and hand-holding by the CSO:
			
			• Farmers ask for interventions other than those that have been planned in the DPR. There may be a lack of funds to implement other interventions and sometimes they are not suited to the agro-climatic conditions of the region.
			• Sometimes they need more money to complete work.
			• Soil may be saline. - Farmers ask for borewells as a precursor for plantation.
			• Some farmers back out; CSO has to select new areas, which lead to delays.
			• Water problems in the summer:
			  ○ No one irrigates when there's hardly enough water even for drinking
			  ○ It is expensive to buy, bring in water
			  ○ Plants could die because of rain delays: Replantation cost is 10% of the total initial cost, but only some farmers are able to afford.
			• Some farmers neglect crops during the growth phase.
			  ○ Free-grazing of cattle (no fencing).
			  ○ Some farmers leave the village after harvesting groundnuts and only come back in the monsoon.

Journey Map: Agroforestry *(with FPO and protective irrigation)*

Stage	Step 4: Promotion of FPO *(if it hasn't been done already)*	Step 5: Farm Maintenance - *plants start bearing fruits*	Step 6: Value Addition
CSO activities	**(Refer to FPO section for more details)**	Help with pest management	Set up infrastructure to prepare millet malt, millet rice and chilli powder
Stakeholders	State horticulture + agriculture department officials *(invited for monthly meetings)*	State horticulture + agriculture department officials	
Timeline	1-2 years	3 years	Long-term process
Resource	• NABARD funding for promotion of FPO. • Working capital loan from a local bank. • NABARD Nabkisan for loan.	Additional funding from government departments	Additional funding from government departments
Output	FPO registered and functional		Value added products prepared
Pain points	**(Refer to FPO section for more details)**	• Fertilisers for horticulture are used for non-project crops -- this takes away from the outcomes that the project is meant to create. • Farmers are sometimes not ready to make their own contribution towards maintaining the farms and expect the project to bear 100% of the expenses, which is not possible over the long-term.	

Summary of Pain Points

Here, we list the different pain points against the farming issue, list possible solutions and outline future lines of inquiry

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Topics
Pre-Production				
Poor quality and expensive inputs: • **Seeds** procured from KVKs or IFFCO-like companies are often of poor quality. This affects the productivity of the crop. • **Fertilisers** don't arrive on time and even when they do, they are expensive. • **Tractors** are unavailable for small and marginal farmers. Most of them also don't have bullocks, which they need to prepare the land for sowing. The ones who do sow find it difficult to maintain them as fodder is either not easily available or is expensive. Most farmers keep only milch cows.	FPOs have been set up as farmers' collectives to buy and sell in bulk. In doing so, they are able to buy inputs like seeds and fertilisers at a reduced price (wholesale as opposed to retail), and they also arrange group sharing of farm machinery.	• CSOs find it difficult to register an FPO since individual members have documentation challenges. This often delays FPO registration. • CSOs do value chain analysis to identify regions of interest for setting up FPOs - this is a time-consuming process since they have to do it every time they want to set up an FPO.	• Bureaucratic documentation process for setting up FPOs needs to be streamlined so that there are no delays in registering an FPO. • CSOs need a digital tool to conduct value chain analysis to identify regions where FPOs can work well using data from secondary sources.	How can we develop tools that have socio-economic and agricultural data layers, without being heavy and cumbersome to use?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Topics
Pre-Production and Production				
Low agricultural productivity, low incomes, low water availability Fruits like mangoes are susceptible to lots of diseases. They have to procure insecticides and pesticides to keep these pests out of their fields, which not only adds to the cost of cultivation but is also seen as being unhealthy for the ultimate consumer. Natural methods of managing pests in these orchards have not worked effectively.	Agroforestry: MOTHER is implementing agroforestry interventions by encouraging farmers to grow horticulture crops, forestry and adopt intercropping as well to provide farmers with more than one income source	• CSOs find it challenging to convince farmers to collectively agree on the horticulture crop that needs to be grown. • CSOs are trying to figure out how to grow and harvest a quality product since horticultural crops are prone to pest attacks. • CSOs need to develop protective irrigation strategies for agroforestry interventions, which often fail in the summer due to lack of irrigation facilities.	CSOs would benefit from disseminating 'success stories' of farmers where agroforestry has worked well, and the conditions for success. This could encourage farmers within their programme to adopt it as a collective.	• What are the conditions under which agroforestry projects can be beneficial for communities? • How do we develop protective irrigation strategies for every watershed/village?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Topics
Supply Chain				
• **Transport:** Farmers find it expensive to transport their produce to the markets. • **Market price:** Since per farm yield from smalls and marginal farmlands is low, the returns they receive from the market is also low. Most produce is subject to high market variability. Farmers need money immediately, so they often can't store produce for very long.	FPOs buy a truck to buy all the produce from individual farmers and take them to the market. They also sell collective produce in the markets.	CSOs are unable to figure out strategies for better marketing and sale, both of which are necessary for ensuring the financial sustainability of the FPO.	• CSOs need to engage with other institutions to help FPOs become financially sustainable by focusing on supply chain and logistics, and marketing and sales. • CSOs need to help FPOs identify crops with value addition possibilities. Like tamarind processing and packaging, create millet-based products. • MOTHER wants to bring all the FPOs they work with under one brand and sell their products at a store in Bengaluru. They are currently in the process of identifying locations for this.	

Conclusion

These journey maps cover two interventions that are not just critical to the regions MOTHER operates in but across the country. Farmers struggle to acquire quality inputs (seeds, fertilisers, pesticides) at an affordable price, and, on the other hand of the farming process, they struggle with fluctuations in the market and poor price for their produce. FPOs aim to address both. While benefits of collectively working through FPOs are apparent, there are still practical concerns - particularly with regard to making these organisations financially sustainable over a long term.

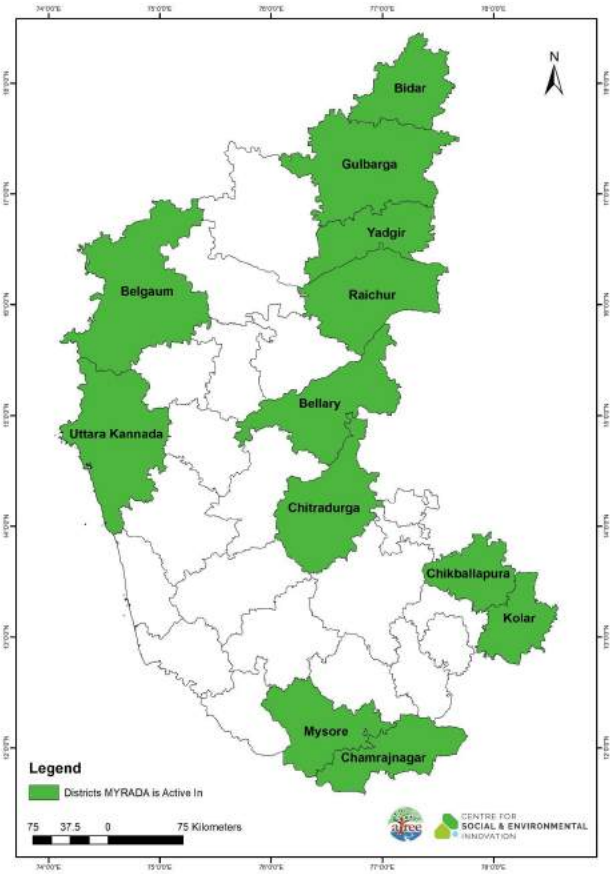
MOTHER's agroforestry projects are complex interventions closely tied to strong FPOs and protective irrigation (detailed under AF Ecology). Like with setting up FPOs, implementation of such work requires the CSO to be closely involved throughout to train and support farmers in carrying out planting and maintenance. But there is still more to be understood in terms of how protective irrigation can be secured for every village and how farmers can be encouraged to change their cropping choices.

Karnataka

MYRADA

Mysore Resettlement and Development Agency

MYRADA was established in 1968 to assist the government in resettling refugees. In the 1980s, they started to focus on improving the livelihoods of the poor and marginalised in rural areas, mainly by regenerating wastelands and improving agriculture. Their projects cut across a number of themes including natural resource management, health and sanitation, education and capacity-building and have benefitted around 200,000 farmers in southern India. MYRADA pioneered the Self-Help Group (SHG) concept, after which it was adopted in 30 countries. There are two journey maps in this section: one captures how MYRADA is developing FPOs and the second focuses on watershed development



MYRADA and FPO Development

After working on soil and water conservation for decades, MYRADA recognised that establishing market linkages is also key to improving farmers' incomes in arid and semi-arid regions. So, like MOTHER, they too started promoting FPOs.

Farmer producers organisations are being set up across the country to tackle high input costs, and inability to get a good market price for produce. They buy inputs and sell produce in bulk, thereby creating economies of scale, reducing the cost of cultivation and improving profitability of small and marginal farmers. We describe this intervention in more detail in annexure 4.

MYRADA works directly in 18 drought-prone districts of Karnataka (marked in the map), as well as in Tamil Nadu and Andhra Pradesh. 70% of their beneficiaries are rainfed small and marginal farmers. As a result of MYRADA's interventions, farmers saw first-hand that there are benefits in collectivisation, especially in terms of getting a fair price, access to buyers, and procuring quality inputs at a good price. MYRADA is mainly involved in establishing infrastructure and conducting training for the FPOs. It focuses on governance, particularly building accountability within the FPO for shareholders, since, in an FPO, the customer, shareholder and beneficiary are all small-holder farmers

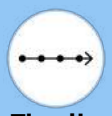
About the Journey Map

Since FPO development is one of the most important interventions covered in this report, we felt it was necessary to illustrate how different CSOs approach its planning and implementation. Here, we populate the journey map based on one case - MYRADA's work in the Hiriyur cluster of Chitradurga district. Farmers' feedback is integral to the success of such projects, which is why MYRADA carries out surveys, focus group discussions and interviews before forming an FPO. Again, the main pain point concerns the long-term financial sustainability of the organisation once the CSO moves out.

Journey Map: FPO Development *(Hiriyur cluster, Chitradurga)*

Stage	Step 1: Cluster identification and securing funding	Step 2: Baseline survey
 **CSO activities**	Identify a cluster of villages *(villages growing onion and coconut were identified to start with, since the project drew initial support from the state horticulture department).*	• Carry out a detailed baseline survey (in this case, of 1520 farmers - 1060 coconut and arecanut, rest producing onions, pomegranate, banana, mango and other crops in 25 villages/hamlets). *The key issues discussed in the baseline survey included soil health cards, irrigation, farm inputs, credits, crops cultivated, varieties, yields, animal husbandry, CBOs etc.* • Supplement survey with Focus Group Discussions (15) and stakeholder interviews.

 **Stakeholders**	• District horticulture department,
	• KVKs
	• IAT (Institute of Agricultural Technology)
		• Farmers
		• Horticulture, agriculture departments
		  ○ KVKs
		  ○ APMC traders
		  ○ Raitha Sampark Kendra
		  ○ District soil health lab

 **Timeline**	> 6 months	May-July 2016 (2-3 months)
 **Resource**	Pre-existing data, mobilisation (field presence) and training (CSO staffs' capacity) from previous project	Funds from the horticulture department (paid for staff to conduct the survey through Small farmers agri-business consortium (SFAC))[15]
 **Output**	Clusters are identified	Baseline study
 **Pain points**	• Had to focus on horticultural farmers because of funding. These are usually irrigated farmers, who MYRADA doesn't typically work with, since they want to keep their focus on rainfed farmers, who are in dire need of support. Internal debate about whether to work with these farmers. • Horticulture farmers are spread across many villages, which is challenging to manage due to low manpower. • Sometimes, conflicts arise between and within villages over allocation of funds • Interference from government officials on village selection could lead to villages most in need of being neglected in favour of others	CSOs do value chain analysis to identify regions of interest for setting up FPOs - this is a time-consuming process since they have to do it every time they want to set up an FPO.

[15] SFAC is an autonomous society promoted by Ministry of Agriculture Cooperation and Farmers' Welfare, Government of India, focused on increasing incomes of small and marginal farmers through aggregation and development of agribusiness

Journey Map: FPO Development *(Hiriyur cluster, Chitradurga)*

Stage	Step 3: Formation of Farmer Interest Groups (FIGs)[16]	Step 4: Training of FIGs, board of directors	Step 6: Registration of the FPO	Step 7: Business plan preparation
CSO activities	• Meet with farmers, share information about the FPO and FIGs • Invite farmers to form the FIG, initiate paperwork, collect money to purchase shares within the FIG and deposit to the FPO (by 2 lead farmers in the FIG)	• MYRADA's centre facilitates training by Local Resource Persons (LRPs) *(on how FPOs and FIGs work, on documentation, opening bank accounts, conducting regular minutes as well as field-level training on agricultural methods etc).* • Participants elect board of directors • Train the board, help with recruitment and training of the CEO and clarify roles and responsibilities.	• Collect documentation, opening bank account, • Transfer share money from the FIG and issue share certificates • Organise annual general meeting (AGMs) • Acquire licenses for the operation of the FPO.	• Conduct monthly meetings on the FPO's growth and market developments. • Support with value addition options, supply input seeds and fertilisers.
Stakeholders	-	KVK, other agricultural institutions, Chartered Accountants/Company Secretaries	Auditors/ company secretaries	RSK, KVK and agriculture department *(provides advice and inputs).*
Timeline	Upto 1 month	3-4 times, once a month. For the board, 3 trainings and 2 field visits over one year		-
Resource	Horticulture department funding	Horticulture department funding	Horticulture department funding	Own resources
Output	FIGs formed	Trainings completed	FPO registered	FPO operational
Pain points	-	-	-	Making the FPO profitable. CSOs are unable to figure out strategies for better marketing and sale, both of which are necessary for ensuring the financial sustainability of the FPO.

[16] FIGs are 15-20 farmers based in the same place, growing similar crops.

A farm pond at Doddaballapur, Karnataka. Photo credits: Anjali Neelakantan

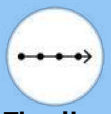
MYRADA and Watershed Development

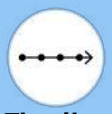
Watershed development emerged as an important intervention throughout the course of our research. MYRADA had initially focused on supply-side water management interventions for agriculture (building water conservation structures to capture and store rainfall). It's over the past 5-6 years that they began to look into demand-side activities such as tracking water consumption patterns and prompting farmers to switch to less water-intensive crops and habits to improve efficiency.

About the Journey Map

MYRADA's watershed development efforts have been funded by central and state governments, mainly via NABARD. CSR funding also drives efforts in some places, and the community contributes 5-10% of the project cost. Like with FPO development, this intervention too hinges on building the capacity of the local community and meaningfully engaging with them from the start. However, the viability of such schemes is also in doubt. As we noted in the final pain point, there is no clarity over how this intervention will fare once the project period is over and the funds run out.

Journey Map: Watershed Development

Stage	Step 1: Social capacity building	Step 2: Plan preparation	Step 3: Plan presentation to community
 **CSO activities**	• Finalise watershed, sub watershed of focus • Conduct transect walk • Develop awareness among community • Plan entry-point activities, PRA tools, • Help form SHGs, watershed devt. associations, executive committee, if not already established	• Prepare a plan for soil and water management activities (net plan for land-holding families and sub-plan for landless families). • Consolidate the data and prepare a DPR	• Present the plan in gram sabhas • Make changes to DPR based on feedback from the community.
 **Stakeholders**	• Gram panchayat • Other NGOs, • State forest, horticulture and agriculture departments • Subject matter specialists - agronomist, engineer, etc.	• Project team with subject matter specialists - agronomist, engineer, etc.	• Subject matter specialists - agronomist, engineer, etc.
 **Timeline**	Upto 1 year	Depends on watershed size, upto 3 years	1 month
 **Resource**	Funding from private philanthropists (CSR)	Funding from private philanthropists (CSR)	Funding from private philanthropists (CSR)
 **Output**	Project areas finalised, community-based organisations formed	DPR prepared	DPR approved by the community
 **Pain points**	• Encroachment of common lands and reduction in area available for watershed management activities • It is difficult to retain the community for a longer period of time while conducting exercises • Awareness activities are time-intensive, and require a lot of the CSO's manpower. • Many people take dual membership to avail loans from different sources. (makes it difficult to recover the loan)	Net plan preparation: Farmers have various demands but watershed guidelines and technical feasibility have to be followed. *For e.g. coconut trees are not allowed in the watershed area since they are more water-intensive, or farm pond may not be possible due to lack of catchment.* This sometimes leads to conflicts between the CSO and beneficiaries, and leads to delays.	-

Stage	Step 4: Project implementation	Step 5: Establish community managed resource centre for project upkeep after the funding period ends (CMRC) ***(not followed for new projects)***
 **CSO activities**	• Follow the DPR and implement the plan in a phased manner. • Conduct entrepreneurship awareness/development programmes, • Facilitate taking loans from SHGs and banks	Recruit a manager for post-project management. *The CMRC covers upto 50 villages with 100 groups.*
 **Stakeholders**	• Banks • Subject matter specialists - agronomists, engineers etc. • Private philanthropists/organisations for CSR funding.	SHGs
 **Timeline**	4-5 years	Year 3 of project - 6-12 months
 **Resource**	CSR funding *(This is the break-up followed for all of MYRADA's projects: 10% community contribution for private land; 60% community contribution for tank desilting; 20-25% community contribution for livelihood promotion activities (tailoring, livestock, petty shop)*	Farmers have to pay for the service, since the project period and funding have ended.
 **Output**	Project plan implemented	Community-managed resource centre established.
 **Pain points**	• Difficult to mobilise contribution for common lands. • Farmers ask for activities that are not in the micro-plan (e.g. building street lights, roads, schools, etc.)	• Interference by other local institutions (like other NGOs or govt bodies) makes it difficult to continue project activities. Lack of convergence is a challenge. • Difficult to generate revenue to sustain the resource centre after the project has ended and the funds have run out.

MYRADA's Watershed Management Projects

Mainly in Malur and Hoskote (16,000 ha, with 5020 ha added this year); Devanahalli and Yelahanka (7000 ha)

At these sites, MYRADA worked with experts to identify recharge zones and implement supply-side interventions such as check walls, recharge pits (open well and borewell), check dams, bunds etc.

They observed that if they focus only on supply-side management, farmers continue planting water-intensive crops. Consequently, **MYRADA started focusing more on demand-side management, convincing farmers to adopt rainfed crops and their package of practices.**

- They also stress on **water use efficiency measures** (micro-irrigation systems).
    - In the past two years, they have installed **water flow meters** for crop water budgeting.
    - They have installed 10 meters in 10 fields and agronomists monitor water use from day 0 to the last day of water use. This information is shared in the farmer field schools.
    - Farmers are also taken for exposure visits to show them good working models for water-sensitive cropping.
- In the past, farmers used to create storage ponds and fill them when they had power supply. They used to flood-irrigate the fields after this. MYRADA has installed **water level controllers** (demos) to avoid the spillage of water, which have saved farmers water and money (by avoiding burning the motor if the pump runs dry).
- MYRADA also conducts up to 100 **farmer field schools** each season (4 months).
    - 12-15 student farmers attend one training programme (4-6 sessions).
- MYRADA is also trying to **reduce chemical fertilisers** and increase organic fertilisers.
    - Farmers test soil every year so they can apply fertilisers in a more informed manner.
    - Soil organic carbon has increased by 0.1% in the past 2-3 years in the project area.
- In Kolar and Chikkaballapur, where ragi is the conventional crop, MYRADA has introduced **line sowing and transplanting** (instead of seed broadcasting) to reduce cultivation cost and improve yield.
    - Farmers are experiencing yields of 20-25 quintal/acre from line sowing, 30-35 quintal/acrea from transplantation. With broadcasting, they would only get 10-12 quintals.
    - As a result, the area under these methods is expanding every year.
- Apart from managing private lands, MYRADA is also working on **commons** in the project, through natural vegetation rejuvenation.

Summary of Pain Points

Here, we list the different pain points against the farming issue, list possible solutions and outline future lines of inquiry

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Pre-Production				
Poor quality and expensive inputs: • The **seeds** they procure from KVKs or IFFCO like companies are often of poor quality. This affects the productivity of the crop. • **Fertilisers** don't arrive on time and even when they do, they are expensive.	**FPOs** have been set up as farmers' collectives to buy and sell in bulk. In doing so, they are able to buy inputs like seeds and fertilisers at a reduced price (wholesale as opposed to retail).	Value chain analysis to identify regions of interest for setting up FPOs - this is a time consuming process since they have to do it every time they want to set up an FPO.	A digital tool to conduct value chain analysis to identify regions where FPOs can work well using data from secondary sources.	
Water scarcity Insufficient or untimely rainfall and depleted groundwater levels	**Watershed management** • Supply side interventions like check wall, recharge pits (open well and borewell), check dam, bund, etc. to reduce runoff and increase percolation • Demand-side interventions like planting less water-intensive crops, efficient irrigation technology (water flow meters) to reduce water use	Farmers sometimes refuse to shift away from cash crops because the alternatives do not have a reliable market. Also, they are no longer useful for subsistence farming - as kids do not eat millets in their villages anymore.		• What factors govern farmers' behaviour? What would it take to change farmers' behaviour? • What are the yield, soil health potential and costs of different low input farming methods? • Why have some interventions like participatory groundwater mapping (PGM) and crop switching worked in some places, and not in others? What are the enabling conditions?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Pre-Production				
Water scarcity Insufficient or untimely rainfall and depleted groundwater levels	**Watershed management** • Supply side interventions like check wall, recharge pits (open well and borewell), check dam, bund, etc. to reduce runoff and increase percolation • Demand-side interventions like planting less water-intensive crops, efficient irrigation technology (water flow meters) to reduce water use	• Encroachment of common areas and reduction in area available for watershed management activities, difficulty in mobilising contribution for common lands. • Difficulty in carrying the intervention forward once the project period has ended, since there is no funding for the Community Managed Resource Centre. • Dual membership in SHGs to get more money from the projects and take loans from multiple institutions (makes it difficult to recover the loan). • Retaining participants in agricultural training programmes is challenging • Community demands non-relevant interventions (street lights, roads, schools, etc.) which the CSO is not able to cater to.	• Each intervention must have a clear owner at the end of the project -- e.g. FPOs, CSOs or panchayat -- with potential sources of funding identified. • Aligning interventions with other institutions to avoid duplication of efforts by the same organisation across multiple projects. . • Plan training sessions in according with farmers' schedules, ask farmers about topics they are interested to learn about	• How can commons be better managed? • What are the factors that determine a project's longevity? How are these factors taken into account in project design?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Supply Chain				
Transport: Farmers find it expensive to transport their produce to the markets. **Market price:** Since per farm yield from smalls and marginal farmlands is low, the returns they receive from the market is also low. Most produce is subject to high market variability. Farmers need money immediately, so they often can't store produce for very long.	**FPOs** buy a truck to buy all the produce from individual farmers and take them to the market to sell collectively. They can also process produce in bulk and sell these value-added products at better prices than raw materials	CSOs are traditionally non-profit institutions -- therefore, they don't have the capacity to figure out strategies for better marketing and sale, both of which are necessary for ensuring the financial sustainability of the FPO.	• CSOs need to engage with other institutions to help FPOs become financially sustainable by focusing on supply chain and logistics, and marketing and sales. • Develop marketing strategies for FPOs to identify the right market channels for their produce	What contributes to the financial sustainability of FPOs? (Case studies)

Conclusion

MYRADA's journey map on FPO development reiterates that farmers see the advantage in working collectively to meet their needs and challenges. Despite the need for such an entity to address acute problems in India's agrarian sector, there are some conditions for its success. As MYRADA demonstrates, a CSO's expertise to facilitate training, channel funds, organise documentation is critical to help FPOs get up and running. But these efforts need to be sustained over a longer period of time so we reiterate that future research needs to look into turning the organisation financially sustainable, so that they are able to run on their own without an external agency propping them up.

Watershed management is a broad term that covers a number of interventions that deal both with the demand and supply of water. MYRADA is now preoccupied with improving water use efficiency and encouraging farmers to change crops and practices so that water use is more prudent in the arid lands that they work in. A bulk of the CSO's effort goes into developing strong links with the community, and this may take years, but we noted that building this trust is key before embarking on projects in the area.

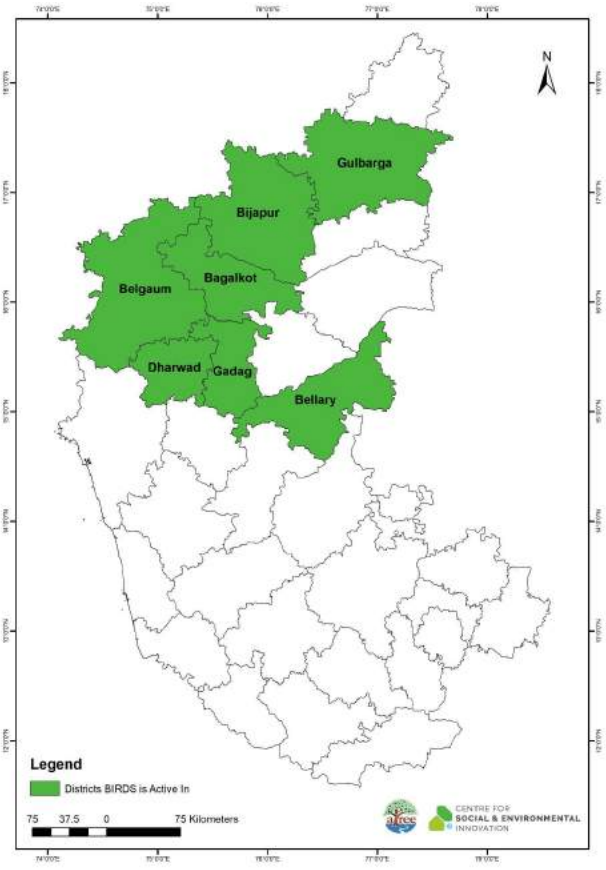
A farm pond at Tumkur, Karnataka. Photo Credits: Pranuti Choppakatla

Karnataka

BIRDS

Bijapur Integrated Rural Development Society

BIRDS was set up in 1989 in Bagalkot district in north Karnataka initially to organise the rehabilitation and compensation of people displaced when construction of the Almatti dam began along the Krishna river. They have since evolved far beyond this mandate to focus on a number of critical areas. They work on livelihood development programmes to support people with disabilities, landless households as well as small and marginal farmers. They estimate that their interventions (through 12 projects) have covered an area of 60,000 hectares. Like MOTHER and MYRADA, BIRDS too has been working on supporting FPOs, the focus of one of the journey maps in this section. The second map here captures how BIRDS led the planning and implementation of the Watershed Desert Development Programme.



BIRDS and All-Women FPO Development

BIRDS' intervention in terms of FPO development is different from MOTHER and MYRADA in that they have a narrower focus - mobilising women farmers in the livestock and animal husbandry sector.

These FPOs are in Badami and Hungund taluks of Bagalkot district and cover 4-5 villages each. The FPOs provide support in goat, sheep, buffalo, dairy and chicken rearing, through activities like procuring manure, setting up a sheep and goat market, establishing milk societies, providing loans, etc. They also deal in products like khova and dharwad peda, and are planning to sell these products online. Staff members of BIRDS currently serve as CEOs of these FPOs. The cost of one FPO share is Rs. 1000 and the membership fee is 500. BIRDS aims to draw 500 shareholders in each FPO by the end of 5 years from the current 125.

About the Journey Map

This journey map is based on BIRDS' efforts to establish these two FPOs in the past six months to support women farmers in the animal husbandry sector. BIRDS helped form the FPO and guided them to provide various services, like loans for the FPO members. Since this journey map is based on an ongoing project, it was not possible for us to list the pain points that came up while running this specific FPO and what overlaps or differences there are compared to the FPO development helmed by MOTHER and MYRADA, discussed above.

Journey Map: FPO Development and Support

Stage	Step 1: FPO Registration	Step 2: Formation of Board of Directors	Step 3: Plan Preparation	Step 4: Animal Husbandry Loans	Step 5: Running of the FPO
CSO activities	• Organise the members • Open bank accounts • Register under the Companies Act	Select the CEO and board of directors *(2-3 members from each village, 11 total members)* and conduct training sessions for them	Guide the newly-formed CSOs to prepare business plans that need to be submitted to NABARD	Provide guidance to the FPO on issuing loans to members.	CSO disengages after 3 years

Stakeholders	• Farmers,
	• Panchayat members
	• Village leaders
		• Farmers,
		• Panchayat members
		• Village leaders
			Expert consultants from NABARD	NABARD fixes interest rate (yet to be announced)	• FPO: Conduct monthly board meetings
					  ○ Apply, sanction and recover loans
					  ○ Conduct trainings
					  ○ Source animal feed.
					• NABARD: Provides market linkages to the FPO.

Timeline	6 months	6 months	3 months	6 months	-
Resource	NABARD funding	NABARD funding	NABARD funding	NABARD funding	Own resources
Output	Company registered, account opened	Board of directors, CEO selected	NABARD releases capital amount to FPO	-	-
Pain points	Difficult to arrange all the necessary documentation including the members' digital signatures, bank passbooks and IDs such as Aadhaar and PAN	-	-	In case of high demand for loans, there can be a shortage of money due to low capital in the FPO. In this case, it is unable to meet the needs of all its beneficiaries.	*Since this project is ongoing, it will take time for pain points at this stage to become apparent*

A pond filled by excess flow from a perched aquifer. (an aquifer above the regional water table)
Photo credits: Surabhi Singh

BIRDS and Watershed Desert Development Program

This intervention aims to work towards more efficient water use among farmers, and aid with employment generation among landless households. BIRDS' Watershed Desert Development Programme helps address issues of high migration (as farmers otherwise move to the cities for work), low horticulture and forest area, as well as low groundwater levels. As a result, borewells now overflow in the rainy season and open well water has significantly increased (now water at 890 ft) in areas where water levels were initially 200-250 ft. The region also has larger areas under horticulture and forest cover.

About the Journey Map

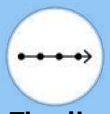
This journey map illustrates the steps involved in planning and executing the Watershed Desert Development Programme in Bagalkot district. Started by BIRDS one year ago (in 2020), the project covers 10 villages in Hungund taluk of Bagalkot district (5000 ha, 40 SHGs, 40 users groups, 4 Executive committees), and 9 villages in Afzalpur taluk of Gulbarga district (5000 ha, 40 SHGs, 40 users groups, 4 Executive committees). The presence of multiple community-based organisations highlight the participatory nature of the work. BIRDS staff remain in the project area[17] for the first three years. Over the next two years, they gradually hand the project over to the executive committee.

[17] This programme covers 10 micro watersheds of 500 ha. In any field area, each micro watershed covers around 500 ha of land and each sub-watershed covers around 5000 ha of land (including both private and commons lands).

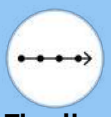
Journey Map: Watershed Desert Development Programme

Stage	Step 1: Community Engagement	Step 2: Watershed Management Training	Step 3: Sub-watershed Action Plan (SWAP) & DPR preparation

 **CSO activities**	• Conduct baseline surveys
	• Form community-based organisations (CBO):
	  ○ SHGs: women and landless people;
	  ○ Farmers Users Groups (FUGs): landed farmers;
	  ○ Watershed Executive Committee (EC): representatives from SHGs, FUGs and panchayats (the EC has one team leader and 2 watershed assistants)
		Conduct training for SHGs, users groups, EC. at the beginning, middle and end of the programme	• Visit each farmers' land and ask about their concerns and needs.
			• Collect information through questionnaires and enter into the MIS (Micro Information System)

 **Stakeholders**	• Community - farmers, women and landless people • Gram panchayat members • State agriculture department	• Community - farmers, women and landless people • Gram panchayat members • State agriculture department	• Farmers and CBO members • Agriculture department employees
 **Timeline**	30 months - 2.5 yrs	1 day non-residential trainings (6 months after the project start date	6 months
 **Resource**	Funding: Agriculture department, watershed development department funding channeled through the district joint director and block level to the NGO	Agriculture department funding (on submission of reports and photos)	Agriculture department funding, state watershed development department funding
 **Output**	CBO formed	With training complete, community takes over responsibility of implementing the programme	SWAP prepared
 **Pain points**	There are several SHGs formed by different institutions (other CSOs, government departments, etc.) because of which community members are part of several SHGs at the same time. This overlap in intervention implementation leads to inefficiency.	Participants arrives late or attend only a few sessions	Some farmers settled in other places (Mumbai, Bangalore, etc.) but owning land in the project area have to be involved in making the SWAP but do not take an interest.

Journey Map: Watershed Desert Development Programme (5 years)

Stage	Step 4: DPR Submission	Step 5: Implementation	Step 6: SHG members skill training for livelihood activities	Step 7: Market Linkages
 **CSO activities**	• Create a bank account in the name of the EC • Submit DPR to the agricultural department through the zilla panchayat - joint director office	EC implements sub watershed management activities on farmers' fields, including preparing bunds, farm ponds, check dams, horticulture, forestry, animal husbandry-related activities	• Conduct entrepreneurship awareness programmes, skill training based on interest (tailoring, animal husbandry, agrabatting making, candle making etc). • After training, release matching grants for capital costs	Establish market linkages and provide farmers with exposure to some government federations to facilitate sale of their produce.
 **Stakeholders**	• Agriculture department • Zilla panchayat (district-level committee)	Community members	Community members	Federations, community members
 **Timeline**	1 month	3 years (some activities e.g. forestry and ag are seasonal)	6 months	3 months
 **Resource**	Agriculture department funding, state watershed development department funding	Funds for project work: Rs. 12,000 per hectare *(90% project funding, 10% farmers contribution)*	Agriculture department, state watershed development department release matching grant of Rs. 50,000 on capital amount and they start the program	Agriculture department funding, state watershed development department funding
 **Output**	Amount released	Activities completed. *Each micro watershed covers 500 ha (private + common), each subwatershed activity covers 5000 ha*	Skill training complete, matching funds released	Links established
 **Pain points**	Too many documents required which makes the process time-consuming, including meeting minutes copy, DPR, joint director approval, bank account details	• Farmers' contribution is sometimes delayed. Some farmers are out of station when the intervention gets underway. • Some small and marginal farmers don't accept some forest species during planting (even if they accepted during the SWAP preparation)		The CSO is under-equipped for marketing and establishing market linkages

Summary of Pain Points

Here, we list the different pain points against the farming issue, list possible solutions and outline future lines of inquiry

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Pre-Production				
Challenges in acquiring credit	FPOs have been set up as farmers' collectives to buy and sell in bulk. In doing so, they are able to buy inputs like seeds and fertilisers at a reduced price (wholesale as opposed to retail).	• In case of high demand for loans, there can be a shortage of money in the FPO due to low capital in the FPO. In this case, it is unable to meet the needs of all its beneficiaries • Extensive documentation required for registration • Difficulty in making the FPO financially profitable. • Extensive documentation required for registration, which is difficult to arrange quickly.	• Develop formal tie-ups with financial institutions that can provide collateral-free loans. • Reduce bureaucratic delays related to FPO registration. • Capacity-building for NGO and FPO staff to complete paperwork and make the FPO financially viable. • Training farmers to account for overall costs incurred, as traditional ways of looking at profit focus only on yields. • Business/ entrepreneurship training for FPO staff. • Government support to FPOs for various service provision (e.g. seed preservation, storage).	What contributes to the financial sustainability of FPOs? (Case studies)
Water scarcity Insufficient or untimely rainfall and depleted groundwater levels	**Watershed management** Supply side interventions: check wall, recharge pits (open well and borewell), check dam, bund, etc. To reduce runoff and increase percolation	• Several SHGs formed by different institutions working in the area. As a result, community members are part of several SHGs at the same time, leading to overlap in intervention implementation. • Poor participation of farmers in agricultural training programmes. Participants come late, leave early, miss sessions and don't participate actively • Some farmers taking lease from outside the area (Mumbai, Bangalore, etc.): have to be involved in making the SWAP but do not take an interest. Their contribution is thus often delayed • Extensive documentation required for funding paperwork. • Some small and marginal farmers don't accept some forest species during planting (even though they accept during SWAP preparation) • Processing and packaging expenses are high, market linkages for crops are not established, marketing produce is challenging.	• Aligning interventions with other institutions to avoid duplication of efforts by the same organisation across multiple projects. . • Planning training programmes while being more mindful of participants' schedules • Create standard templates between philanthropic organisations and other funding agencies to apply for and receive approvals for grants. • Conduct awareness programmes (backed by data) to help farmers see the value of the interventions to their land.	• Where has the overlapping SHG problem been solved? • How can funding be made more accessible to field organisations? • How can project success be measured more 'accurately'?

Conclusion

Both journey maps under BIRDS are based on very specific projects that the CSO implemented in parts of Karnataka - the promotion of a women farmers' FPO that focuses on animal husbandry-related activities and the Watershed Desert Development Programme. For Karnataka, we covered FPO development promotion under all three CSOs because we wanted to understand the degree to which challenges and opportunities overlap in order to put together a more well-informed toolkit - the main objective of this exploratory study. With BIRDS, since the project is newer and ongoing, we can't yet ascertain whether financial viability is a hurdle that impacts its functioning once the CSO stops hand-holding the FPO. We did, however, note that organising the extensive documentation required to register an FPO (like MOTHER) and make it eligible for NABARD funds. This underlines the need for more streamlined bureaucratic processes.

In terms of watershed activities, the condition for scaling up is clear - provide effective training to staff members and SHGs is to ensure that projects run successfully over a longer period of time. These training programmes need to be arranged in a manner that aligns with farmers' schedules to improve participation; low attendance was a pain point that came up. As with the FPO work, inefficient management stood out with this project as well since multiple SHGs are formed by different institutions leading to time-consuming duplication of efforts.

A vegetable field at Doddaballapur. Photo Credits: Anjali Neelakantan

Laxuman (Anna) Kamthe, farmer associated with GGP.
Photo Credits: Prashant Boravake (GGP staff)

Maharashtra

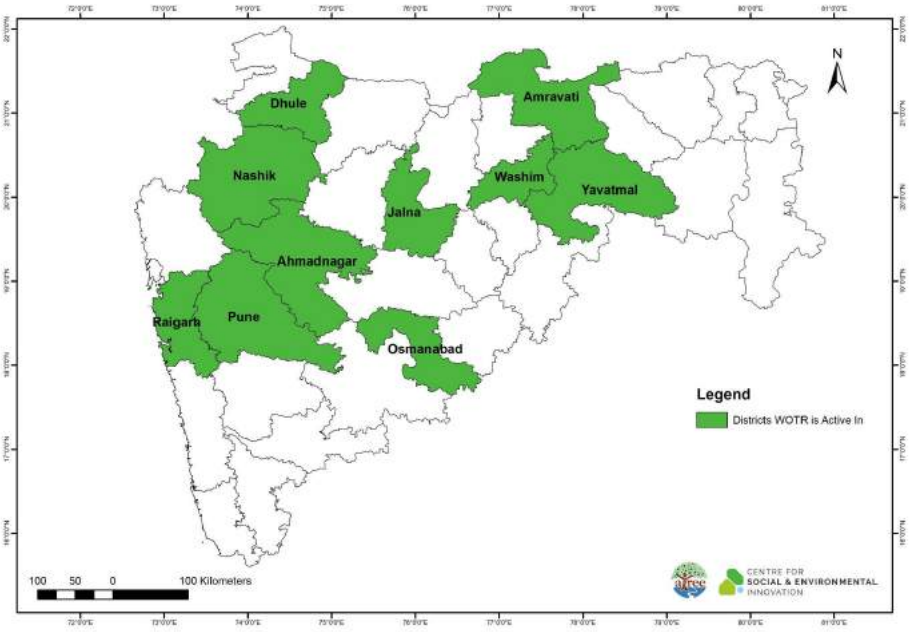
Maharashtra

WOTR

Watershed Organisation Trust

The Watershed Organisation Trust (WOTR), established in 1993, began as a capacity-building organisation for NGOs working in the watershed development space. Based in Pune, their aim is to improve the lives of poor rural communities through participatory watershed development and ecosystem restoration. They are currently engaged in projects spread across a number of cross-cutting themes such as agriculture, ecosystem conservation, climate change adaptation, gender, sanitation, health and nutrition. WOTR began conducting water budgeting exercises in 2006-07 to focus on water demand management in drought-prone regions in Maharashtra.

There are three journey maps that are covered under this section - agromet advisory systems, low input farming methods and water budgeting. WOTR says their interventions have impacted an estimated 3.8 million people in 3,754 villages over the last 25 years.



- Within Maharashtra, WOTR has worked in 23 districts with 45 ongoing projects. The districts with active projects are highlighted in the map.
- Across India, WOTR currently operates in 7 states: Maharashtra, Madhya Pradesh, Rajasthan, Telangana, Jharkhand, Chattisgarh, Odisha

WOTR and Agromet Advisory Systems

Due to the climate crisis and variability of weather patterns, traditional knowledge systems that farmers used to rely on are now inadequate. Even though agriculture is weather-dependent, farmers do not have access to reliable locally-relevant meteorological and agricultural information to plan and manage their farming operations. WOTR's agrometeorology advisory systems provide timely and local information directly to a farmer's cell phone via three outputs:

- ***Block level***: Crop calendars for different weather scenarios.
- ***Village level***: Forecasts and advisories sent via SMS.
- ***Individual plot level***: The Farm Precise mobile app.

Once farmers upload their plot-level data on the Farm Precise app, the app provides: five-day weather forecasts, information about market prices for different crops at nearby markets, information about managing nutrients, irrigation, pests and diseases, and general best practices in agriculture. Farmers are able to select seed varieties that are most likely to survive anticipated climate fluctuations and focus on farming methods and inputs that are likely to end up being least costly and most profitable. Farmers are also able to plan market visits such that they get optimum prices for their produce.

This is an example from the compendium of crop calendars that WOTR provides. Data specific to Akole block in Ahmednagar district is shown here.

Standard Meteorological Week Number: 23 (4 June to 10 June)

SMW no.	WAS (23rd)	Period	T max (°c)	T min (°c)	RH I (%)	RH II (%)	BSS (Hrs)	Wind Speed (Km/hr)	Rainfall (mm)
23	0	4 June to 10 June	34.4	24.8	80	60	5.6	7.0	34.4

Anticipated weather likely to be observed	Crop Stage	Recommendations based on likely effects of anticipated weather changes
Normal weather condition	Nursery/ Seedling (23 SMW sown crop)	• Prepare nursery beds • Apply-1. FYM/Compost @ 100 kg/R of nursery bed 2. Urea @ 1 kg + 3 kg SSP/R before sowing of seed in the nursery bed • Seed treatment with 3% brine solution • Seed treatment with Thiram / Captan @ 2.5-3 g/kg of seed • Seed treatment with *Azotobacter culture* @ 25 g/kg of seed • Seed treatment with *Pseudomonas fluoresces* talc @ 10g/kg of seeds • Sowing of seeds @ 5 kg/ha in SRI method and 40 kg/ha for other methods
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		
Sufficient rainfall followed by clear sky and high RH (>75%)		
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		• Prepare nursery beds • Do not sow seed in the nursery
No rainfall, hot and dry winds during day time		

Sr.No.	Disease	Existing crop stage	Remedial Measures
1	**Early Leaf Spot-** *Cercospora arachidicola* 	Flowering, Flowering/Pegging, Pegging	• Removal of volunteer groundnut plants are important measures in reducing the primary source of infection • Crop rotation with cereal crops • Spray Mancozeb 75 WP @ 30 g/15 lit of water **OR** Spray Carbendazim 50 WP @ 15 g/15 lit of water

Sr.No.	Pest	Existing Crop Stage	Remedial Measures
1	**Jassids-** *Empoasca kerri* 	Branching and Flowering/ pegging	• Timely sowing of the crop and field sanitation is necessary • Crop rotation with non-host cereal crops • Intercropping with pearl millet (7:1) • Place Yellow sticky card @ 10/ha • Spray *Dashparni* ark @ 150 ml/15 lit of water • Spray 5% NSKE @ 150 ml/15 lit of water • Spray Dimethoate 30EC @ 15 ml/15 lit water

Source: https://wotr-website-publications.s3.ap-south-1.amazonaws.com/102_Complete-Crop-Calendar.pdf

Top to bottom: Recommendations for inputs required during the seedling stage of paddy crop cultivation for eight different weather scenarios - such recommendations for all (13) growth stages of the crop are included. The compendium also contains details about how to manage all common diseases and pests of the crop.

About the Journey Map

This journey map captures how WOTR sets about building and introducing their agromet advisories. Right from the onset, they engage with farmers to understand their challenges when erratic weather patterns adversely impact crop yield. It's also apparent that building these systems calls for the expertise of multiple stakeholders, including government institutions such as India Meteorological Department (IMD) and Indian Council of Agricultural Research (ICAR), to bring together available data on shorter-term forecasting as well as long-term climatic trends. WOTR also regularly conducts training programmes and feedback workshops with farmers as a key part of improving these advisory systems.

Journey Map: Agromet Advisory Systems

Stage	Step 1: Preparatory stage	Step 2: Setting up Advisory Systems	Step 3: Compendium on climate-resilient agriculture	Step 4: Farm Precise App
CSO activities	Identify need for advisories by holding discussions on climate fluctuations with farmers, who raise concerns regarding erratic weather	• Set up weather stations at the village level • Carry out data analysis • Develop advisories with CRIDA[18] • Arrange community awareness camps	• Identify weather scenarios and formulate recommendations accordingly • Create crop weather calendars and conduct awareness camps	• Review advisories • Develop app • Train users (farmers) through workshops and aid them to input data such as crop sown, methods, farm inputs etc • Maintain the app
Stakeholders	• CSO Facilitators • Farmers	• IMD staff (for technical guidance to set up stations, identify parameters for advisories) • Farmers (feedback on 3-day village level forecasts) • CRIDA	• IMD staff (for historical data and parameter analysis for long term scenarios) • Farmers (feedback, knowledge building)	• Farmers • ICAR, • Institutes/colleges (scientific advisors for support in developing in-app calculators)
Timeline	Began in 2007 when heavy impacts of climate change were felt	2009-10: slow roll out of SMS advisory in villages with stations; 2012: set up complete for initial target region - *ongoing*	2012: weekly printed bulletin - *ongoing*	2019: App launched - *ongoing*
Resource				
Output	For farmers, agrometeorology advisories were understood as a major part of climate adaptation.	Reach of advisories expanded. Currently, daily SMS advisories are sent to 28,000 farmers.	• Paper advisories made available for those who prefer them • Long-term planning facilitated	App launched, use of it widened - currently, 46,000 farmers use it.
Pain points		Network connectivity issues - could do only weekly advisories in the beginning	Technical explanations not always easy to understand for farmers	• Farmers reluctant to use smartphones, they prefer paper advisories • Network connectivity issues

[18] Central Research Institute for Dryland Agriculture, part of the Indian Council for Agricultural Research.

WOTR and Crop Water Budgeting

With most watershed interventions focusing on improving supply of water, consecutive droughts have led to crop loss and failure in many parts of Maharashtra. The drastic depletion of groundwater is resulting in an increase in the number of villages dependent on tankers for drinking water and livestock needs. Like WASSAN, discussed earlier in this guidebook, WOTR too has been implementing water budgeting measures - as a demand management intervention. They aim to promote farmers to shift their cropping patterns to less water-intensive crops and farming methods by equipping rural communities with the necessary knowledge and tools.

About the Journey Map

This journey map shows that a key part of WOTR's approach is that they train representatives of the local community in water management and guide them to take the lead on these projects. These Jal Sevaks (water-use promoters), in turn support 'water stewards', i.e. farmers and other community members to plan and implement farming choices based on the water budget. The map also shows that implementation hinges on systematic and well-planned discussions held with diverse stakeholders – to dialogue on local water related issues, with the aim of building knowledge and consensus around cropping decisions..

WOTR facilitators training the local community in water management. Source: WOTR website

Journey Map: Water Budgeting

Stage	Step 1: Preparatory stage	Step 2: Stakeholder engagement	Step 3: Implementation	
CSO activities	• Guide and train Jal Sevaks to collect primary data such as rainfall, groundwater levels, lead water budgeting process • Collate and analyse secondary data, validate collected primary data • Prepare the water budget	Facilitate Gram Sabha meeting to discuss rainfall, water needs and understand water use patterns in the region.	Conduct **Pre Kharif season event:** • Moderate community discussions, • Conduct water use-per-crop awareness campaigns and encourage farmers to make less water-intensive choices	Conduct **Pre Rabi season event** • Moderate community discussions • Promote alternative non-agricultural livelihoods and subsistence farming
Stakeholders	• CSO facilitators • Village Water Management Teams (VWMT) - Jal Sevaks/Sevikas	• Farmers, including 30% representation by women participants, • Small and marginal land holders • Gram panchayat	• Farmers • Technical experts - plot level suggestions and guidance for best practices for water management	Farmers
Timeline	Feb (two months)	March, April (two months)	May-July (three months)	Nov-Dec (two months)
Resource	• WOTR data analysis platform • Primary data - household level, sec data - crop area records, water harvesting structures in the village	Communication material and funds to disseminate findings from the water budgeting exercise	Information pamphlets explaining water use per crop; funds for creating these resources and conducting the workshop	Case studies of successful crop diversification and shifts to alternative livelihoods (documentaries/talks from farmers practising SCI, etc) to motivate farmers to make changes
Output	• Recommendations are made depending on whether water is surplus or deficit. • Water balance is displayed in the village on a board	Collective cropping decisions are made	Farmers shift to less water-intensive crops, adopt water-saving farming techniques	Farmers shift to less water-intensive crops, subsistence crops and alternative livelihoods for *Rabi* season
Pain points	Water budgeting process is too technical and not easily accessible for the community.	Conflicts are common; Farmers sometimes refuse to forego income by changing cropping patterns	Finding labour is very difficult for millets like Jowar and Bajra; some technological solutions like harvesters do not work for these crops.	Lack of market linkages for less water intensive crops because of changing food habits is difficult - eg. Orissa farmers shifted from paddy to millets but even their children don't eat millets.

WOTR and Low-Input Farming Methods (Organic + SCI)

Conventional farming methods often deplete soil nutrients and can be very water intensive. WOTR aims to encourage farmers to switch to more ecologically sound farming techniques such as organic farming and System of Crop Intensification (SCI). To achieve this, WOTR conducts Farmer Field Schools where farmers are exposed to new farming techniques, field demonstrations and coping mechanisms within the context of water scarcity and climate variability.

The demonstrations conducted involve soil preparation and management, decreasing crop density per acre and appropriate crop spacing/crop geometry, systematic application of organic inputs and reducing dependence on chemical inputs, spraying of micronutrients and using high quality seeds. Alongside improving soil health,this also leads to enhanced crop yields. Farmers who agree to give parts of their land for these demos learn new farming techniques first hand.

Table 2: Mean grain yield of Soybean in kharif season (2016-17 and 2017-2018)

Village	Mean grain yield of Soybean (kg/ha)		
	Organic	SCI	Farmers practice
Banegaon	1669	1732	-
Chandai Tepli	2030	1638	1500
Chandai Thombari	1250	1459	1344
Chincholi	2582	2550	2214
Devulgaon Tad	2600	1938	1200
Palaskheda Thombari	2078	2478	1600
Pimpalgoan Barav	2360	1500	-
Thigalkheda	2538	2325	-
Average	**2138**	**1953**	**1572**

Statistics from a WOTR report show the impact of organic and SCI methods for soybean in Bhokardan block of Jalna district, Maharashtra.

This table compares the yields achieved by demonstrated cultivation methods viz. organic farming and System of Crop Intensification (SCI) against the yields achieved by methods that the farmers usually practice in the region.

About the Journey Map

The journey map shows the process that WOTR used for carrying out these demonstrations and how they engage with farmers throughout. This is a continuous process and is carried on in the same village for many years. The demo plots keep varying and WOTR attempts to do at least one demo with all farmers over the course of their engagement with the village. Usually, farmers take up these new methods after 1-2 years of demonstration in parts of their land, while sometimes even switching completely to these methods. Over time, farmers have also developed a deeper understanding of why and how to improve the health of their soil.

Journey Map: Low-Input Farming Methods (Organic + SCI)

Stage	Step 1: Village and plot selection	Step 2: Crop demonstrations	Step 3: Review/Discussion	Step 4: Uptake of new methods
CSO activities	• Hold discussions on SCI and organic farming methods with landholders • Provide incentives such as inputs or set-up costs to farmers	• Demonstrate different farming methods in plots • Instruct demo farmer on organic/SCI practices • Conduct field schools in other WOTR regions • monitor plot and engage with all (demo + non-demo) farmers throughout the cropping season	• Hold discussions with all farmers - showing the impacts of SCI+organic methods on soil, yields, farming costs	• Field staff collects and maintains adoption data from village • Offer step-by-step guidance to farmers who want to take up demonstrated methods
Stakeholders	Farmers *(in addition to discussing their concerns, they volunteer parts of their land for demonstration as this stage)*	Two groups of farmers - demo and non-demo	All farmers - reviewing their experience of the demo, raising concerns	New farmers
Timeline	No particular timeline for the discussion	Kharif or Rabi or both cropping seasons – 2 to 3 months each	Post harvest – 1 week	
Resource				
Output	Plots selected and allotted for different farming techniques	Demonstration of SCI + organic farming methods done from seed procurement stage to harvest for different viable crops for the region in multiple plots in the village	A deep understanding of SCI and organic farming methods is built in the village community	Some farmers take up SCI+organic farming methods in parts or (rarely) all of their land
Pain points	Farmers are often reluctant to forego yields from the land they volunteer - heavy incentivisation is needed in a few cases	Even after successful demonstrations, farmers reluctant to switch because there is no demonstration of market linkages, no guarantee of buyer	Accounting for inputs in profit calculations is not a common practice for farmers -- this needs to be done to truly demonstrate all advantages of these farming methods. This is not an easy discussion because farmers tend to consider profits only from farm yields.	• Farmers know that returns take time, so they refuse to take up these methods on the entire plot • Labour is very hard to find for farmers practising these methods

Summary of Pain Points

Here, we list the different pain points against the farming issue, list possible solutions and outline future lines of inquiry

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Pre-Production (Crop Choice, Soil Preparation, Sowing)				
Insufficient water for *Rabi* crops (sometimes even for drinking) due to low rainfall and over-extraction of water	Crop water budgeting - demand management	Water budgeting is a scientific and complex exercise. As a result, CSOs have a hard time explaining the water budgets and its conclusions in a way that makes them relevant to the farmer at a plot scale.	Generating awareness around how water budgeting and crop choices for *Kharif* season affect the availability of water during Rabi -- helps to demystify the complex water budget for the farmers.	What are some practical ways to highlight the linkages between crop choice at a plot scale and water availability at the watershed scale?
		Farmers sometimes refuse to shift from cash crops because the alternatives do not have a reliable market. Less water-intensive crops like millets are also not useful for subsistence farming - as kids in their villages do not eat it	WOTR does not have a solution for this yet, and stressed on having a plan for creating market linkages for these alternative crops before asking the farmers to shift to them. Ultimately, increasing consumer demand for less water intensive crops is required.	• What kind of behaviour change interventions can help to shift diets to millets and other less water intensive crops? • What are the leverage points to change consumer demand to dryland and resilient crops?
• High input costs • Depletion of soil quality	Low Input Agriculture - System of Crop Intensification (SCI), organic farming	Farmers are unwilling to shift to lower income/lower input crops and farming methods as they worry that they could suffer losses.	Demonstrate how net profit is higher with SCI+organic/integrated farming methods even if the income from produce is lower because input costs are reduced. (CSO needs to have enough resources to incentivise farmers to volunteer for demonstrations).	• What would it take for farmers to be able to take a more holistic view of the costs they incur in the farming process? • Identify low input crops that can be of higher value (e.g. medicinal plants)?
		• Even when farmers want to make a shift, labourers are unwilling to work with Jowar and Bajra that require a lot of work to manually harvest. • Labourers are also unwilling to work in farms practicing more labour intensive techniques like SCI.	WOTR has no solution for this. Innovations in mechanising work for dryland crops could help.	• What are the exact pain points in the labour process for low input agriculture? • What are the potential technological solutions for them? There is also a need to understand whether it's an affordability issue (for existing tech) or if there's a need for new solutions?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Production (Irrigation, Fertilisers, Pesticides, Harvest)				
Unpredictable weather patterns make farming decisions really difficult	Agromet advisories - crop weather calendars, SMS forecasts, Farm Precise app	Lack of access/reluctance towards smartphone use, internet connectivity issues	Printed weekly crop weather calendar displayed in all villages even now --this works provided that farmers trust the CSO displaying the calendar and and take collective cropping decisions.	Why are farmers in certain parts of the country unwilling/reluctant to use smartphones?

Wadzire, Maharashtra. Photo credits: Srushti Paranjpe + Mukta Deodhar

Conclusion

This set of three maps captures the diversity of WOTR's work to support rural farming communities in Maharashtra. Agromet advisories are critical in a climate changed world and this information-sharing technological intervention holds potential, evidenced by the number of farmers who subscribe to these services. There are, however, roadblocks in terms of smartphone access and network connectivity.

We discussed water budgeting under WASSAN too and found that the pain point related to poor market linkages for less water-intensive crops emerged here as well. Effective water budgeting relies on awareness campaigns that prioritise farmers' concerns. This is also important with regard to the final intervention we covered - low input agricultural methods. Demonstrations, incentives and discussions that underline how reducing inputs can contribute to higher profits and improved soil health are key to guiding farmers to take up such methods.

Maharashtra

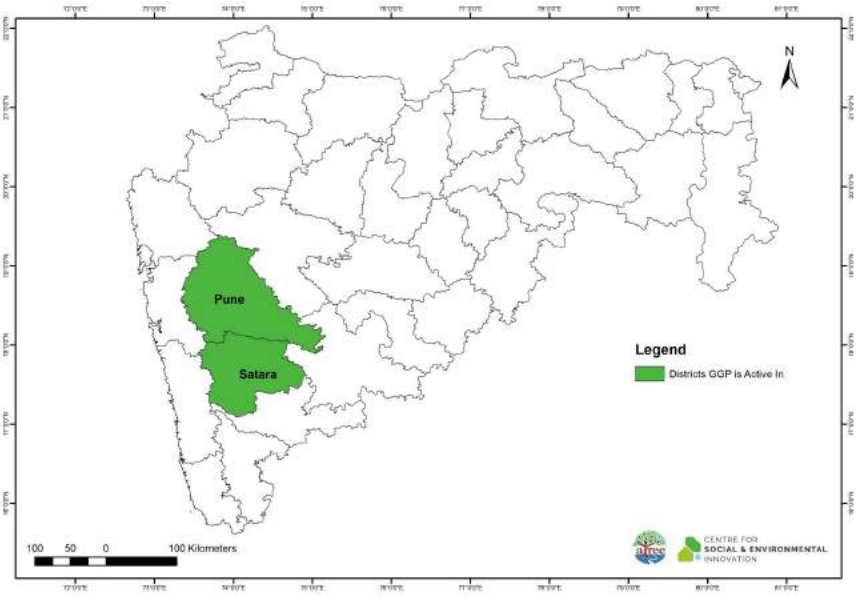
GGP

Gram Gaurav Pratishthan

Gram Gaurav Pratishthan
Pani Panchayat

Gram Gaurav Pratishthan (GGP) was established as a charitable trust in 1974 in Naigaon village near Pune. The founder, Vilasrao Salunkhe, pioneered the Pani Panchayat (a Water (User) Association) movement of community lift irrigation schemes[19]. The principles guiding the movement were later included as policy directives in Maharashtra, Andhra Pradesh, Madhya Pradesh and Odisha.

GGP has been working towards sustainable rural development with a focus on equitable distribution of water. The thematic areas of work include watershed management, organic farming, and improving access to health and education. Their current focus is on the Panchakroshi Model - a watershed management programme implemented in clusters of five villages. The journey maps here capture how GGP shares information on water budgeting and guides farmers through a systematic water management process.



GGP and Water Budgeting

In low-rainfall and drought-prone regions like Purandar block in Pune district, crop yield can be significantly lower due to unavailability of water - especially for the crucial last few irrigation rounds.

GGP conducts water budgeting exercises, mainly by providing information to panchayats depending on whether monsoon rainfall was poor. They guide farmers to estimate the amount of water that is available for the *Rabi* crop, and thus prompt them to alter their crop management - either choice of crop and/or area used for cultivation - to ensure optimum use of scarce water resources. Because of the impact this practice has on crop yield, there is an incentive for farmers to adopt this approach.

About the Journey Map

This journey map shows that a crucial part of introducing water budgeting in drought-prone villages is to engage with the community and explain to them the benefits of switching to less water-intensive crops and methods. Right from the preparatory stage, GGP trains the local community to collect data regarding rainfall, keeping them invested in the process from the start. For the final stages, GGP serves as an advisory who furnishes the right information to villagers and is not involved in actual implementation.

[19] Lift Irrigation helps bring irrigation water to the fields that are not adjacent to a surface water resource, such as river, lake or canal.

Journey Map: Water Budgeting

Stage	Step 1: Preparatory	Step 2: (Training for) Data Collection	Step 3: Information Sharing & Community Engagement	Step 4: Implementation
CSO activities	• Write proposals for 1-2 villages in the five-cluster unit (Panchakroshi) on water budget estimates. • Install data collection tools (e.g. rain gauge).	Train villagers to carry out data collection, for e.g. reading rain gauges.	Facilitates open forum with panchayat members and villagers to: • Explain how much estimated water is available (GGP estimates that 28% of rainfall over the monsoon is available for Rabi crop cultivation). • Underline impact of choosing water-intensive crops. • Share information about alternative farming practices, such as different crops, reducing area for crops like wheat.	• GGP is not involved in decision-making; they share information and guide farmers to switch to more sustainable practices. • GGP is now aiming to guide decision-making at the gram panchayat level.
Stakeholders	Villagers	Villagers	• Trained villagers • Panchayat members (to share information and suggestions provided by GGP). • Villagers (attendees)	Village gram panchayat Villagers
Timeline	Before rains begin *(precise duration unclear)*	During the Kharif season (rainy season ~4 months)	One-day activity: Ideally after Kharif harvest before Rabi sowing	
Resource	Funds to install instruments and pay staff to carry out preparatory activities		List of optional crops (e.g. Bengal gram, some low-water vegetables etc.)	
Output	Begin the process of calculating the rainfall - the main component in calculating the water budget for a village.	Local community trained to take readings and improved rainfall data documentation	While people qualitatively know if the season's rainfall was less and if water is sufficient for cultivation, they are able to get a clearer picture of the scale of the problem when GGP explains with numbers.	Some villagers follow the GGP's advice and choose crops and areas for farming accordingly.
Pain points			The formula used for calculation provides an estimate and may not be very accurate.	While the CSO conducts these information-sharing exercises, not everyone in the village necessarily takes up their suggestions.

Farm pond in Munjawadi, Maharashtra, at the farm of Namdev Jhurange, associated with GGP.
Photo credits: Mukta Deodhar + Srushti Paranjpe

GGP and Watershed Management

Unlike water budgeting, which is a demand-side intervention carried out by GGP, watershed management is a supply-side intervention that increases availability of water, to an extent, for the *Rabi* season.

GGP has over 45 years of experience in watershed development with a focus on equitable water sharing. They carry out activities like Continuous Contour Trenching (CCT), earthen dam and percolation tank repair, soil excavation, as well as bund repair and desilting. These activities ensure drinking water for the villagers throughout the year, reduces soil erosion, recharges groundwater and ensures fodder availability. This intervention helps families in drought-prone regions reduce/avoid the financial stress of ordering tankers for water or resorting to the Purandar lift irrigation scheme [20]. The availability of more water has also allowed farmers to move to horticulture.

About the Journey Map

This journey map shows how GGP selects a village for intervention based on their longstanding understanding of the watershed of Karha river or when they are approached by a funder for a project in a particular village. Through a *Shivar Pheri* or village walk, GGP collects some primary data about the village. They then propose an 'entry point activity' during the execution of which they get a better sense of the water needs and receptiveness of the villagers. Based on this, GGP takes a call on the bigger activities and is involved mainly in the planning and supervisory role during execution.

We have excluded the timeline row because watershed management encompasses a range of activities - the timeline for which varies depending on the nature of work. For instance, even the time taken for fund-raising can vary from a week (funders who have engaged with GGP before and established trust) to two years.

[20] The Purandar Lift Irrigation Scheme transports wastewater downstream of Pune, through the Mula-Mutha rivers to the drought-prone blocks in Pune district

Journey Map: Watershed Management Activities

Stage	Step 1: Preparatory	
	Fund-raising	**Data Collection**
CSO activities	• Study government data on villages that rely on tankers for water • Shortlist potential villages for watershed management activities based on the study, with a focus on Purandar block.	• CSO visits village (called *Shivar Pheri*) and are shown important watershed features • Discuss with villagers to prepare a detailed village profile based on a data collection template GGP has (including crops, demography, employment figures, facilities, potential for value-added services)
Stakeholders	Funders	• CSO facilitators • Villagers
Resource	Block-level study and documentation by GGP	• Village watershed map • Funding to carry out site visits Documentation material
Output		The requirements of the village are identified.
Pain points	Funders take up to two years to provide funding. This is too long when the need of the village is urgent. GGP often has to send back the money if the needs of the village have lapsed by the time funds arrive.	

Journey Map: Watershed Management Activities

Stage	Step 2: Implementation		
	Early Community Engagement (through an entry point activity)	**Advance Planning**	**Supervision**
CSO activities	• Write proposals (usually falls under a budget range of Rs. 2 to Rs 20 lakh) and submit to 2-3 funders simultaneously. • Initiate an 'entry point' activity, i.e. a cleanliness drive, minor restoration or repair work for wells, dams, to estimate the receptiveness of the local community. • Work with the panchayat to source a 'demand letter' signed by the sarpanch which specifies the responsibilities of the village (e.g. *shramdaan*, 5% voluntary contribution).	• Facilitate expert visit for work that the GGP team does not have the expertise for. • Prepare a detailed plan and estimate budget for activities	Supervision during dam construction
Stakeholders	• Gram panchayat • Villagers • Funders	• Funders • Engineers (in case of L section, new RCC structure, check dam in area of steep slope + heavy rainfall) • Vendors, contractors • Farmers (for desilting)	Vendors/contractors, labourers
Resource	Funds to hire an excavator and workers to carry out repair/restoration works, *shramdaan* (labour contribution) by villagers	Funds for construction material, excavators, labourers and engineers.	HR of GGP
Output	This preliminary exercise shows the village's potential to engage with participatory interventions.	Through such activities, greater water availability can be achieved, thereby improving water security	
Pain points	The village may not be cooperative and may have fixed ideas for interventions that GGP must carry out even before the site study is done.		

Summary of Pain Points

Here, we list the different pain points against the farming issue, list possible solutions and outline future lines of inquiry.

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Pre-Production (Crop Choice, Soil Preparation, Sowing)				
Insufficient water before planting Rabi and perennial crops (e.g. horticulture) and even for drinking in the dry season due to low rainfall	Water budgeting	• There is no guarantee that GGP's suggestions on less water-intensive cropping practices and planning will be followed. • Rainfall was double the average annual rainfall for two consecutive years (2019-20). Low-water crops failed and sugarcane was observed on a large scale for the first time.	Water budgeting works in low-rainfall, hard-rock regions. • For decision-making and to ensure follow through, GGP plans to work more closely with gram panchayats for the implementation of water-budgeting exercises at village level. • Government directives to supplement social rules can help sustain this intervention, e.g., legal water sharing agreements, timely renewal of water budgets and resolutions of disputes between farmers. A key enabler is trust as evident from GGP's work in Purandar block for over 45 years.	Crop water budgeting calculations are carried out based on rainfall trends. But as climate change alters precipitation patterns, how can such exercises factor in extreme weather events?
		The calculation of water available for the dry season is done using simple rainfall-data based formulae making the result approximate and not very accurate.	Access to digital tools, training on how to use them as well as data sharing platforms with other CSOs will ease the data collection and analysis process for GGP. This will help them save time and resources and enable them to make more accurate water budget estimates.	What are some practical ways to highlight the linkages between crop choice at a plot scale and water availability at the watershed scale? How can the process of calculating the water budget be made more simple and accurate?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Production (Irrigation, Fertilisers, Pesticides, Harvest)				
Insufficient water, for the last few crucial irrigation rounds for Rabi and perennial crops (e.g. horticulture), in the dry season.	Watershed management activities	Funding for projects is often delayed because some funders require extensive documentation. This is especially problematic when drought-distressed villages need urgent action.	• Better awareness, standardising processes and improving coordination among donors can reduce bureaucratic delays and hasten funding. • Create standard templates recognised by CSRs and philanthropies that CSOs can use to apply for funding.	• How can funding be made more accessible to field organisations? • How can project success be measured more accurately?
		The village may not be cooperative and may have fixed ideas for interventions even before the site study is completed. Such studies are necessary to inform the right decision.	Conduct awareness programmes (backed by data) to help farmers see the value of these interventions to their land and crop yield.	• What are the conditions for more effective cooperation that would make an intervention proposed by a CSO more acceptable? • How can we make the link between these programmes and benefits to farmers' incomes clearer?

We met two farmers from Munjawadi and Kumbharwalan villages in Purandar block in Pune district. As a result of surplus water, both farmers increased the area for horticultural crops like custard apple, guava and mango.

The farmer from Kumbharwalan village used to source wastewater from the Purandar Lift Irrigation Scheme. He described the water as coloured and foul-smelling. The GGP implemented Continuous Contour Trenches, a technique that allows for water and soil conservation, after which he stopped needing water from the lift scheme. He said he now gets enough water through protective irrigation (detailed under AF Ecology and annexure 4) to water custard apples and his low-water Rabi crops.

The farmer from Munjawadi, Namdev, used to order tanker water for drinking and to water his custard apple plants during the summer. After GGP's work of bund repair and desilting, he increased the area used for custard apples as he gets enough water for protective irrigation in the summer months. He has also started keeping livestock resulting in higher income. He takes pride in being able to build a new house and send his children to college, as a result of this intervention.

Conclusion

GGP is engaged in demand and supply-side interventions through water budgeting and watershed management activities but they face a number of challenges as illustrated above. Additionally, during the COVID-19 pandemic, their work was impacted as they could not hold events such as field extension visits and training sessions, which they partly depend on for income. Moreover, they said that documentation was not their strong suit since they work with limited staff.

To sum up, there is a need to work more closely with farmers to alter their farming practices to be less water-intensive. This is a challenge to implement because digging borewells and extracting groundwater has more tangible and immediate benefits. It's also important to ease the application process for funding by creating toolkits and templates. Funding delays lead to grave impacts on the ground especially in severely water-stressed villages.

Case Study

Abhinav Farmer's Club

and the 'One Acre Model'

About the club

Abhinav Farmers' Club (AFC) is one of the biggest farmers' clubs in India with over 1.56 lakh members. It produces organic (chemical-free) products such as vegetables, fruits, grains, pulses, and milk. They focus on low-input, organic farming, and direct marketing and sale of produce - often by collaborating with self-help groups for post-harvest activities (cleaning, grading, and packaging) and sale.

Based in Pune, AFC has been active in six states - Maharashtra (all districts), Telangana, Andhra Pradesh, Gujarat, Madhya Pradesh and Karnataka - for the last 17 years. They aspire to form an Abhinav group in every village in the country.

Via Free Press Journal Bureau

Dnyaneshwar Bodke, the founder and leader of AFC, is a visionary experimental farmer who believes that farming can be a viable profession only when done with a business-like outlook, i.e. only when farming choices are made based on careful calculations of profit and loss, rather than what's popular at the time or on one-time success stories.

This, he believes, can be achieved by minimising farmer's expenses by:

- producing most inputs on the farm itself,
- producing based on orders through direct marketing and not depending on APMCs (rates could be lower),
- use of technology and mechanisation to gain efficiency and reduce dependence on labour (a huge problem for farmers).

As the owner of one acre of farmland himself, Bodke created the 'One-Acre Model' mainly for marginal farmers. This model ensures a minimum income of Rs. 1,000 per day from one acre of land for a family.

What is the 'One Acre Model'?

Under this model, a one-acre plot is divided into **four equal parts** and polyhouses (a type of greenhouse) are set up to **practice controlled farming** to minimise crop loss to weather extremes and pest attacks.

Total Requirements:

Water

10,000 litres/day minimum (through drip and precise irrigation)

Bodke advises buying water in the summer if water is unavailable or reducing the area under cultivation.

Power

1-2 hours of single-phase electricity (or switching to solar pumps in case of unavailability)

Labour

2-4 family members for four hours per day (with investment in high automation and machinery like power tillers)

*Bodke says that through this model, farmers can earn a minimum of **Rs. 1,000 per day per acre per family**. Here, we explain how his farm works:*

The four quarters

Vertical farming in a polyhouse in 0.25 acre.
Photo credits: Srushti + Mukta

- One quarter: 4-5 exotic vegetable varieties grown = 15 kg of harvest every day.
- From this quadrant alone, he earns Rs. 1,000/day.
- Three quarters: 15-20 local vegetable varieties (leafy vegetables, climbers, and cabbage, okra, eggplant etc).
- He earns Rs. 900/day from this .
- Farmers can choose to grow pulses and grains in one or more quadrants instead.

Bodke also encourages vertical farming (growing plants at different levels) to fully utilise the space and accommodate plants that need direct sunlight and those that thrive in the shade.

Automated drip irrigation system.
Photo credits: Srushti + Mukta

Farm bund *(narrow elevation created on farm boundary)*

- 60-70 fruit plants (5 custard apples, 5 oranges, 5 mosambi, 5 guava etc) grown
- Watered once a week for 1-2 hrs through drip irrigation (low water requirement)
- Provides additional income, nutritional diversity to farmer family

Low-cost biogas plant that gives slurry which, when filtered and mixed with water, can be used as water soluble fertiliser (given through drip irrigation network)
Photo credits: Srushti + Mukta

SHG member engaged in cleaning, sorting, grading and packing the day's produce according to the order in carts (see in the right corner)
Photo credits: Srushti + Mukta

Livestock

Dnyaneshwar Bodke at his cowshed.
Photo credits: Srushti + Mukta

- **1 cow (local breed) recommended** for:
  - Consumption and sale (8 litres/day) of A2* milk, which fetches a higher rate (range of Rs. 70/litre to Rs.160)
  - A minimum of Rs. 500 can be earned per day from the sale of milk alone
  - Cow urine or *gomutra* is used as pesticide on the farm and sold at a wholesale rate of Rs. 8/100 ml
  - Cow dung is used for biogas and as organic fertiliser
- AFC *gomutra* and *gowrya* (dung cakes) business turnover is in crores now
- These products result in more income and cost of chemical fertilisers saved
- For fodder, 7 kgs of hydroponic fodder (sprouted corn grown in trays with little water and without soil) twice a day, 6 kg of dry straw fodder (total 20 kgs/day)
- The cow's daily requirement is around Rs 200/day.

This is how Bodke, who pioneered the 'One Acre Model', earns Rs. 1,900 from vegetables and Rs. 300 from one cow which amount to Rs. 2,200/day from his one-acre farm.

* A2 is a milk variety which contains mainly A2 beta-casein (the most common protein group in cow milk). Common Indian cow breeds such as Tharparkar, Gir, Khillar, and Sahiwal have high A2 content in their milk. A2 milk is said to be healthier than A1 milk.

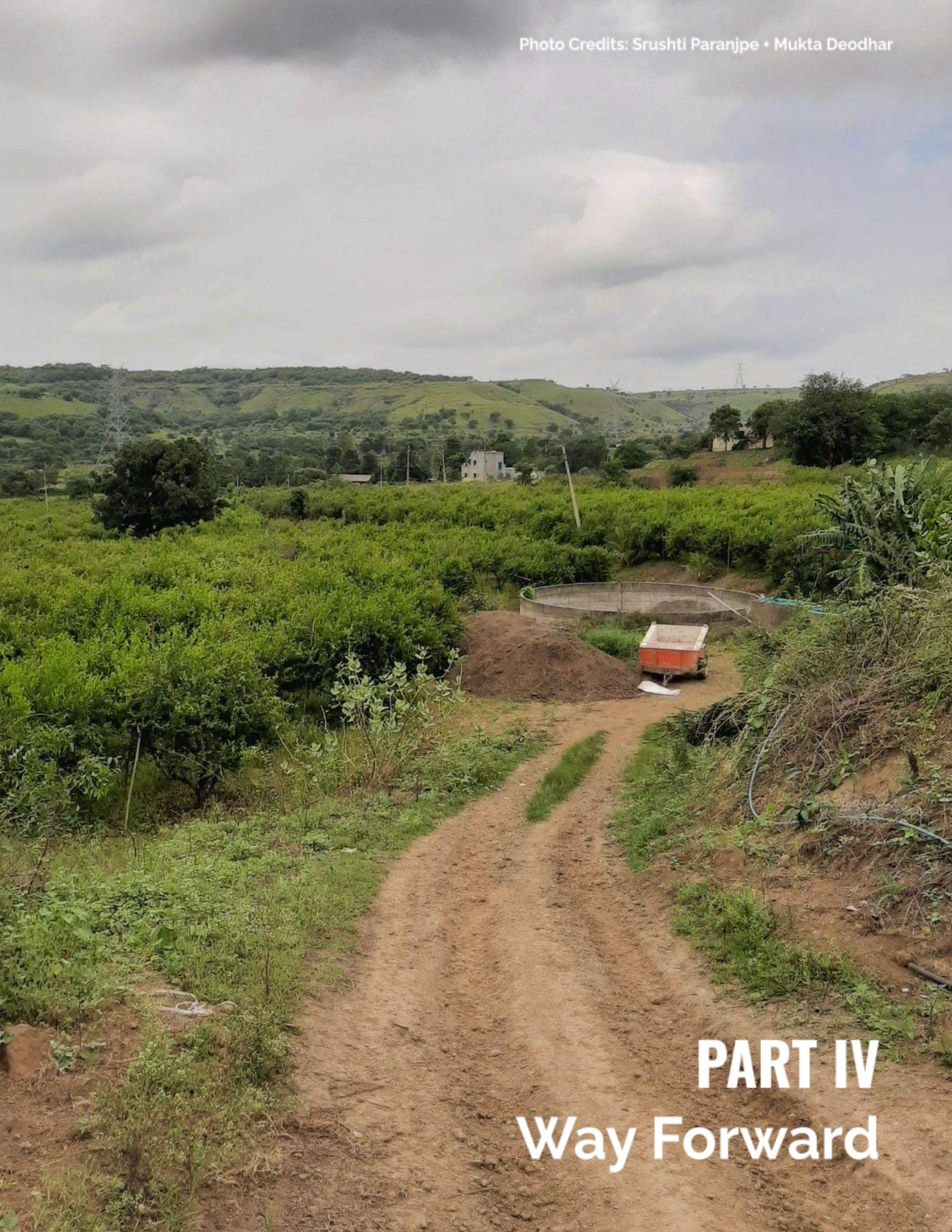


Photo Credits: Srushti Paranjpe + Mukta Deodhar

PART IV
Way Forward

From Journey Maps to Solutioning

The following is a summary of pain points across all interventions, and solutions we have suggested for overcoming these pain points. In cases where solutions are not easy to identify, we have recommended additional research questions in the final column.

We have identified 5 broad categories of solutions - governance, capacity building and awareness generation, research and development, digital tools, and finance. They have been colour coded, so please refer to the legend to identify the category each solution belongs to.

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Pre-Production (Crop Choice, Agricultural Practices, Inputs, Water Budgeting)				
High cost of inputs (like seeds, fertilisers, and pesticides)	FPO (to bulk-buy inputs and seeds and supply to farmers at a low cost.)	CSOs need to conduct initial value chain analysis, from multiple data sources (for socioeconomic and agricultural indicators), which is cumbersome (MYRADA, MOTHER).	Develop tools to conduct initial value chain analysis in a more streamlined manner.	
		Extensive documentation required for FPO registration (BIRDS, MOTHER),	• Reduce the bureaucratic delays related to FPO registration. • Capacity-building for CSO and FPO board members to complete paperwork.	
		FPOs do not get sufficient returns for their produce (MOTHER, BIRDS)	• Business/ entrepreneurship training for FPO staff. • Government support to FPOs for provision of various services (e.g. seed preservation, storage).	What contributes to the financial sustainability of FPOs? (Case studies)
Lack of affordable credit for procuring inputs	FPO (to provide low-cost loans to members)	FPOs have insufficient capital to provide loans to members (BIRDS)	Develop formal tie-ups with financial institutions that can provide collateral-free loans.	
Deteriorating soil health	Shifting to low input farming methods (organic, integrated farming, SCI, agroforestry) to reduce costs, improve soil health.	Farmers are unwilling to shift to lower income/lower input crops and farming methods as they worry that they could suffer losses.(WOTR)	Demonstrate how net profit is higher with low-input farming methods even if the income from produce is lower because input costs are reduced. *(CSO needs to have enough resources to incentivise farmers to volunteer for demonstrations).*	• What would it take for farmers to be able to take a more holistic view of the costs they incur in the farming process? • What are the yield, soil health potential and costs of different low input farming methods? • Identify low input crops that can be high value (e.g. medicinal plants).
		Farm labourers are unwilling to work with crops that are labour intensive. (WOTR)	Innovations in mechanising work for dryland crop areas could help.	• What are the exact pain points in the labour process for low input agriculture? Is this an affordability issue (for existing tech) or is there a need for new solutions.

Governance | Capacity building & awareness generation | Research & Development | Digital tools | Finance

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Pre-Production (Crop Choice,Agricultural Practices, Inputs)				
Farmers choose water intensive crops even in semi-arid regions because of the potential for high profits.	Water budgeting: The CSO facilitates crop water budgeting exercise at the village level before the start of an agricultural season.	Water budgeting is a scientific and complex exercise. It requires lot of data, time, financial resources and skilled manpower. Often CSOs have to adopt simple methods for water budget estimation which are not that accurate. (GGP, WOTR, WASSAN).	• Open access digital tools to collect primary data and calculate water budgets by analysing primary and secondary data. • Data sharing platforms for CSOs to share data related to current or past crop water budgeting exercises facilitated by them.	Develop data quality standards for publicly/crowd sourced datasets relevant for crop water budgeting
		CSOs have a hard time explaining the water budgets and its conclusions in a way that makes them relevant to the farmer at a plot scale. (WOTR)	Generating awareness around how water budgeting and crop choices for *Kharif* season affect the availability of water during Rabi -- helps to demystify the complex water budget for the farmers.	What are some practical ways to highlight the linkages between crop choice at a plot scale and water availability at the watershed scale?
		Recommendations from crop water budgeting exercise may or may not be accepted. (GGP) Lack of legal water sharing agreements, graduated sanctions for violators, untimely renewal of water budgets and delayed resolution of disputes between farmers affects shifting to new practices.(WASSAN)	• CSOs should facilitate legal water sharing agreement between water user groups and plan for timely resolution of disputes. • Since a community's social structure varies across regions, there is a need to consider how government rules and regulations can sustain an intervention.	• How can we enable existing rural institutions like Water User Associations, FPOs, etc. to create rules for water sharing and draft legal water sharing agreements based on them? • Analysis of case studies where water sharing rules and practices, dispute management, legal water sharing agreements have been implemented.
		Participatory water budgeting only works at present in certain aquifer conditions -- where farmers have a high risk of running out of water before the end of the season. (AF Ecology)	Develop a map of aquifers and conditions for collective action, so that participatory water budgeting can be scaled up in those regions.	Under what conditions does participatory water budgeting actually induce behaviour change and why?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Pre-Production (Crop Choice,Agricultural Practices, Inputs)				
Farmers choose water intensive crops even in semi-arid regions because of the potential for high profits.	Water budgeting: Approximate estimation of farm level water consumption at the end of the season using parameters like crops grown, size of the land, total pumping hour ,etc.	Equipment to measure groundwater levels, agriculture run-off, evapotranspiration and flow sensors are not easily available for farmers. It is also unprofitable for farmers to invest in such water monitoring devices because of hold smaller tracts of land. (WASSAN)	• Innovate low cost solutions for measuring real time water consumption at farm scale and village scale. • Establish appropriate communication channels to disseminate this information to farmers.	How can we assess crop water consumption at farm scale using low cost IoT devices?
	CSO provides a list of crops to the farmers which have less water requirement but can ensure higher profits.	There is no discussion in the Gram Sabha on establishing market linkage for the crops recommended by the CSOs. (WASSAN) Institutions like gram panchayat, Water User Associations (WUAs), Village Water and Sanitation Committees (VWSC), involved in water budgeting exercise don't have the mandate to work on market linkage for less water intensive crops. (WASSAN)	• Discussion on establishing market linkages for crops recommended during crop water budgeting exercise. Institutions like FPOs or FPCs, government mandis, etc. need to be involved as well. • Need for an agro-ecological map for India, which shows which crops can be grown to maximise farmer income, while enhancing climate resilience. • Collate block/district wise list of less water-intensive and high value (nutritional, income etc.) crops to plan for market linkages.	
		Farmers sometimes refuse to shift from cash crops because the alternatives do not have a reliable market. Less water-intensive crops like millets are also not useful for subsistence farming - as kids in their villages do not eat it. (WOTR)		• How can we incentivise or support farmers to grow less water intensive crops? • What kind of behaviour change interventions can help to shift diets to millets and other less water intensive crops? • What are the leverage points to change consumer demand to dryland and resilient crops?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Production (Growing, Irrigation, Harvesting)				
Insufficient availability of water (general resource constraints in terms of groundwater and surface water)	**Watershed management:** Supply side activities such as building check walls, recharge pits, open well and borewell, check dam, bund, etc.	Encroachment of common areas and reduction in area available for watershed management activities (MYRADA)		What are the rules that can be established for better commons management? What are necessary conditions for successful commons management?
		Poor participation of farmers in agricultural training programmes (participants come late and leave early, don't attend all the sessions, do not participate actively) (BIRDS),	CSOs need to plan training sessions that are aligned with farmers' schedules, ask farmers about topics they are interested to learn about	How can we provide more useful training programmes for farmers?
		• Delay in farmers' making their financial contribution to the project (BIRDS) • Difficult to mobilise contribution for common lands (MYRADA), • Lack of interest taken by farmers who own or lease land in the intervention area but reside outside it (BIRDS) • Villagers' non-cooperation or rigid ideas of interventions without site study. (GGP, WOTR)	Conduct awareness programmes (backed by data) to help farmers see the value of the interventions to their land.	How can we communicate the benefits of watershed interventions to the farmer's income?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Production (Growing, Irrigation, Harvesting)				
Insufficient availability of water (general resource constraints in terms of groundwater and surface water)	**Watershed management:** Supply side activities such as building check walls, recharge pits, open well and borewell, check dam, bund, etc.	Organising farmers into SHGs - farmers are part of SHGs formed by various institutions. Individual farmers sometimes take out loans from two or more SHGs at the same time, making recovery of loans challenging for each of these SHGs. Further, there is an overlap of interventions implemented by different SHGs and lack of cohesion in action. (BIRDS)	Aligning interventions with other institutions to avoid duplication of efforts by the same organisation across multiple projects.	
		• Too many documentation requirements for project design, theory of change, impact evaluation, etc. • Delay from funders in disbursing the funds makes it difficult for the CSO to execute the project. (GGP, BIRDS)	Create standard templates/ toolkits between philanthropic organisations and other funding agencies to apply for and receive approvals for grants.	How can funding be made more accessible to field organisations? How can project success be measured more 'accurately'?
		Difficulty in carrying the intervention forward (operating and maintaining watershed structures, continuing SHGs, once the project period has ended (MYRADA)	Each intervention must have a clear owner at the end of the project -- e.g. FPOs, CSOs or Gram Panchayat -- with potential sources of funding identified.	What are the factors that determine a project's longevity? How are these factors taken into account in project design?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Production (Growing, Irrigation, Harvesting)				
Insufficient water availability (seasonal resource constraints - Inadequate water for rainfed crops in semi-arid area.)	Protective Irrigation	• Limited reach of current government inter-basin water transfer projects, like Handri Neeva, to facilitate filling of surface water bodies in villages. (AF Ecology) • Delays in releasing the water into the canal at the right time, thereby missing the crucial spells of protective irrigation. (AF Ecology)	• Re-design irrigation canal projects to supply water first to the village tanks and then to the individual farmers in the canal command area. • Plan for releasing excess water to the surface water bodies as per the actual crop water demand in the watershed.	Analyse how water can be equitably distributed in semi-arid areas by supplying water from reservoirs to the shared surface water bodies.
		• In times of severe drought owners of farm ponds and borewells break the mutual consent to share water. • Water sharing decisions are not being revised in a timely manner creating disputes among water users. (AF Ecology)	• Create awareness to use groundwater as a common pooled resource. • CSO and FPOs to create a district/mandal/block-wise drought contingency plan. • Plan for timely renewal of water sharing decisions.	How can farmers be encouraged to adhere to water sharing decisions made by them?
		• Due to very low market value for most of the less water-intensive crops, it's difficult to get farmers to crop them. (AF Ecology)	• Campaigns and incentives for advocating less water-intensive crops • Set up a Minimum Support Price (MSP) for less water intensive crops, like millets. • Ensure guaranteed procurement of produce either by FPO or other collectives. • Set up a processing unit to create value added products that have higher market value.	How can farmers be encouraged to change their behaviour to adopt less water intensive crops and irrigation methods?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Production (Growing, Irrigation, Harvesting)				
Unpredictable weather patterns make farming decisions really difficult	Agromet advisories - app, crop weather calendars, SMS forecasts	Lack of/reluctance towards smartphone use, internet connectivity issues (WOTR)	• Display a printed weekly crop weather calendar in all villages. • SMS based agromet/irrigation advisories in regional language to tackle internet connectivity issues.	Why are farmers in certain parts of the country unwilling/reluctant to use smartphones?
Farmers don't know when and how much to irrigate.	Farmers discuss irrigation requirements with CSO and other experts during crop water budget exercise.	Farmers need irrigation advisory specific to their farm condition, crop growth stage and weather conditions to optimise their water use pattern. (WASSAN)	Issue farm-scale irrigation advisories along with seasonal crop water budgets so that farmers can act upon the information given to them and change their water use pattern.	How can a bottom up irrigation advisory services be designed, whereby marginal farmers have a say in the advice they need and when they need it?
Low agricultural productivity, low incomes, low water availability Fruits like mangoes are susceptible to lots of diseases. They have to procure insecticides and pesticides to keep these pests out of their fields, which not only adds to the cost of cultivation but is also seen as being unhealthy for the ultimate consumer. Natural methods of managing pests in these orchards have not worked effectively.	Agroforestry: MOTHER is implementing agroforestry interventions by encouraging farmers to grow horticulture crops, forestry and adopt intercropping as well to provide farmers with more than one income source	• CSOs find it challenging to convince farmers to collectively agree on the horticulture crop that needs to be grown. (MOTHER) • CSOs are trying to figure out how to grow and harvest a quality product since horticultural crops are prone to pest attacks. (MOTHER) • CSOs need to develop protective irrigation strategies for agroforestry interventions, which often fail in the summer due to lack of irrigation facilities. (MOTHER)	CSOs would benefit from disseminating 'success stories' of farmers where agroforestry has worked well, and the conditions for success. This could encourage farmers within their programme to adopt it as a collective.	• What are the conditions under which agroforestry projects can be beneficial for communities? • How do we develop protective irrigation strategies for every watershed/village?

Issues	CSO Intervention	Pain points for implementing interventions	Potential solutions to overcome pain points	Research Questions
Supply chain				
Farmers sometimes refuse to shift away from water-intensive cash crops because the alternatives do not have a reliable market. Processing and packaging expenses are high, market linkages for crops are not established, marketing produce is challenging.	FPO (for providing market linkages.)	Unable to identify right marketing and sales channels for their produce (MYRADA)	• Develop marketing strategies for FPOs to identify the right market channels for their produce • Develop a guidebook that can help FPOs become financially sustainable by focusing on supply chain and logistics, and marketing and sale.	
Low price for the raw produce	FPOs (to provide value-addition (flour-making/ oil-extraction etc.)	FPOs are unable to identify crops where value addition is possible (MOTHER)	Conduct a maker-fair to develop processing techniques and tools for raw produce	What crops can be processed and stored for future consumption, so it is less susceptible to market volatility?

Our learnings from these journey mapping exercises have demonstrated the need for two things:

1. Need for a knowledge commons

CSOs need to reduce the time and resources they put into problem diagnosis. They spend a considerable fraction of their time and budget replicating basic maps and resources that ought to be freely available. Creation of a knowledge commons, in the form of digital tools, will allow CSOs to share data and knowledge, enabling cross-learning between projects. Digital tools could allow CSOs to explore challenges in the geographical regions they work in by giving them access to key data layers.

We have identified four use cases for the knowledge commons:

- Develop water budgeting tools and communicate it to CSOs, gram panchayats and farmers
- Make it easy for farmers to choose crops based on hydrogeology of locations and socio-economic conditions
- Develop an all-India aquifer map
- Develop a tool that can estimate agricultural value chain at a district/block level

2. Need for a research marketplace

During the journey mapping exercise, we realised that some of the CSOs' pain points needed to be studied in greater detail. For instance, it was clear that participatory groundwater budgeting worked well in some aquifer conditions and not all. To be able to replicate the success of this exercise in other contexts, we need to study all the other conditions that could enable participatory groundwater budgeting.

Across the journey maps, we have identified a set of questions that require additional research. To address these questions, we recommend the setting up of a research marketplace that could bring together the research questions that need answering, and researchers interested in answering them. CSEI could function as the research marketplace, and use the research outputs generated to create solutions for the pain points we have identified. Students, particularly Masters and PhD candidates, interested in working on relevant and impactful research topics would benefit from this marketplace. This is a win-win for all parties involved, and could unlock key research insights for solutioning for CSOs.

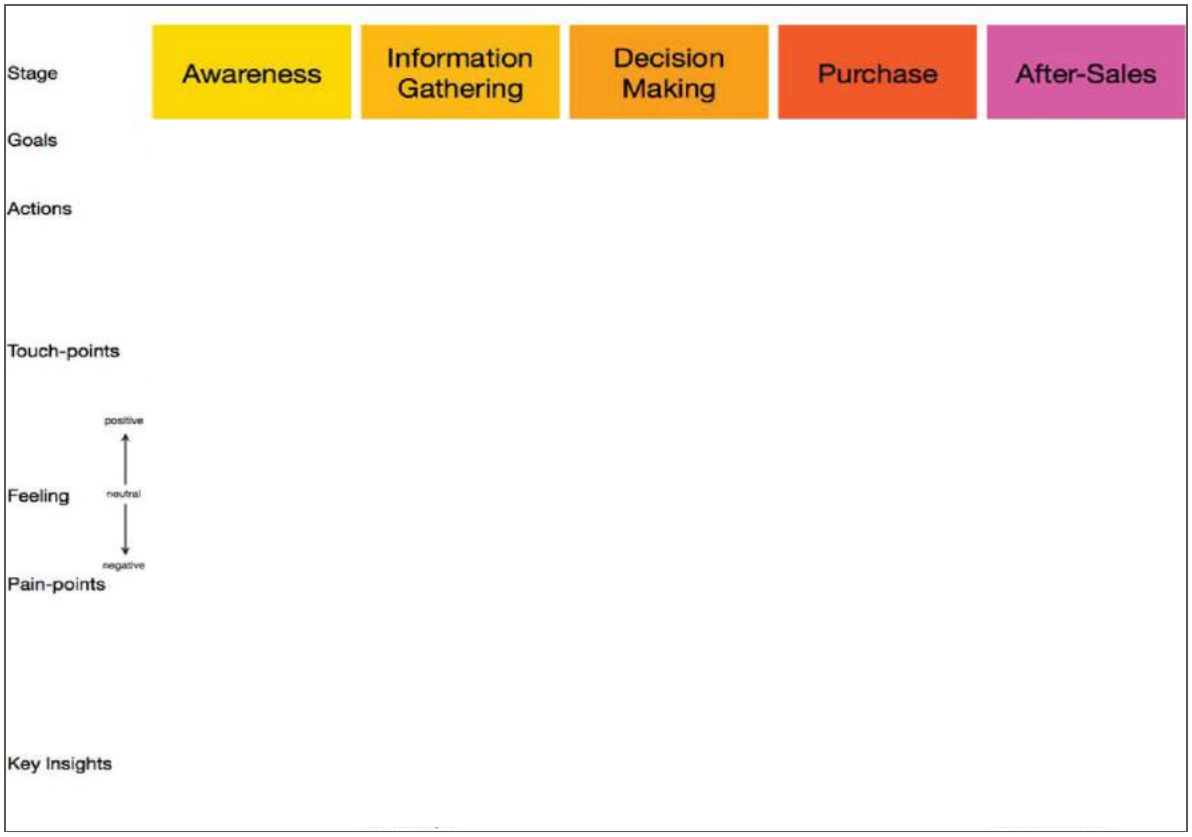
For the next part of our project, we will solicit inputs from the Rainmatter Foundation, and work on developing a paper toolkit for one of the use cases. We will determine a use case of mutual interest.

PART V
Annexure

Annexure 1: Journey Maps

To diagnose the problems, we used journey mapping - a tool that's commonly used in design thinking. Originally a market research technique developed in the 1960s and '70s, journey mapping, also known as 'experience maps' or 'customer experience maps' is a conventional research technique 'used to document and understand the many different steps or stages in a journey that a person may undertake' (Crosier and Handford, 2012).

In addition to physical actions and decisions, journey maps may also be used to identify and illustrate problems, successes, and emotional responses at each point of accessing a service, developing a personal narrative of an experience (Panzera et al., 2017; Howard, 2014; LeFebvre, Taylor, & Thomas, 2016).



An example of a journey map illustration.

Some applications for journey mapping include:

- **Social marketing** - which values client-centered strategies. Here, journey mapping accesses important information from participants as they are 'the only ones who can identify the problems from their perspective' (BenTovim et al, 2008, p. S15)[21].

[21] Ben-Tovim, D. I., Dougherty, M. L., O'Connell, T. J., & McGrath, K. M. (2008). Patient journeys: the process of clinical redesign. Medical Journal of Australia, 188(S6), S14-S17.

- **Public health** - Participation in a special supplemental nutrition programme for women, infants and children in Kentucky, United States (Panzera et el., 2017)[22]
- **Citizens' water use** in Melbourne
- **Shopping experience** of visually challenged consumers (Crosier & Handford, 2012)[23]
- **Agricultural** extension services (Silvert and Warner, 2019)[24].

Journey mapping is done through direct observations, abbreviated participant observation, and focus groups (Panzera et al., 2017). The individual who prepares the journey map asks the participants to undertake a series of journeys recorded both on audio and in the form of written notes as they complete their journey, through one-to-one interviews at various stages of the journey. A series of journey maps are then produced (Crosier and Handford, 2012). Video, focus groups, mystery shoppers, direct observation, and customer personas are also used to collect data and the data is brought to life through journey maps (Ortbal et al., 2016a)[25].

Methods vary and typically involve, but are not limited to, qualitative techniques that highlight 'glitches' in processes influencing service quality (Crosier & Handford, 2012), thus developing 'narratives' of participant experiences. Narratives develop the chronologies and types of events experienced by programme participants within a cultural context and in relation to others (Miller, 1999)[26].

While there is no standardised approach or methodology for customer journey mapping, a survey of current practitioners and an evaluation of surrounding literature (Ortbal et al., 2016a) revealed four universal traits:

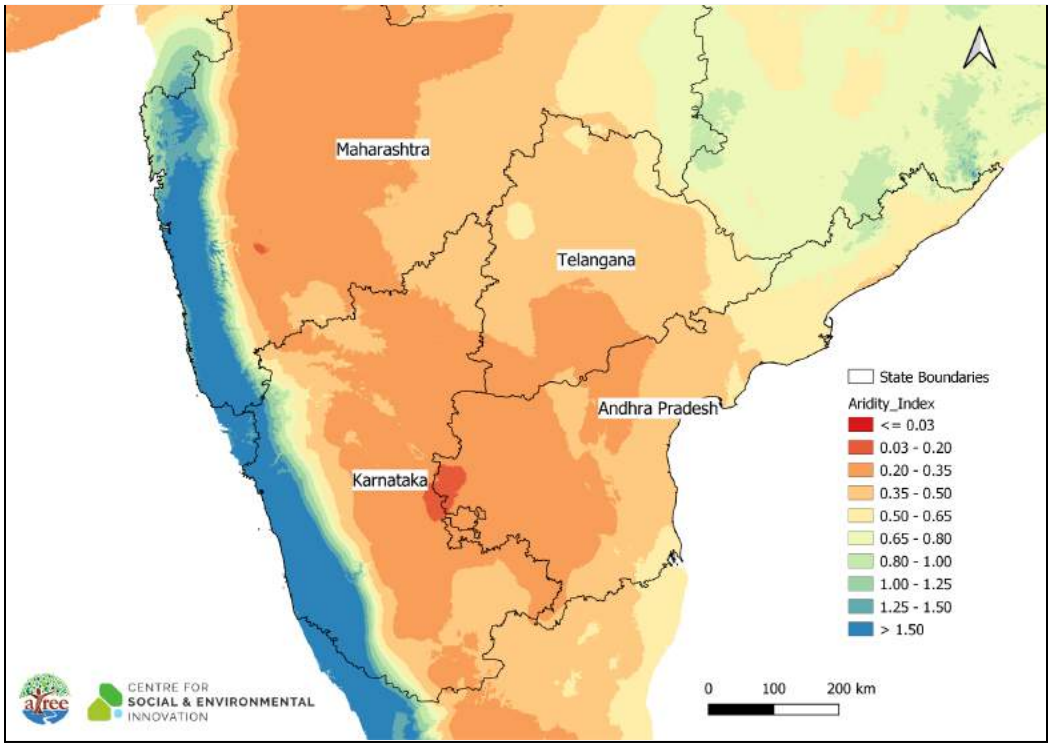
- Team-oriented execution
- Highly visual nonlinear nature
- Use of touch-points
- Emphasis on real customers and consumers

[22] Panzera, A. D., Bryant, C. A., Hawkins, F., Goff, R., Napier, A., Kirby, R. S. & O'Rourke, K. (2017). Audience segmentation of Kentucky mothers by nonparticipation status in the special supplemental nutrition program for women, infants & children. Journal of Nonprofit & Public Sector Marketing, 29(1), 98-118.
[23] Crosier, A., & Handford, A. (2012). Customer journey mapping as an advocacy tool for disabled people: a case study. Social Marketing Quarterly, 18(1), 67-76.
[24] Silvert, C., & Warner, L. A. S. (2019). Using Journey Mapping within Extension: A Tool for Supporting Behavior Change Programs. EDIS, 2019(2).
[25] Ortbal, K., Frazzette, N., & Mehta, K. (2016). Stakeholder journey mapping: An educational tool for social entrepreneurs. Procedia engineering, 159, 249-258.
[26] Miller, J. H. (1999). Narrative approaches to qualitative research in primary care in doing qualitative research. In B. F. Crabtree & W. L. Miller (Eds.), (Chap. 12, pp. 221–238). Thousand Oaks, CA: Sage Publications.

Annexure 2: Indicators for Choice of Regions

Aridity index

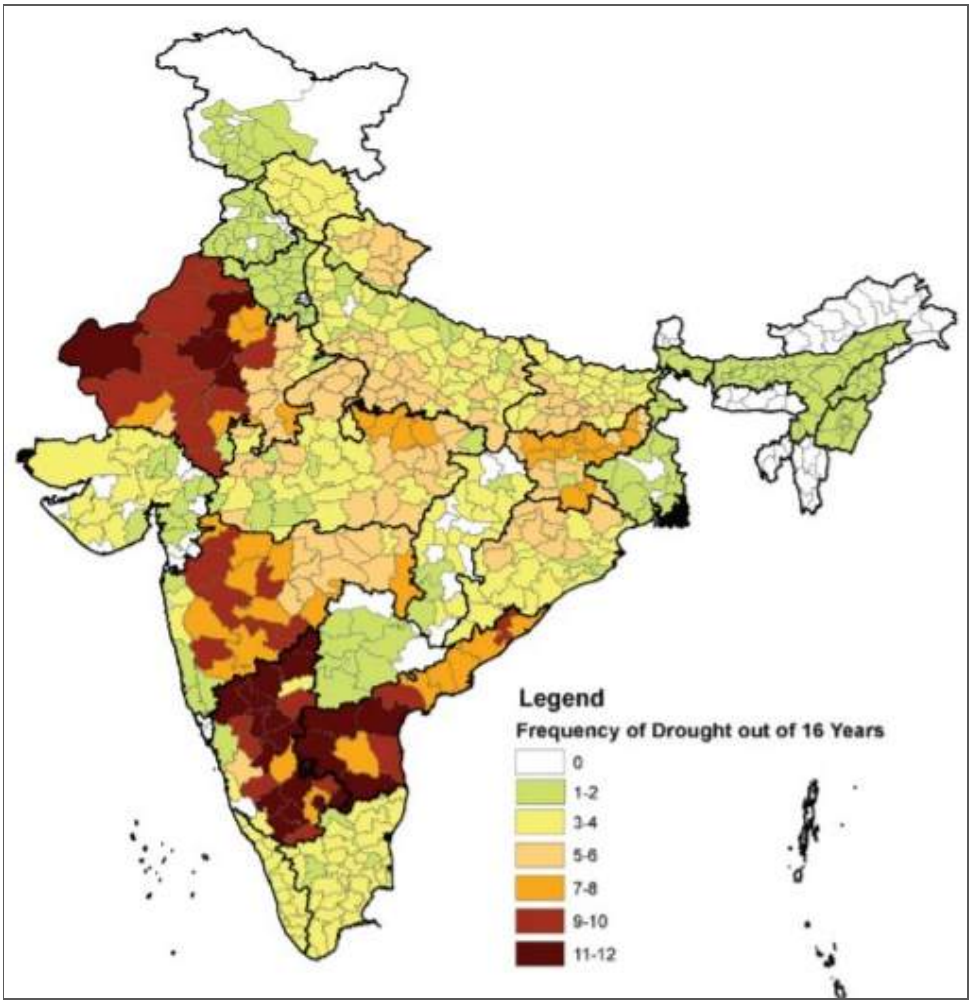
Aridity Index, defined as the ratio of mean annual precipitation to mean annual evapotranspiration (potential), is widely used to infer water stress in a region due to the shortage of soil moisture and rainfall. It also helps in monitoring drought events which directly impact the agricultural productivity of a region. From the aridity index map, it is evident that most districts in states like Maharashtra, Karnataka, Andhra Pradesh and Telangana, fall in the category of hyper arid, arid and semi-arid regions.



Mapping of Aridity Index (AI) values for the southern part of India (1970 - 2000 period). Note that higher AI (green/blue colors) represents more humid conditions, with low AI (brown/yellow colors) representing higher aridity. (Source: CGIAR-CSI Global-Aridity Index)

Rayalaseema, the arid western region of Andhra Pradesh comprising Kurnool, Anantapur, YSR Kadapa and Chittoor districts, has seen 15 drought events between 2000 and 2018, out which last nine were consecutive.

In Maharashtra, 11 of the 36 districts, which account for almost 40% of the cropped area across central Maharashtra, are highly vulnerable to droughts and increasing water stress. With 70% of Maharashtra's geographical area falling under semi-arid region, the state has 'prominently observed' droughts from 2011-12 onwards. A similar situation is persisting in the state of Karnataka which has declared 23 of its 30 districts as drought prone. At least 16 of these districts are eternally drought-prone, featuring in the list of 24 districts from across the country.



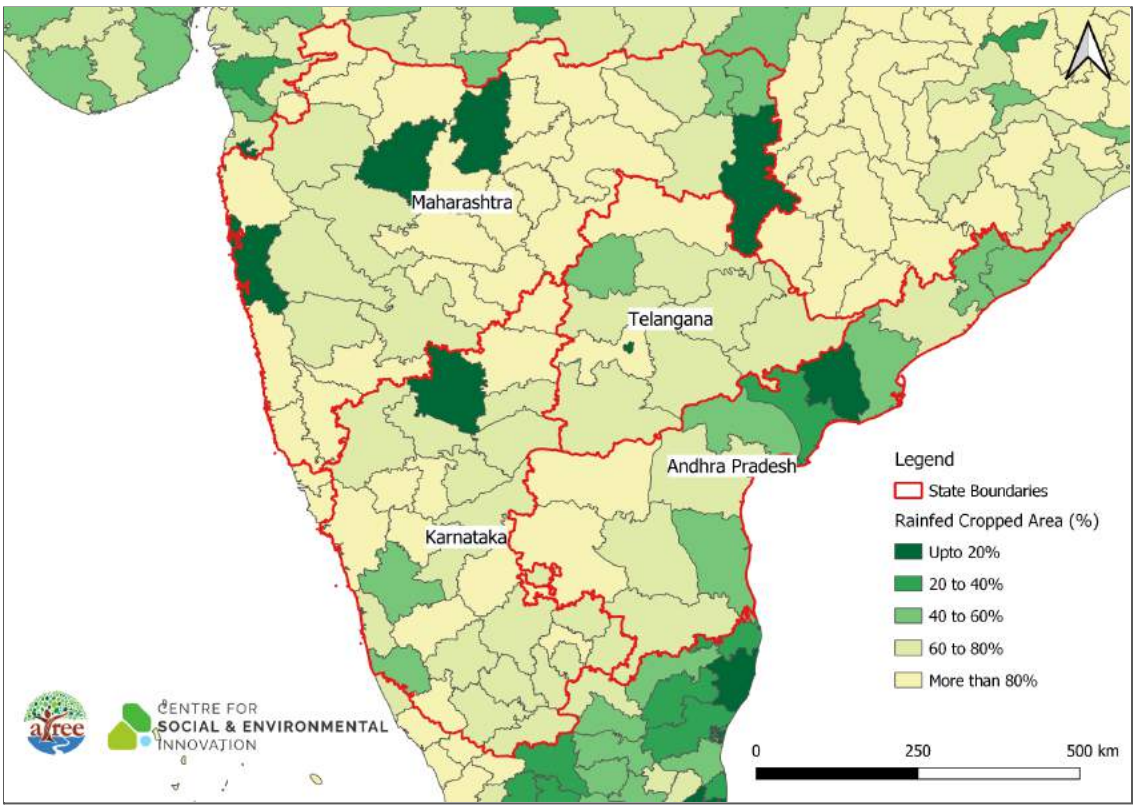
District-level drought occurrence frequency (2000 - 2015) as declared by state governments. (Source: Manual for Drought Management 2016 by Ministry of Agriculture & Farmers Welfare)

Percentage of rainfed land/farmers

Rainfed agriculture relies on rainfall for meeting the water requirement of crops grown. India ranks first in rainfed agriculture globally in both area (86 Mha) and the value of produce. Rainfed regions in India produce 40% of the food grains, support two-thirds of the livestock population, and are critical to food security, equity, and sustainability. However, water scarcity and climate change threaten rainfed farming through increased vulnerability to droughts and other extreme weather events.

In rainfed areas, degradation of soil by water erosion, wind erosion and salinity, has resulted in loss of fertile surface soil and soil organic content (SOC). The severe depletion of SOC in rainfed agroecosystems in India has adversely impacted soil quality, crop productivity, and sustainability. Crops under rainfed farming systems also suffer from multi-nutrients deficiency (like sulphur boron, and zinc etc.) because of low rates of fertilizer use.

46% of land in Karnataka is degraded; in Maharashtra, it amounts to 35%; and in both Andhra Pradesh and Telangana, it is 37%.



District level mapping of percentage of rainfed cropped area (Source: Census 2011)

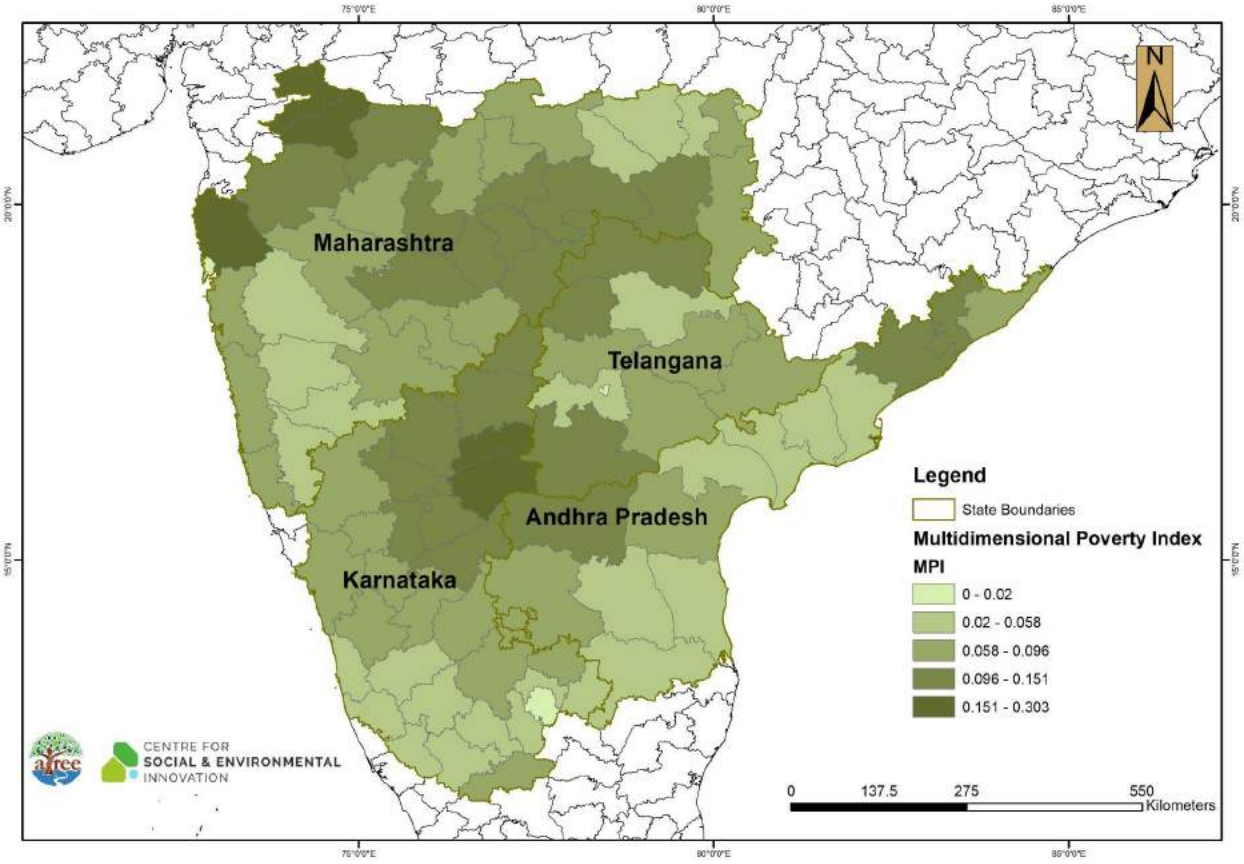
Rainfed agriculture in India mostly comprises small and marginal farmers, accounting for a large part of operational landholdings in 2018. Total income of small and marginal farmers in these regions is low, which limits their investment capacity and increases their dependence on loans. Poor market linkage for dry crops and price volatility also adds to the woes of small rainfed farmers.

Percentage distribution of agricultural households by size class of land possessed (ha.) for different States/Group of Union Territories/ Group of North-Eastern States during July 2018 – December 2018

States	Size class of land possessed (ha.)							Total
	< 0.01	0.01 - 0.40	0.40 - 1.00	1.01 - 2.00	2.01 - 4.00	4.01 - 10.00	10.00 +	All classes
Maharashtra	1.4	12.3	36.4	27.9	15.9	5.5	0.6	100
Karnataka	1.2	12.8	37.9	25.9	16.4	5.2	0.6	100
Telangana	0	11.4	30.8	30.8	20.2	6.3	0.4	100
Andhra Pradesh	0.2	17.6	35.2	24.3	17.7	3.5	1.5	100

Multidimensional Poverty Index (MPI)

In terms of differences in incomes between districts, we have used the MPI. The MPI is a non-monetary measure of poverty, and captures deprivation across three dimensions: health, education and living standards. The index is estimated with a set of 12 indicators across these three dimensions. We have mapped the multidimensional poverty index to identify poorer rural districts. In the figure below, districts with a higher MPI have a higher level of multidimensional poverty -- these are the ones in the darkest shade of green.



Source: National Multidimensional Poverty baseline report based on NFHS-4 (2015-16), Niti Aayog

Annexure 3: Farming Process

A series of steps related to the growth and harvest of a crop constitute the farming process or the agricultural cycle. Right from deciding which crop to plant to logistics that determine how well the crop sells, each step is informed by a number of factors that vary across regions.

Here, we explain the different stages of the farming process based on our fieldwork and conversations with farmers, FPOs and CSOs.

Step 1: Crop choice

To begin with, farmers need to decide what sort of crop is most suitable for the climate, soil type and resources particular to where they are located. These environmental factors aside, the market demand and consequent price that crops are sold for play a pivotal role in helping farmers decide what to cultivate.

Crop choice is also determined by availability of labour, extent of mechanisation, institutional support that incentivises growth of certain crops. There are also considerable overlaps across the different stages; for example, the introduction of solar-powered pumps for irrigation can influence what crops are selected for cultivation. One of the big pain points we identified at this stage is that even though farmers select crops based on market demand, it falls by the time they harvest, spelling losses for them.

Step 2: Soil preparation

Next, the farmland has to be prepared for cultivation. This step focuses on enriching the soil and taking precautionary measures against weeds and pests. This process has, to a large extent, been mechanised as farmers either use their own tractor or rent cultivators or rotavators to till the land. Loosening the soil aerates the nutrient-rich top soil, removes weeds and allows seeds to take root more easily. Farmers also apply manure, fertilisers as well as pesticides like neem cake to prevent infestation. Preparation of the land is normally carried out from April to June, before the onset of the south-west monsoon.

Step 3: Sowing

Once the land is prepared, seeds are planted usually around the time of the first rains of the season in June and July, unless it is a *rabi* crop (like groundnut) which are planted in October or November. They need to be placed at the right depth and spaced from each other but there are different methods by which this part of the agricultural cycle is carried out. This includes drilling, whereby machinery or animal-ploughs are used to drop seeds into furrows; transplanting, by which seedlings are first grown in nurseries before being shifted to the fields; and broadcasting, which involves scattering the seeds uniformly on soil surface either by hand or with the support of cultivators to turn the seeds into the ground. The broadcasting method is what we encountered most during our fieldwork.

Step 4: Irrigation

For the seeds to grow, water is essential. Irrigation or the process of supplying water to the

fields is the critical next component of this cycle and is also the focus of many of the interventions we came across during the course of this fieldwork.

Agricultural water use is broadly divided into two categories: rainfed and irrigated. Half of India's agricultural lands is rainfed, meaning farmers rely on direct rainfall to replenish their land and crops. But as the likelihood of drought and dry spells increases in a warming world, our fieldwork found that interventions such as protective irrigation help farmers sustain their crops even during the harsh summer months.

Irrigation entails tapping sources such as groundwater (through wells), and surface water (through canals, rivers, lakes and reservoirs). There are also different types of irrigation systems such as surface irrigation, sprinkler irrigation and, the one used by a majority of farmers we spoke to, drip irrigation. This method involves delivering drops of water close to the roots of the plant through a network of pipes. We also found that borewells are a common fixture in many of the farms we visited.

Step 5: Weed management

An important and often labour-intensive part of the agricultural process is controlling the growth of weeds. It has to be removed because weeds compete with crops for resources such as soil nutrients, sunlight and water; and can host dangerous pathogens or insects. These factors decrease crop yield and impact its quality.

Our fieldwork showed that farmers employ different deweeding measures, the most common being, manual labour. If there's enough space between the saplings plants (at least 3 feet) farmers also use tractors or more traditional tools like *danthe* or *guntka*, which are tied to bulls, to extract the weeds. Since employing workers is too expensive for many farmers, they take preemptive measures such as using plastic mulching paper or spraying herbicides, which cost far less than hiring workers to deweed acres of land. We also found that some farmers manage to use weeds to their advantage such as allowing them to flourish before the crop is sown thus trapping more carbon in the soil.

Step 6: Fertilisers/pesticides

Fertilisers and pesticides are important inputs that are mainly applied at the growth stage of the agricultural cycle. Fertilisers are substances used by farmers to increase crop yield by supplementing the soil's nutrient levels, and pesticides are used to eliminate or prevent pests. These are both broad terms used to refer to a wide range of substances with different chemical compositions. For instance, some of the farmers we spoke to said that they use di-ammonium phosphate and urea as fertilisers and copper oxychloride as a pesticide. Farmers mainly acquire them in bulk from FPOs.

Only farmers who owned cattle apply cow dung as fertiliser, usually during the summer months as part of land preparation before sowing. Neem cakes and horse gram residue are also used as natural fertilisers and pest repellent. A *ragi* farmer we interviewed said that he also planted leguminous crops in rotation to replenish soil nutrients in another example of a natural alternative.

The pain point that came up often during our conversations with farmers was that yield was affected by pests such as peafowls, locusts, soldier worms and root borers, leading to

added costs in procuring pesticides.

Step 7: Harvesting

Harvesting marks one of the final stages of the agricultural cycle, when the ripe crop is reaped from the fields. It is carried out when the plant reaches maturity and hence the timeline varies depending on the crop, with tomatoes being harvested 70 days after it is sown, while the arecanut takes four to five years to fully mature. It is also carried out through different methods, again depending on the type of crop.

Harvesting, like deweeding, is among the most labour-intensive parts of the process. Workers are hired mainly to gather crops like vegetables, fruits, arecanut, millets like jowar and bajra that cannot be collected using a harvester. Even the manner in which this work is manually carried out varies with vegetables needing to be plucked by hand, while the stalks of ragi are cut using tools like a scythe. Tractors and harvesters are mainly used to harvest paddy.

The timing for harvest has to be precise and increasingly erratic rainfall patterns were cited as a pain point to us because it delays harvests, ruining part of the yield.

Step 8: Post-harvest processing

The crop begins to deteriorate once it has been cut from the main plant. To either retain the quality of the produce or to turn it into an altered product that can be sold on the market, a set of processes need to be carried out, which could entail cleaning, drying, peeling, dehusking, pressing or powdering. This too depends on the specific crop. Our experience showed that the arecanut crop involved the most elaborate processing stage. The nuts are peeled, segregated, boiled and dried before sale. It also does not spoil easily allowing it to be stored for long. Perishable vegetables like tomatoes, on the other hand, need to be transported to processing facilities quickly in order to turn them into value-added products such as pickles or jams.

It's important to explore the potential of value-addition at this processing stage of the agricultural cycle in terms of improving farmers' income. For instance, if millet is sold for Rs. 90/kilogram, millet flour is sold for Rs. 240-300/kilo in urban areas. Millet processing is one of the key initiatives of one of the CSOs we worked with.

Step 9: Transporting to markets/storage

Once the crop has been harvested and/or processed, it needs to be transported to markets for sale. Robust storage and transportation systems are critical to the success of the entire farming process. Without them, the farmer's investment, in terms of money, time and labour, is wasted if the produce does not make it to the consumer on time and in good quality. As mentioned above, we found that storage is a big issue especially in terms of perishable, horticultural crops like tomatoes, which, if not transported on time, ruin quickly. We identified FPOs as a crucial intervention in this regard because collectively organising transport and arranging storage facilities helps bring down costs for each individual farmer.

Annexure 4: About the Interventions

Agroforestry

Agroforestry is the 'intentional integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits (USDA).' Although agroforestry has been traditionally practiced in India for a few thousand years and finds mentions in the epics and cultural rituals, 'recognition of trees as components of farming systems has been rather limited' (Puri and Nair, 2004)[27]

In terms of policy, agroforestry has drawn much attention. The Indian Council of Agricultural Research (ICAR) launched the All India Coordinated Research Project on Agroforestry in 1983 and established the National Research Centre for Agroforestry in 1988. A separate council - The Indian Council of Forestry Research and Education (ICFRE) was set up to promote agroforestry research. The Government of India launched the National Agroforestry Policy [28] in 2014.

Agroforestry benefits farmers by providing income through harvest from the trees/shrubs, timber, cattle fodder, green mulch etc. and environmental benefits through ecosystem services. Indian farmers may or may not find agroforestry beneficial depending on their climatic zones and other factors such as landholding, land slope etc. There is also a perception of planting trees on farm boundaries reducing crop yield, which is supported by some studies. Whether the benefits of these trees outdo the crop yield decline depends on the farmer's context (Puri and Nair, 2004).

Agromet advisories

Indian farmers have relied for long - and still do - on traditional knowledge like particular *nakshatra* (constellations) for beginning different stages of farming activities. However, this knowledge is not sufficient as the weather becomes erratic and extreme weather events become more frequent due to climate change. This and other factors have also made the farms more vulnerable to pest attacks and diseases. Agromet advisories thus have become a necessary tool for the farmers.

An agromet advisory is a combination of weather and crop-related information and practical advice for farmers. The development of automatic weather stations and diversification of satellite technology use along with the revolution in computer capacities has made this possible, since the 2000s (CSE). This, along with the pre-existing crop data collection system has made the agromet advisory system possible.

'The Government of India, under the leadership of the Indian Meteorological Department (IMD), set up Agromet Field Units (AMFUs). These Units collect data and send it to the IMD, receive forecasts from the IMD, and employ meteorologists and crop experts to generate agromet advisories' (ibid). WOTR[29], a CSO in Maharashtra, has also developed its own

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[27] Puri, S., Nair, P. Agroforestry research for development in India: 25 years of experiences of a national program. Agroforestry Systems 61, 437–452 (2004). https://doi.org/10.1023/B:AGFO.0000029014.66729.e0
[28] https://agricoop.nic.in/sites/default/files/National%20Agroforestry%20Policy%202014.pdf
[29] https://wotr.org/agriculture/

agromet advisory system in which they use the weather information and forecast from IMD and send locale-specific mobile advisories via SMS or an app called Farm Precise.

Participatory Groundwater Management (PGM)

The PGM experience is relevant, in the context of overall groundwater development and management, because it provides scientific insights into some practical issues faced by community management of groundwater resources.

The key issues and policy responses that PGM could possibly bring about are:

- Demystifying groundwater circulation;
- Determining the unit of groundwater management;
- Overcoming scarcity of hydrological data and user access to scientific information
- Estimating groundwater recharge and groundwater over-withdrawal;
- Addressing risks in groundwater development;
- Addressing issues of equity and social justice that arises when aquifers are accessed and groundwater is allocated.

The core strength of PGM is its approach to demystifying science and technology. Access to scientific information holds the key to sustainable management of water resources.

Crop water budgeting

Crop water budgeting is a community-led process where local communities come together to make an assessment of water resources in a given region. In this process, villagers understand the quantity of water available in the village, that is used and is available for future use. Based on this analysis they decide on rules and practices for managing surface and groundwater as a shared resource.

Crop water budgeting is crucial for ensuring sustainable and equitable usage of water in a region. It also forms the basis of deciding scientifically and socially appropriate interventions for enhancing water security. Central and state governments also focus on water budgeting and water security plans through various schemes and policies like Jal Jeevan Mission, Atal Bhujal Yojana, PM Kisan Sinchayee Yojana, which has water budgeting as a core element.

Farmer producer organisations/companies (FPOs/FPCs)

In 2011-12, the Department of Agriculture, Cooperation and Farmer Welfare (DAC&FW), Ministry of Agriculture, Government of India, piloted a programme for creating and promoting farmer producers organisations (FPOs). They implemented this programme through the Small Farmers Agribusiness Consortium (SFAC), in partnership with state governments. They mobilised over 2.5 lakh farmers into 250 FPOs under two schemes: i) the Rashtriya Krishi Vikas Yojana or the National Vegetable initiative for Urban Clusters, and ii) the programme for pulses development for 60,000 rainfed villages.

Most FPOs are promoted through the National Bank for Agriculture and Rural Development (NABARD), or through SFAC. In some cases, FPOs are also being promoted through philanthropic organisations and CSR, including the Bill and Melinda Gates Foundation, Reliance Foundation, Ambuja Cements Foundation, HDFC Foundation, C&A Foundation,

HSBC CSR, Axis Bank Foundation, Jindal Steel & Power Limited, Syngenta Foundation and TATA Trust.

The government decided to collectivise small and marginal farmers (owning less than 1-2 ha of land), so they could achieve economies of scale through collective effort. Through the FPOs, they wanted to 'foster technology adoption, improve productivity, facilitate adoption of good agricultural practices, enable improved access to inputs and credit, develop direct marketing capacity and thereby enhance farmer incomes, concomitantly augmenting their sustainable agriculture-based livelihoods' (SFAC, 2019)

FPOs engage in a number of activities including, but not restricted to:

- Procuring inputs in bulk at wholesale rates to reduce the cost of production
- Aggregating output in bulk and helping with marketing and sale
- Providing access to modern technology, extension services, and joint training on good agricultural practices
- Minimising post-harvest losses through the provision of joint storage and value addition facilities
- Engaging in contract farming to tackle price fluctuations and distress sale.
- Disseminating information to all farmer members on prices and volumes sold to reduce information asymmetry.
- Improving access to institutional credit without individual collateral, through joint liability of FPO board members.

In India, the legal constitution of FPOs typically comprises of Societies and Trusts, Co-operatives, Mutually Aided Co-operative Societies and Farmer Producer Companies (FPCs). Two types of legally registered FPOs are formed in India: i) Farmer Producer Companies (FPCs), and ii) Cooperatives, with the former being more popular than the latter. This is because over time, cooperatives faced a lot of political and government interference and this often prevented them from not being able to follow democratic principles of decision making. FPCs, by nature, cannot accommodate non-farmers or non-producers as members, hence curbing interference by external agents.

As of 2020, there are 4,979 FPOs in the country. These numbers are likely to increase in the coming years as the Government of India has promised to set up at least 10,000 FPOs by 2027-28 using a large budgetary outlay of Rs. 6,865 crores.

Hence, any interventions we design and implement for and with farmers need to be channelled through collectives like these. These collectives could potentially play an influential role in changing farmers' behaviours, and helping them move towards sustainable water use practices.

Low Input Agriculture

The concept of low input agriculture is to minimise the use of external inputs (e.g. chemical pesticides and fertilizers) and to use the resources available on the farm itself wherever possible (e.g. pesticide made from neem and datura leaves extract) to bring down the production cost for the farmers and increase their farm profits.

This also has an environmental benefit of reduced pollution of surface and groundwater

resources, better soil health as well as the consumer benefit of less/no pesticide residues in their food.

India launched the National Project on Organic Farming (NPOF) in 2004, which was merged with the National Mission on Sustainable Agriculture (NMSA) scheme in 2012. The scheme is implemented by National Centre Of Organic Farming, Ghaziabad and its eight regional offices, which mainly aim to promote organic farming through technical capacity building, technology dissemination, promotion and quality control of organic/bio-inputs and promotion of low-cost Participatory Guarantee System-India (PGS-India) for organic certification.

Low input agriculture is a broad term that covers a range of interventions such as organic farming, climate-resilient agriculture, biodynamic agriculture, sustainable farming etc. which are promoted by various CSOs. It also covers System of Crop Intensification, an agro-ecological farming technique with the objective of raising productivity, discussed in this report. It started out at SRI, System of Rice Intensification, and learnings are now being applied to many different crops. Its key features include reducing crop density, enriching the soil with organic matter, and keeping the soil well-aerated to support the better growth of roots and of beneficial soil biota.

Protective irrigation

In low-rainfall drought-prone regions, crops can fail due to soil moisture deficiency after a prolonged dry period of 20-30 days. Protective irrigation is provided during this crucial interval to save the crops. According to AF Ecology's (CSO covered under AP) [30], 'about 80% of crop failure can be saved if two cycles of protective irrigation can be carried out during such dry spells, particularly at the crucial periods of plant growth. The sources of protective irrigation can be individual, like farm ponds and private borewells or ordered tanker water, or collective - like village tanks or shared borewell water.

Protective irrigation consists of a package of interventions including:

- Cultivating **less water intensive crops** (protective irrigation is not offered to water-intensive crops like paddy or sugarcane.)
- **Farm management** such as soil conservation and mulching.
- I**dentifying the water source**, which could be:
    - Farm ponds: These are constructed on farmers' own fields. This is the easiest and most efficient source of irrigation;
    - Borewell water: This can be transported to the field by using a tractor drawn tanker or through pipes in case a borewell is available nearby;
    - Village tanks: When water is available in the tank or at any public source, it can be transported to the fields through pipes from the tank to nearby fields. Water can also be transported by a tanker to fields located farther away.
- **Identifying institutions** in the village that can coordinate with the CSO to bring the water from the source to the fields.
- **Coordinating with the farmers** to see that they can pay a nominal amount for this service.

[30] http://af-ecologycentre.org/wp-content/uploads/2019/04/Protective-Irrigation-Raising-Hope.pdf

Andhra Pradesh has made protective irrigation a state policy and allocated Rs. 1,600 million in the budget to scale up protective irrigation measures in 2016-2017 covering the entire state. The state government promised to provide infrastructure, equipment and support for 2.5 million farmers in Andhra Pradesh.

Watershed management activities

Watershed is the area on which rain falls to be drained through a single outlet - which may be a stream, river or even a lake. Watershed management activities is a collective term that includes various measures with a focus on increasing water availability and improving its quality within the watershed along with other benefits such as preventing soil erosion and benefiting vegetation.

This supply-side intervention has a long history in India, starting with a focus on dam construction in southern India (since 1844 during the British rule) to prevent rapid runoff from large rivers. During the 1970s, the focus shifted to drought-proofing - evident from the programmes launched by the central government like the Drought Prone Areas Programme (DPAP) and the Desert Development Programme (DDP) in 1971. The government launched the Watershed Programme in 1983-84 in a big way 'to conserve and utilise natural resources for higher productivity of crops and more income/ employment generation in addition to creating better climatic conditions' (ICAR).

The government actively tried to involve NGOs as collaboration partners for these programmes. The National Committee on DPAP and DDP also recommended community participation during the late 1980s.

The activities typically involve Continuous Contour Trenching (CCT), percolation tank construction and desilting, check dam construction or stream bunding and repair, stream deepening/widening etc. The ridge-to-valley approach is often adopted where soil and water conservation structures are made from the highest points (ridges) in the watershed and subsequently moving downhill. It increases durability of the structures downhill as runoff and soil erosion are taken care of by the upstream structure while ensuring maximum rainfall is being stored/used for recharging the groundwater within the watershed.
The limitations of this intervention was observed after 8-10 years in watersheds where watershed development work was undertaken in the 1970s and 1980s - as farmers shifted to higher-paying water-intensive crops as more water became available for irrigation. Water scarcity was felt in spite of greater water availability pushing governmental and non-governmental actors to consider demand-management techniques.

In the low-rainfall regions in the country, these interventions are still implemented as they provide drinking water security and often manage to supply for the protective irrigation for dry seasonal/perennial crops as well - having a positive impact on rural health and economy in these regions.

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