Situational Analysis of Current Monitoring Systems for Eco-restoration (Soil Restoration and Water Resource Development) Projects in Agro-ecological Landscapes

Prepared by

SOPPECOM, Pune

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Society for Promoting Participative Ecosystem Management (SOPPECOM), Pune

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Foreword and Acknowledgements

Society for Promoting Participative Ecosystem Management (SOPPECOM) is a non-profit, non-governmental organisation based in Pune, India, working in the area of natural resources management, primarily in rural areas. The organisation is committed to the principles of sustainable and rational use of natural resources, equity, and social justice in the distribution of benefits, especially to disadvantaged groups like Dalits, the landless, and women. As an organisation committed to these principles, SOPPECOM extends its support to grassroots groups working on NRM issues through training, resource literacy, participatory planning, research, and policy advocacy.

TMG Research gGmbH is a Berlin-based research organisation working on sustainability issues in the areas of sustainable management and responsible governance of land and oceans, food systems, and climate. As an organisation, TMG brings sound knowledge and practical experience in facilitating national, European, and international processes and is dedicated to the analysis and solution of new and complex challenges. The following study commissioned to SOPPECOM by the TMG Research group is a part of the SEWOH lab project. The purpose of the SEWOH lab project is to analyse the linkages between digital and social innovations for achieving Sustainable Development Goal 2, and especially to understand the potential of digital solutions for inclusive rural and agricultural development in sub-Saharan Africa and India.

Within this larger project, SOPPECOM conducted the study under the Ecosystem Restoration Workstream: “Digital Tools to Cover the Last Mile in Restoration Monitoring.” The study focussed on two distinct work packages – i) Situational Analysis of current monitoring systems: To understand existing tools (digital or otherwise) for monitoring and impact assessment of SOC and soil health resulting from agricultural and farm management practices; ii) Scoping study on the monitoring, verification, and reporting in ecosystem landscape restoration: To assess, how the implementation of programmes and projects in the field of ecosystem restoration is reported to the state and national level in India. This report, “Situational Analysis of Current Monitoring Systems for Eco-restoration (Soil Restoration and Water Resource Development): Projects in Agro-ecological Landscapes” presented below is the synthesis of

the research work done under work package one as mentioned above. The study was done for five months from February to June 2022

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List of Acronyms/Abbreviations

BAIF	Bharatiya Agro Industries Foundation
CBO	Community Based Organisation
CMPP	Concurrent Monitoring of Progress and Products
CPR	Common Property Resources
CoDriVE-PD	Community Driven Vulnerability Evaluation - Programme Designer
DANIDA	Danish International Development Agency
DDP	Desert Development Programme
DPAP	Drought Prone Areas Programme
DRDA	District Rural Development Agency
FGD	Focus Group Discussion
FES	Foundation for Ecological Security
FP	Farm Precise
FPO	Farmer Producer Organisation
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoI	Government of India
GP	Gram Panchayat
IGWDP	Indo German Watershed Development Programme
IWDP	Integrated Wasteland Development Programme
IWMP	Integrated Watershed Management Programme
JSA	Jalyukt Shivar Abhiyan
KfW	Kreditanstalt für Wiederaufbau
KVK	Krishi Vikas Kendra
MoA	Ministry of Agriculture
MoRD	Ministry of Rural Development
MRV	Monitoring, Reporting and Verification
NABARD	National Bank for Agriculture and Rural Development
NGO	Non-Governmental Organisation

NiceSSM	Network for Information on Climate (Ex)-change (NICE) for Sustainable Soil Management (SSM)
NRAA	National Rainfed Area Authority
NWDPRA	National Watershed Development Programme for Rainfed Areas
PIA/PFA	Project Implementing Agency/Project Facilitating Agency
PIM	Participatory Impact Monitoring
PMKSY WDC	Pradhan Mantri Krishi Sinchayee Yojana – Watershed Development Component
PNP	Participatory Net Planning
QAM	Qualitative Assessment Matrix
RRC	Regional Resource Centre
RVP	River Valley Project
SDC	Swiss Agency for Development Cooperation
SDG	Sustainable Development Goals
SES	Socio-Economic Survey
SHG	Self Help Group
SOC	Soil Organic Carbon
UN	United Nations
VDC	Village Development Committee
VWC	Village Watershed Committee
WOTR	Watershed Organisation Trust
WSD	Watershed Development
ZP	Zilla Parishad

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Executive Summary

Monitoring, verification and reporting are integral components of all major ecosystem restoration projects as they help in improving efficiency, effectiveness and impact. There are many tools, both analogue and, in recent times, digital, that are being used for this purpose. This report is a situational analysis of such tools, mainly those developed and deployed by Watershed Organisation Trust (WOTR)—a non-government, civil society organisation based in India since the last three decades—in their ecosystem restoration work. Other experiences have also been brought into the analysis to enrich the findings. It is undertaken as part of the ecosystem restoration workstream of the SEWOH Lab Project and as a collaboration between SOPPECOM, Pune and TMG, Berlin.

Ecosystem restoration work along watershed lines has a long history in the country. It was strategized as a development intervention suitable for rainfed areas of the country which were left behind by the dominant agrarian paradigm of the green revolution. In the 1960s and 70s, the work was mainly in the form of piloting and extension research on dryland farming, developed by various research institutions in the country, and by the 1970s and 80s, it had moved into the mainstream developmental agenda. By that time, non-governmental agencies and community leaders had started initiating community involved watershed development intervention, which was a major break from the top-down, science and technology-centred, bureaucratic interventions that had prevailed till then. Based on the experience and success of participatory interventions, mainstream projects funded by various ministries also institutionalised participatory mechanisms in watershed development from the 1990s onwards, at least in policy formulation, if not in practice.

As watershed development became farmer and community involved, project monitoring systems also underwent changes. Farmer and community involved planning and monitoring tools started emerging, mainly facilitated by NGO actors. It helped building stakes in restoration projects for the people who are in fact impacted by the degradation of natural resources, besides being the intended beneficiaries of restoration measures. Here, we analyse such a set of planning and monitoring tools which are participatory in their objective, design and practice. These are: Socio-economic Survey and Vulnerability Assessment Tool – CoDriVE PD (Community Driven Vulnerability Evaluation Programme Designer), which is used for

conservation planning and adaptation measures and as baseline for monitoring and impact assessment; Participatory Net Plan (PNP), a farmer-centred scientific and technical plan for various conservation measures at the plot and watershed level; various sets of tools for monitoring of outputs, outcomes, impacts and processes such as Qualitative Assessment Matrix (QAM); Concurrent Monitoring of Project Output and Participatory Impact Monitoring (PIM). Besides, the digital tool to deliver advisories to farmers, the Farm Precise app, is assessed to understand the potential of digital solutions for farmer-led self-monitoring system for reporting conservation and soil health. While most of these tools, except the Farm Precise app, are not digital in design, they do use various tool-specific software for their applications.

Monitoring systems are still not farmer-led in many instances. Even though the systems and tools are designed with the objective of participation and actually involve the farmers and community in planning and monitoring, they are still facilitated by the project facilitating agencies and the support staff. The incentive for farmers to undertake a self-reporting monitoring of restoration work or soil health is not yet realised, and newer ways and means have to be explored to realise the same. However, it is also important to appreciate the gains made by participatory mechanism in involving farmers and the community in various aspects of conservation work including their role in monitoring.

Application of digital tools is gaining ground in various restoration works in the country. It can be seen in two major streams of work: as farmer advisories within risk mitigation objective and as concurrent monitoring system in soil and water conservation work. While there are many examples of the former such as Farm Precise of WOTR, NiceSSM of the ProSoil project of GIZ, weather advisories of the Indian Meteorological Department (IMD) and various private players such as Agrostar in Maharashtra, digital monitoring solutions on the other hand are used by major players in restoration such as WDC-PMKSY of the Government of India, NABARD-supported watershed projects and some of the major NGOs involved in watershed development.

In the case of digital advisory tools, by their very nature, they are not monitoring tools, even though in the case of Farm Precise and NiceSSM, such scopes could be brought into them by customising them for the same. For example, Farm Precise has a facility called ‘farm diary’ where farmers can report their economics of farm activity. This could be modified to include

conservation, soil improvement measures, soil health indicators, etc., which can become the basis of monitoring.

In instances where digital monitoring solutions for various conservation measures (read watershed development projects) are employed, it is mainly on reporting project outputs from a physical and financial accountability perspective. These tools have facilities for geotagging the work, uploading photos of the work as well as real-time data transfer so that project funding agencies and departments can monitor the physical measures, the financial aspects and also the quality of work. These are project driven and undertaken by project facilitating agencies at the ground level. Even though it addresses the issue of accountability, it has in fact become more project staff centred, diluting the gains of participatory watershed development.

Digital solutions for monitoring can also create a great divide, given the digital divide in terms of access to technology, digital knowledge and literacy etc. This was evident from the field wherein women have very little access to smartphones and most often, they depend on their husbands' or children's smartphones for using Farm Precise. While there is a small percentage of women using the digital tool, it cannot reach a critical mass unless it is consciously facilitated and enabling conditions are created. The same is also true for the older generation farmers who are not well-versed with the functions of an app.

At present, digital monitoring systems, in most cases, are working in a project mode. If it has to become a demand and farmer-driven tool, farmers have to visualise incentives in doing so. For example, in the case of Farm Precise, two or three features which are very popular with farmers such as mandi (market information) and weather advisory are seen as useful by farmers, while farm diary which is a function for reporting of farming details, is the least popular one as it does not fit into their frame of benefits.

Digital solutions for project management including monitoring of interventions opens up great opportunities, but it often dilutes the gains of participatory processes which has been a major strength of conservation work in India. The challenge, however, is to merge technological innovations within the architecture of participatory processes, be it need identification, project planning, implementation or monitoring. In the name of efficiency and real-time monitoring, technology should not be made a substitute for participation. As watershed development has

evolved over the years to address many challenges in its objectives, design and operationalisation, participatory digital solutions for planning and monitoring will also not be far behind.

Chapter 1. Introduction

1.1. The Context

This study is an outcome of the situational analysis of various tools, both digital and non-digital (analogue), used for monitoring and impact assessment of ecosystem restoration projects in agricultural landscapes. It is undertaken as part of the ecosystem restoration workstream of the SEWOH Lab Project. Ecosystem restoration in agricultural landscapes can contribute to the enhancement of food security, rural livelihood resilience and biodiversity. Monitoring reporting and verification (MRV) is an important component of restoration projects, which helps in tracking the objectives and outcomes, besides helping in drawing learnings and facilitating course corrections. While conventional MRV, with a focus on physical verification of conservation measures, is time consuming, costly and mostly analogue, the emergence of technologies, especially digital technologies, opens up immense opportunities if they can be customised as participatory and farmer-friendly, keeping in mind the limitations of the end user (farmer) in terms of her access to resources, technology, literacy and so on. If appropriate incentives and enabling conditions are created, farmer-managed monitoring solutions can provide reliable and updated information on restoration measures and farm-level practices in a timely and cost-effective manner from a broad agro-ecological and socio-economic milieu.

Ecosystem restoration projects in agricultural landscapes in India mainly follow a watershed development approach, with a clear focus on soil conversation, biomass development and water resource development. The situation analysis of MRV tools on restoration here focuses on various participatory tools developed by Watershed Organisation Trust (WOTR) for monitoring of ecosystem restoration activities undertaken as part of watershed development and ecosystem-based adaptation projects. Even though these tools are project specific, the parameters and indicators have relevance and applicability for other agro-ecological contexts and restoration projects. Besides, other experiences are also brought into the analysis that could help in strengthening the possibilities and opportunities to monitor ecosystem restoration and soil health parameters.

WOTR, during the last three decades of undertaking watershed-based restoration measures in the country, has developed a large number of tools for planning, generating baseline and

benchmark as well as for monitoring of interventions and impacts. While some of the tools such as Participatory Net Plan (PNP), which is widely used by both government and non-government agencies across the country, were developed as part of the Indo-German watershed Development Programme[1] almost 25 years back, the farmer advisory tool (Farm Precise) is a digital tool of recent origin.

As part of the situational analysis, we look into a set of seven tools developed by WOTR. They are Socio-Economic Survey Format and Vulnerability Assessment Tool known as CoDriVE-PD (Community Driven Vulnerability Evaluation - Programme Designer)—both of which provide input for planning restoration and adaptation measures and act as baseline data for further monitoring. This is followed by Participatory Net Planning (PNP), which generates plan for various conservation measures at the plot and watershed level. Then we look into three participatory monitoring tools, namely, Qualitative Assessment Matrix (QAM), Concurrent Monitoring of Progress and Products (CMPP) and Participatory Impact Monitoring (PIM), and finally, the digital crop advisory tool, the Farm Precise app. All seven tools are analysed to understand their functions, use and the processes of their application, with special emphasis on the participatory, farmer-led protocol. The situational analysis also assesses the digital potential of these tools, especially the farm advisory tool (Farm Precise) for facilitating farmer-led participatory, self-reporting system of monitoring of soil restoration and soil health and Soil Organic Carbon (SOC).[2]

1.2. Watershed Development: A Brief Overview

Ecosystem restoration of agricultural landscape has a long history in India. In the initial years, it primarily consisted of soil conservation and catchment stabilisation work undertaken with a mainly technical objective of arresting soil loss and silt load in large irrigation reservoirs. Gradually, it started to encompass drought mitigation objectives. By the early 1980s, participatory watershed development involving farmers in soil and water conservation work emerged in different parts of the country, especially in the state of Maharashtra, led mainly by

[1] WOTR as the official partner for Capacity Building Phase (CBP) funded through GIZ was responsible for creating systems, tools, processes, knowledge, etc. for the IGWDP, besides handholding all partner NGOs for undertaking watershed-based soil restoration and water conservation work.

[2] Soil restoration objective is the main theme of the Sewoh Lab projects, as healthy soil is a precondition for sustainable food production besides being the most important source for carbon store after oceans.

community leaders and non-government organisations.[3] The success of these interventions resulted in improved ecosystem services and productivity enhancement, and it slowly got the attention of policy makers. This resulted in mainstreaming participatory, micro watershed-based interventions in most of the public-funded soil conservation work, and watershed development become a major programme for rural and agricultural development in the country.

Participatory watershed management provides opportunities for rural communities to jointly negotiate their interests, set priorities, evaluate opportunities, implement, and monitor the outcomes of conservation activities around soil and water (Singh, 2017). It also helps in building a stake for the farmers and other rural population in the interventions as a result of their participation in planning, implementation and monitoring of various conservation activities. This is a major departure from the earlier interventions, which were top-down, led by the technical and bureaucratic machinery (Kerr, 2002). Watershed management, by its very nature, is a social organisation problem also, as it has to bring different interests as well as cost and benefits patterns into a common agenda and platform.[4]

During the course of its evolution, a large number of agencies and programmes have emerged in participatory watershed-based restoration works. Central and state governments, public institutions such as NABARD, multilateral and bilateral agencies such as the World Bank, KfW, GIZ, DANIDA, DFID, etc., to name a few, various agencies under Corporate Social Responsibility (CSR), a large number of NGOs, trusts and individual philanthropy initiatives are now involved in watershed development programmes in the country. With the exception of a few programmes—notably the soils programme of KfW and GIZ and the interventions of NABARD and a few NGOs—the focus of soil conservation and biomass development is losing out and the work is becoming more water conservation centric in the country.[5] However, we

[3] WOTRs work could be traced to these initiatives where its Founder Fr. Herman Bacher who was earlier associated with Social Centre initiated participatory watershed works in villages in the drought-prone Ahmednagar district of Maharashtra such as Pimpalgaon Wagha, Mendhwan and Kasare.

[4] Unequal cost and benefits of upstream/downstream are one of the most commonly debated issues in participatory watershed. The same is regarding social restrictions such as restrictions on grazing in common property land resources which adversely affects the herders (Kerr, 2002).

[5] Jalyukt Shivar Abhiyan (JSA), translated as 'movement for farms with water', a Government of Maharashtra initiative institutionalised in 2014, was the new name for watershed development projects in Maharashtra, initiated with the goal of making Maharashtra drought-free. Studies show that more than 80 per cent of the project portfolio included water conservation activities and in the case of soil conservation measures also, the work revolved around run-off capture through deep contour trenches on non-agricultural lands (Bhadbhade et al. 2019; Shah et al., 2021: 573–596).

should acknowledge that watershed-based agro-ecological conservation has created a large pool of knowledge on restoration work. This is mainly a result of the monitoring and evaluation systems that existed in the projects and very focused academic research undertaken by various academic, bilateral and multilateral agencies and individual researchers.

1.3. Policy Evolution in Watershed-based Restoration Programmes

Programme Guidelines are the major policy document guiding the restoration work in the country. While the public-funded programmes have their own guidelines which are the national policies and assessed in this section, there are specific guidelines for programme implementation by other agencies such as NABARD, some of the externally funded programmes, programmes funded by CSRs, NGOs, etc. However, the guiding principles and objectives are mostly common; the difference may be in institutional arrangements, cost of per unit conservation, project period, etc.

From River Valley Projects (1960s) to the recent draft Guidelines for New Generation Watershed Development Projects WDC-PMKSY 2.0 (2021)[6], the policies and practices of watershed development in the country have travelled a long way, broadening their objectives and expected outcomes. The guidelines spell out the policies, objectives and guiding principles, project norms and selection criteria, type of interventions, technology for conservation, participatory and institutional mechanism and, most importantly from our point of view, the systems for Monitoring, Evaluation and Learnings. Over the years, watershed-based agricultural landscape conservation started incorporating emerging challenges of agriculture and ecology and modeling its objectives and interventions to address them. This is evident from the fact that the Common Guidelines for Watershed Development issued in 2008 had recognised the importance of sustainable agricultural production and livelihood development as a major objective of watershed development, with a dedicated budget for such activities to the tune of 19 per cent of the overall watershed budget (Common Guidelines for Watershed Development Projects 2008, revised in 2011[7]) while the latest draft Guidelines for

[6](http://wmduk.gov.in/download/GuidelinesforWDC-PMKSY2.0.pdf)

[7](https://dolr.gov.in/sites/default/files/Common%20Guidelines%20for%20WDP%202008%20Revised%20Edition%202011.pdf)

New Generation Watershed Development Projects (WDC-PMKSY 2.0) highlight mitigating climate risk as an objective of watershed development (op. cit.).

The responsible agencies for implementing the programme also underwent changes. Till the emergence of Common Guidelines for watershed development in the year 2008, there were two separate guidelines and ministries running soil and water conservation work: the Ministry of Rural Development with its own set of guidelines, the last being the Hariyali Guidelines of 2003 and the Ministry of Agriculture which worked under its guidelines known as the National Watershed Development Programme for Rainfed Areas (NWDPRA-Jansahabhagita). While the emphasis of the former was drought mitigation and ecosystem restoration, the latter focused on production enhancement in rainfed areas. However, from 1994 onwards, the participatory mechanism got streamlined in mainstream projects such as Drought Prone Areas Programme (DPAP), Desert Development Programme (DDP) and Integrated Wasteland Development Programme (IWDP) under the Ministry of Rural Development and also in NWDPRA under the Ministry of Agriculture.

Following an intensive review of watershed development programmes in the country in the year 2005, very crucial recommendations on various aspects of the programme were incorporated in both policy and practice (Government of India, 2006). This resulted in Common Guidelines for Watershed Development Projects (2008), wherein all public-funded restoration projects came under one policy umbrella. The programme was named the Integrated Watershed Development Projects (IWMP). In the year 2015, watershed development was brought under the programme called 'Prime Minister's Krushi Sinchayi Yojana' (PMKSY), roughly translated as Prime Minister's Agricultural Irrigation Plan. A new guideline was issued on watershed component under PMKSY known as the Watershed Development Component (WDC) of PMKSY. The very idea of bringing it under PMKSY indirectly shifted the focus of intervention more towards irrigation expansion through watershed development, with a reduced focus on soil conservation. As recently as 2021, the Ministry of Rural Development issued revised draft guidelines known as Guidelines for New Generation Watershed Development (WDC-PMKSY 2.0), trying to incorporate the emerging challenges of climate change and adaptation into the mainstream soil and water conservation measures.

Table 1.1 provides a brief overview of the policy evolution of public-funded eco-restoration projects along watershed lines in the country.

Table 1: Policy Evolution of Soil and Water Conservation/Watershed Development Programmes: Major Milestones

Year	Programme/Policy Guidelines	Major Objective(s)	Relevant Ministry at the National Level
1962-63	RVP	Catchment protection flood control, irrigation, soil and water conservation in micro watersheds etc.	Ministry of Agriculture (MoA)
1973–74	DPAP	Promote economic development and mainstreaming of drought prone areas through soil and moisture conservation measures. The emphasis was on soil conservation to improve in-situ soil moisture.	Ministry of Rural Development (MoRD)
1977–78	DDP	Minimise adverse effects of drought and desertification through soil water restoration and reforestation.	MoRD
1989–90	IWDP	Regenerate degraded non-forest land through silvipasture and soil and water conservation on the village and micro-watershed scale.	MoRD
1990	NWDPRA- Jansahabhagita	Promote sustainable natural resource management, enhance agricultural production, restore the ecological balance, reduce regional disparities, and create	MoA

Year	Programme/Policy Guidelines	Major Objective(s)	Relevant Ministry at the National Level
		sustained employment opportunities in rainfed areas.	
1994	Guidelines for Watershed Development	Bringing DPAP, DDP and IWDP under one guideline, with focus on watershed-based soil and water conservation, streamlining participatory mechanisms in project implementation and NGOs in project implementation.	MoRD
2003	Hariyali Guidelines13	Integration of Gram Panchayat institutions, in-situ soil water conservation, participation, agriculture production and livelihood.	MoRD
2008-09	Common Guidelines for WSD (IWMP)	Formation of dedicated institutions at the central and state level, leveraging of technology, cost increase for conservation, production and livelihood promotion, dedicated fund for project planning, monitoring and evaluation.	NRAA and MoRD
2015	WDC- PMKSY	Restore the ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover and water and provide sustainable livelihoods.	MoRD

Year	Programme/Policy Guidelines	Major Objective(s)	Relevant Ministry at the National Level
2021	WDC-PMKSY (2.0)	New generation watershed projects to arrest soil degradation, desertification and decline in soil organic carbon, increase productivity, sustainable management of groundwater, climate change adaptation, etc.	MoRD

Source: Samuel et al., 2006;[8] Gray and Shrinidhi, 2013

The focus and scale of WSD has changed over time. At present, the watershed approach recognises the importance of ecosystems services, community participation, sustainable management of natural resources, production, and livelihoods and of late, climate adaptation potential of the intervention. The objectives and approach of watershed-based development projects in India has the potential to align with global concerns of desertification, habitat loss, soil degradation and issues of decline of soil organic matter and soil organic carbon. These concerns are also articulated in the latest guidelines of the GoI and also some of the interventions such as the NABARD-KfW soils projects and GIZ ProSoil projects.

1.4. Monitoring, Reporting and Verification (MRV) Tools in Watershed Monitoring and Development

Monitoring systems and protocol in watershed programme have also undergone significant transformation over the years. This is a result of changes in objectives, activities and expected end results as well as resulting from introduction of new systems, tools and technology. While in the earlier generation programmes, techno-centric experts dominated the monitoring systems and approach, with the advent of participatory watershed development and involvement of NGOs, monitoring has become simpler and farmer involved (Kerr, 2002; Singh,

[8] The information with reference to various guidelines are updated periodically by SOPPECOM, the latest being the WDC-PMKSY programme guidelines.

2017). However, these participatory methods of monitoring also focused more on institutional processes, participation of community, case studies of impacts, etc., while the technical components of monitoring were still the preserve of experts and project staff. In the last few years, there has been a realisation that the community has a better understanding of their resources and they are better equipped to understand the technical parameters such as soil loss, soil health, groundwater situation, cropping systems, irrigation, water use, pest and diseases and so on (Shah, 1998; Johnson et al., 2001; Yoganand and Gebremedhin, 2006).

There is substantial experience on monitoring and evaluation in watershed-based agro-ecological conservation measures in the country. This is mainly a result of a large number of programmes being implemented over the years with varying focus and under varying agro-climatic conditions involving multiplicity of actors from public institutions, government agencies, NGOs, research and development agencies, external agencies, etc. While there were no earmarked resources for monitoring in the first-generation projects, there is now increasing realisation about the need for resources (both personal and financial) and allocation of resources for planning, monitoring and evaluation in both mainstream projects and other funded projects.

Watershed Guidelines elaborate on the monitoring and evaluation framework the government funded programme has to follow. For example, the WSC-PMKSY (2.0) has an elaborate section on Monitoring & Review, Evaluation, Learning and Documentation – MELD (pp. 74–78). It elaborates on the MELD architecture in terms of areas of monitoring (progress, processes, performance indicators, etc.), the responsible agencies at different layers, use of technology (RS/GIS, geo tagging, mobile apps, etc.), end results to be monitored such as reduction in soil loss, increase in water availability, increase in green cover, etc. It also elaborates on the evaluation and learning framework. The importance of monitoring co-benefits that are important data points for reporting on national achievements vis-à-vis its international commitments is also highlighted. However, the importance of participatory and community and farmer-centred monitoring and leveraging of technology for monitoring is sadly missing and it mainly focuses on the physical and financial progress and achievements.

This is where the importance of NGOs and bilateral supported projects fill the gap. Since long, there has been an attempt in these projects to bring participation, innovations and technology in the monitoring, be it IGWDP supported by GIZ/KfW and implemented by WOTR/NABARD,

Indo German Bilateral Projects (IGBP) implemented by RODECO and government agencies, Andhra Pradesh Rural Livelihood Mission (APRLP) supported by DFID and implemented by the AP government, Sujala Watershed Programme supported by the World Bank and implemented by the Karnataka government, Indo-Swiss Participatory Watershed Development Project - Karnataka (ISPWDK) supported by the SDC or Danish International Development Agency (DANIDA) supported watershed projects.

Watershed programmes have generated a large number of monitoring systems and tools which assess processes, institutions, outputs, outcomes and impact through participatory mechanisms (Lobo and Samuel, 2005; Kumar et al., 2011; GoI, 2006). Of late, there is also an increasing use of technology, such as mobile app, computer software, MIS and expert systems by agencies such as NABARD, GIZ, WOTR, BAIF, FES, various government departments, etc., to name a few.[9] This is where the importance of some of the systems and tools employed for monitoring needs to be analysed to examine their potential to foster participatory self-monitoring as well as to see how analogue (non-digital) and digital tools could be customised, to help marginalised land users, especially women, to undertake monitoring of soil and water resources, leading to reduced transaction costs and more efficient and transparent monitoring and reporting of project activities.

A broad set of parameters and indicators monitored generally as part of watershed-based agricultural landscape conservations in India are as follows:

[9] As examples for two large-scale projects implemented in the country, WDC-PMKSY, the union government supported watershed programme uses Srishti & Drishti 'Bhuvan Portal' developed by ISRO/NRSC for planning and monitoring of projects. Srishti is a GIS-based geo-portal developed to assist in monitoring, evaluation, change assessment and provide inputs in planning for watershed management and preparation of Detailed Project Reports. Drishti is the mobile application tool to capture data including visuals from the field for real time monitoring of IWMP projects. The tool can also be used for community monitoring of IWMP works (https://dolr.gov.in/sites/default/files/NRSC%2C%20Hyderbad%20presentation.pdf).
The other is the NABARD supported watershed projects (its own fund as well as government and external funds) wherein NABARD, supported by NRSC-Bhuvan, monitors watershed projects using geo spatial technologies and a mobile app. The app is a tool for field data capture of the development activities undertaken in the NABARD watersheds and also supports revisits for monitoring the status of the activity and includes a facility to upload photos of work. However, most of these digital monitoring systems are used for monitoring the project implementation (progress of various conservation measures) in real time and do not include monitoring of outcomes or impacts of intervention or community-oriented monitoring systems (https://bhuvan-app1.nrsc.gov.in/nabard/mobile/BhuvanNabard_App_Manual.pdf).

- Biophysical indicators: surface runoff, land use, water resources, groundwater table, soil erosion (soil loss), soil moisture, green cover, etc.
- Agriculture and production system: agricultural land use, irrigation coverage, cropping pattern, cropping intensity, agronomic practices, agricultural production, livestock and livestock production, etc.
- Socio-economic: income, assets, institutions and social capital, regulatory norms, migration, livelihood scenario, food security, drinking water security, etc.

The list can be quite exhaustive as there is a tendency of 'burden of expectations' from watershed development. However, what we could observe is that unlike monitoring of water resource related indicators, there is little appreciation of the soil health components in the monitoring portfolio in WSD as there are very few user-friendly and participatory tools available for monitoring soils. For example, the Technical Review of watershed projects in the country (GoI, 2006) cited above has a whole section on impact assessment indicators in which groundwater fluctuation, cropping, productivity, etc. are elaborated but there is no mention of soil health related indicators. In the absence of regular monitoring of data on soil, Kerr (2002) uses proxy indicators such as visual assessment of rill and gully formation to understand soil loss. Sample soil test, issuance of soil health card to farmers, erosion (soil loss) and soil moisture (crop survival) aspects are monitored in a few instances but it is often technology driven and not easily amenable for participatory methods.

For example, the Department of Land Resources has developed an Operational Manual for Benchmarking of Watershed Management Outcomes under which two indicators related to soil health are identified for impact monitoring, namely, Soil Organic Carbon and Erosion Reduction Status. The guidelines suggest that Soil Organic Carbon is to be monitored using NMR Spectroscopy and Erosion Reduction Status is to be monitored through sediment measurement gauges and gully formation images, both of which are to be done by experts and M&E agencies (GoI, 2015).

Chapter 2. Methodology

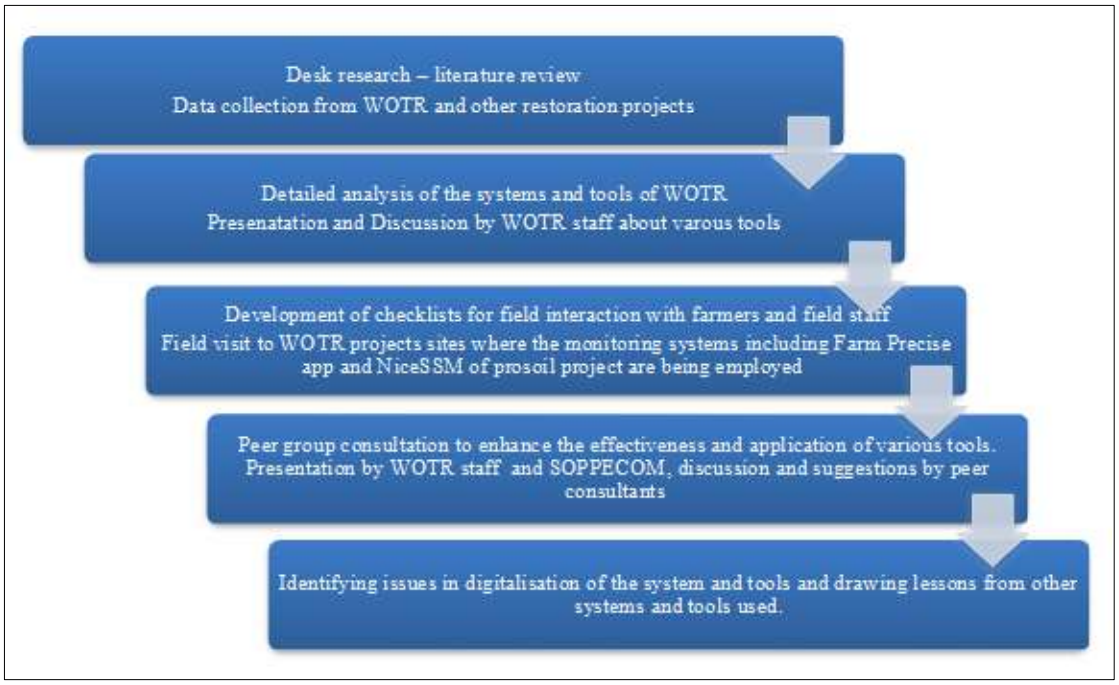
The present enquiry of participatory monitoring tools to understand its relevance, applicability and opportunities for customisation (factoring soil related monitoring indicators) is undertaken methodologically as a Situational Analysis. Situational analysis is basically the starting point for developing a strategy and for that, we need to understand the present situation. Thus, situational analysis here is used as a process to understand the present situation of a set of conservation monitoring tools deployed in watershed-based agricultural landscape restoration projects. Conventionally, a SWOT analysis is deployed as one of the processes in situation analysis. However, we desist from such approaches and employ an 'appreciative enquiry' strategy as these are tools to assess a socio-technical developmental intervention implemented in real life and complex social situations, and the various factors that can impact its deployment are not always in the direct control of the agency or the people using it.

The overall approach adopted was of regular interaction with WOTR to understand the tools, analysis and clarifications, presentations by WOTR staff to create clarity on its content and application as well as field visits and interaction with project staff and end users (community) to understand their working in real time. Seven sets of tools were selected from a large set of systems and tools deployed in watershed development projects by WOTR, looking into the relevance and opportunities for monitoring restoration activities.

The key objectives of the situation analysis are:

i. To assess various monitoring tools for agricultural landscape restoration projects, including the digital farm advisory tool such as Farm Precise app developed by WOTR.
ii. To understand its relevance, applicability and scope for customisation in monitoring restoration, especially soil restoration and soil health.
iii. To explore ways to improve the current monitoring systems with a view to make these digital, farmer user-friendly, efficient and transparent.

2.1. Approach for Situational Analysis



2.2. Field Visit and Interaction with Community and Project Facilitators

One of the important methods of the situational analysis was to understand the working of these tools in real field situation. Some of the tools such as PNP, PIM, QAM, etc. have been in use for the last 25 years or more and are used in various projects and the agro-ecological context, while the CoDriVE-PD and Farm Precise are of very recent application. WOTR has been using these tools in their watershed development projects across seven states in India. In order to understand the field implementation and utility of these tools, nine villages spread across four talukas of two districts, namely Aurangabad and Jalna in the state of Maharashtra, were visited. During the process, in-depth interaction with community members and users of tools such as Farm Precise were conducted. It also provided an opportunity to hear from the field level facilitators about the working of the tools and the issues related to their applications (the list of participants is annexed). Field visits were conducted in a cluster of villages in Ahmednagar district where NiceSSM is being used by farmers under the ProSoils project supported by GIZ.

2.3. Peer Consultation

A mid-term peer consultation meeting was organised to bring together experts, development practitioners and academics who have worked extensively in the areas of ecosystem management and restoration from varied agro-climatic regions and contexts. The tools (Farm Precise, CoDriVE-PD, PIM and PNP) were presented in the meetings by WOTR staff and preliminary findings of the situational analysis were presented by SOPPECOM. The consultation provided inputs based on the experiences of the participants from their projects and working context. For the List of Participants, see Annexure B2.

The situational analysis is an outcome of all these processes wherein the review of the tools of WOTR and a few other projects such as ProSoil project of GIZ, learnings from the field and feedback from the peer consultation besides SOPPECOM's own accumulated experience in conservation work contributed towards making the analysis more systematic and broad-based.

Chapter 3. Detailed Analysis of the Tools

Watershed development projects deploy various tools for planning, implementation, monitoring and evaluation of projects. The different tools developed and used by WOTR in watershed development for socio-economic and ecological assessment for planning, monitoring of product, processes and impacts of conservation works and most importantly, the farmer advisory digital tool,[10] a risk mitigation measure, are analysed in detail with respect to the context of the tool, its key objectives, approach, parameters and indicators used in each tool, outcomes and effectiveness in impact monitoring and evaluation. The WOTR tools analysed include:

A. Socio-economic and Ecological Assessment Tools

a) Socio-economic Survey (Baseline and Endline Assessment)
b) Vulnerability Assessment Tool – CoDriVE-PD

B. Planning Tool

a) Participatory Net Planning (PNP)

C. Monitoring Tools

a) Qualitative Assessment Matrix (QAM)
b) Concurrent Monitoring of Progress and Products (CMPP)
c) Participatory Impact Monitoring (PIM)

D. Digital Tool

a) Farm Precise App – The Crop Advisory

[10] Farmer advisories through digital tools are used as a risk mitigation intervention in the country in the face of climate uncertainties and there are many actors such as government agencies, pubic and research institutions, NGOs and private players involved in this. Some are just weather advisories while others provide various other agricultural related advisories; Farm Precise reviewed here has such multiple features.

3.1. Socio-Economic Survey

Socio-economic data is integral to the watershed planning process. The data is used for project design and as baseline information for future evaluations and impact assessment. It is one of the data gathering tools for planning for conservation while there are other field survey methods such as net planning, well inventory, soil sample survey, etc. for biophysical and ecosystem indicators. The socio-economic survey tool collects detailed information about households on various socio-economic indicators that can be assessed both at the household level and at the village/watershed level. It can also give disaggregated information based on landholding, caste, gender, etc. The socio-economic survey is done initially as part of project planning whereby information is fed into the Detailed Project Report (DPR) and for endline assessment and Project Completion Report (PCR). Sample survey of households, drawing from socio-economic baseline information, is also undertaken in many instances for impact assessment at the household level.

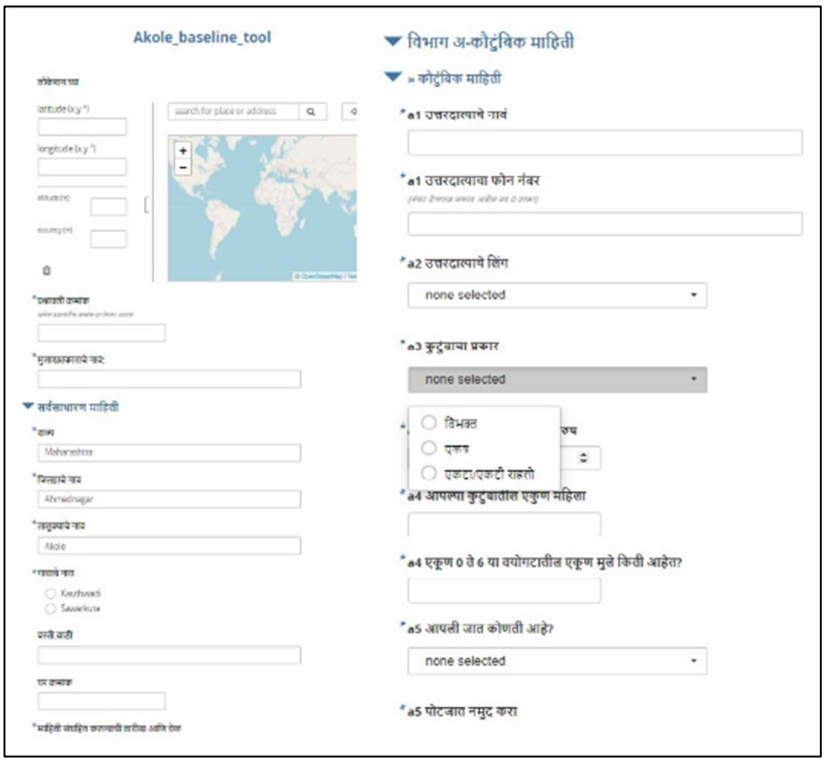


Figure 3.1: SES (Baseline Survey) Digital Format Using Open Data Kit Tool

3.1.1. Objectives

- To assess the current socio-economic status of the village.

- To use available information for further analysis, vulnerability assessment, project planning and designing.
- To set baseline indicators for project monitoring and impact evaluation in the later stages.

3.1.2. Methodology

The socio-economic data is collected through household surveys, focus group discussions (FGDs) and key informant interviews to create two sets of data, namely, i) household profile and ii) village profile.

The sample size of household surveys may vary depending on the specific project objectives but the sample is invariably comprised of representation from all socio-economic sections including the large and the marginal farmers along with the landless households in the village and also covers the ridge, middle and lower reaches of the micro watersheds. In IGWDP projects, 100 per cent household surveys were done, whereas in some other projects, 30 per cent to 60 per cent sample surveys were done, which follows the IWMP mandate of minimum 20 per cent households to be surveyed in the project area.

3.1.3. Household Level Indicators

The socio-economic survey collects multi-layered detailed household level data in specific formats developed by WOTR (digital format using Open Data Kit tool) based on the following seven broad categories. The information collected under each of these categories is summarised below:

1. Household Profile – The household profile includes data regarding the members of the family, age and gender ratio, education, primary and secondary occupation of the family for sources of livelihood, income and expenditure, landholding status, water resources used.
2. Energy Sources – The energy consumption section covers the type of energy used in the household and on the farm, including energy used for heating, cooking, lighting, petrol/diesel/electric water pumps, tractors and the expenditure thereby incurred.
3. Landholding and Agriculture Information – This section covers information regarding landholding (ownership), land use, irrigation status, source of irrigation, crops cultivated (irrigated and rainfed), agricultural inputs, cropping method, type of inputs

related to seeds, fertilisers, pesticides, use of various agricultural equipment, agriculture labour inputs, etc.

4. Livestock – The livestock section includes information about livestock rearing, including the type of livestock, ruminants which include crossbred cows, indigenous cows, bulls, buffaloes, goat and sheep. The information also includes milk production and income generated through it. Fodder availability, sources of fodder, crop residues used as fodder and crop residue used as raw material for making manure are also collected in this section.
5. Government Schemes, Credit and Insurance Related Information – The data related to enrolment in government schemes, crop insurance, crop loans are collected in this section. Financial inclusion/exclusion of the household is assessed through this.
6. Health Facilities Related Information – Sanitation related information such as availability of latrines at the household level, its usage, type of disposal using soak pits, one pit and wastewater disposal is covered here. Regarding health, the availability of one, two or three meals per day, drinking water cleanliness, use of utensils to fetch water, water purification for drinking purposes, and the disease history in the family are reported.
7. Micro-enterprises – The number of households associated with micro-enterprises such as agricultural produce processing plants, income generated through these micro-enterprises, challenges faced in sustaining these micro-enterprises are captured in this section.

The data collected at the individual household level could be assessed at the aggregate village level and at the disaggregated level based on landholding, caste, gender and other socio-economic characteristics.

3.1.4. Village Profile

The data for village profile is collected through focus group discussions and key informant interviews. Key informants are those individuals from the village itself who know about the village either because they have been staying in the village for long or they hold positions in important local level institutions.

The information collected under village profile is summarised in Table 3.1 below:

Table 2: Parameters Addressed in SES under Village Profile

Demographics	Land Use Information	Facilities Available in the Village
• Total Households • Total Population of the Village • Total Male Population of the Village • Total Female Population of the Village • Total Scheduled Castes Population of the Village • Total Scheduled Tribes Population of the Village	• Geographical Area • Forest Area • Area under Non-Agricultural Uses • Barren & Un-cultivable Land Area • Net Area Sown • Total Unirrigated Land Area • Area Irrigated by Source • Area under Different Crops	• Electricity • Education • Health • Drinking Water • Waste Management • Gram Panchayat Office • Other Facilities in the Village (such as PDS, KSK, Government Health Centres, etc.)

Information on agricultural land use, cropping, irrigation and related indicators which has an impact on ecosystem restoration and its outcomes is collected as part of the socio-economic survey. Since watershed development in the country is taken up in highly managed agro-ecological landscapes, household decisions on land use and cropping impacts are also impacted by restoration measures and its outcomes. These indicators provide information on agricultural biodiversity, water use for various needs including agriculture, which are part of the ecosystem indicators. Other ecosystem parameters such as soil characteristics, soil health, ground and surface water information, vegetative cover and biomass production, etc. are collected through various other mechanisms while the conservation planning is being undertaken. Well inventory, geohydrological survey, plot-wise soil information collected as part of participatory net planning, sample soil survey, biodiversity register, etc. provides detailed baseline information on various ecosystem indicators and is used in watershed planning. Since financial provision is made in projects for detailed planning, most of the projects collect this information even though there may be problems with the quality of data collection.

3.1.5 Application of Data and Information

Information generated through SES provides details about the households on various socio-economic and livelihood indicators, poverty, food security, assets owned by the households

and so on. This baseline information is used in analysing the village situation at the project level and in designing the project activities. The information helps in analysing the current status of agricultural land use and cropping patterns, livestock ownership and fodder requirement, distress migration, livelihood strategies of households and social categories (such as land owners, landless, women-headed households, dalits and oppressed castes, etc.). This would not only help in prioritising interventions to address the concerns of equity and poverty reduction but also help in monitoring the impact of the intervention on the most marginalised among the community.

The baseline data generated through the SES is also used as an input data in CoDriVE-PD for vulnerability assessment. The SES information forms an important component for assessment, project design, planning, implementation, monitoring and evaluation.

The SES data is used during the project to indicate progress towards the goal and objectives (monitoring) and post project, to measure the amount of change (impact evaluation). It allows those involved in the project to understand the initial livelihood conditions of the people, land and water management practices, resource use and what needs to be done to ensure livelihoods for various sections as part of ecosystem restoration. Thus, baseline assessment builds the necessary foundation for the planning of project activities and obtains proper information for effective monitoring and evaluation.

SES is one of the many tools used in planning ecosystem restoration projects as it provides desegregated information on households and social sections and helps in taking decisions regarding prioritising households while restoration measures are undertaken. Since poverty alleviation and focus on the poor and the marginalised, including the rainfed farmers, is the larger goal of watershed projects in the country, the importance of SES cannot be undermined.

3.2. Community Driven Vulnerability Evaluation – Programme Designer (CoDriVE-PD) – The Vulnerability Assessment Tool

Community Driven Vulnerability Evaluation – Programme Designer (CoDriVE-PD) is a vulnerability assessment tool that evaluates the vulnerability of the community to climate change and also its adaptive capacity based on five types of livelihood capital: Human, Social, Natural, Physical and Financial.

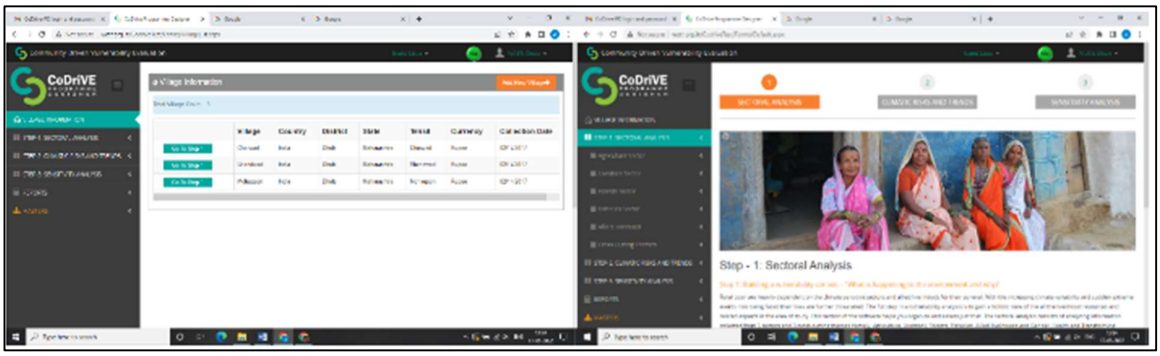


Figure 3.2: CoDRive-PD Software

3.2.1. What Does CoDriVE-PD Do?

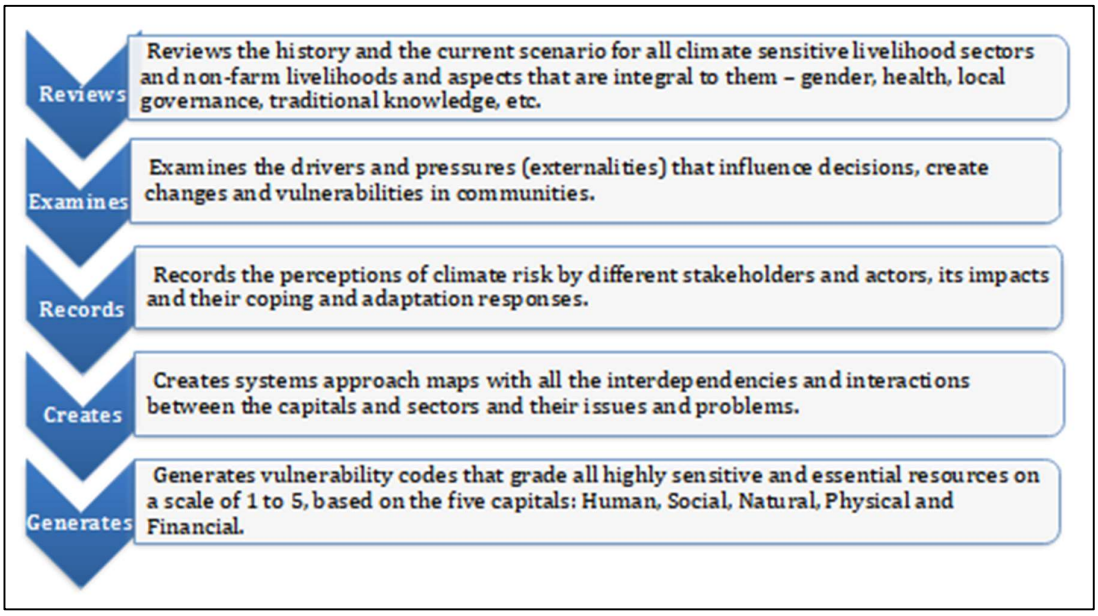


Figure 3.3: Steps in CoDriVE-PD Assessment

3.2.2. How Does CoDriVE-PD Work?

CoDriVE-PD is developed by WOTR as a software programme for data inputs and vulnerability assessment. It uses both quantifiable and qualitative data at household and village watershed level. At the beginning of the exercise, the facilitators orient the community about the objective and the process of the exercise. In addition to the baseline assessment data collected through the socio-economic survey, the community responses to impacts of climate change on

livelihood sectors including agriculture, livestock, water resources, forest, health and gender are captured for the present and also as historical data through recall and from secondary sources (for 30–40 years). This is the first step in actual field deployment of the tool. The perceptions of the community for each of the above are documented in the field through community interaction. Community perception about climate risk, extreme weather events such as droughts, excess rainfall, etc., and community and household response to climate change and adaptive strategies are documented for analysis. This information is used to identify the drivers and pressures of change over time. The community responses are filled in by the technical team in specific digital formats and worksheets that are used for further system analysis based on systems thinking and resilience theory.

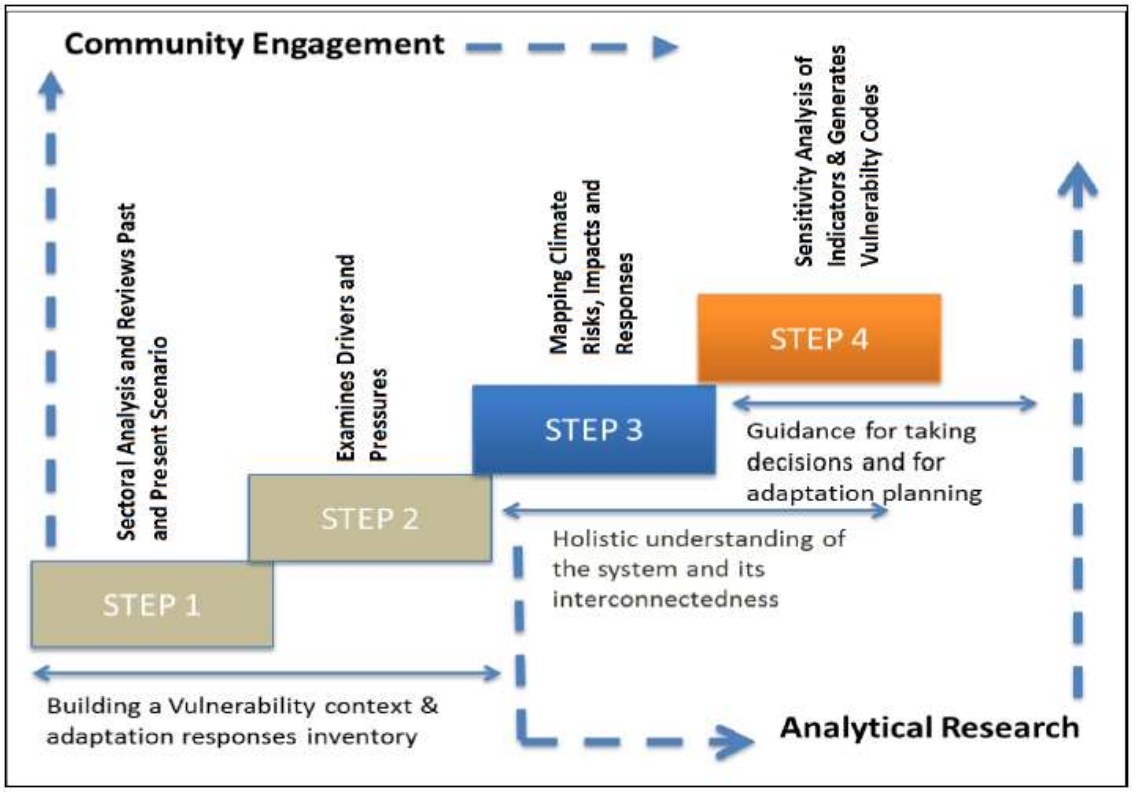


Figure 3.4: CoDriVE-PD Assessment – Schematic Representation

Source: Rao et al., 2013

The next step involves generating system maps to understand the key linkages, critical problem areas and high leverage points and their links to climate risks in the region from

systems approach rather than looking at stressors and impacts in silos. A sample systems map is shown below in Figure 3.5.

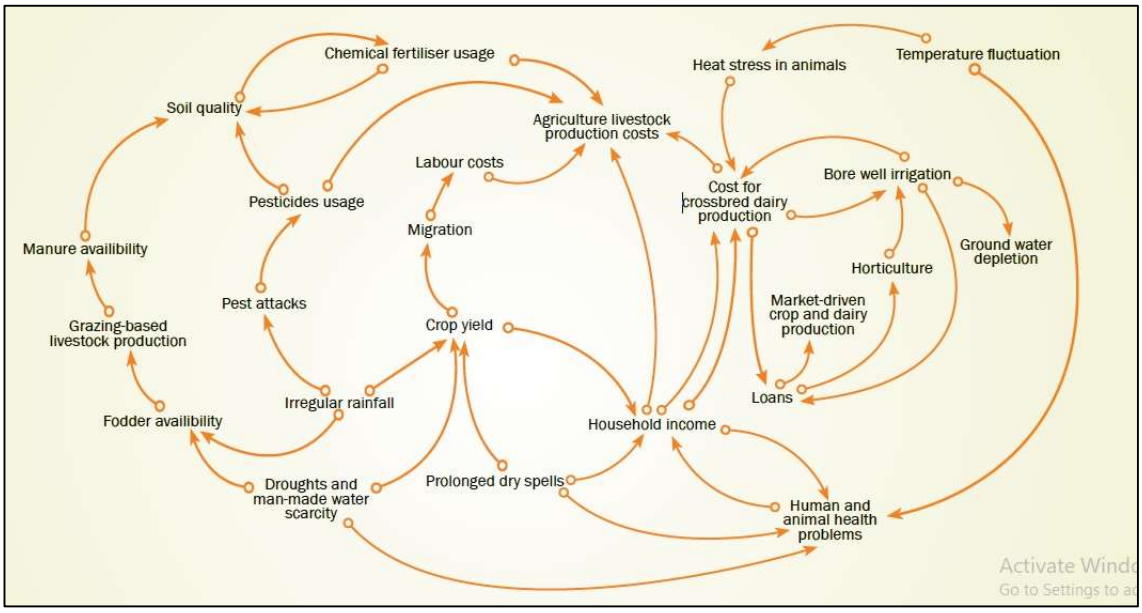


Figure 3.5: CoDriVE PD generated Sample Systems Map

Source: CoDriVE PD - A Handbook, WOTR, 2013

As the next step, a sensitivity analysis of the livelihood resources that are essential to coping with climate risks identified in the area is done on a scale of 1 to 5. This analysis is done at two levels:

1. At the watershed level.

2. At the household level, for the vulnerable groups identified.

The Capital-based Resilience Scale is used to grade capitals on a scale of 1 to 5 based on their adequacy where 1 = nil (0–10%), 2 = minimum (11–25%), 3 = low (26–45%), 4 = adequate (46–70%), 5 = high (71% and above), which will indicate the vulnerability. A high score like 4 and 5 will mean that the system under study has more resilience and hence is less vulnerable. For further clarity, vulnerability colour coding index for indicating vulnerability based on capitals is used simultaneously where:

Red = Danger (1), Orange = Risk (2), Yellow = Alert (3), Blue = Stable (4), Green = Safe (5).

To further illustrate this, the vulnerability codes generated for a sample village (at watershed level), is shown in the Table 3.2 below:

Table 3: Vulnerability Code Based on Status of Five Livelihood Capitals – A Village Sample

Financial Capital	Human Capital	Natural Capital	Physical Capital	Social Capital
Recent project with village fund for watershed development is available. VOs are strong and have funds.	Human capital with respect to climate-sensitive livelihoods is low; most of the knowledge is increasing mal-adaptation, with climate change increasing the risk. CBOs like the VOs and watershed committee, have funds but have no knowledge of climate-adaptive strategies to use the funds effectively; currently the funds are being used/ allocated for more maladaptive livelihoods which will further increase vulnerability to climate variability.	No forest lands. Minimal availability of common property resources. Low in local biodiversity. Groundwater scarcity very high. Natural water bodies decreasing/ drying up. Degrading cultivable lands (problems of soil, fertility, salinity, etc.).	Physical capital with respect to education, transportation, and institutions is adequate. However, physical capital with respect to climate sensitive livelihoods is very low. Seed banks and agricultural warehouses are located very far away. There are large numbers of bore wells but no recharge structures.	No farmers clubs/ cooperatives. No labour associations. Watershed Committees have been formed but are weak; high political problems. VOs are formed but are dominated by the richer class.

Financial Capital	Human Capital	Natural Capital	Physical Capital	Social Capital
4	1	2	2	3
Stable	Danger	Risk	Risk	Alert

Source: Rao et al., 2013

The final step of assessment generates vulnerability codes as an outcome based on the status of each capital as shown in Table 3.3. It further analyses the community vulnerability at the village level and the household level separately and generates specific vulnerability codes for the same. The household level vulnerability codes are further categorised based on type of landholding as large and medium farmers, small and marginal farmers and the landless, as shown in Table 3.3 below.

Village and household level vulnerability codes are given as follows:

Table 4: CoDriVE-PD-generated Village and Household Level Vulnerability Codes

	Financial	Human	Natural	Physical	Social
Village Level	2	2	2	2	2
Large and medium Farmers	3	2	2	3	2
Small and Marginal Farmers	2	2	1	2	2
Landless	1	3	1	1	1

Source: Rao et al., 2013

Although the tool analyses community vulnerability based on five livelihood capitals including hundreds of parameters, the focus of this Work Package (WP) is ecosystem restoration monitoring, and the evaluation parameters and data points related to this are covered under the natural capital domain.

The parameters considered for assessing the community vulnerability to natural capital related to soil and water resources are listed below in Table 3.4.

Table 5: Natural Capital Parameters Assessed in CoDriVE-PD

Sr. No.	Parameters	Sr. No.	Parameters
1	Barren and wasteland	13	Soil health (qualitative data through discussion and observation besides sample soil survey)
2	Area under miscellaneous trees, groves, etc.	14	Soil quality (qualitative data through discussion and observation besides sample soil survey)
3	Culturable waste land	15	Soil erosion (discussion and observation)
4	Total cropped area	16	Undulating land
5	Current fallow land	17	Type of crops: commercial-indigenous
6	Fallow land other than current fallow[11]	18	Type of crops: commercial-hybrid
7	Forest land	19	Type of crops: Food crops-indigenous

[11] The definition of Fallow Other than Current Fallow in Land Use Classification System (nine-fold classification) in India means all lands, which were taken up for cultivation but are temporarily out of cultivation for a period of not less than one year and not more than five years while Current Fallow is the land kept fallow during the enumeration year.

Sr. No.	Parameters	Sr. No.	Parameters
8	Irrigated land	20	Type of crops: Food crops-hybrid
9	Land under agricultural uses	21	Ecosystem services (Regulating services such as climate regulation, flood prevention, erosion control, etc.)[12]
10	Net area sown	22	Ecosystem services (Supporting services such as climate regulation, soil formation, etc.)
11	Permanent pasture and grazing land	23	Vegetation cover
12	Rainfed land		

The natural capital assesses the community vulnerability to land degradation, reducing oil fertility, salinity, drought, water scarcity and dwindling biodiversity. The community vulnerability to the degradation of natural capital can be used in effective planning, designing, implementation and monitoring of restoration of the natural capitals and eco-restoration projects.

3.2.3. Application of the Tool

The tool not only helps in monitoring and evaluating impacts based on indicators but also analyses the status of various conditions that affect the value of a particular indicator. In other words, the tool helps us to understand whether the positive impact in relation to one indicator creates a negative externality for some other indicator. For example: A project sets 50 per cent of cropped area being seasonally irrigated as a result of the watershed project as an indicator of good watershed development. An evaluation reveals that 75 per cent of land is now irrigated.

[12] Ecosystem services are measured through focussed group discussions (qualitative data) where the communities' perceptions, feelings and experiences (exposures) are assessed using various proxy variables related to water, air quality, biodiversity, soil etc. These data are further assessed using the grading system explained above.

However, it is found that the main sources of irrigation are the numerous wells and tube wells and that the groundwater levels have gone down from 120 ft to below 500 ft over the years. Hence, although the target (75 per cent irrigated agriculture) is more than achieved, the lowering of the ground table is an indication of a looming problem and is unsustainable.

The vulnerability codes help in identifying which capital/s need immediate intervention. Thus, this information can be utilised in the process of planning and designing of the project activities accordingly. This tool can be applied at different stages of the project as per requirement. Though the tool can be used in planning, designing and monitoring of a project, this tool does not necessarily replace any of the existing tools including PNP, PIM and other monitoring tools. It is a comprehensive tool that not only analyses the parameters and their impacts but also helps develop the linkages between impacts and its causes using system generated systems maps.

The application of the tool at a particular village is based on typology identification. Typology identification is a process of grouping or classifying villages with similar characteristics against certain groups of indicators such as the biophysical indicators using geo-spatial technologies. Biophysical parameters such as type of catchment (lower, middle, ridge), topography, natural vegetation cover are considered in typology identification. Based on these indicators, typologies in the cluster of villages leads to identification of the representative village where the tool can be applied and the results of the assessment can be applied or generalised to the villages with similar typologies.

CoDriVE-PD can be used to establish interlinkages between impacts on soil health, water, biodiversity, crop yield and application of fertilisers to generate a systems map and identify actions to be taken accordingly. Following the vulnerability analysis using CoDriVE-PD, WOTR has developed an Adaptation Planning and Risk Mitigation Tool to enable communities to undertake adaptive actions and build resilience.

3.3. Participatory Net Planning (PNP) (Lobo, Crispino, 2010)

Participatory Net Plan (PNP) is the tool developed by WOTR for planning watershed development activities with the farmer as well as at the watershed level. It was an innovation from the gross planning system mainly based on maps and secondary data, with minimum

interaction with the community. PNP changed this and put the farmer and the community at the centre of planning of conservation measures.

3.3.1. What is Participatory Net Planning?

Participatory Net Planning (PNP) is a tool that actively involves landowners and other stakeholders in the planning and implementation of measures related to land use, soil conservation, water harvesting and biomass development—that regenerate the ecosystems and watersheds they live in.

It focuses primarily on site and locale-specific resource management and is concerned with the conservation, productivity enhancement and sustainable management of all natural and biotic resources in the watershed. The specific characteristics and current use of each plot (parcel of land), water and vegetation resources are assessed and detailed plans, together with costs and timelines to realise the desired outputs, are worked out.

By its very nature, PNP also serves as a mobilisation, training and monitoring tool that is also invaluable for evaluation purposes. PNP is undertaken using a digital format in a village and assessment is done using a software developed by WOTR known as Participatory Net Plan Software, with an expert system for validation and monitoring of project measures.

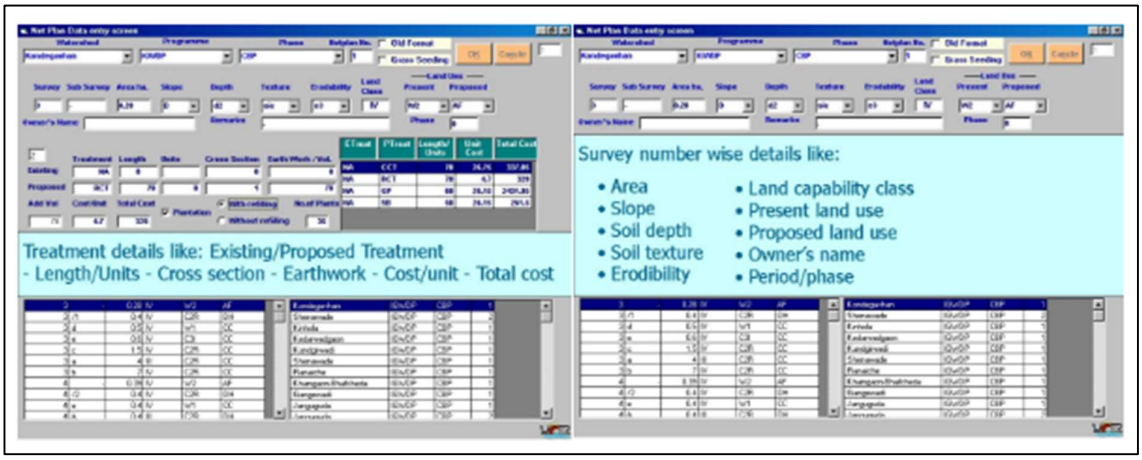


Figure 3.6: PNP Software for Generating Plot/Watershed Level Conservation Plan

3.3.2. Objectives of PNP

i) Secure ownership and 'buy-in' amongst various stakeholders such as landowners, landless, shepherds and other users of natural resources, project implementing agency, local gram panchayat, forest department, etc. in a particular watershed so as to enhance the sustainability of the works undertaken.

ii) Plan for measures that are tailored to site requirements, address farmers and community needs and increase productivity.

iii) Formulate proposals—activities, budgets and timelines—that are realistically implementable and result in minimal divergence between what was planned for and what is actually realised.

iv) The aggregation of individual plot details to create watershed level conservation plan.

v) To create plot level baseline information on land capability, land use, erosion, etc.

3.3.3 The Approach

The PNP methodology puts the stakeholder at the centre of the process. This is achieved by involving the landowner/farmer household (all adult men and women of the household, as far as possible) or users from the community, mainly the landless and herders (as in the case of Common Property Resources or CPRs) in the planning and decision-making process specific to the land or CPR in question.

3.3.4 PNP Activity on Field Process

At the time of undertaking PNP, the planning team visits each landholding or CPR together with the owners of the plots or concerned stakeholders (in the case of CPR) and this exercise is conducted on-site. The land/CPR is jointly surveyed and assessed. The views of the stakeholders regarding current and proposed land use and the soil and water conservation treatments necessary to be undertaken in order to realise desired benefits, are elicited. They are then engaged in a dialogue wherein they are introduced to the best practices and scientific knowledge pertaining to land husbandry and the various possible interventions and their purpose and potential are discussed and agreed upon.

The final word in regard to conservation measures to be undertaken rests with the stakeholder, except in the case where it would adversely affect the neighbours, the surrounding lands/CPRs or result in damage elsewhere. In such instances, attempts are made to convince the stakeholder, failing which, no treatments are taken up on the concerned land or CPR. Once consensus and agreement has been secured, the 'understanding'—proposed interventions and treatments—is finalised in writing and also sketched out on a diagram or map of the concerned parcel of land or CPR, as applicable. Geo tagging the land parcel is also undertaken so that monitoring of the conservation is possible.

PNP is also gender inclusive. Men and women are both involved in the planning and formulation process. PNP is preferably undertaken when the 'farmer couple or land-owning couple' is present on their lands at the time of the planning, even in the case where the land ownership is in the man's name only.

When PNP is done for Common Property Resources (CPRs), where the landless poor, marginal farmers, small livestock owners and the shepherd communities are the primary stakeholders, then the Village Watershed Committee (VWC) or the Village Development Committee (VDC), as the case may be, and the Gram Panchayat (GP) are also involved. This is necessary in order to address the concerns of equitable access, compensatory arrangements in the case of loss of access, resolve conflicts and establish effective, transparent and representative institutional arrangements for sustainable management of the CPRs and the created assets.

Land use is assessed based on discussion and observation with farmers, while land capability (based on slope of the land, soil depth, soil texture and erosion) is actually measured in the field for each plot using various techniques. Soil samples based on a grid area of 25 ha are also tested to understand the soil components and soil health factors, which are part of the watershed planning process.

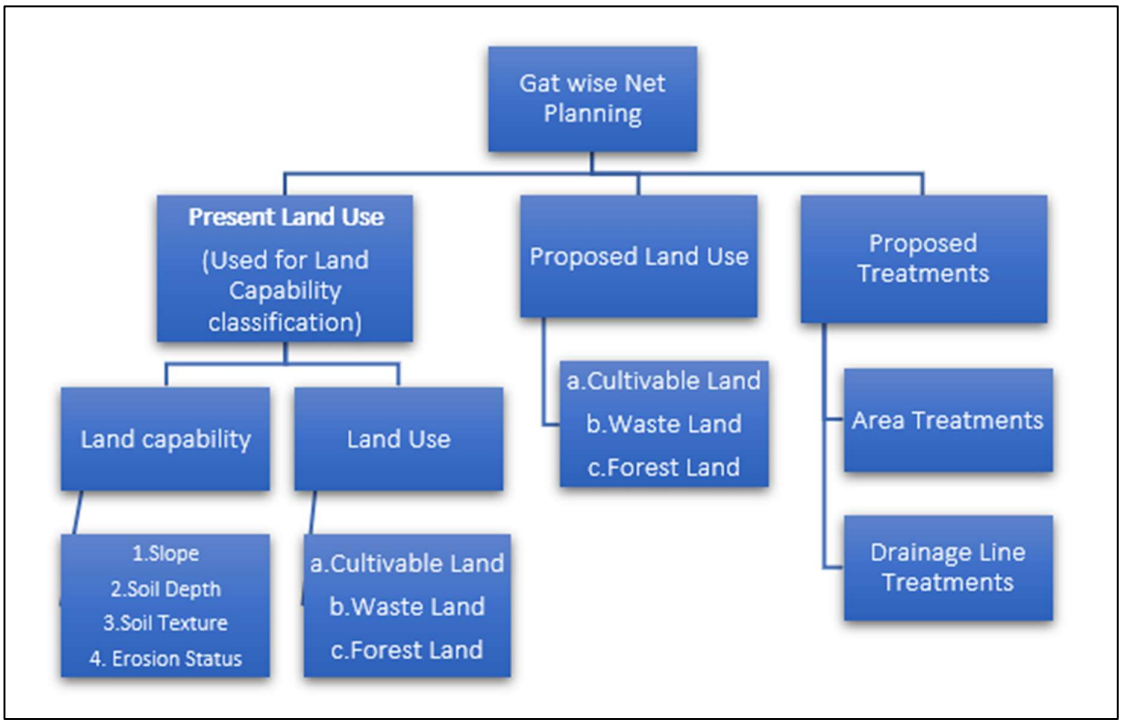


Figure 3.7: PNP Analytical Frame

Table 6: Ecosystem Restoration Parameters Addressed through PNP

Land	Water
Slope	Runoff
Soil Depth	Crops Grown – Rainfed
Soil Texture	Crops Grown – Irrigated
Erosion Status	Existing Land Use
Existing Land Use	Proposed Land Use
Proposed Land Use	Proposed Treatments - Area Treatments - Drainage Line Treatments
Existing Treatments	Mapping of Existing Streams and Gullies
Proposed Treatments - Area Treatments - Drainage Line Treatments	
Crops Grown	

Land	Water
Permeability	
Electrical Conductivity	
Mapping of Existing Streams and Gullies	
Vegetative Cover	

Soil parameters are measured in the field. Slope is measured using clinometer or hydromarker (a water tube fitted to a calibrated scale, which is very easy to use even for villagers, to measure land slope), depth by actually digging the top soil, erosion through observation on formation of rills, gullies, etc. and soil texture using the ribbon method. Simple methods that are easy to learn by the farmer are used to understand the soil characteristics. This is done for each plot in the watershed, and based on this, a land capability database for the watershed is created. The proposed land use and the necessary conservation measures are decided by the land capability class of the plot. However, if the situation demands a land capability class of VI, which is generally not suitable for agriculture, but the farmer is poor and has only that parcel of land then the conservation measure would aim to make it cultivable by forming farm bund, maybe through additional silt application.

3.3.5 Application of PNP

The PNP methodology was formulated in the context of the Indo German Watershed Development Programme (IGWDP) in 1994-95 and further modified in 2004. It is one of the most popular participatory planning tools for conservation work across the country. It adheres to the basic principle of ridge to valley conservation and site-specific measures. Since then, it has been adopted, with some location and project specific adaptations, by major government implemented watershed development projects in Maharashtra (Hariyali, IWMP, etc.), Andhra Pradesh Rural Livelihoods Programme in Andhra Pradesh (APRLP), the Rajiv Gandhi Watershed Mission in Madhya Pradesh and all watershed projects funded by the National Bank for Agriculture and Rural Development (NABARD), a major funder of watershed development in India, and many NGO and CSR funded[13] initiatives.

[13] CSR funded projects are implemented either through NGOs or by the agency itself or through other charitable organisations.

The PNP tool is applied once in the project cycle in the planning phase. The PNP generates net planning maps such as present land use and proposed land use and proposed treatments for soil and water conservation. The integration of the plan software generated data along with the specific net plan maps generates a watershed level soil and water conservation plan used for overall project implementation.

MONITORING TOOLS

In order to track and steer the project towards its objectives and generate information for decision making at different levels, different monitoring and evaluation systems are put in place. These systems and tools are integrated into the project cycle so that decisions can be made to improve the efficiency and effectiveness of the interventions.

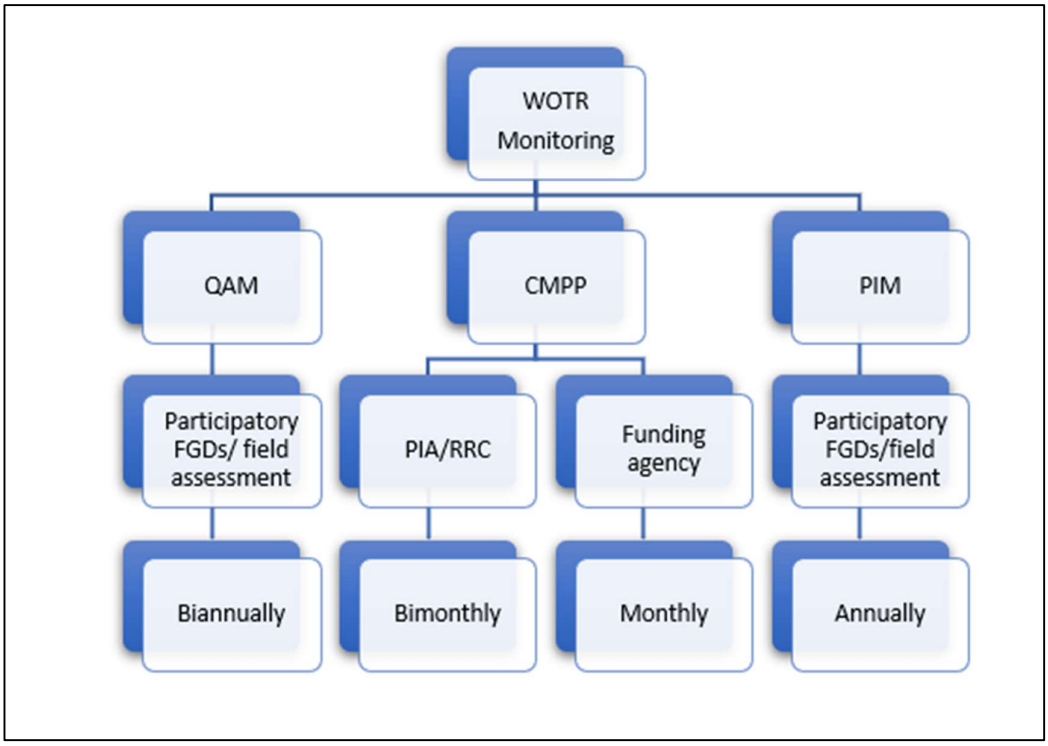


Figure 3.8: Schematic Representation of Different Monitoring Tools Used by WOTR with Timelines

In this regard, WOTR had developed a number of tools to monitor the product (various project measures related to conservation, livelihoods, institutions and capacity building), process and impacts of the IGWDP intervention. These tools were further adopted by different projects for

monitoring and evaluation of the project (GoI, 2006). Three sets of tools have been analysed here to see how they support the monitoring of ecosystem restoration activities undertaken through the watershed development projects.

I) Qualitative Assessment Matrix (QAM)

II) Concurrent Monitoring of Progress and Products

III) Participatory Impact Monitoring (PIM)

3.4 Qualitative Assessment Matrix (QAM)

3.4.1 What is QAM?

It is a participatory assessment system designed to monitor the quality of processes and outcomes on a periodic basis, which helps in identifying the areas of strength and concern in a specific project. The idea behind application of such a tool is that if the quality of processes and products is tracked on a regular basis, it can lead towards achieving sustainable outcomes and impacts, besides helping in decisions regarding capacity building/support requirements for the areas of concern.

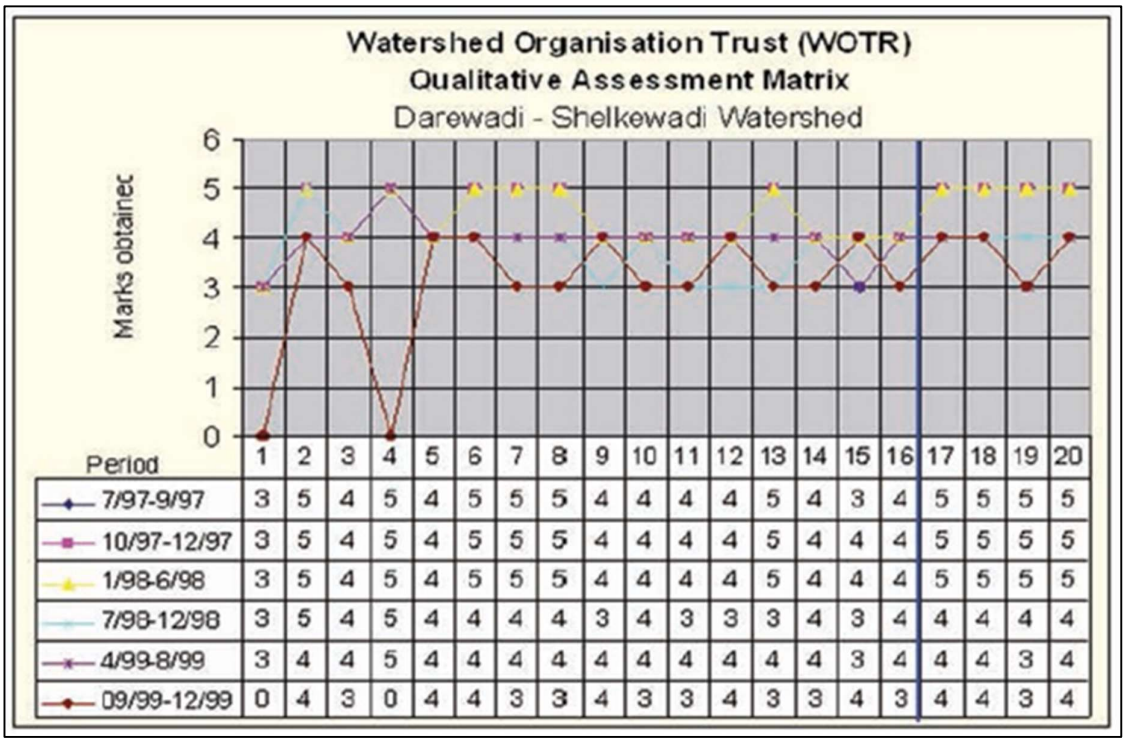
It helps not only the watershed community and their organisations to understand the health of the project and areas where improvements are required, but also the project management to decide on incentives and sanctions. Good outcomes in QAM monitoring were a pre-condition for IGWDP projects to move ahead. The project staff, along with the community organisations, discuss and decide the grading on various parameters.

3.4.2 Methodology

The qualitative assessment is done on 20 parameters related to capacity building, planning, implementation, village institutions, rules and regulations of the project, and the quality of support and facilitation by the project staff. Each parameter is assessed on a certain set of performance indicators, depending upon the details of activity and expected outcome from a specific parameter. Each parameter is graded on a scale of 1 to 5, depending upon the performance of each parameter. The scoring scale is divided into five categories such as 1-very poor, 2-poor, 3-satisfactory, 4-good and 5-excellent. Thus, the maximum possible score for 20 indicators is 100 and the lowest would be 20. Hence, in an assessment, a watershed

can score in the range of 20 to 100, depending upon the grades received on each parameter. If a watershed scores 60 or above, the quality of processes followed is considered satisfactory and the health of the project is said to be good.

The assessment matrix is done regularly on a six-monthly basis. The assessment team consists of two subject matter specialists (technical and social/gender specialists) from the Regional Resource Centre of WOTR. It also includes the project staff and the manager from the concerned NGOs. The facilitation team conducts a field visit of different activities undertaken and checks different records related to project implementation prior to assessment. The assessment is done through discussion with members of Community Based Organisations (CBOs) and general community members. Each parameter is put up for discussion, and after detailed discussions, the members reach a consensus (the facilitators are also aware about the status of each component due to their constant interaction with the project) regarding the marks (grade) to be given to the particular parameter, and the facilitator notes down the score on a sheet. Thus, all the parameters are enumerated and the reasons for the scores are discussed. It also helps in sensitising the CBOs regarding problems/concerns and actions required to overcome those problems. Thus, information regarding the quality of processes is gathered for all projects in each Regional Resource Centre, and forwarded to the Head Office for consolidation. This generates a timeline of changes occurring in the quality of processes. The results of each project are discussed in the coordination meetings and action required to improve the processes are taken up. The data aggregation on a regular basis is done as part of the Management Information System and a ‘graph’ is prepared for each project.



Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
7/97-9/97	3	5	4	5	4	5	5	5	4	4	4	4	5	4	3	4	5	5	5	5
10/97-12/97	3	5	4	5	4	5	5	5	4	4	4	4	5	4	4	4	5	5	5	5
1/98-6/98	3	5	4	5	4	5	5	5	4	4	4	4	5	4	4	4	5	5	5	5
7/98-12/98	3	5	4	5	4	4	4	4	3	4	3	3	3	4	3	4	4	4	4	4
4/99-8/99	3	4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4	3	4
09/99-12/99	0	4	3	0	4	4	3	3	4	3	3	4	3	3	4	3	4	4	3	4

Figure 3.9: QAM – A Sample Matrix

Source: Lobo and Samuel, 2005

The qualitative assessment was earlier done based on 20 parameters, out of which the first 16 parameters are related to issues of community, participation, quality of products and strategies, while the last four parameters try to understand the quality of support and facilitation of the NGO to the project. Over time, the list of parameters has been updated and now almost 30 parameters are assessed. The new list of parameters and assessment matrix is shown in the Table 7 below.

Table 7: QAM sample Matrix with Current List of Parameters

Qualitative Assessment Matrix (QAM)data																																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
	Name of the Villages	First Four shramadan	Exposure visits of	Entry Point Activity	Net planning	Planning of work	Execution & quality of	Regular shramadan &	Project record	Afforestation	Gram Sabha & its Records	VDC Meetings and	Ban on free grazing	Ban on tree felling	Portfolio management	Women's involvement	VDC/SMS trainings	Horticulture	Demonstration of new	Organising institutions	Gender sensitisation	Govt. Dept. Co-	Poorest of	Accounts	Equity	Livelihood	Innovative activities	Livestock	Maintenance fund	WOTR-Team-Technical	WOTR Team-Social	**Total Score**	**Percentage**
S. No.	**Rating**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**150**	**100**
1	Malwan	3.6	3.0	3.6	2.7	2.7	3.7	3.6	2.4	3.5	3.3	2.9	2.7	2.2	2.4	3.2	3.2	3.2	2.7	2.4	3.2	2.3	3.3	3.5	2.7	3.2	3.5	2.0	2.8	3.6	3.4	90.5	60.3
2	Pimpale	3.5	3.0	3.6	3.2	2.8	3.6	3.6	2.4	3.5	3.6	3.4	3.3	3.6	2.6	4.0	3.6	3.0	2.0	2.6	4.0	3.0	3.0	3.8	2.0	3.5	3.8	2.0	2.5	3.6	3.8	95.9	63.9
3	Khadkipada	3.4	3.2	2.0	2.5	3.0	3.3	3.6	2.6	3.5	3.4	3.1	2.7	2.4	2.0	3.2	3.2	3.0	3.0	2.0	3.2	2.7	3.3	3.5	3.0	3.2	3.8	2.0	2.5	3.8	3.8	89.9	59.9
4	Kholvihir	4.0	3.2	3.6	2.7	3.0	3.9	3.6	2.4	3.3	2.9	2.9	2.7	2.4	2.2	3.4	3.2	3.0	3.0	2.2	3.4	3.0	3.0	3.5	3.0	3.2	3.8	2.0	2.8	3.8	3.4	92.5	61.7
5	Mohane	4.0	3.2	2.0	2.5	3.0	3.9	4.0	2.6	3.7	2.9	2.8	3.4	2.8	2.6	2.8	3.0	3.4	2.0	2.6	2.8	2.3	2.5	3.5	2.0	2.8	2.8	2.0	2.3	3.8	3.2	87.2	58.1
6	Jambhore	3.8	3.0	4.	2.6	3.0	3.4	3.8	2.4	3.	3.1	2.	2.6	2.6	2.	3.0	3.	2.	2.0	2.2	3.0	2.3	3.	3.5	2.	3.0	3.	2.	2.	3.2	2.8	86.	57.

				0						2		8			2		0	6					3		0		3	0	3			0	3
7	Palashi	4.0	3.2	2.8	2.7	3.0	3.7	3.8	2.0	3.5	3.1	3.0	2.3	2.6	2.4	4.0	3.2	3.2	3.3	2.4	4.0	2.7	3.3	3.8	3.3	3.3	3.8	2.0	2.8	4.0	3.6	94.8	63.2
8	Aundhewadi	4.0	4.0	-	4.0	4.0	4.0	5.0	5.0	3.0	4.0	3.0	2.0	2.0	4.0	4.0	4.0	2.0	1.0	5.0	3.0	3.0	2.0	3.0	4.0	2.0	4.0	4.0	-	3.0	4.0	96.0	64.0
9	Tamkadwadi	3.0	4.0	-	3.0	3.0	4.0	4.0	4.0	2.0	3.0	3.0	2.0	2.0	3.0	4.0	4.0		1.0	3.0	4.0	3.0	3.0	4.0	3.0	3.0		2.0	-	4.0	4.0	82.0	54.7
10	Hivare	3.0	4.0	-	4.0	4.0	3.0	3.0	3.0	4.0	2.0	3.0	4.0	2.0	3.0	4.0	4.0	4.0	3.0	3.0	3.0	4.0	4.0	4.0	2.0	3.0	-	2.0	-	4.0	4.0	90.0	60.0

The QAM is a recurrent monitoring tool applied every six months in a project cycle. It monitors the ongoing implementation process with respect to awareness amongst farmers about the PNP, participation of farmer couple and proper documentation of the PNP formats.

It also monitors the implementation of common activities in the village, such as the ban on open grazing and ban on tree felling, along with the quality of field implementation of the proposed soil and water conservation structures. For the comprehensive list of parameters monitored through the QAM tool earlier and now, see Annexure A1.

The tool is not very actively pursued now as it is very project specific and integral to the project design. However, looking into the need of the project, and with the support of additional monitoring indicators, it can be adapted as it can generate a sound quality assessment of the intervention.

3.5 Concurrent Monitoring of Progress and Products (CMPP)

Concurrent or embedded monitoring is another tool developed and being used by WOTR to monitor input–output (products such as various conservation measures) and results (outcomes). It is an embedded system to monitor the input–output relations and quantity and quality of products in relation to expected results as identified in the planning process and sanctioned by the project. It is done periodically with close and frequent monitoring in the initial stages and with reduced periodicity in the later stages—bimonthly or quarterly in the Capacity Building Phase (preparatory phase) and six monthly in the Full Implementation Phase.

The major objectives of this system are to understand, check and verify input and output with expected outcomes (quality which leads towards results), with steering of the output towards the desired objective. The tool is designed to be a capacity-building measure to transfer the skills of monitoring to NGOs and CBOs. It becomes part of the overall decision support to project management in terms of identifying the need for additional capacity building, lengthening the period of capacity building and project duration, if required, and ensures follow-up action required at different levels.

It is an ongoing, regular monitoring of activities related to physical work, institution building, documentation and capacity building undertaken under the project. Field monitoring takes place on a bimonthly basis through which the completion and quality of biophysical work is

monitored regularly through community interaction. It also includes financial monitoring of the intervention.

3.5.1 The Method

The monitoring is done in an interactive mode, following an indicative checklist related to core areas. The process consists of desk appraisal of physical, financial and shramadan (voluntary labour contributions) status (the documents are submitted by the NGO/CBO) and review of all relevant records related to project implementation (in the CBO/NGO office), physical verification of work—implemented and ongoing—as sanctioned in the project, on-field discussions with different stakeholders, including CBOs, NGO staff and beneficiary farmers involved in the project implementation.

The objective is to appreciate, suggest changes and provide feedback, and have decision-oriented discussions with the CBOs and NGOs about the quality and quantity of products, issues of social discipline, voluntary contribution, involvement of women, issues related to participation, etc. Based on field observations, desk appraisal and discussion, a joint monitoring report is prepared, with actions to be taken and their related responsibilities. The information generated through the monitoring is fed into a Decision Support System (DSS), which facilitates decisions regarding the specific project.

3.5.2 The Process

The process of this monitoring starts prior to the actual field visit, when the NGO/VWC applies for release of funds (called 'next instalment') after finishing 60 per cent of the previous instalment released. The release request consists of a formal request letter, physical and financial progress (for the period and cumulative) reports, status of shramadan, report on trainings, exposures, women's promotion activities and declaration about display of information in the village, status of project staff and a work done map (based on sanctioned land use) in the prescribed format. This information is fed into a Decision Support System (DSS) and the system analyses the current status, changes and deviation (as against sanctioned plan and reporting till date). The sanctioned project plan is the base document for comparing the current status of outputs and activities.

Monitoring activities include Verification of Request for Financial Release, Desk Monitoring, Field Monitoring, Gram Sabha/VWC Meeting and Samuykt Mahila Samiti (SMS) Meeting/SHG Monitoring.

The Concurrent Monitoring system helps in tracking the progress and quality of outputs such as type of conservation work completed in relation to the plan, status of various community organisation such as Village Watershed Committee (VWC), Self-Help Groups (SHGs) of women, implementation of capacity building, non-farm livelihood measures, etc. It facilitates decisions related to project management and capacity-building needs. It generates consensus on the expected systems, strategies and procedures of project implementation, helps in motivating CBOs, farmers and labourers. Disputes, if any, are resolved through discussion and consensus. It helps in creating a database on the timeline related to the project cycle.

3.6 Participatory Impact Monitoring (PIM)

The major objective of any watershed development project is to improve the natural resource base through conservation and management of resources so as to increase the productive potential of the resources and create livelihoods for the people depending on those resources. In order to achieve this, a set of interventions are planned and implemented in consultation with the community which generates certain outputs, outcomes and impacts. In order to understand whether the planned activities are creating the expected outputs and impacts, a tracking and measurement system is required, which facilitates all the stakeholders to understand and take timely decisions and steer the project towards its expected objective. Understanding and analysis of outcomes and impacts at the primary stakeholder level is very crucial not only for them to appreciate a specific intervention but also to ensure maintenance and sustainability of the same. Interventions that do not add value and benefit would not have a high sustainability.

Understanding this and realising the fact that the community is the best judge of project outcomes, a participatory impact monitoring tool was developed by WOTR to facilitate monitoring of impacts at the community level.

3.6.1 Objectives of Participatory Impact Monitoring (PIM)

- To understand the impacts from watershed development through participatory observation, measurement and analysis.
- To facilitate the process for the community to learn and assess impacts on their own.
- To capacitate people to gather impact information and document it so as to create a timeline of information on various participatorily chosen indicators.
- To help the facilitating organisation learn from the community their understanding of impacts and facilitate the project interventions based on these understandings.

3.6.2 The Method (Lobo Crispino and Abraham Samuel, 2006)

In watershed development, impacts take a longer time to become visible. Hence, outcomes and visible impacts are monitored on a yearly basis as part of the project cycle and intervention sequence. Monitoring is considered as a continuous observation, reflection and correction of activities; hence it is designed as a tool to assess the changes as well as to facilitate correction, if required. It is done through facilitation and active participation of the community, whereby the CBO and community members identify a set of parameters/indicators to judge, undertake field visits, measure and assess impacts arising out of the activity with respect to social, technical, institutional and socio-economic aspects. Charts, data points, stories, etc. are documented and displayed and the monitoring concludes with a presentation and discussion by community organisations, wherein interested villagers also participate.

3.6.3 Types of Impact Indicators Monitored in the PIM

1. Technical indicators:
    - *Runoff*: Time of concentration, runoff velocity, runoff quantity (based on local understanding such as time taken for water to reach the outlet, surface visibility of fast flowing water, etc.).
    - *Soil erosion*: Silt deposits, gully stabilisation (observation of silt deposits in gully control measures, water harvesting structures through field observation and community perception)
    - *Water level in wells*: Depth of water in the well, time required for replenishing the well water after pumping, withdrawal time, pumping time in different seasons, number of wells pre- and post-watershed development.
    - *Tree cover:* pre-and post-watershed tree covers, type of tree species, total area under tree cover, canopy, survival rate, care of the planted area, institutions in relation to forest (FPC), sustainability, natural regeneration.
    - *Grass/fodder*: Increase in fodder availability, quantity of fodder, total area under fodder/ grasses.
    - *Wildlife*: Whether any animal/bird species returned or was seen, attitude of villagers towards wildlife.
    - *Change in CPR*: Production and use.

    Agricultural production:

- *Additional area brought under cultivation*[14]
- *Increase in kharif/rabi/summer season area*
- *Change in irrigated area*
- *Change in cropping pattern (horticulture/pulses/oil seed crop/floriculture/medicinal herbs, etc.)*
- *Change in crop yield*
- *Change in total production (in terms of approximation)*
- *Availability of foodgrains (foodgrains available at home/months)*

2. Social-cultural indicators: *Education, school enrolment, social cohesion, equity, environmental awareness, etc.*
3. Economic indicators: *Increase in per capita income, utilisation of credit, increase in savings, access to subsidies, improved housing pattern, possession of consumer durables, income generation activities, increase in employment, reduction in migration, etc.*
4. Institutional indicators: *Functioning and portfolio management of village watershed committee, decision making, initiative in planning and implementation, record keeping and reporting, regular meetings with minutes maintained, number of cooperatives established, savings group organised, etc.*
5. Gender and equity indicators: *Access to common property resources, streamlining of government developmental projects for landless and marginal farmers, savings and credit groups for women and landless, income generation activities, increased participation and decision making, time saved due to reduced drudgery, etc.*
6. Community indicators: *Contribution of regular shramadan, participation in Gram Sabha, adherence to social fencing, awareness about the programme, linkages with credit, government development agencies, etc.*
7. Sustainability indicators: *Judicious resource utilisation, maintenance strategy, creation and enforcement of use practices (rules and regulations), etc.*

In Participatory Impact Monitoring (PIM), the community measures the positive and negative effects of an intervention. In watershed management, groundwater recharge and increase in area under irrigated cultivation can be a positive impact, while the ban on free grazing, which may affect shepherds and other traditional users of common property resources, can be a

[14] Impact indicators are sometimes double-edged. For example, additional area brought under cultivation is positive from a production perspective, especially for poor marginal farmers, but not desirable from the ecosystem sustainability angle as different land uses are required in an ecological scape. It can also impact equity, as the landless also depend upon such resources.

negative impact. Impacts are understood by using measurable indicators—both qualitative (turbidity of water, duration of runoff to reach the exit, green cover, confidence of the community, etc.) and quantitative (such as increase in area irrigated, increase in area under seasonal crops, water level in well, duration of water availability, etc.) through observations and discussions. Good indicators measure the relevance, effectiveness, efficiency, outcome, impact and sustainability of an intervention.

3.7 Farm Precise App: Crop Advisory – The Digital Tool

With climate change and increasing weather uncertainty, agriculture and farming has become a high-risk gamble. Rising costs of agricultural inputs, low and declining productivity, market volatility, low returns and erratic weather patterns are making farming an unviable source of livelihood and income, especially for smallholder farmers, who constitute at least 85 per cent of the farming community in India. Further, extensive use of high-cost chemical inputs and excessive use of water is degrading the environment, while polluting and depleting the groundwater table. This ultimately affects nature, health, agricultural viability and overall societal well-being.

The Farm Precise app was developed by WOTR to address these challenges and to provide farmers with a weather-based, dynamic decision support system which they can customise to their specific crops and farm resources across key agricultural operations. It is strategized as a risk mitigation measure in the face of climatic stressors.

The Farm Precise app is an android based mobile application[15]. Farm Precise was rolled out in Dec 2019 in five languages (English, Marathi, Hindi, Telugu and Odiya) and in four states in India (Maharashtra, Telangana, Madhya Pradesh and Odisha). Till date, 56627 farmers have downloaded the app, which currently provides advisories for 26 crops, besides weather advisory and various other features.

Of the total of above 56000 downloads, only 3621 (6.4 per cent) are women farmers. There are 43136 male farmers and for around 9700 downloads, it is difficult to specify the gender as this aspect was not set initially in the app. The app is used in four states namely Maharashtra, Madhya Pradesh, Telangana and Odisha. With 38767 downloads, Maharashtra has the highest downloads followed by Madhya Pradesh (7855).

[15] https://play.google.com/store/apps/details?id=wotr.farmprecise&hl=en&gl=US.

3.7.1 Farm Precise Features

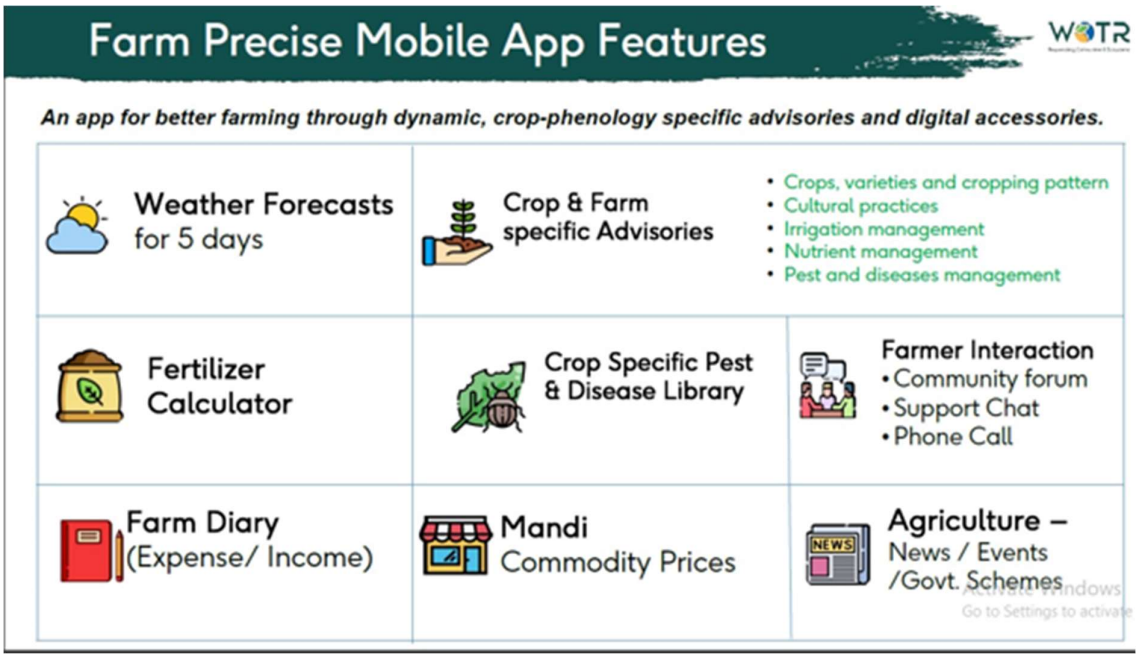


Figure 3.10: Farm Precise App Features

Source: Farm Precise Concept Note, WOTR, 2019

A brief description of the features currently provided by the app is listed below:

1. **Weather Forecasts** – It provides weather forecasts for five days, from two data sources, namely, IMD and Open Weather. It enables farmers to make informed decisions. Recommendations to apply/spray fertilisers or pesticides are driven by three-hourly weather forecasts, thus reducing weather-health risks (with respect to pesticide use). The forecast includes information about Min–Max temperature (° C), humidity (%), wind speed (Km/h), Rainfall (mm) and cloudiness.

2. **Crop Advisory** – The crops covered under the advisory include onion, wheat, maize, sorghum (kharif), sorghum (rabi), paddy, pearl millet, finger millet, cabbage, cauliflower, cotton, marigold, chrysanthemum, pomegranate, tomato, brinjal, soyabean, groundnut, pigeon pea, chick pea, green gram, black gram, chilli, ginger, turmeric and sugarcane. A farmer can input information pertaining to season of sowing, area and type of irrigation available (drip, flood, sprinkler). Based on this information, crop advisory related to weather forecast, watering, spraying (how, when and what needs to be sprayed) is sent/provided to the farmer as a notification.

3. **Fertiliser Calculator** – In the fertiliser calculator, the farmer needs to select the crop for which the advisory is required and also enter how much area the crop occupies. There is a set of recommended doses of N-P-K for every crop, given in kg/hectare. If a farmer has done soil testing, he/she can enter the test results for N-P-K, target yield (quintal/hectare) and Farm Yard Manure (FYM) (tone/hectare) applied to get the fertiliser advice. If soil testing is not done by a farmer, then the fertiliser is calculated based on the crop specific recommended dose. The farmer is provided with 13–14 options of fertiliser combinations that can be used, as all recommended doses and combinations may not be available at the village level. The emphasis is given to the use of organic fertilisers that can be made on-site with available materials. The procedures and quantities of material is given for reference. Even video links on how to make organic fertilisers and pesticides are provided, wherever possible.

4. **Pest and Disease Library** – In this section, a crop specific photo library is provided whereby a farmer can select the pest or disease spotted in his/her farm. Upon selection of a pest or disease, the crop specific symptoms, preventive measures and control measures are provided to the farmer.

5**. Community Forum** – In the community forum, a farmer can directly put up his/her query to get a specific advisory. If a person has difficulty in identifying a disease or a pest, one can send a photo directly in the open forum and get the advisory.

6. **Farm Diary** – Through this feature, the farmer can maintain a record of agriculture related expenditure and income. The expenditure incurred in land preparation, seeding/sowing, intercultural operations, pest and disease management, nutrient management, harvesting/threshing, other expenses and total income generated is recorded here.

7**. Mandi** – This feature gives location specific latest market prices for farm produce in the nearby markets. This helps farmers fetch best prices for their produce.

8**. News** – This section helps farmers to keep abreast of all the latest developments taking place in the agriculture sector including government schemes, events, and it also provides daily news updates.

Farm Mapping has been added recently. Through this feature, a farmer can mark his crop specific farm location by dropping a pin on google maps.

Additional features such as image recognition for pests and diseases and integration of remote sensing data for decision making are underway. AI based applications are also in progress.

Some of the key features of the app are as follows:

- Farm Precise app, being a digital tool and independent of any project framework such as watershed development projects, can be downloaded by any farmer in any part of the country for crop advisory benefits. It is easily available on the Google Android Play store.
- It is a participatory two-way digital tool wherein farmers can raise queries, report and document, while experts provide advisories based on specific queries of individual farmers.
- Currently, the data collected through the app can be utilised to track crops grown seasonally, rainfed or irrigated, type of irrigation used, area under each crop, crop specific disease and pests, seasonal cropping patterns, weather conditions and economics of farming.
- If a farmer has done soil testing, the NPK values for his farm can be tracked.
- Location-specific information added by farmers can be fetched from the data repository for further analysis. This can help in monitoring the restoration activities remotely.

3.7.2 Field Observations of Farm Precise App

The Farm Precise app has reached around 56,000 downloads since its launch in 2019. Though the numbers look good considering the entire Covid-19 scenario over the last two years, the reach and use of the app is still limited. On an average, in a village with a total population of ~1500 and total number of households being ~350, the number of Farm Precise users is around 80–90. The major reasons, as seen on the field, are the need for facilitators to promote and explain the features in the app in spite of the availability of the app in the regional language. One of the reasons for this is that people are hesitant towards using digital tools and exploring features on their own, as it is a new technology for them. Another reason is the use of another similar app, Agrostar. In some villages, people are more familiar with using the Agrostar.

Amongst users of the Farm Precise app, the most used feature is **mandi** (Market Prices). The farmers use the feature to sell their produce at the best prices and at the best times to earn maximum benefits. Farmers can compare the latest prices in nearby markets and decide where and when to sell their farm produce. Another use of mandi is to check which crop is in demand in the region and which crop fetches more income so as to plan the next crop accordingly.

Presently, the market related information (for example prices) provided is a couple of days old. The users said they would benefit further if they can get the information for the same day when they want to sell the produce.

The second most used feature by farmers is the **community forum**, where the farmer clicks pictures of the pest or disease on his crop and asks for relevant solutions advisory. Women farmers were also found using this app, as the women are present on the farms most of the time and they are the ones to notice such issues. Earlier, the women used to share the issue with their husbands so as to get solutions from the market, but as they are getting used to the 'community forum', they click pictures themselves and post them on the community forum for advisory. Women are also involved in preparing organic fertilisers and pesticides as suggested by the advisory.

The **weather forecast** is helping farmers plan various crop related activities—from sowing to harvesting. It is also used to decide spraying days/times for pesticides. If the forecast mentions cloudy weather or rainfall, farmers can decide and plan the watering and harvesting accordingly.

The **fertiliser calculator** is an important feature which helps farmers decide on the optimum quantity of fertilisers per acre for each of the 26 crops covered under the advisory. This helps in reducing the excess load of fertilisers on the soil and also helps avoid additional expenditure on fertilisers and pesticides. Also, the advisory gives 12 to 13 options to choose from a range of fertiliser combinations, as suited for the region, the season and the crop selected. The farmer can select an option that is available to him and that is best suited to his farm. Most of the fertilisers and pesticides suggested through the advisory are organic and are made from readily available materials in the villages.

There is a feature that enables them to add soil testing results for N, P, K in the fertiliser calculator if soil testing is done by the farmer, but it is rarely used as soil testing at individual farms by farmers is not yet a common practice. Even though soil testing is a popular programme of the government, it has not been widely undertaken due to lack of testing facility nearby. In rare cases, farmers do it themselves as it involves a cost and most often, the labs are available in far-off places. Mobile testing kits are, however, slowly becoming popular in some of the areas.

Benefits reported by farmers using the Farm Precise app:

- Seed sowing advisory instead of broadcasting has helped in input cost reduction.
- Weather advisory is highly appreciated as the app provides almost accurate weather predictions.
- Better marketing options for farm produce.
- Optimum use of fertilisers also helps in expenditure reduction.
- People do not have to depend on shopkeepers to decide about which, and how much, chemical fertilisers need to be used in their farms.
- Women feel empowered in decision making on their farms.
- Using the various functions of the app has contributed to the farmers' knowledge and capacity building.

Challenges in field utility of the Farm Precise app:

- Network issues and poor connectivity sometimes lead to less downloads and less use of the app and more time to register queries.

- Initially, farmers need facilitators to download, understand and utilise all the available features.

- Digital literacy is low. Even if the app is available in local languages, typing in local languages like Marathi is sometimes difficult for users.

- Older people are ignorant about the app and prefer experience-based farm practices. The younger generation tend to sometimes uninstall the app in favour of installing games due to limited storage. Users initially do need help to some extent.

- The availability and use of smartphones with women is comparatively low. Women without android phones are using the app on either their husbands' or children's phones. Women have to depend on their husbands or children to get access to smartphones as very often, the smartphones are with the latter. This is a hurdle in achieving wider use of the app by women.

- WOTR collects weather data, especially rainfall related data from the villages it works in. So, the pertinent question is whether it is possible to use such data in the weather forecast. This will greatly improve the quality and specificity of information as there is variability of rainfall locally. Wherever WOTR has collaborated with IMD in establishing weather monitoring stations and data links, updated and accurate local weather data is provided by the Farm Precise app. This was evident during the field visit wherein people were using

both the Farm Precise and the NiceSSM promoted by GIZ ProSoil project. Farmers in Bhangadewadi watershed (Ahmednagar district, Maharashtra) were of the opinion that Farm Precise provided accurate weather information compared to the generic weather advisory at the taluka scale provided by NiceSSM.

Chapter 4. Observations, Discussions and Way Forward

In this section, we analyse the merits of each tool, while looking into how participatory and farmer-driven these tools are, highlight the necessary conditions for the application of these tools, examine how the tool captures the key variables related to soil restoration and soil health and note the experiences from other such systems and tools that could add value to and strengthen these tools. We analyse each set based on its primary objectives as desired in its design and application.

4.1. Socio-economic and Ecological Assessment Tools

There are two assessment tools under this category: the Socio-economic Survey and Vulnerability Assessment Tool (known as CoDriVE-PD). Both the tools are digitised tools: while the socio-economic survey is conducted using Open Data Kit (ODK) tool, for CoDriVE-PD, WOTR has developed a software by the same name. However, in both cases, the researchers, community facilitators and farming households collect the data while community members provide the necessary information through household survey method and focussed group discussions.

Details about various indicators and data points are given in the earlier section. The outputs are village/watershed-based baseline report in the case of socio-economic survey and a vulnerability rating and vulnerability assessment report of village and households in the case of CoDriVE-PD. Both of these are used (along with other biophysical ecosystem data tools) for project planning such as watershed development plan and adaptation projects. Socio-economic data also provide data inputs for CoDriVE-PD. These tools also provide baseline information that can be used for monitoring of restoration and adaptation measures. However, linking these data to future monitoring still needs streamlining.

Both are participatory tools, as the data is collected with the active involvement of the stakeholders such as farming and landless households and the village community. However, we cannot say that the tool is driven by the community as its design and functions are project-centred and driven by the organisation.

There are various natural resource and agricultural related indicators on which data is collected. Indicators related to soil health and soil composition are a few of these. The tools

could incorporate both the farmers' and the community's understanding of soil health parameters (and proxy variables) for plots and land units on colour and composition, water holding capacity, moisture content, etc. which are locally familiar to all the farmers. Scientific soil test results (being a major programme of the states) could also be brought into the information, besides the inclusion of agronomic practices of farmers that helps soil health and conservation.

Socio-economic survey tools have been widely used in conservation projects over time, while vulnerability assessment is of recent origin, mainly after the emergence of climate adaptation projects. While there is a commonality across projects and agencies regarding socio-economic indicators, there are also many problems related to the quality of information and its reliability as farmers tend to underestimate/overestimate the same depending on various factors; problems of data validation in the case of large-scale digital surveys are also an area of concern. Resources, well-trained manpower, etc. are also limitations in undertaking good quality surveys in developmental projects.

CoDriVE-PD analyses vulnerability for both the watershed/village unit and for individual households in the watershed. While secondary data, remote sensing data, and focussed group discussion provides information for watershed level analysis, household surveys are the basis for information for vulnerability grading at the household level. As resources are unevenly distributed, the households' impact of vulnerability, or its resilience capability, is also unequally distributed. At the same time, lack or access to certain types of capital such as ownership of land, water resources, etc. has a higher impact on household vulnerability and livelihood opportunities. The analysis and the strategy have to keep this in mind. While the tool adopts systems approach rather than taking each capital and related indicators in silos, the vulnerability grading is done independently for each capital.

CoDriVE-PD is a more complex tool as compared to the socio-economic survey, and well-trained researchers and facilitators are a prerequisite. Sociological, ethnographic and climate and agricultural experts are needed for undertaking a quality assessment and it requires sufficient budget and skilled analytical personnel. The facilitators' understanding of climate patterns and risks and community processes is essential as the community responses will vary, and important points, if missed, can cause a shift in final outcomes that might affect the final goals to be achieved in the long run.

CoDriVE-PD analyses the impacts of climate change on Agriculture, Livestock, Water Resources, Forest, Health and Gender. However, the impact of climate change on a very important resource such as soil/land does not seem to have been adequately addressed and it will be worth capturing this impact too.

Another issue that emerged is that villagers are very often not clear about the purpose of this exercise, as observed in the field. A large number of indicators and data points create saturation during community interaction. The historical time frame of information (30–40 years) is tagged as a concern in the peer group while there were also concerns raised about DFID five capital based sustainable livelihood framework[16] used in the tool.

4.2. Watershed-Based Conservation Planning Tool

Participatory Net Plan (PNP) which is applied as a planning tool in a large number of programmes and projects across the country has been in existence for more than two and half decades. This was a result of the need for developing an alternative method for watershed planning as opposed to the gross, expert-driven top-down planning mechanism that existed in watershed projects. Net plan facilitated participation of the farmer in the choice of conservation activities, thus building a clear stake for her in the project. It brought together farmers' knowledge and scientific approaches of conservation on one platform, creating a lasting impact in project implementation. It is thus a participative tool facilitated by technical and social experts.

PNP is also a digitised tool wherein information on the land use—present and proposed—is part of planning consultation with the farmer couple along with the type of conservation measures to achieve the proposed land use, and this information is fed into a digital survey format in the field. A Net Plan Software developed by WOTR analyses this data and generates a conservation plan for each farmer's land as well as for common lands in the village besides creating an aggregate plan at the watershed/village unit. The software also consists of an expert system which checks the feasibility of particular measures as well as supports the ongoing monitoring of the implementation. As work done data gets fed into the system, the

[16]As an example, for a Dalit household in the Indian context, their social capital/network is very limited and most often, they are landless and with very little access to natural capital including access to water, and have very few opportunities for accessing financial capital and institutions. Deprivation often gets accumulated over generations and those who have access to one type of capital, say land, tend to attract other types of capital such as social networks, political power, access to financial resources, as seen in rural situations. Poverty and deprivation often work in a vicious circle and the causes are interlinked rather than being isolated and independent factors.

software generates information on whether there are any deviations in implementation from what is being planned, and this is used by the project management as part of monitoring.

Even though the tool is applied once in the project cycle, it provides land capability and land use information on each plot, which works as a baseline and could be used for monitoring of land use change as a result of conservation. However, it is not a farmer-driven monitoring even though the farmer is aware about the conservation work and its results. Information on land and soil is limited to the basic parameters of land capability such as soil texture, soil depth, slope of land and erosion. Other parameters of soil health and agronomic practices could be incorporated in the baseline information. Some of the learnings from Participatory Resource Mapping (PRM),[17] a resource literacy and baseline information tool on watershed natural resources developed by SOPPECOM could help in bringing more information on land forms and soil parameters (Sinha and Varma, 1994; Paranjape et al., 1998).

PNP is an intensive planning tool in terms of resources, time and expert facilitation. Even the peer group felt that almost six months are required to undertake a net planning exercise in a micro watershed of around 750 ha, a usual village watershed unit. Hence, it has the chances of getting diluted, as agencies want to complete the planning activity very quickly, and in the process, participation becomes the casualty. It is also noticed that farmer participation is as good as the facilitation team's efforts, and often, many such tools lose their participative rigour over the years and get routinised. Even farmers often do not devote the required time for various reasons. Nevertheless, it is still a sound tool for conservation which also allows the farmer to be brought to the centre of planning. How to evolve a planning tool into a farmer-driven monitoring tool remains a challenge.

4.3. Monitoring Tools of Products, Process and Impacts

Three tools are analysed as part of this: Concurrent Monitoring of Products and Process (CMPP), Qualitative Assessment Matrix (QAM) and Participatory Impact Monitoring (PIM). All the three systems were developed as part of IGWDP in the 1990s, with modifications from time to time, based on the demands of projects and local conditions. All three are analogue (non-digital) participatory tools, wherein the community and the farmers are active

[17] Participatory Resource Mapping is a mapping exercise involving the farmer and community members to understand land, water, biomass and other biophysical features using a cadastral map and field survey. It captures land use, land form, location of plots in the watershed, soil characteristics, various water resources, forest resources, etc. as data in prescribed formats and on village cadastral map in consultation with land owners which can be used for planning, resource literacy, collective action and community mobilisation as seen in the Peoples Planning Campaign in Kerala.

participants in the monitoring process. The monitoring is undertaken by the project facilitating team involving the farmers and the community members.

Concurrent monitoring of products (outputs) is a prerequisite for any conservation project. It is undertaken in different ways depending on the nature and the scope of the project as well as its volume or spread. Increasingly, digital tools are used for monitoring outputs in large-scale projects. The World Bank supported Sujala Watershed Programme in Karnataka (Vijaykumar, 2014), Integrated Watershed Development Programme (now Watershed Component of Prime Minister's Krushi Sinchayi Yojana) of Government of India, Programme for Climate Resilient Agriculture (PoCRA) in Maharashtra and NABARD's collaboration with NRSC-Bhuvan for online monitoring of conservation projects are a few examples. However, the monitoring is driven by the project field staff and only the activities undertaken as part of the projects, especially the physical progress, is monitored. The role of the farmer in the process is very limited.

CMPP is undertaken as a hybrid process wherein information generated through expert system referred under PNP (which is the system output of comparison of plan and implementation) is used for field monitoring and interaction with community-based organisations, beneficiary farmers, etc. to understand the conservation work and other social and institutional processes in the project. A common action plan with clearly defined roles and responsibilities is derived after the monitoring process to improve the project. Unlike purely digital and MIS based monitoring of outputs as mentioned in the previous paragraph, this method provides opportunities for the farmers to learn and rectify and build stake in the projects. Farmers also get an opportunity to air their views and demands. However, it is not a farmer-driven/reported monitoring system, nor does it have space for reporting farmers' initiatives in conservation or innovative agricultural practices.

QAM as a process monitoring tool is project specific and, as admitted by WOTR staff, it is not applied in projects anymore. Another issue is that it is a community and CBO oriented tool and the responses are 'collective response' about the quality of a project. It is the very nature of the tool that it does not provide a scope of reporting on individual work or innovations in conservation measures, but it can be a useful monitoring tool at the community level to understand social processes (as watershed development is a problem of social organisation also), conservation and agricultural practices if the design of the project is in tune with such issues.

PIM is a very commonly used monitoring tool in most of the watershed projects, especially the projects facilitated by NGOs. There are many examples from the country where the community and the farmers are facilitated in self-monitoring of conservation work and its impact. There are also different processes adopted such as use of participatory mapping, transact walk of watershed, farmers narratives, etc. One such attempt (for the first time) is the tool developed and used by the Agha Khan Rural Support Programme (AKRSP) in Gujarat. While the process of AKRSP system is also more or less the same as that of PIM, it also captures the impact of conservation on soil erosion, soil moisture, productivity, land reclaimed for cultivation and so on (Shah, 1991). However, it is not clear whether it has been modified over the years.

PIM is a tool facilitated by the project facilitating agency and it is operational as long as such facilitation is in place. It is also a 'collective response' tool even though individual examples and success stories are incorporated in the monitoring process. Soil parameters are limited to soil erosion and soil moisture and it is mainly qualitative information based on silt deposition in the structures, gully formation, etc. Both QAM and PIM, by the very nature of their design and purpose, are not much amenable to digitised self-reporting structure. Though it is a participatory tool, the discussion, meetings, knowledge sharing happens mostly amongst the interested few and the committee members.

4.4. Farmer Advisory App: Farm Precise

By the very nature of its objective, design and content, Farm Precise is a tool which has a lot of potential to be customised as a farmer-driven self-reporting monitoring tool for conservation management and monitoring. However, it would require modifications in design, content and operationalisation.

Farm Precise app, being an advisory tool, is an open access platform for any user and is not linked to any specific project as in the case of other tools. It is a two-way communication app as farmers can also raise queries, provide inputs and information on various aspects. Users are found to be from WOTR intervention areas and from outside. Unlike other weather and crop advisory tools of public and private service providers, it has innovative features and also provides space for farmers to share their information such as farm diary. This is precisely why it can be a platform for farmers' self-reporting. As it is a risk mitigation intervention tool, farmer-driven self-reporting needs to be posited as a strategy for risk management.

At present, the app does not provide information on conservation activities or of monitoring of soil-related parameters even though it can link the NPK[18] value of the farm if soil testing is being done. It can also track various agronomic practices if the farmer fills the farm diary. However, the farm diary is not being utilised to its potential by farmers due to various reasons, such as the time taken to fill it up, as there are continuous farm activities in the crop season. During field visit, farmers also opined that filling the farm diary only creates additional stress as the returns are less than the investments.

Farm Precise has reached 56000 downloads and around 19000 active users in the last one and a half years. During the field visit, it was observed that around 80–90 households in a village of say 350–400 households use the app in WOTR catchment villages. There are many reasons observed for the low coverage. Facilitation is required for downloading and understanding all the features of the app. The older generation who are into agriculture are not very familiar with digital solutions, while the younger generation who are well-versed with mobile applications are not into agriculture. Even if the app is downloaded, youngsters sometimes remove the app and create space for downloading entertainment applications such as games, videos, etc. Women users are either without a phone, or have to depend on their husbands' or children's phones. Android smartphones are generally found with men and youngsters. Only a small percentage of the users are women, as per WOTR data.

Even though the language is vernacular (Marathi in the case of Maharashtra), most people are not comfortable typing in details such as farm inputs, cost, etc. As far as working with images is concerned, such as taking a photo of the pest and uploading it, it is not very easy for older people, even though interacting with images is found to be more popular than writing texts. Now, even women have learnt to do so on their own.

It is found that farmers use those features that are more beneficial to them. Thus, mandi (market) is very popular as it gives updated prices of various agricultural commodities from nearby markets. They can compare the prices and opt for markets accordingly. This is followed by weather advisories which helps them in planning various activities, mainly fertiliser and pesticides application, harvesting, marketing, etc. Community Forum and Fertiliser Calculator are also popular to some extent as they help the farmers in sharing and getting advisories on pests as well as manging the fertiliser application depending on the crop or the NPK value of

[18] At present, the app has a provision to enter the NPK value, but it can easily be modified to enter each of the 12 parameters provided by the soil test health cards.

the soil. Thus, it is important to note that the use of the tool is based on the benefits and while planning the monitoring, it is important to think about the incentives involved in self-reporting.

Another issue farmers felt is that the advisories on fertiliser and pesticides are not that easily available at the shop counter (mostly advisories are on organic home-made products) and farmers prefer those inputs that are easily available. Thus, another advisory such as Agrostar which provides the brand names of pesticides and fertilisers and can be accessed on non-android phones (as messages) is found to be commonly used in the areas the team visited.

Other issues such as lack of internet network for downloading the app and uploading information, issues of digital literacy and lack of access to phones among women are found to be limiting factors. Still, it is more like a supply-driven product as one needs facilitation for people to download it and help them to use it on a continuous basis. However, due to its specific features, it has a lot of potential not only as an advisory but also as a digital farmer reporting system.

4.4.1. .ProSoil's Project: GIZ

The GIZ supported project, Soil Protection and Rehabilitation for Food Security in India (ProSoil) is implemented in two states, Maharashtra and Madhya Pradesh. Three NGOs are involved in project implementation (two in Maharashtra, i.e., WOTR and BAIF, and one in Madhya Pradesh, i.e., FES) and the current phase of the project is nearing completion. The projects are implemented in already developed watersheds and as additional interventions aimed at improving soil health, judicious use of resources, promoting sustainable agriculture and providing farmers' platforms such as Farmer Producer Organisations (FPOs). During the field visits to ProSoil's projects, it was noticed that farmers are appreciative of the interventions and are familiar with the importance of soil organic matter and soil organic carbon. One of the interesting interventions was the linkage between urban waste (compost) and rural soil health improvement, which is highly appreciated by beneficiary farmers. FPOs procure urban compost manure from nearby municipalities and provide them to farmers at an almost no-profit basis. Farmers are also able to report about the soil organic matter from the soil texture and composition (proxy indicators such as the softness and reboundability of soil after stepping on it). However, there is no systematic monitoring of these aspects (especially soil organic carbon) in the project even though the baseline information on soil organic matter

is collected through soil testing and provision of soil health cards.[19] There was also a detailed discussion with project staff and farmers on issues of monitoring of soil organic carbon and the issues related to carbon credits. There is no discussion in the project about working on carbon credits yet, even though farmers were very curious to know how it would work in the real context and what would be the nature of data and monitoring required.

ProSoil's project has developed a digital advisory platform, 'Network for Information on Climate (Ex)-change (NICE) for Sustainable Soil Management (SSM)' known as NiceSSM. (https://play.google.com/store/apps/details?id=com.nicessm&gl=US).

The objective of this digital solution platform is to provide localised multimodal and quality agro-advisories to farmers besides integrating soil protection and management (soil health advisories) as well as an efficient monitoring tool for managers and policy makers, especially monitoring of extension services. One of the features of this app is the collaboration of various research and public institutions. However, it has also been noticed by users that the advisories are not timely as they are provided by experts from Krishi Vigyan Kendras (KVKs) and agricultural universities. During our visit, the app had not been functional for the previous few days and farmers reported that it faced technical issues that were not addressed immediately. Even though they felt that the advisories they receive are very scientific, its utility is gets diminished as it arrives very late and, by that time, the farmers are likely to have solved the problems themselves through other means. Farmers also felt that the weather advisory is very generic at the taluka/district level and that local variations are not captured. The app does not have any facility for farmer-led monitoring or reporting of soil health or soil conservation measures even though soil health related advisories can be generated. However, it is interesting to note that the village we visited had problem soils (high alkaline content) and farmers got the support of a retired professor of an agricultural university to assess the issue and provide remedial measures. Farmers felt that such on-field advice by witnessing the problem first hand and interacting with farmers is a better option. This is not only relevant for this digital advisory tool but is symptomatic of a general trend wherein farmers are convinced when one actually observes and suggests solutions for problems they face. As NABARD is a partner in the project, the KfW supported NABARD's soils project also uses this app.

[19] Sample soils are tested for a grid area of 2.5 ha in the case of irrigated land and 25 ha in the case of pure rainfed lands, and farmers are provided soil health cards which assess 12 parameters including soil organic matter and micro nutrients. A mobile testing kit was initially used for this purpose and later, the samples were tested in the Krushi Vigyan Kendra (KVK).

4.5. The Way Forward

Soil and water conservation and sustainable management of soils and agriculture is an important strategy to strengthen the resilience of the smallholder farmers as well as the ecosystem at large. Gradually, the importance of soil organic matter and soil organic carbon is gaining ground, not only from the perspective of productivity enhancement but also for its role as a carbon store. The latest watershed guidelines issued by the Government of India highlight this objective of watershed development projects. Digital solutions for project management including monitoring of interventions open up great opportunities but it often dilutes the gains of participatory processes which has become a major strength of conservation work in India. Thus, it is very important to merge technological innovations within the architecture of participatory processes, be it need identification, project planning, implementation and monitoring. In the name of efficiency and real-time monitoring, technology should not become a substitute for participation.

While online monitoring of most of the state-supported projects is proceeding in that direction, there are participatory monitoring systems which are also partially aided by technology. At the same time, we also have examples of digital innovations in advisory, which is designed as two-way communication, as in the case of Farm Precise and NiceSSM.

Farm Precise still has a long way to go in its endeavour to become a farmer-driven and farmer self-reporting tool, but it does have the potential. It needs design customisation, which is possible; but more than that, there are framework conditions for it to become truly functional in the field. This requires facilitation, technology literacy, access to technology, besides the farmer visualising the benefits from such an action, or in other words, perceiving incentives in undertaking self-monitoring and reporting. In a project mode, it may work; but as a voluntary self-reporting system, it is a challenge.

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Annexures

Annexure A: QAM Parameters and Rating System

Annexure A1: QAM – Parameters Assessed and Their Indicators

Sr. No.	Parameters	Indicators
1.	First Four Shramadan	- Good attendance (at least 70% attendance is expected). - Work done in a planned fashion. - Output of the Shramadan is equivalent to the expected output in the case of paid work. - At least 70% of the expected output is completed.
2.	Regular Shramadan & Records	- Extent of participation of eligible families. - Frequency of Shramadan. - Output equals 19% of total unskilled labour costs. - Records are maintained in the prescribed manner.
3.	Exposure Visit	- Large number of villagers participated (including women). - It was a planned visit. - Discussions took place before and after the tour. - The visit promoted better understanding of watershed development. - Effect of exposure visit.
4.	Participatory Net Planning	- The concept is understood by VWC/villagers - Farmer couple (husband and wife) participated. - Proper documentation is done and completed PNP forms in Marathi are with the VWC.
5.	VWC Meetings	- Frequency of meetings is satisfactory. - Attendance is satisfactory. Women's participation is satisfactory and there are at least 33% women in the VWC. - Issue-based discussions take place. - Follow up of decisions taken is reflected in activities and measures. - The VWC members understand their roles and responsibilities - Documentation/Records are maintained properly with the active participation of the VWC.

Sr. No.	Parameters	Indicators
6.	Portfolio Management	- Understanding and distribution of portfolios is done. - Rules and regulations are fixed by the VWC (e.g. fine recovery on violating the ban on free grazing, etc.). - Responsibilities are carried out by the concerned members. - Review of portfolio is undertaken regularly. - VWC understands its responsibilities and actively organises implementation of the work.
7.	Gram Sabha Meetings	- Frequency (at least once in 3 months) - Attendance is satisfactory (at least 70% of the adult villagers participate). - Gram Sabha reviews the completed activities and decisions are arrived at consensually. - Women participate actively.
8.	Gram Sabha Records	- They are maintained properly and regularly. - Follow-up action is seen through records. - Accountability of the VWC to Gram Sabha is observed (once in three months).
9.	Ban on free grazing	- It is strictly observed. - Increasing acceptance of the ban (the level of resistance has decreased). - The VWC has an effective mechanism to enforce discipline. - Recovery of fines from those who violate the ban. - Increased stall-feeding practices observed.
10.	Ban on Tree felling	- It is strictly observed. - VWC monitors it closely and has an effective mechanism to enforce discipline. - Alternative arrangements made by villagers (e.g. smokeless chulha, increased access to kerosene, etc.). - Fine recovery, if any, from those who violate the ban.
11.	Planning for work implementation	- The proposed work area is known to the VWC. - Planning for the next 15 days (or whatever the duration may be) is done and understood by the VWC. - PLS is involved in this process. - VWC can identify the proposed area on the map and Net Planning has been undertaken. - Discussed in VWC meeting regarding new areas of work.
12.	Execution &	- VWC members visit the work site regularly and motivate the

Sr. No.	Parameters	Indicators
	Quality of Work	labourers. - The VWC reviews the quality of the work done periodically and takes remedial steps when necessary. - Adequate number of labourers is available. - Disputes, if any, are settled by the VWC. - VWC is involved in taking measurements and making payment to the labourers. - Work is implemented according to the Net Plan. - Overall impression of the work quality. - Trainings inputs are reflected in the quality of the work. - PLS performs his responsibilities satisfactorily.
13.	Record Maintenanc e	- VWC is active in the maintenance of the different records with the help of the PLS/NGO staff. - All records related to work implementation and monitoring are updated regularly. - Records of work planned, work done, monies received, expenditure incurred, together with map, are displayed in a public place and updated regularly (fortnightly/monthly). - VWC can explain the entries and their relationship with work done (at least primary knowledge). - Proceedings books of the different institutions are maintained regularly.
14.	Trainings for VWC/PLS	- All the relevant training programmes are conducted and their content understood. - Impact on the work and functioning of VWC is observed. - Follow up of trainings is taken by NGO/RRC during meetings. - PLS has undergone relevant trainings and is well-equipped to perform his/her duties.
15.	Women's Involvement	- Savings groups are formed and registers are being maintained by the group leaders. - Regular SHG meetings are held. - SHG are involved in watershed activities and other income-generating activities. - Nursery or part of it is done by women's groups. - Women members of the VWC actively participate in the discussions. - Drudgery reduction and quality of life enhancing activities are

Sr. No.	Parameters	Indicators
		implemented by the SHGs, e.g. kitchen gardens, improved cooking devices, soak pits, etc. - SMS is formed and it takes an active role in women's development activities. - Increased awareness among the SHG members about social issues pertaining to women and active steps are being taken for overcoming negativities.
16.	Linkages with Government Departments	- NGO/VWC makes efforts to link up with the local government networks. - Government department officials visit the watershed. - Planning and implementation of government department work is done in consultation with VWC. - Villagers avail of the existing government schemes. - Synergistic relationship between Gram Panchayat and VWC.
17.	Community Organiser	- Supportive to the VWC and capable of mobilising the community. - Attended all the relevant training programmes. - Supervises the records maintenance with respect to Gram Sabha, VWC meetings, Shramadan, etc. - Capable of conducting Gram Sabhas, VWC meetings, etc. - Works in close collaboration with other NGO staff.
18.	Technical Officer	- Has relevant knowledge about the technical issues of watershed development and has the necessary skills. - Has attended the prescribed training programmes. - Has the ability to implement the work according to the plan. - Supervises the implementation of the work and physically checks the quantity and quality of the work. - Supervises the maintenance of records. - Liaises with the VWC and farmers in order to build trust.
19.	Mahila Samaj Sevika	- Is socially oriented and has an understanding of gender issues. - Has undergone the relevant trainings. - Capabilities are reflected in activities with regard to women's promotion (e.g. women's SHGs plan, implementation and maintenance of records). - Motivates and facilitates women's active participation in Gram Sabha and VWC meetings.

Sr. No.	Parameters	Indicators
		- Is capable of undertaking need analysis and implementation of women's development activities.
20.	Awareness /Interest among Villagers Regarding the Project	- The majority of the villagers have a fair idea about the work being implemented in their village. - Are aware of their responsibilities with respect to the watershed project. - Are in a position to explain the project and its benefits to visitors. - Can motivate and guide villagers from other villages. - Contribute regular Shramadan and follow the other social responsibilities related to watershed development. - Actively participate in the Gram Sabhas. - Consensually resolve any conflicts which affect the project.

Annexure A2: QAM Rating System

Assessment	Indicators	Score
Very Poor	Severe Problems – Needs attention and improvement is difficult.	**01**
Poor	Problems which can be addressed – There is scope for improvement.	**02**
Satisfactory	Basic success conditions exist – Likely to shape up well.	**03**
Good	Quality of social mobilisation + work is as expected – In terms of performance and effects are achieved.	**04**
Excellent	Very good and an example worth sharing with other NGOs and projects.	**05**

Annexure B: Field Visit

Annexure B1: Places Visited for Field Study

District	Taluka	Cluster	Village	Activity Done
Aurangabad	Gangapur	Gangapur	Ambelohal	Farm Precise User Interaction
			Eklahara	i) Farm Precise Women Users Interaction ii) Farm Precise Discussion with Field Staff
Jalna	Jafrabad	Adha	Adha	Farm Precise User Interaction
			Sipora	Farm Precise User Interaction
		Khasgaon	Merkheda	Farm Precise User Interaction
			Borgaon Bk.	Farm Precise User Interaction
			Jafrabad	Farm Precise Discussion with Field Staff
	Bhokardan	Rajur	Rajur	CoDriVE-PD Discussion with WOTR Field Team
Aurangabad	Paithan	Deogaon	Gevrai Marda	i) PNP and PIM Farmer Interaction ii) PNP and PIM Discussion with Field Staff
Ahmednagar	Sangamner	-	Purushwadi	Adaptation Project – Discussion, Field Visit
	Parner		Bhangadewadi, Dhavalpuri	ProSoil Project Discussion, Field Visit, FPO Visit, etc. Discussion on NiceSSM and Farm Precise

Annexure B2: Lists of Participants

Village Name	Ambelohal (Users List)		
S. No.	**FP User Name**	**Landholding(acres)**	**Education**
1.	Mrs. Jayshree Desai	5	10th
2.	Mr. Akash Sonawane	13	12th
3.	Mr. Kartik Bankar	2	12th
4.	Mr. Ashok Ugale	5	12th
5.	Mr. Krushna Desai	4	12th
6.	Mrs. Chandrakala Desai	1	11th
7.	Mrs. Komal Ugale	4	Graduate
8.	Mrs. Parigabai Desai	4	-
9.	Mrs. Sunita Ugale	2	Graduate
10.	Mrs. Hirabai Dudhar	3.5	9th
11.	Mr. Avi Bankar	15	Graduate
12.	Mr. Tukaram Desai	9.5	M.Com
13.	Mr. Sandip Pradhan	11	10th
14.	Mr. Ramdas Pradhan	8	12th
15.	Mr. Arun Karbhari Pradhan	10	Graduation

Village	Eklahara (Users List)		
S. No.	**FP User Name**	**Landholding (acre)**	**Education**
1.	Mrs. Kalpana Uddhav Ausarmal	4	10th
2.	Mrs. Ashabai Dadasaheb Ausarmal	4	6th
3.	Mrs. Nirmala Vasant Ausarmal	4	7th
4.	Mrs. Tarabai Laxman Gaikwad	4	7th
5.	Mrs. Rani Sopan Bhagwat	4	12th
6.	Mrs. Dhondabai Laxman Ausarmal	3	7th
7.	Mrs. Vijaya Dadasaheb Gangurde	0.8 acre (32 gunthe)	10th
8.	Mrs. Asha Baban Sopane	-	7th
9.	Mrs. Swati Vijay Gangurde	2.5	10th
10.	Mrs. Kanta Minnath Ausarmal	3	10th
11.	Mrs. Kaveri Ankush Gangurde	14	10th

Village	Sipora (Users List)		
S. No.	FP User Name	Landholding (acre)	Education
1.	Mr. Vikas Nana Ambhore	2	B.A. D.Ed.
2.	Mr. Kailas Prakash Shewale	4	MBA (Marketing)
3.	Mr. Anantrao Saluba Ambhore	5	B.A.
4.	Mr. Ganesh Shamrav Ambhore	4	B.A.
5.	Mr. Dattu Aatmaram Navle	3	B.A.
6.	Mr. Ankush Devidas Tarmale	4	10th
7.	Mr. Anil Bhagwan Ambhore	3	12th
8.	Mr. Shivaji Fakirba Navle	4	12th
9.	Mr. Shankar Prakash Navle	3	12th
10.	Mr. Vijay Gajanan Navle	2	B.A.
11.	Mr. Bhikaji Tukaram Ambhore	3	10th
12.	Mr. Vaibhav Sanjay Mokale	1	PhD
13.	Mr. Anil Madhukar Ambhore	2	B.Sc.
14.	Mr. Ashok Santoshrav Navle	2	10th

Village	Adha (Users List)		
S. No.	FP User Name	Landholding (acre)	Education
1.	Mr. Vinayak Sampat Kannar	5	9th
2.	Mr. Haribhau Tukaram Kale	31	9th
3.	Mr. Ganesh Pandit Zhende	30	B.A.
4.	Mr. Pandurang Vasanta Gajre	2	10th
5.	Mr. Manikrao Baburao Kannar	2.5	12th
6.	Mr. Shrikant Shamikram Kannar	6.24	12th
7.	Mr. Akash Eknathrao Narwade	5	B.A.
8.	Mr. Raju Gujeba Mahale	4	10
9.	Mr. Sandu Shivaji Sarode	3	7th
10.	Mr. Dhananjay Tukaram Kale	4	10th
11.	Mr. Baban Bhagwan Mhaske	1	12th
12.	Mr. Ramu Kadam	3	8th
13.	Mr. Sharad Anandrao Mahale	4	12th
14.	Mr. Bhanudas Sayaji Kannar	4.5	8th
15.	Mr. Gajanan Dnyaneshwar Kale	3	10th
16.	Mr. Satish Dinakar Gaikwad	2	10th
17.	Mrs. Kalpana Nitin Mahale	0.8	12th
18.	Mrs. Seema Eknath Khandade	8	12th

Field Staff List: Village: Eklahara		
S. No.	**Name of the Staff Member**	**Designation**
1.	Mrs. Ujwala Kavthekar	Social Officer
2.	Mr. Gopal Thakur	Field Officer
3.	Mrs. Sunita Pardeshi	CLP
4.	Mrs. Sheila Kolhe	CLP
5.	Mrs. Savita Gaikwad	CLP
6.	Mrs. Neeta Jadhav	CLP

Field Staff List: Village: Jafrabad		
S. No.	**Name of the Staff Member**	**Designation**
1.	Mr. Anil Wandhekar	Taluka Coordinator
2.	Mr. Ravindra Sahni	Agronomist
3.	Mr. Sandeep Pandit	Social Officer
4.	Mr. Kishor Sonawne	Agriculturist
5.	Mr. Gajanan	Social Development Officer
6.	Mr. Rupesh Nagnathwar	Technical Officer

Annexure C: List of Attendees at the Peer Group Consultation

S. No.	Name	Organisation	Email
1	Amita Shah	GIDR, Ahmedabad	amitagidr@gmail.com
2	Siva Muthuprakash	Vikas Anvesh Foundation, Pune	sivam@vikasanvesh.in
3	Vijay Shankar	SPS, Dewas, MP	viju28@gmail.com
4	Yugandhar Mandavkar	GRASP, Pune	yugandharm@rediffmail.com
5	Crispino Lobo	WOTR, Pune	cslobo1@gmail.com
6	Ajay Shelke	WOTR, Pune	ajay.shelke@wotr.org.in
8	Sneha Shinde	BAIF, Pune	snehashinde@baif.org.in
9	Siddharth Patil	ACWADAM, Pune	acwadam@gmail.com
10	Abhijeet Kavthekar	WOTR, Pune	abhijeet.kavthekar@wotr.org.in
11	Anuradha Phadtare	WOTR, Pune	anuradha.phadtare@wotr.org.in
12	K.J. Joy	SOPPECOM, Pune	joykjjoy2@gmail.com
13	Abraham Samuel	SOPPECOM, Pune	samabe64@gmail.com
14	Kiran Lohakare	SOPPECOM, Pune	kiran.lohakare@gmail.com
15	Trupti Satpute	SOPPECOM, Pune	satpute.trupti2107@gmail.com
16	Nakul Heble	SOPPECOM, Pune	heble.nakul@gmail.com
17	Neha Bhadbhade	SOPPECOM, Pune	neha2282@gmail.com
18	Pratima Medhekar	SOPPECOM, Pune	pratimamedhekar@gmail.com
19	Tanaji Nikam	SOPPECOM, Pune	t90nikam@gmail.com