WORKING PAPER

TRACKING ADAPTATION SUCCESS FOR COMMUNITY LEVEL WATERSHED DEVELOPMENT IN INDIA

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EXECUTIVE SUMMARY

Watershed development has been promoted as a restoration strategy for rainfed areas in India since the 1970s for the objectives of reducing poverty and improving agricultural production. Watershed development (WSD) implementing and funding agencies are now realizing the importance of integrating climate change adaptation interventions and approaches into WSD to address rising climate concerns, including more frequent droughts, changes in the monsoon season, and temperature and rainfall fluctuations that can increase vulnerability of populations already susceptible to the negative impacts of climate change.

While WSD in India continues to receive large-scale funding from government and international organizations, it is not clear the extent to which WSD has been successful; nor is it clear whether implementing agencies are tracking climate change adaptation success, especially over sufficient time frames, to understand long-term changes in ecosystem health, community behavior, and institutional processes. Developing this understanding is critical for equipping implementing agencies, government actors, and funders with information they need to direct investments, plan watershed development strategies, and implement interventions to address climate change in rainfed regions.

This working paper presents a joint effort by the World Resources Institute and the Watershed Organisation Trust (WOTR), a WSD implementing and research organization based in Pune, India, to develop an adaptation monitoring

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Working Papers contain preliminary research, analysis, findings, and recommendations. They are circulated to stimulate timely discussion and critical feedback and to influence ongoing debate on emerging issues. Most working papers are eventually published in another form and their content may be revised.

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and evaluation (M&E) or tracking system to track success of WSD projects in terms of achieving climate change adaptation objectives. The goals of this paper are twofold: (1) to design an adaptation tracking system (ATS) for WOTR and share recommendations and lessons learned from this experience with the wider WSD community; and (2) to provide context on adaptation M&E or tracking and its challenges. This paper begins by identifying key challenges for developing adaptation M&E systems based largely on community-based adaptation literature. Next, the paper presents recommendations for developing an ATS (steps shown in Figure ES-1 and on page 9 below) specific to WOTR but with relevance for the wider WSD community. The recommendations are informed by the literature review and meant to address the key challenges.

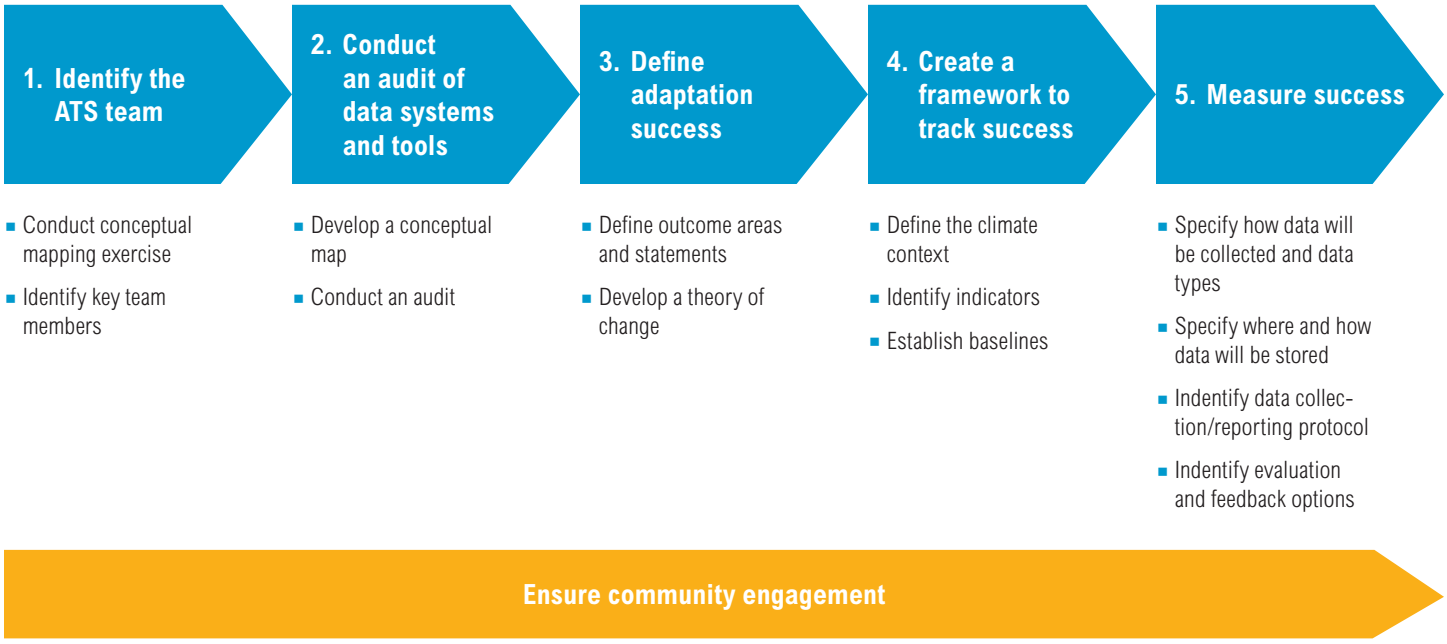
In addition to recommendations for WOTR for designing the ATS, the appendix of this paper provides more detailed results from the ATS design process, including results from conceptual mapping exercises, development of a theory of change, outcome statements, and indicators, and an audit of WOTR's data systems and tools.

Overall, three general conclusions applicable to the wider WSD community were reached based on this research exercise:

- **Adaptation tracking with respect to WSD in India needs to be fundamentally rethought** to better enable the tracking of short- to long-term adaptation success to key vulnerability drivers. It will be important to move away from quantitative or output-focused M&E and impact reporting models to better enable long-term tracking of both quantitative and qualitative indicators covering ecosystem conditions, capacity-building efforts and social improvements, economic impacts, and changes in processes and behaviors by institutions and community members.

- **WSD implementing agencies and funders need to cooperate to adjust reporting requirements to promote consistent and long-term reporting that enables tracking of adaptation success.** WSD implementing agencies face resource constraints, both financial and technical, in developing and maintaining quantitative/qualitative M&E systems. Funders of WSD can help by (1) cooperating with implementing agencies to understand their needs and goals related to WSD and adaptation success; (2) adjusting their reporting requirements to promote consistent reporting on key indicators over regular intervals to track changes in biophysical and human conditions; and (3) adjusting their reporting requirements and funding mechanisms to promote

Figure ES-1 | **Steps for Designing an Adaptation Tracking System**



long-term reporting on ecosystem, social, and climate conditions, processes, and behavioral changes, and/or supporting greater training on adaptation tracking and understanding of long-term success.

- **Participation by community members throughout the adaptation tracking development and management process is critical for adaptation success.** Ultimately, WSD success is defined by the target communities of WSD; and, as such, they should be involved in every step of the process. It is important that community input is representative of age, gender, occupation, and income levels. Additionally, community members can be better integrated into adaptation tracking by training them to support data collection and evaluation efforts. This can help to reduce the financial and time burdens on implementing agencies and to encourage understanding and adoption of results. Community participation in adaptation tracking processes should be coupled with data quality check efforts to reduce possible biases in developing, for example, indicators and definitions of adaptation success. Finally, the level and structure of community involvement should be tailored by the implementing agency to address cultural sensitivity issues (e.g., women might feel more comfortable having a female-only focus group as they might feel less restricted in giving input than if they were with men in the community).

INTRODUCTION

This working paper represents a joint effort by the World Resources Institute (WRI) and the Watershed Organisation Trust (WOTR), a watershed development (WSD) implementing and research organization in India, to design an adaptation monitoring and evaluation (M&E) or tracking system that will enable WOTR to track the extent to which WOTR is addressing adaptation to climate change. Ultimately, the objective of this partnership is to support climate-resilient development programming for WSD over the long-term for implementing agencies of WSD (over 20 years). The goals of the current project and this paper, however, are to (1) design an adaptation tracking system (ATS) for WOTR and share recommendations and lessons learned from this experience with the wider WSD community; and (2) provide context on adaptation M&E or tracking and its challenges. The literature to date on adaptation tracking for projects like WSD is strong in providing frameworks and tools to track adaptation success but is weaker in terms of describing how frameworks and tools are applied. This paper addresses this need.

To meet our goals, WRI and WOTR first conducted a literature review of adaptation tracking frameworks and guidance documents to determine a logical and systematic approach for designing an ATS for WOTR. The literature review largely focused on community-based adaptation tracking as WOTR employs a participatory approach to implementing WSD projects. In particular, two recent adaptation tracking documents, in addition to WOTR's own tools, were used to create WOTR's ATS: CARE International's Participatory Monitoring, Evaluation, Reflection, and Learning for Community-based Adaptation (PMERL) manual (Ayers, Anderson, Pradhan, and Rossing 2012); and the International Institute of Environment and Development's Tracking Adaptation and Measuring Development (TAMD) framework (Brooks and Fisher 2014). WRI and WOTR then held targeted focus groups with two representative watershed communities and numerous WOTR staff meetings to further refine and inform the ATS design.

Because this working paper represents an initial phase of work, it does not explore the operationalization of the ATS by WOTR, but rather, provides initial recommendations for designing the ATS for WOTR. The main body of this paper includes sections on adaptation tracking challenges, WOTR's history and climate change adaptation project, steps and recommendations for designing the ATS for WOTR, and concluding comments. The appendix of this paper presents specific findings and products for (and by) WOTR.

What is watershed development?

Watershed Development is a participatory, community-based approach for restoring ecosystems and building capacity of rural watershed communities in rainfed areas of India, primarily to meet national objectives of reducing poverty and improving national food security through enhanced agricultural production (Government of India 2011). Rainfed regions represent 65 percent of arable land in India and support 40 percent of India's food needs (Ahmad, Alam, and Haseen 2011; Government of India Planning Commission 2012). These regions are also home to the majority of India's rural poor and are characterized as having low productivity due to both geographical and climate conditions and a history of unsustainable land management practices. Owing to their location and biophysical characteristics, these regions are also

highly vulnerable to climate variability. The approach used to achieve these objectives can be characterized as a participatory, community-based approach rooted in ecosystem restoration. WSD traditionally uses a combination of technical, environmental restoration, and social or capacity-building interventions to harvest and trap rainfall and improve soil conditions.

WSD implementing and funding agencies are now realizing the importance of integrating climate change adaptation interventions and approaches into WSD to address rising climate concerns, including more frequent droughts, changes in the monsoon season, and temperature and rainfall fluctuations that can increase vulnerability of populations already susceptible to the negative impacts of climate change.

Why is adaptation tracking needed?

While WSD in India continues to receive large-scale funding from government and international organizations, today it is not clear the extent to which any implementing agencies of WSD are tracking success. Additionally, it is not clear the extent to which implementing agencies that are applying climate change-specific interventions are tracking climate change adaptation success, especially over sufficient time frames to understand long-term changes in ecosystem health, community behavior, and institutional processes. Evaluations of WSD projects to date list data availability and collection as key impediments for understanding even short-term economic success (Gray and Srinidhi 2013). Developing an understanding of WSD and adaptation success is critical for equipping implementing agencies, government actors, and funders with information they need to direct investments, planning and guidance measures, and implementation of interventions to address climate change in rainfed regions of India.

Monitoring and evaluation (M&E) is an important and useful tool for participatory restoration projects like WSD in that it can help shape successful adaptation efforts (Spearman and McGray 2011), identify good versus bad interventions, avoid maladaptation,* and help implementing organizations prioritize funding and implementation of tasks as well as communication efforts. Monitoring refers to a process of iterative tracking and reviewing of project or program interventions, results, and the surrounding context. Evaluation involves the analysis of results to draw conclusion on their effectiveness (Lamhauge, Lanzi and Agrawala 2012). Effectively, M&E provides a feedback system so practitioners can assess and reevaluate their efforts over time (i.e., adaptive management) to adjust interventions as needed and ensure that projects are meeting their intended objectives (Lamhauge et al. 2012; Spearman and McGray 2011).

WOTR'S CLIMATE CHANGE ADAPTATION APPROACH

WOTR is a leading not-for-profit development agency that has been implementing WSD projects since the 1990s in rainfed regions of seven Indian states. Since its inception in 1993, WOTR has been working at the forefront of mobilizing vulnerable communities in rainfed, semi-arid and resource fragile regions to help create a pathway out of poverty by harvesting rainwater and regenerating the ecosystems they live in through WSD. WOTR has played a pivotal role in the evolution of WSD in India not just through implementation efforts, but also through the development of its capacity-building pedagogy and training for implementing agencies and through policy recommendations for government. WOTR has consistently engaged with rural communities and key policy-making bodies and individuals to develop its various tools and data analysis methodologies. Over the last 20 years, WOTR's various data systems, tools, and methodologies have offered systems for M&E (see appendix for more detailed information). WOTR has a systematic M&E and reporting process, as well as a data storage system in place. However, efforts to date do not yet incorporate climate adaptation tracking into WOTR's M&E system since climate change adaptation has been recently included in WOTR's approach.

WOTR's WSD approach is rooted in the assumption that five livelihood capitals—physical, financial, social, human, and natural—have to grow and develop simultaneously and harmoniously to have sustainable growth. As a result, understanding changes to these five capitals is critical for M&E. WOTR has also found that categorizing resources into livelihood capitals makes it easier and quicker for the stakeholders, particularly the communities, to assess their livelihood resources.

*Maladaptation occurs when an intervention in one location or sector increases the vulnerability of another location or sector or increases the vulnerability of the target group to future climate change (Intergovernmental Panel on Climate Change 2014).

WOTR has historically applied a systems-based approach to WSD, focusing on people-centric participatory interventions including a variety of technical, environmental, and social interventions. With abnormal weather variations now being increasingly experienced in India, WOTR recently launched (from 2009 to 2015) a large-scale pilot project called "Climate Change Adaptation" (CCA) in the semi-arid rainfed regions of Maharashtra, Telangana, Andhra Pradesh, and Madhya Pradesh with the following objectives:

- Developing knowledge systems and strategies, measures, and processes that can be scaled up and widely adopted; and
- Building the adaptive capacities of vulnerable communities through ecosystem restoration, livelihood diversification, and adoption of agricultural and renewable energy technologies.

The project brought together a unique blend of partners including WOTR, the Swiss Agency for Development and Cooperation, the National Bank for Agriculture and Rural Development (NABARD), the Central Research Institute for Dryland Agriculture, the Mahatma Phule Krishi Vidaypeeth, the India Meteorological Department, the International Centre for Research on Agriculture and Forestry, and the Bharati Vidyapeeth Institute of Environment Education and Research.

The project adopted a multidisciplinary and participatory approach that combined traditional WSD interventions (e.g., technical, environmental, and social activities including rainwater harvesting, capacity building on sustainable agricultural and livestock techniques, livestock grazing bans, biodiversity registers, drip irrigation, afforestation, and farm ponds) with adaptation-specific interventions (e.g., technical and informational interventions including integrated water resource management, adaptive sustainable agriculture, locale- and crop-specific agricultural meteorology (agro-met) advisories, vulnerability assessments, disaster risk management, and renewable energy technology training and installation). The CCA project is now being implemented in 78 villages in the states of Maharashtra, Madhya Pradesh, Andhra Pradesh, and Telangana. WOTR now aims to integrate adaptation activities into *all* its projects. As such, the focus of the ATS is to capture WOTR's new WSD strategy which incorporates CCA interventions.

WOTR implements all its projects using a participatory, community-based approach. In addition, all its WSD and adaptation activities are rooted in restoring rainfed ecosystems. Therefore, WOTR's climate change adaptation project adopts aspects of both community-based and ecosystem-based adaptation approaches (see Box 1).

With this programming under way, WOTR notes the following as key motivations for developing an ATS:

- Have a more forward-looking and long-term approach to the implementation of WSD projects;
- Improve the adaptive capacity and resilience of rural communities to respond to climate change and reduce their vulnerability;
- Determine if CCA project achievements are meeting expectations;
- Improve the understanding of which interventions are working best and in what combination for each watershed project; and
- Ensure that adaptation activities do not result in maladaptation or unintended consequences to community members.

WOTR aims to develop a unique or stand-alone ATS that pulls from WOTR's current data systems and tools and M&E efforts.

CHALLENGES OF ADAPTATION TRACKING

This section presents challenges of developing an ATS as identified by a literature review of guidance and research documents on adaptation tracking frameworks. WRI and WOTR's literature review focused on both peer-reviewed and gray literature covering adaptation and rural development M&E documents. We note that the majority of M&E frameworks and guidance documents relating to adaptation were focused on community-based adaptation as opposed to ecosystem-based adaptation. As a result, there is a heavier emphasis in this paper on community-based adaptation. However, the challenges summarized below also apply to ecosystem-based adaptation. See Box 1 for a discussion of ecosystem-based adaptation and community-based adaptation.

Box 1 | **Community-based Adaptation and Ecosystem-based Adaptation**

Two adaptation approaches that have gained popularity over recent years for rural regions are Community-based adaptation (CbA) and Ecosystem-based adaptation (EbA). Definitions have varied over time for these approaches but the following are commonly accepted definitions:

Community-based adaptation has been defined as "a community-led process, based on communities' priorities, needs, knowledge, and capacities, which should empower people to plan for and cope with the impacts of climate change." The term was first used in 2006, and its roots are in human rights-based principles (Girot, Ehrhart, and Oglethorpe 2012). The PMERL manual provides more clarity by stating that "the goal of CbA is to build resilience of vulnerable individuals, households, communities and societies from the ground-up" and that CbA "addresses social drivers of vulnerability, including gender inequality and other factors related to social exclusion."

Ecosystem-based adaptation was defined by the Convention on Biological Diversity as "use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change." The term is also young, and its roots are in ecosystem conservation and restoration principles.

These approaches are not mutually exclusive, and many people have called for the integration of the two (Girot et al. 2012). A major reason for this is that many projects focused on rural regions aim to improve human welfare through the restoration and/or protection of ecosystem services. Populations in rural regions are often dependent on land production systems (e.g., agriculture, forestry, livestock) for their livelihoods, so empowering these vulnerable populations necessitates enhancing and protecting ecosystem services. WSD is a prime example of a program that combines both concepts and motivations in that WSD emphasizes using participatory community-led restoration and sustainable management of rainfed regions to promote sustainable livelihoods and poverty reduction. WOTR's main objective in terms of its CCA strategy is to build the adaptive capacity of vulnerable rural communities through ecosystem restoration, livelihoods diversification, and application of renewable energy technologies. WOTR's CCA and WSD interventions incorporate both humanitarian and ecosystem-based principles and as such, WOTR's CCA strategy employs both CbA and EbA aspects.

In terms of adaptation monitoring and evaluation guidance, however, the literature is much more robust for CbA than for EbA. Additionally, CbA M&E guidance documents, such as the PMERL manual and TAMD report, could easily be applied to an EbA context.

Defining adaptation

The term adaptation is still ambiguous as it is still an emerging area of research (Sanahuja 2011). The available literature provides a multitude of definitions and terminology elated to adaptation (e.g., adaptive capacity vs. resilience vs. vulnerability reduction) and there is confusion about how to deal with the differing terminology in a context-specific way.

Attribution

The attribution challenge is twofold: There is difficulty in decoupling adaptation interventions from conventional development or sectoral interventions (Sanahuja 2011; Lamhauge et al. 2012); and there is difficulty in decoupling climate change from other drivers of vulnerability (e.g., market shocks). As a result, it can be difficult to attribute success of a single intervention or a suite of interventions to overall project success or adaptation to climate change. The former challenge is described in depth by McGray, Hammill, Bradley, Schipper, and Parry (2007), who state confusion in defining development vs. adaptation has hindered project design and the allocation of funding for adaptation efforts. Overall, this report found that adaptation activities occur along a broad development to adaptation continuum that can be framed by four types of adaptation activities:

1. Efforts to address drivers of vulnerability (e.g., poverty, inequity, etc.);
2. Efforts to build response capacity for problem solving, that lay the foundation for more targeted activities;
3. Efforts to manage climate risk by incorporating climate information into decision-making; and
4. Efforts to confront climate change that focus exclusively on addressing climate change impacts.

McGray et al. (2007) state that different M&E tools may be needed for adaptation and development activities, depending on how closely the activities target climate-change impacts.

For the latter challenge, Dinshaw, Fisher, McGray, Rai, and Schaar (2014) describe evaluation methods such as the development of a counterfactual (e.g., what would have happened without the adaptation intervention) to decouple adaptation drivers and interventions.

Determining successful adaptation

Given the difficulty in defining adaptation, it can be equally challenging to define what successful adaptation looks like. Understanding adaptation success necessitates M&E over the long term (more than 20 years) (Ayers, Anderson, Pradhan, and Rossing 2012; Brooks and Fisher 2014; OECD 2012; Sanahuja 2011; Spearman and McGray 2011) to truly understand changes in land productivity, human behavior, climate, and processes. Conventional M&E systems, however, tend to focus on measuring more short- to medium-term activities and outputs resulting from project/program implementation, typically covering a project or program's implementation period (Lamhauge et al. 2012). Lamhauge et al. (2012) examined how bilateral development agencies evaluate their projects and programs that have adaptation components or aspects, recognizing that most funding for adaptation is channeled through these organizations. The report found that the majority of agencies use Results Based Management (RBM) and logical frameworks to design and manage their projects and programs. Lamhauge et al. (2012) found that many projects develop indicators for activities, outputs, and outcomes and that indicators become less focused for outcomes as these are more long-term and less tangible.

Overall, the literature suggests that adaptation success is defined by both discrete changes in conditions that can be measured by conventional quantitative development indicators, as well as changes in behavior and processes that can be tracked by both quantitative and qualitative indicators. Key processes to consider include (McGray et al. 2007)—

- Processes for learning as we go;
- Processes for checking and correcting for maladaptation as we learn;
- Processes for making trade-offs that reflect public values; and
- Processes for sharing information to support the trade-offs.

Spearman and McGray (2011) add to this discussion, stating, "The adaptiveness of an intervention depends not upon the activities undertaken, but rather, upon the relationship between the activities, the climate change context, and the vulnerability of the stakeholders targeted by the intervention. M&E for adaptation, therefore, hinges upon a process of understanding key aspects of the context, identifying changes needed to reduce vulnerability in that context, and measuring progress toward realizing the changes." The call for understanding behavioral, contextual, and procedural processes as key for understanding adaptation success is echoed throughout the literature (Lamhauge et al. 2012, Brooks and Fisher 2014, Ayers et al. 2012)

Misaligned M&E timelines and objectives

Many agencies implementing adaptation projects are confined by resource and staffing constraints and are only able to carry out M&E during the project implementation period (five years or less), and not the long term (over ten years). M&E objectives can also be donor driven, whereby donor information needs might not match the needs of the populations that WSD addresses (Ayers et al. 2012). Donor-required M&E may also result in duplication of efforts if NGOs or other implementing agencies have their own M&E processes in place and then have to respond to M&E demands of one or more donors. Additionally, data collection and evaluation efforts for WSD have lacked rigor and consistency by both WSD implementing and administrative agencies, due to both funding constraints and a lack of technical capacity (Gray and Srinidhi 2013). Because of this lack of data and resource capacity, few if any evaluation studies have been conducted that provide long-term evidence regarding the success of watershed development interventions and projects.

Shifting climate baseline

Guidance for adaptation M&E systems recommends developing baseline data on climate variability and hazards. The literature emphasizes that the type and frequency of climatic hazards changes with climate conditions. As a result, there is a "shifting climate baseline", meaning that M&E must take place against a moving

target and changing scenarios (Brooks and Fisher 2014; Villanueva 2011). Indicators should then be normalized or supported by data on climatic and other trends (e.g., vulnerability drivers) (Brooks and Fisher 2014).

DESIGNING THE ATS

This section presents recommendations for developing an ATS specific to WOTR but with relevance for the wider WSD community. The recommendations are informed by the literature review discussed earlier and meant to address the five challenges. However, the ATS is more heavily informed by two reports that WRI and WOTR identified, in addition to WOTR's own tools, as being especially relevant for WOTR's purposes. The first is "Participatory Monitoring, Evaluation, Reflection, and Learning for Community-Based Adaptation: A Manual for Local Practitioners" developed by CARE International and the International Institute for Environment and Development (IIED) (Ayers et al. 2012). The PMERL manual provides detailed guidance and tools to help actors like WOTR develop their own adaptation tracking system that incorporates reflection and learning. The manual provides a menu of tools and, as such, is not intended to be a strict framework, but rather a guiding document. Additionally, it is not meant to replace external M&E reporting to funders. The second is a report by the International Institute of Environment and Development titled, "Tracking Adaptation and Measuring Development" (TAMD) (Brooks and Fisher 2014). This report is designed to help NGOs evaluate their programs and to assess the effectiveness of adaptation and is not designed to focus on a specific adaptation approach. TAMD promotes "a 'twin track' framework that evaluates adaptation success as a combination of how widely and how well countries or institutions manage climate risks (Track 1) and how successful adaptation interventions are in reducing climate vulnerability and in keeping development on course (Track 2). The aim is to generate bespoke frameworks for individual countries tailored to specific contexts." (Brooks and Fisher 2014)

To begin, we identified four main steps included in developing and implementing an ATS. These steps include (1) design the ATS; (2) operationalize the ATS; (3) evaluate results; and (4) communicate results and integrate lessons learned into decision making and processes. Figure 1 shows how this is intended to be a cyclical process that encourages adaptive management, whereby lessons learned from evaluations of data collected are incorporated into the design of the ATS such that it can be changed to reflect new realities and a changing definitions of success, if applicable.

This paper covers step one, designing the ATS. Guidance from the literature, focusing on the PMERL manual and the TAMD reports, was tailored for WOTR, whereby WRI and WOTR established a systematic process for designing the ATS that included the following steps:

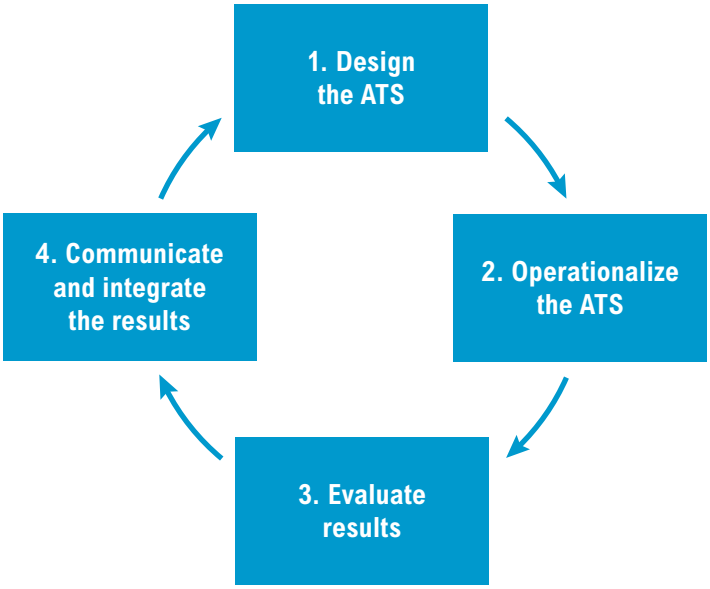
1. Identify the ATS team.

2. Conduct an audit of current M&E and other data systems and tools to ensure that the ATS leverages current data collection and M&E efforts and avoids duplication of work.

3. Define success, that is, decide what to monitor by defining what successful adaptation looks like. This is a critical step and should be adapted for each watershed or village based on community input. Defining success entails defining key outcome statements (i.e., statements of success) and defining a theory of change that serves as the "backbone" of the ATS.

4. Identify a framework to track success. This step entails deciding on a preliminary set of indicators and

Figure 1 | **Key Steps for Watershed Development Adaptation Tracking Systems**



baselines for outcome statements, as well as identifying how to establish the climate context.

5. Establish evaluation and feedback procedures for the ATS. This step entails identifying how the ATS can leverage current capabilities and expertise, and also establishing initial guidance for WOTR for how to track adaptation efforts (e.g., how this is to be tracked, how frequently, and how data will be reported, evaluated, and ultimately used.

Figure 2 provides a conceptual diagram of the key steps and sub-tasks for designing an ATS. Figure 2 highlights that designing the ATS should follow a participatory process (as WOTR already employs) that encourages community engagement throughout every step. We note that Figure 2 provides a general ATS for WOTR, but the ATS, specifically steps 3 and 4, would have to be adjusted for each individual watershed.

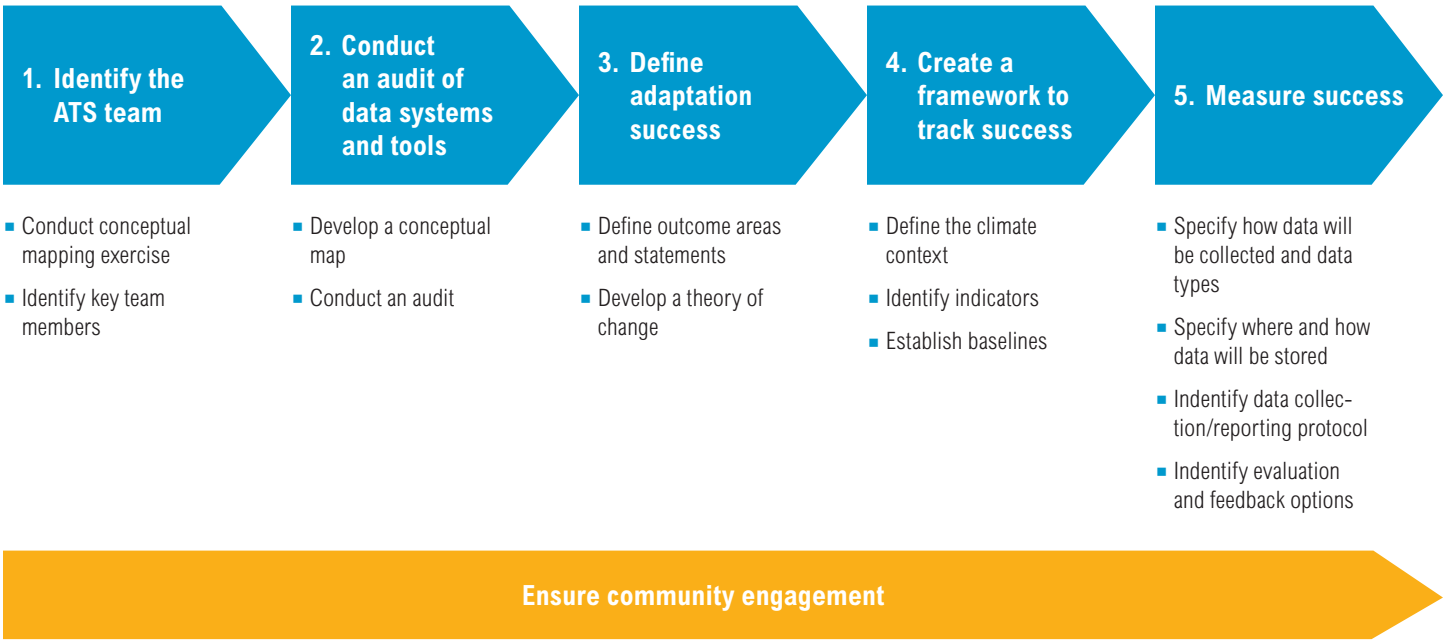
To ensure that community members were involved in the initial design of the ATS for WOTR, WRI and WOTR identified two pilot watershed communities to provide input into each step of the proposed methodology and to test the system in a later phase beyond the scope of this report.

Step 1: Identify the ATS team

The first step of designing the ATS for WOTR entailed identifying key team members. Recommendations from the PMERL manual are useful in this regard as it was one of the few guidance documents that discussed establishing an adaptation M&E team and mapping stakeholder information needs. The PMERL manual recommends selecting a facilitator, that is, one person responsible for initiating and overseeing the adaptation tracking process, to ensure meaningful participation of stakeholders in each stage of the M&E process. The facilitator should have "good experience facilitating participatory processes" and should be familiar with the local context for the watershed. PMERL also recommends selecting six to eight additional team members in consultation with local stakeholders to aid in data collection and analysis.

WOTR has multiple levels of operation, with field offices, regional offices, a main research headquarters, and a project management office. Before selecting ATS members, it became apparent that we needed to better understand WOTR's organizational and reporting structure and needed a visual representation of this structure.

Figure 2 | **Steps for Designing an Adaptation Tracking System**



Conduct a conceptual mapping exercise of WOTR's organizational and reporting structure

WRI and WOTR undertook a conceptual mapping exercise to (1) identify stakeholders within a typical WOTR WSD project, (2) better understand how data travels from villages of WSD projects to WOTR's research office and to WOTR's funders, and (3) identify who is already engaged in M&E efforts. After the map was complete, WRI and WOTR worked together to identify a facilitator and additional team members needed for the ATS team. We discussed the following considerations (Ayers et al. 2012):

- Who is already engaged in M&E, data collection, and data analysis efforts?
- Who has information that is vital to the adaptation tracking process?
- Who would be most likely to participate (e.g., do they have the time and willingness to become involved)?
- Who should be included to ensure that different views are represented from across the community (i.e., from different age groups, income groups, and genders)?

Identify key team members

Overall, eight members were identified by WOTR as being vital for the ATS for a given watershed. They included village members and WOTR staff for data collection and management, a data analysis expert, and, as facilitator, someone responsible for adaptation activity implementation from a management perspective. Additionally, WRI and WOTR discussed the importance of ensuring that the ATS team included key community leaders representative of age, gender, and occupation composition of the watershed. The makeup of the ATS team would need to vary based on the watershed or cluster of watersheds. The appendix provides WOTR's conceptual map and suggested makeup of the ATS team.

Step 2: Conduct an audit of data systems and tools

After identifying the ATS team, the next step was to review the data systems and tools that WOTR already has in place related to monitoring, data collection, data management, and adaptation to ensure the ATS would leverage current efforts. This task aligns well with the recommended first step of the PMERL methodology for designing a monitoring plan of "mapping stakeholder information needs," which states that a key question should include identifying information that is already being collected and mapping it according to different stakeholder information needs. WOTR conducted two exercises as a part of the audit process: (A) developing a conceptual map of existing data systems and tools; and (B) developing an audit spreadsheet to characterize data systems and tools and their relevance to the ATS.

Develop a conceptual map of existing data systems and tools

As WOTR is involved with WSD from both an implementation and research perspective, it became necessary to better understand how WOTR's current data systems and tools interact and how information flows from watershed villages to WOTR headquarters and external audiences, including donors and the general public. This exercise allowed WOTR to easily organize its current data systems and tools into categories, to identify current M&E efforts, and to visualize how an ATS could leverage current systems and tools. Additionally, this exercise allowed WOTR to identify knowledge gaps associated with data reporting and evaluation efforts. WOTR's map is presented in the appendix.

Conduct an audit of data systems and tools

Following the conceptual mapping exercise, WOTR determined that a thorough audit of the data systems and tools identified earlier would be necessary for designing an ATS to avoid duplication of efforts. WOTR already has M&E systems in place and collects a wealth of data, so it was more important to understand which tools could be used in an adaptation tracking context and whether there were any gaps in data collection that would need to be addressed. For example, WOTR has several tools developed over time that are used for monitoring and has multiple levels of evaluation. All monitoring tools provide information to support each other and are meant as shared learning tools. However, not all monitoring tools should be integrated with the ATS.

WRI and WOTR developed an audit tool that asks for the following data for each data tool/system:

- Description
- Type of tool (e.g., household survey, simulation game, etc.)
- Objectives

- Whether the tool/system has an adaptation focus/lens and can be used in the ATS
- Key outputs (i.e., type of data collected)
- Frequency of data collection
- Where the tool is applied (e.g., watershed or project level)
- Ongoing (yes or no) OR period of time data is collected
- Whether the tool interacts with other tools/databases

The audit revealed that currently, WOTR's systems and tools only collect data before, during, and upon completion of the project implementation period, which generally takes place over a period of four to eight years. In other words, long-term data collection is not occurring due largely to funding limitations.

In terms of reporting progress to donors, project funds are often limited to baseline and endline (end of project) impact reports. The audit revealed that baseline and endline reports often report on different indicators, making it difficult to track trends in WSD success. This is a direct result of typical funding requirements, which specify reporting only at the beginning and end of a project implementation cycle.

The audit also revealed that some tools provide input into other tools and feed data directly back to watershed communities, while others feed data into local, regional, and research offices.

The audit process also allowed WOTR to identify likely data systems and tools that it will integrate into its ATS. The appendix presents results from the audit process whereby data tools/systems that should be incorporated into the ATS were identified by WOTR. The appendix also provides a detailed description of WOTR's Community Driven Vulnerability Evaluation Programme Designer (CoDriVE-PD) tool, a key tool to be used for tracking adaptation and conducting vulnerability assessments.

As a next step, WOTR will need to more thoughtfully review the systems and tools identified in this audit to determine how best to use them in coordination with the ATS.

Step 3: Define adaptation success (i.e., decide what to monitor)

After understanding tools and efforts under way, the next step was to define success in terms of what WOTR hopes to achieve in terms of its WSD approach (including WSD planning interventions, WSD interventions, and adaptation interventions) and how best to measure it, leveraging its current M&E capacities. Activities under this step aim to address the challenge of defining adaptation success. The first task necessary to develop outcome statements, or statements of success, with watershed stakeholders. The next step was to define a consistent theory of change for WOTR's WSD adaptation approach, which includes applying both traditional watershed development and CCA activities. The theory of change links WSD interventions to adaptation outcomes.

Define outcome areas and statements

Following recommendations from the PMERL manual, WRI and WOTR developed outcome statements and areas. The PMERL manual defines outcome statements as "simple, positive statements about desired changes as a result of the [...] project." In other words, outcome statements describe what successful adaptation looks like for different stakeholders and provide information on how and why WSD and CCA activities should result in particular outcomes. PMERL recommends grouping outcome statements into major outcome areas or categories (between three and six). The PMERL manual also recommends developing outcome statements through an inclusive process of all major stakeholders through an "adaptive visioning" exercise to, in the WSD context, identify how communities envision high adaptive capacity or success for themselves in light of expected climate trends through the next 20 years.

To develop a preliminary list of outcome areas and statements, WRI and WOTR held targeted focus group discussions with staff from WOTR's Pune research office, relevant field staff for our pilot watersheds, and then key community members from the two pilot watersheds that were representative of age, gender, and occupation (e.g., farmers and herders).

Outcome areas and statements were developed through adaptive visioning exercises that identified how the communities envision high adaptive capacity or success for themselves over the next 20 years. WRI and WOTR staff developed questions for village participants tailored

to focus on how to elicit the best response from community members based on expert opinion from WOTR field staff. The villagers were led by WOTR field staff who spoke the local language and were trained beforehand in how to lead the questions by WRI and WOTR research staff. The following questions were included:

1. What would you like to see for the/your community and their/your children and grandchildren 10, 20, or 30 years down the road? What does a successful community look like?

2. What are the biggest challenges for being successful in the future? How do you think climate change might have an impact on your livelihood?

3. How do your goals change considering climate change and other challenges?

4. How can you judge whether you are achieving your goals or being successful? What signs would indicate whether you are being successful?

5. As part of this project, we hope to continue to collect information to help judge success into the future. Do you think this is a valuable input, and who within your office/community would be best suited to help us collect information?

Based on these discussions, we came up with the following outcome *areas* or key long-term adaptation outcomes:

1. The natural resource base (i.e., ecosystem) is secured for the watershed to secure water supplies during periods of drought, temperature and rainfall fluctuations, and heat extremes and to prevent soil loss during periods of drought or intense rainfall.

2. Households have an increased capacity to invest in nutrition, education, and health services in the face of climate change.

3. Households have diversified income sources because they can invest in new equipment and small business endeavors.

4. Services and infrastructure (e.g., disaster risk reduction training and planning, renewable energy technologies, conflict resolution training and institutions) are in place to support climate change adaptation.

5. Gender equality is improved as women are more active in village and watershed decisions and have a better quality of life.

6. Villagers' ability to adjust behaviors and practices in response to climate change is improved due to capacity-building efforts and access to information and technology.

Both ecosystem health and human welfare were central to the communities' vision of adaptation success.

After agreeing on these outcome areas, WRI and WOTR developed outcome statements based on focus group discussions. Table 1 lists the summary outcome areas and statements based on input from the two pilot sites. WOTR and WRI did not define specific targets (i.e., 50 percent of women experience reduced drudgery), but instead identified general targets for each outcome area, based on community needs and desires.

Develop a theory of change

After identifying outcome areas and statements, it became necessary for WOTR to think through how its WSD strategy is linked to these outcome statements. A theory of change is an explanatory model that links project or program interventions to outcomes and impacts by identifying causal mechanisms and pathways (Brooks and Fisher 2014; Dinshaw 2014). A theory of change serves as the backbone of an adaptation M&E system (Spearman and McGray 2011); and, as such, a theory of change sets the stage for the ATS in that it explains how success is expected to occur and for whom. A theory of change should outline how expected program interventions lead to outputs, outcomes, and overall impacts. The ATS should be designed in such a way that it either proves the theory of change, or provides insight into how to adjust the theory of change over time to account for new realities (such as how ecosystems actually respond to climate change over time).

In developing a theory of change, it is also critical that WSD agencies have a clear definition of adaptation and how it relates to WSD (a key challenge noted earlier). Developing an understanding of adaptation and related concepts is important for understanding how to modify existing practices and interventions to take climate change into consideration, and how to develop new practices and interventions. Box 2 provides definitions

Table 1 | **Outcome Areas and Statements for Pilot Watersheds**

OUTCOME AREA	OUTCOME STATEMENTS
1. Natural resource base is restored and can withstand climate variability	1. The vulnerability of natural resources and physical assets is reduced (e.g., agricultural yields, livestock yields, biodiversity count, increased tree cover) 2. Households are using sustainable and resource-budgeting agricultural and livestock practices to protect land production-related income during periods of stress 3. Water security is achieved even during periods of drought
2. Households have improved well-being in the face of climate change	1. Food and nutrition security is achieved for all households 2. Overall education level of youth is improved 3. Households have access to affordable health care services
3. Households have diversified and secure income sources	1. Farmers are able to diversify and strengthen livelihood sources 2. Households feel more equipped to take risks with regard to expanding agricultural and livestock activities 3. All households have access to affordable credit/financial services
4. Services and infrastructure are in place to support climate-change adaptation	1. Communities improve social cohesion and communications to reduce conflict and increase adoption rate of adaptation interventions 2. Households have the information and training needed to prepare for disasters 3. Climate-resilient technologies and practices are adopted and scaled up (e.g., renewable energy technologies)
5. Gender equality is improved	1. Women have a stronger role in community development and planning 2. Women experience reduced drudgery (e.g., fetching drinking water and firewood) 3. Women have equal access to information on climate change and adaptation
6. Villagers' ability to adjust behaviors and practices and plan interventions in response to vulnerability drivers improves	1. All households have access to real-time information on weather, climate, and pests and can incorporate this into agricultural and livestock planning 2. All households have up-to-date information on new production technologies (resource budgeting techniques) and techniques that are climate adaptive (e.g., low input, organic, and climate resilient, prevent soil erosion) and can be incorporated to increase resilience to drought, market pressures, and other vulnerability drivers for livestock and agriculture

that WOTR used to develop its initial theory of change for its CCA project and for the ATS.

WRI and WOTR staff developed their theory of change using guidance from Spearman and McGray (2011).

The following theory of change resulted: By planning scientifically designed WSD and CCA interventions in a watershed using a participatory approach, watershed ecosystems will be restored, watershed communities' resource needs (e.g., energy, water) will be reduced, and communities' capacity to sustain interventions over time will be improved. Ecosystem restoration will result in improved ecosystem health and thus increased provision of ecosystem services (including water provision/storage, soil creation, reduced erosion, and enhanced biodiversity and habitat) and villagers will be able to sustainably intensify crop and livestock production. Subsequently, the improvement in ecosystem health combined with enhanced capacity of villagers to sustain interventions over time, will lead to more environmental and social benefits from higher earnings and greater flexibility to diversify livelihood income sources. As a result of these economic, social, and environmental benefits, resilience to climate change and adaptive capacity will be improved as ecosystems and communities will be better able to withstand climate shocks and other vulnerability drivers.

Improved ecosystem and human resilience, improved adaptive capacity, and reduced vulnerability for community members represent ultimate "impacts" of a WSD project. Impacts result from the achievement of longer-term outcomes, which the ATS described in this report aims to track. Iterative evaluation of outcomes over time results in understanding the nature of long-term impacts.

The theory of change is presented graphically and in more detail in the appendix, along with assumptions and risks. The diagram shows that intermediary or "milestone" outcomes are necessary to achieve the adaptation outcomes presented in Table 1.

Box 2 | **Key Concepts**

For the purpose of this paper, the following definitions are adopted (from IPCC 2014) for major adaptation-related terms:

- **Adaptive capacity:** "The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences."
- **Climate change adaptation:** "The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects."
- **Resilience:** "The capacity of a social-ecological system to cope with a hazardous event or disturbance, responding or reorganizing in ways that maintain its essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation."
- **Vulnerability:** "The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity."

Step 4: Create a framework to track success

After identifying outcome areas and statements and a theory of change, WRI and WOTR developed a way to define the climate context and address the shifting baseline challenge and developed indicators and baselines to track success against the previously defined outcome statements.

Define the climate context

Baseline data on climatic conditions and projections of future climatic change are needed to set the climate context (Ayers et al. 2012). As a result, M&E systems must include indicators on climate change that are frequently tracked based on quantitative data on weather (e.g., rainfall, temperatures) and stakeholder input (Spearman and McGray 2011; Action Research on Community Adaptation in Bangladesh 2012).

Where historic and current climate data are not available, participatory vulnerability assessments can be used to leverage stakeholder knowledge of climate conditions. Vulnerability assessments can be conducted at regular intervals to address the challenge of a shifting climate baseline. However, vulnerability assessments should be considered a short-term solution as ultimately there is a need for better climate monitoring data. Additionally, vulnerability assessments can be time-consuming and resource intensive.

WOTR does not always have access to historic and current climate data for all watersheds, but WOTR does have a vulnerability assessment tool: the Community Driven Vulnerability Evaluation Programme Designer (Co-DriVE PD). WOTR has begun employing this tool to understand community perceptions on vulnerability, identify vulnerability drivers to track with an ATS, and set the climate context and baseline.

It is important to note that, while vulnerability assessments are useful for generating climate baseline data in data poor environments, it is still important to advocate for improved climate monitoring data.

Identify indicators for each outcome statement

The TAMD framework defines indicators as "[M]etrics that are used to measure change. They can be used to describe a situation, monitor the evolution of a situation and/or measure achievements against an objective, comparing levels of quantitative or qualitative units to a baseline" (Brooks and Fisher 2014). Indicators are necessary to understand whether outcome statements are being met through WOTR's adaptation interventions. WSD is heavily rooted in ecosystem-based restoration as a means to both promote ecological resilience and improve the adaptive capacity of watershed communities. As such, WOTR's ATS must have a long-term vision to understand changes in both biophysical and human systems and responses to WSD.

The literature largely agrees that conventional M&E systems are limited for tracking adaptation because they rely on cause-and-effect thinking and are not able to capture adaptation as a continuous process. The literature strongly supports developing ATS's that consider both qualitative and quantitative indicators that allow for learning by tracking progress made toward achieving the defined outcomes, changes in decision making and institutional processes, and changes in ecosystems and human behavior (Sanahuja 2011; Villanueva 2011).

WRI and WOTR decided to adopt two types of indicators: "milestone" or short- and medium-term indicators that track progress on milestone outcomes that might or might not be tracked through project baseline and endline reports (but which should be collected for both baseline and endline reports); and "adaptation" indicators that focus on behavior change, learning, and processes and track progress on adaptation outcomes.

Milestone outcomes and indicators are intended to promote a process of sequential targeting (Dinshaw et al. 2014) that will allow WOTR to adaptively manage its interventions over time as WOTR can track progress on these indicators and, through an evaluation process, decide if outcome statements and indicators should change to reflect a new reality. Milestone indicators focus on understanding quantitative changes in ecological and social conditions. Adaptation indicators are intended as medium- to long-term indicators that are focused on understanding both quantitative and qualitative changes in awareness/knowledge, ecological and social conditions, and institutional changes.

Based on WOTR's practical experience, it became evident that to assess the status of a resource, using qualitative indications or rankings may be a better approach in *some* circumstances than using quantitative indicators for tracking long-term adaptation success. Also, achieving a desired change as represented by a quantitative indicator is not always practical and requires technical expertise, while indication (qualitative evidence) emerges from tangible sensing of the status of various conditions. CoDriVE-PD uses the same approach to assess community vulnerability to climate change and other stressors. Application of the CoDriVE-PD tool will provide an adaptation indicator that is assigned a grade for availability, functionality, quality, and accessibility on a resilience scale, (Resilience Grade, Table 2 of 1—5, where 1= nil (0-10%), 2= minimum (11-25%), 3= low (26-45%), 4= adequate (46—70%), and 5= high (71 % and above) (WOTR, 2013). The final code will give an indication of the degree of vulnerability due to absence or inadequacy of a capital resource that is essential to cope with climatic and non-climatic risks or hazards. This also gives an indication of the adaptive capacities and the degree of resilience of each capital (vulnerability is inversely proportional to adaptive capacities and degree of resilience). The use of qualitative vs. quantitative indicators by WOTR will need to be refined over time after the ATS is implemented.

Given resource constraints faced by WSD implementing agencies, it is important to limit the number of indicators for which data need to be tracked (Spearman and McGray 2011; Ayers et al. 2012).

Establish baselines

Baselines must be set for each indicator to allow for measuring trends and changes over time and overall change in human welfare. Baselines should be established for the climate context as well. A strong ATS system should include not only baseline assessments but should also be constructed to observe and document the operating context of the implementing agency (i.e., do they have the capacity and technical expertise to conduct a baseline assessment?).

For WOTR, the baseline for each indicator should be set at the year before the project implementation period starts. However, it is important to understand, at least anecdotally, the historical climate context from the community perspective during the vulnerability assessment using CoDriVE-PD.

Step 5: Measuring success (data collection, management, and evaluation processes)

The fifth step builds largely on progress made from the data systems and tools audit. This step includes deciding on how best to collect data on the identified indicators and the type of data that will need to be collected, how and where to store data, and evaluation and feedback processes that will be used to ensure adaptive management of the ATS.

Guidance and recommendations for WOTR in this section are preliminary as evaluation and feedback processes will need to be refined over time after the ATS is piloted and WOTR is better able to assess how to collect data on needed indicators, how to store it, and what evaluation options are most appropriate.

Specify how data will be collected and the type of data to collect

The first task required by WOTR is to review its audit tool to see if its current data systems and tools are collecting data on any of the identified indicators for the ATS, as well as for its baseline and endline reports. If data are missing, WOTR will need to identify how to collect these data and who should be responsible. For example, can current tools be adjusted, or are additional household surveys needed?

Can community members assist in collecting data? This task may require refining of the selected indicators. As WOTR's intends to incorporate adaptation interventions into all its implementation work, WOTR must consider whether it intends to collect data for every village or watershed or whether it will use longitudinal surveys or random sampling. The TAMD framework provides useful information on how to select representative samples.

Another consideration for WOTR is to determine how to address the attribution challenge. Addressing this challenge is important for understanding which adaptation interventions are most useful and/or in what combination. The TAMD framework provides useful guidance on this and states that participatory approaches can be used to elicit information on the extent to which an intervention contributed to changes in resilience. Alternatively, and preferably, it might be done throughout an intervention by building attribution questions into any participatory assessments or household surveys."

Specify where and how data will be stored

Data collected for the ATS (e.g., through CoDRiVE-PD, current M&E tools, or new data collection efforts) are best stored centrally and such that such data are accessible to the implementing team as well as the ATS team. The development of such a system should be an iterative process that incorporates the needs of relevant stakeholders, including WSD community members up to research and technical staff.

Developing this data repository should serve as a key next step for WOTR for initiating the ATS. This can then be used by the research staff in Pune to track of trends over time and conduct needed evaluations (e.g., economic valuation) and longer term analysis on project outcomes.

Identify a data collection/reporting protocol

WOTR has determined that the ATS should collect data not just on the indicators identified for the outcome statements identified in this report, but should also collect data for a set of standardized metrics collected by WOTR's baseline and endline reports. Thus, the ATS indicators and baseline/endline indicators could be combined for a single report. As baseline and endline reports do not currently report on the same set of metrics, however, WOTR must first standardize this set of metrics. Baseline and endline reports are necessary for conducting analyses of changes in biophysical and economic conditions and could be used to conduct benefit-cost analysis of project success. WOTR can work with organizations like WRI to conduct economic analyses when WOTR staff lack relevant expertise. Gray and Srinidhi (2013) provide additional discussion on the usefulness of economic valuation for understanding WSD success and recommendations on how to integrate economic analysis with climate change adaptation efforts.

Although data should ideally be collected on for the ATS every three to five years, the regularity of data collection should be decided based on (1) community consent and with reference to the commitment of organizations to continue to liaise with the community in the region and (2) availability and resources available to WOTR field staff. For example, community members currently or previously engaged in data collection for baseline/endline reports would now need to be trained on how best to collect data for the ATS. Communities will also need to be sensitized to the need for the ATS and the need for long-term data collection so that they assist in data collection. The capacities of such communities can be built by incorporating specific modules on ATS into the already prevalent technical and social training conducted under the project.

Identify evaluation and feedback options

Evaluation of outcomes and impacts is necessary to understand adaptation success and to ensure that the ATS is providing useful information. Lessons learned must be fed back to targeted stakeholders to ensure that both WOTR staff and watershed communities are learning from the ATS.

WOTR already regularly conducts evaluations of its work, both to provide funders with information on progress and results and for internal learning purposes to better understand how to adapt its WSD implementation strategy. WOTR will need to carefully review its data systems/tools audit spreadsheet to better understand how to leverage its current evaluation efforts. However, as the ATS will be a new system, it is likely new evaluation procedures and learning systems will need to be put in place.

WRI and WOTR developed an initial set of recommendations. First, WOTR should conduct regular evaluations for internal purposes every five to eight years to understand adaptation success in terms of outcome statements. These evaluations could be in the form of short reports meant

for internal purposes, but WOTR could also work with its donors to avoid duplication of reporting efforts on its adaptation work. Additionally, WOTR should prepare a more detailed report on its adaptation progress every eight to ten years that details longer-term learning on impacts (e.g., improved resilience and adaptive capacity and reduced vulnerability), based on the five to eight year reports. If possible, the longer-term reports should try to summarize trends not just from the specific watershed, but from a set of watersheds within a given region to see if trends can be drawn across a landscape.

There are two processes necessary for effective feedback: (1) a documented reflection process of evaluation results and (2) a process to ensure that information is used to do adaptive management of WOTR's adaptation efforts and the ATS design itself. The reflection process should be an inclusive process in that WOTR discusses evaluation results with community members, and both sets of actors can discuss results and develop recommendations for adaptation. Recommendations should be systematically documented, stored, and shared with community members. This would sensitize communities to the value of the ATS and hopefully encourage participation in data collection efforts (Brooks and Fisher 2014). WOTR should also consider sharing recommendations with funding agencies so that they too understand the need for alternative actions taken.

The adaptive management process requires developing feedback mechanisms to ensure that recommendations are integrated into WOTR's CCA strategy. Feedback entry points may include WOTR staff meetings or retreats where review happens, community meetings, monitoring visits, and funder meetings (Ayers et al. 2012). Additionally, feedback incentives may be necessary to ensure that feedback actually happens. WOTR should work with field staff and local watershed communities to identify appropriate feedback mechanisms and incentives for each watershed.

CONCLUSIONS

This section reports our key conclusions drawn from our literature review and the process of designing the ATS for WOTR.

First, adaptation tracking with respect to WSD in India needs to be fundamentally rethought to better enable the tracking of short- to long-term adaptation success to key vulnerability drivers. It will be important to move away from quantitative or output-focused M&E and impact reporting models to better enable long-term tracking of both quantitative and qualitative indicators covering ecosystem conditions, capacity-building efforts and social improvements, economic impacts, and changes in processes and behaviors by institutions and community members.

Second, it should be recognized that WSD implementing agencies face resource constraints, both financial and technical, in developing and maintaining quantitative/qualitative M&E systems. Funders of WSD can help by (1) cooperating with implementing agencies to understand their needs and goals related to WSD and adaptation success; (2) adjusting their reporting requirements to promote consistent reporting on key indicators over regular intervals to track changes in biophysical and human conditions; and (3) adjusting their reporting requirements and funding mechanisms to promote long-term reporting on ecosystem, social, and climate conditions, processes, and behavioral changes, and/or supporting greater training on adaptation tracking and understanding of long-term success.

With respect to WOTR, project baseline and completion (i.e., endline) reports required by funders are important for understanding early outputs from project activities and could be even more useful for understanding WSD and adaptation success if conducted at repeated intervals over the long term, especially for conducting impact assessments and economic analyses. However, these reports need to be streamlined and should report on the same indicators over the long term to allow evaluation of trends in key development and activity indicators.

Third, participation by community members throughout the adaptation tracking development and management process is critical for adaptation success. It is also important that community input is representative of age, gender, occupation, and income levels. Ultimately, WSD success is defined by the target communities of WSD, and, as such, they should be involved in every step of the

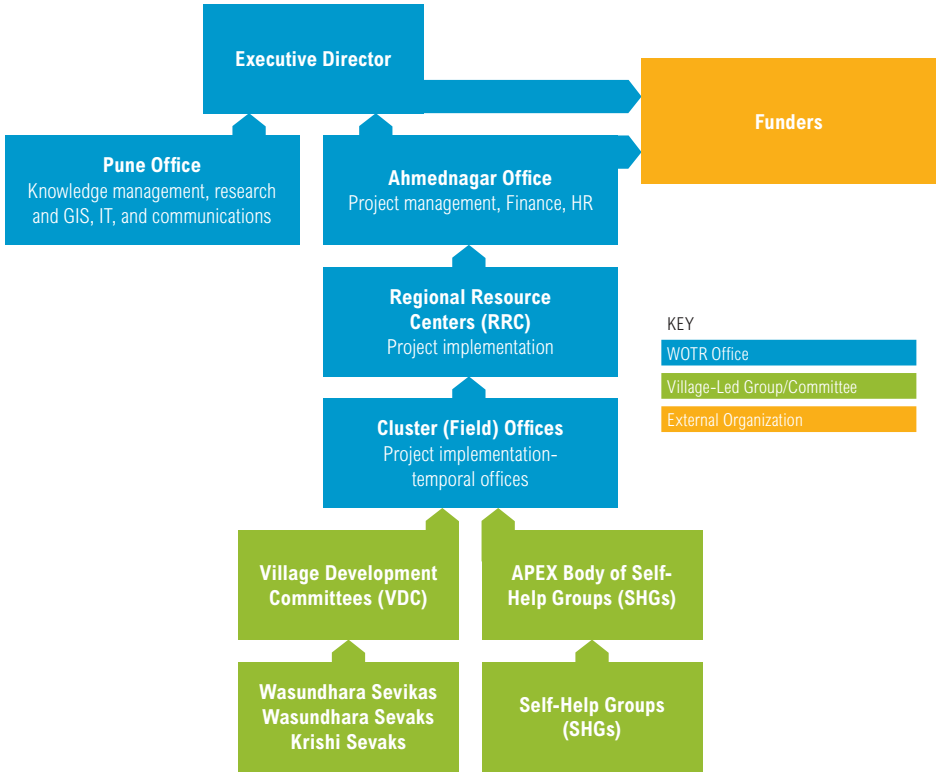
process. Additionally, community members can be better integrated into adaptation tracking by training them to support data collection and evaluation efforts. This can help to reduce the financial and time burden on implementing agencies and to encourage understanding and uptake of results. Community participation in adaptation tracking processes should be coupled with data quality check efforts to reduce possible biases in developing, for example, indicators and definitions of adaptation success. Finally, the level and structure of community involvement should be tailored by the implementing agency to address cultural sensitivity issues (e.g., women might feel more comfortable having a female-only focus group as they might feel less restricted in giving input than if they are with men in the community).

As next steps, WRI and WOTR hope to implement the ATS and further refine recommendations from this report. Additionally, further research on ecosystem-based adaptation would help to strengthen these initial recommendations and the ATS. Finally, promoting climate change adaptation tracking considerations in national WSD guidelines will be an aspiration of both organizations.

APPENDIX: DESIGN OF ADAPTATION TRACKING SYSTEM FOR WOTR

Step 1: Identify the Adaptation Tracking System team

Figure A-1 | **WOTR Organization and Reporting Structure**



WOTR's Adaptation Tracking System Team:

- **Facilitator:** The facilitator of the ATS should be a staff member from the Ahmednagar office as that office is ultimately responsible for project implementation. An individual person from this office should facilitate the ATS and be responsible for data aggregation from RRC and cluster offices. The facilitator should be familiar with socioeconomic, political, and environmental considerations for the watershed. Additionally, the facilitator should be responsible for ensuring that WOTR's theory of change is incorporated into the ATS and development of outcome statements and indicators.

- **Data collection and management:** Data collection and management must be coordinated across the Pune, Regional Resource Centres (RRCs), cluster offices, and community groups.

  - **Pune office representative:** A Pune office researcher should be responsible for training on the data collection methodology with ATS members from the RRC and cluster offices.

  - **RRC representative:** A representative of the RRC should spearhead the data collection task. That person should be responsible for collecting and organizing data from the cluster office and bringing that data forward to the Ahmednagar office facilitator.

  - **Cluster office representatives:** The cluster level representatives (one to two people) should be responsible for data collection and reporting to the RRC representative.

  - **Male and female members from the Village Development Committee (VDC):** The VDC should be the primary source of data provision, with support from RRC and cluster office staff. To ensure gender representation, at least one male and one female member of the VDC should assist with data collection for the ATS.

  - **Female Self-Help Group representative:** The self-help group representatives should also be a source of data on financing and loans and would lend an additional female voice.

- **Data analysis:**

  - Ultimately, data must travel from the watershed to the Pune office for storage, analysis, evaluation, and reporting. One to two members from the Pune office should be integrated as a part of the ATS for each watershed and should be responsible for coordinating with WOTR staff from other offices. This officer should be recommended by WOTR staff based on knowledge of the specific village or watershed. The person should ideally have experience in project evaluation, environmental science, and economic/financial analysis. The Pune staff should also be responsible for ensuring that field staff and watershed community members *see* and *learn* about evaluation results.

Based on this design, at least one staff person is included from all of WOTR's offices and from each of the village committees.

Step 2: Conduct an audit of data collection tools and reporting processes

Figure A-2 | **Conceptual Map of WOTR Data Systems and Tools**

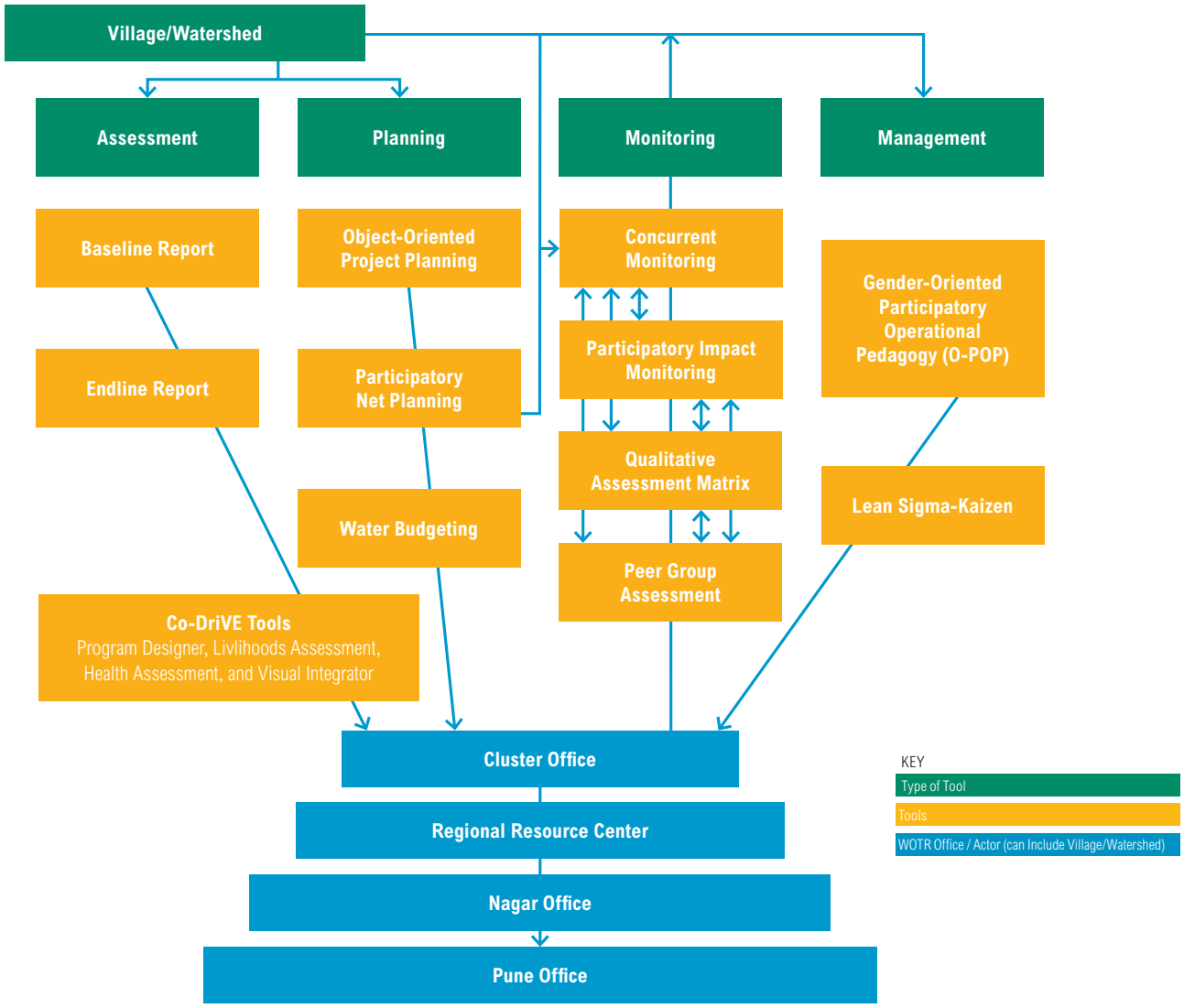


Table A-1 | **Audit Spreadsheet: Assessment Tools**

NAME OF TOOL	BASELINE ASSESSMENT	ENDLINE ASSESSMENT	COMMUNITY-DRIVEN VULNERABILITY EVALUATION—PROGRAM DESIGNER (CODRIVE-PD)	COMMUNITY-DRIVEN VULNERABILITY EVALUATION—LIVELIHOOD ASSESSMENT (CoDriVE-LA)
Description	In-depth socioeconomic survey of 100% watershed households. Generally driven by funder reporting requirements.	Socioeconomic *sample* household survey. Generally driven by funder reporting requirements.	A recombinant tool (developed by converging key aspects of three well-known international research methodologies) that is built upon the Five Livelihood Capitals Framework. A web-based software program is being developed.	A project adjustment tool that uses both qualitative and sample household survey and sample livelihoods survey methods. It is used for assessing project activities to ensure reduced vulnerability of communities to risks of climate change. It also assesses local money flows.
Type of tool	Household survey.	Household survey.	Focus group and household survey.	Focus group and household survey.
Objectives	Develop a pre-project scenario for project activity planning and implementation.	Assess project impact, including creation of community and household assets and improvement in land productivity.	1. Enable communities to articulate how they are being affected by climatic forces. 2. Identify and assess communities' areas of vulnerability. 3. Encourage communities to plan for and undertake adaptive actions to build resilience and reduce vulnerability.	1. Identify climate and market risks and historic and present coping mechanisms. 2. Identify risk-sensitive livelihood resources. 3. Measure local money flow of livelihoods and identify areas of financial leakages. 4. Assess and modify existing project activities. 5. Design new project activities.
Does this tool/system have an adaptation focus/lens? Can it be used in the ATS?	Not currently, but the data provide valuable baseline information and can be adjusted to track data on ATS indicators.	Not currently, but the data provide valuable insights for research on communities' success on interventions/activities and can be adjusted to track data on ATS indicators.	Yes—Completely focused on gathering information on vulnerability of communities, regions, and livelihoods.	Yes—Completely focused on creating livelihoods for adaptation to the risks of climate and globalization on communities.
Key outputs	Socioeconomic data and detailed report.	Socioeconomic data and detailed report.	Generates a quantitative vulnerability code that grades community vulnerability to climate impacts; Generates systems approach map that shows interdependencies and interactions between capitals and sectors and their issues and problems; Records perceptions of climate risks, drivers, and pressures.	Local Money Multiplier (LM3) score for each village, each livelihood, and each household; A recommended list of livelihood initiatives necessary to ensure risk mitigation and improving LM3 in the village and resources required for the same.
Frequency of data collection	Once, before project implementation phase.	Once, after project completion.	Has been done extensively once in several villages.	Has been done once in 13 villages.
Where is this applied?	Villages and households.	Villages and households.	Villages (Ongoing for watersheds).	Villages, households, and enterprises.

Table A-1 | **Audit Spreadsheet: Assessment Tools (continued)**

NAME OF TOOL	BASELINE ASSESSMENT	ENDLINE ASSESSMENT	COMMUNITY-DRIVEN VULNERABILITY EVALUATION—PROGRAM DESIGNER (CODRIVE-PD)	COMMUNITY-DRIVEN VULNERABILITY EVALUATION—LIVELIHOOD ASSESSMENT (CoDriVE-LA)
Ongoing (Y/N) or period of time data collected	No	No	Yes	No
Does this tool interact with other tools/ databases?	This tool is referred to while producing the endline report.	The tool is referred to while writing outcome reports. It reflects on the findings from the baseline.	Some modules of this tool are used in Co-DriVE LA.	Some modules of this tool are used in Co-DriVE PD.

Table A-2 | **Audit Spreadsheet: Planning Tools**

NAME OF TOOL	COMMUNITY-DRIVEN VULNERABILITY EVALUATION VISUAL INTEGRATOR (Co-DriVE VI)	OBJECT-ORIENTED PROJECT PLANNING (OOPP)	PARTICIPATORY NET PLANNING (PNP)	WATER BUDGETING[1]
Description	A tool that villagers can use to communicate indigenous spatial knowledge in a digital form. The tool involves the construction of a scaled relief model of the community onto which communities can demarcate relevant spatial features pertaining to development needs. Additionally, the model can be transposed into GIS and geo-referenced for scaling up local development priorities and concerns.	A logical frame analysis tool designed to help project designers prepare a project by converting community needs and problems into objectives. Objectives are linked to project inputs and outputs.	A tool for carrying out surveys and planning area treatments and minor drainage line treatments in each and every gat/survey number of the watershed in collaboration with the farmer/household.	A simulation game that provides and showcases representative trends of water availability and water requirement according to the anticipated availability and proposed usage.
Type of tool	Focus group, workshop, and community built 3D model.	Stakeholder analysis and project formulation.	Landowner-wise survey.	Simulation game with focus groups and household discussions.
Objectives	1. Communicate local spatial knowledge concerning land use, environmental history, and cultural identity among local villagers and project facilitators to pinpoint vulnerabilities and refine development objectives. 2. Improve the local understanding of climate change. 3. Transfer local spatial knowledge to relevant government officials and other development agencies via geographic information technologies.	Provide a systematic structure for identification, planning, and management of projects developed in a workshop setting with principal interest groups.	1. Secure ownership of community members to enhance sustainability of the works undertaken. 2. Plan for measures that are tailored to site requirements, address stakeholder needs, and increase productivity. 3. Formulate proposals-activities, budgets, and timelines that are realistically implementable.	1. Raise awareness on water budgeting by demonstrating to the user consequences of using water inefficiently. 2. Encourage efficient water use for drinking water, agriculture, and livestock with a view to optimize benefits in the context of climate variability.

Table A-2 | **Audit Spreadsheet: Planning Tools (continued)**

NAME OF TOOL	COMMUNITY-DRIVEN VULNERABILITY EVALUATION VISUAL INTEGRATOR (Co-DriVE VI)	OBJECT-ORIENTED PROJECT PLANNING (OOPP)	PARTICIPATORY NET PLANNING (PNP)	WATER BUDGETING[1]
Does this tool/ system have an adaptation focus/lens? Can it be used in the ATS?	Yes—this tool is used for disaster risk reduction planning and the Peoples Biodiversity Register.	Not currently, but as a planning tool it can be used to support the creation of outcome statements and indicators for the ATS.	Not currently, but the tool can be useful for the ATS as it assesses the current and changing characteristics of the land, water, and vegetation resources and their current use.	This tool is completely focused on adaptation to the changing rainfall patterns and water scarcity that are seen as a direct outcome weather variation and climate change. As a learning tool, however, it is not applicable for the ATS.
Key outputs	Scaled relief model of the village and neighboring watershed boundaries constructed by the community.	Development of objective indictors and the means of verification.	A blueprint for project implementation that promotes learning, incorporation of indigenous technologies and experiences, and community knowledge and concerns.	Participant learning and education on managing water risk.
Frequency of data collection	Constructed once in project cycle.	Once at the start of project.	Once at the start of project.	Operationalized once after each summer.
Where is this applied?	Watershed level.	Project level.	Project level.	Village and households.
Ongoing (Y/N) or period of time data collected	Yes (through project period).	Yes (through project period).	Yes (through project period).	Yes (through project period).
Does this tool interact with other tools/ databases?	Disaster risk reduction strategy development.	It interacts with all tools and project deliverables.	OOPP.	Agro-met advisories.

Table A-3 | **Audit Spreadsheet: Monitoring Tools**

NAME OF TOOL	CONCURRENT MONITORING	PARTICIPATORY IMPACT MONITORING (PIM)	QUALITATIVE ASSESSMENT MATRIX (QAM)	PEER GROUP ASSESSMENT
Description	A tool developed to monitor the output and results of a project. It is an embedded system to monitor the input-output relations and quality and quantity of products in relation to expected results as identified by the planning process.	A qualitative impact monitoring tool. The primary stakeholders are trained and facilitated in understanding the impacts of watershed development and related aspects. It provides an opportunity for the people to understand, evaluate, and measure the impacts that the work has had on the natural resource base, like biomass, water, etc., as well as on agricultural production, afforestation, livestock, and other related activities. It also includes the impact on social and gender aspects of project intervention.	A participatory ranking assessment system designed to monitor the quality of process and outcomes of a given project, which helps in identifying areas of strength and concern.	A peer learning exercise in which representatives from participating villages visit each other's development projects in order to discuss achievements, failures, innovations, and best practices. The three most successful villages are publicly felicitated, creating a spirit of healthy competition between the various projects.

Table A-3 | **Audit Spreadsheet: Monitoring Tools (continued)**

NAME OF TOOL	CONCURRENT MONITORING	PARTICIPATORY IMPACT MONITORING (PIM)	QUALITATIVE ASSESSMENT MATRIX (QAM)	PEER GROUP ASSESSMENT
Type of tool	Desk appraisal, field verification, discussion.	Field visits.	Field visit and discussions.	Field visits.
Objectives	Understand, check, and verify inputs and outputs with expected outcomes with steering of the output toward the desired objectives.	1. Understand impacts from WSD through participatory observation, measurement, and analysis. 2. Facilitate community learning. 3. Capacitate people to gather impact information and document it so as to create a timeline of information on various indicators. 4. Help the facilitating organization learn from the community about its understanding of impacts and facilitate the project interventions based on this understanding.	Show what's working and what needs improvement in near-real time, while changes can still affect the outcome of the project.	Encourage sharing and learning through competition between villages on the implementation of project activities.
Does this tool/system have an adaptation focus/lens? Can it be used in the ATS?	Not specifically. This is a project management tool to ensure that the project is progressing according to the plan and design. WOTR does not recommend using this in the ATS.	Many indicators that are monitored can be used to track adaptation/adaptive capacities. This tool can be used in adaptation tracking system and is the most appropriate tool to carry forward out of WOTR's current monitoring tools.	The tool is used for participatory assessment of the quality of the project and performance of local institutions and implementing agency staff and the impact of performance of the NGO in the village. Useful during the project implementation phase, but some information can be used in ATS.	The functionality depends on willingness of the participating cluster of villages. Because other tools are all participatory in nature, this can be excluded in the ATS.
Key outputs	Equip NGOs and community groups with skills needed to monitor project success.	Community learning (i.e., the community comes to understand the impacts brought by the intervention).	If the quality of processes and products is regularly tracked, it will assist in decision making regarding capacity building/support requirements for areas of concern, thereby helping those in charge of the project understand the health of the project and areas for improvement.	Increased sharing of ideas and learning's between project village and increased support from community for project activities.
Frequency of data collection	Close and frequent monitoring in the initial stages and reduced monitoring in later stages.	Annually during project period.	Every six months during project period.	Once or twice during the project period.
Where is this applied?	Project	Village	Project overall with village level assessments.	Across project villages.

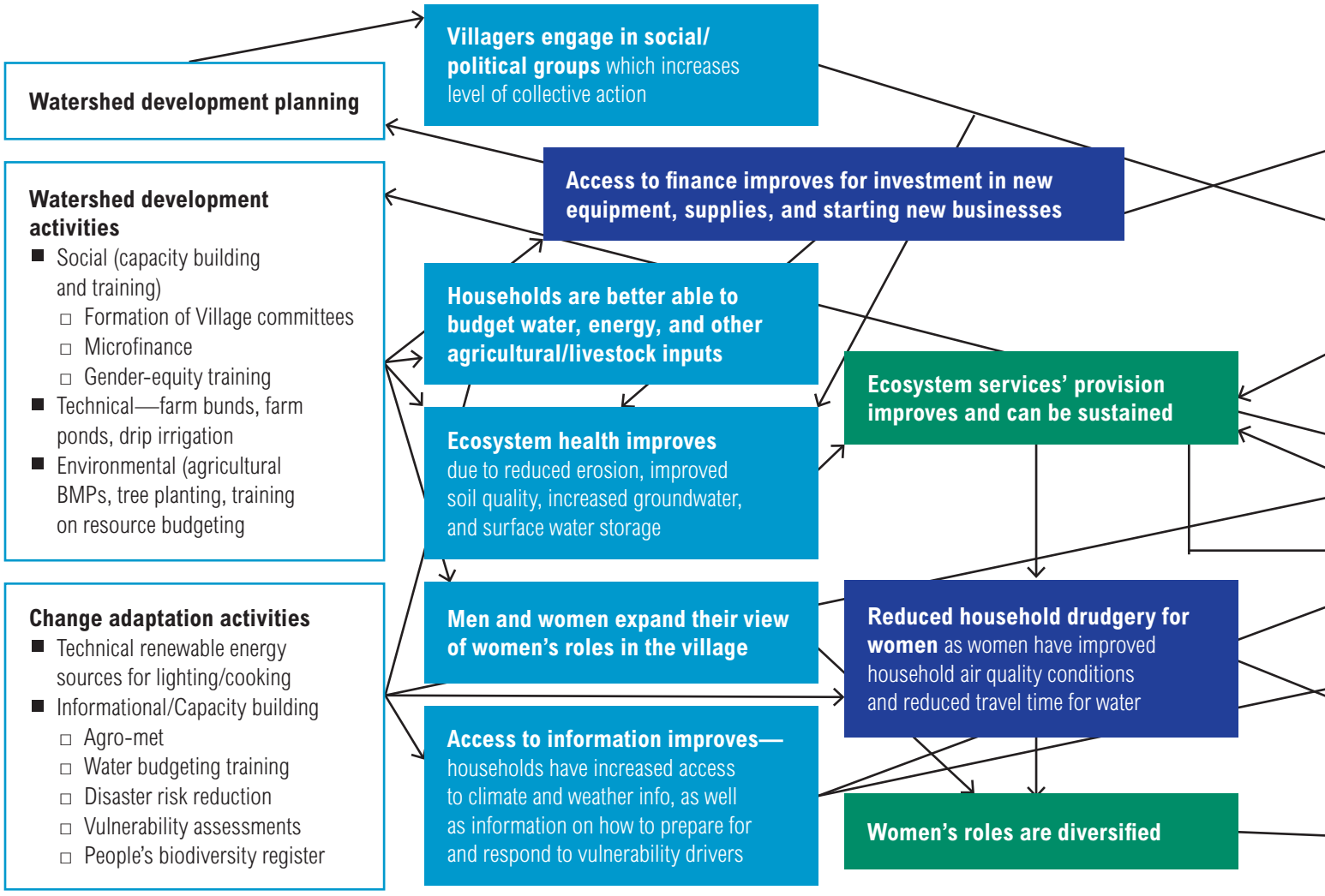
Table A-3 | **Audit Spreadsheet: Monitoring Tools (continued)**

NAME OF TOOL	CONCURRENT MONITORING	PARTICIPATORY IMPACT MONITORING (PIM)	QUALITATIVE ASSESSMENT MATRIX (QAM)	PEER GROUP ASSESSMENT
Ongoing (Y/N) or period of time data collected	Yes	Yes	Sometimes	Yes
Does this tool interact with other tools/ data-bases?	PGA, QAM, and PIM	Concurrent Monitoring, PGA, and QAM	Concurrent Monitoring, PIM, and PGA	Concurrent Monitoring, PIM, QAM

Table A-4 | **Audit Spreadsheet: Management Tools**

NAME OF TOOL	GENDER-ORIENTED PARTICIPATORY OPERATIONAL PEDAGOGY	LEAN SIGMA-KAIZEN
Description	A systematic approach to building up the organizational and social capacities of NGOs and village self-help groups to undertake and eventually scale up watershed development. It includes a gender empowerment component that engages and includes women at all stages and levels of the development process.	A management tool to reduce waste. Lean is a methodology that eliminates waste and boosts efficiency. Kaizen means continuous improvement. This methodology emerges from both philosophies. Lean Kaizen helps the WOTR management team get rid of waste and continuously implement good practices
Type of tool	Group planning with stakeholders, self-help groups, and women's organizations.	Brainstorming and group planning involving stakeholders.
Objectives	Efficient management of large-scale, multi-actor and multi-disciplinary programs	To increase efficiency, effectiveness and reduce costs
Does this tool/system have an adaptation focus/lens (if so, please detail). Can it be used in the ATS?	This can be used in the ATS to ensure equal participation of women during the process; however, it needs to be modified based on the objectives of the interventions.	Can be implemented with adaptation focus; however, it is only useful during the project implementation phase, so it can be excluded in ATS.
Key outputs	A pedagogy of sequenced practices tied to milestone and goal achievement.	Efficiency, waste and cost reduction.
Frequency of data collection	Revised whenever needed.	Whenever required.
Where is this applied (# watersheds/villages)?	Program/ multi-location complex projects.	For any activity in need of efficiency enhancement and cost reduction.
Ongoing (Y/N) or period of time data collected	Whenever needed.	Yes
Does this tool interact with other tools/ databases? (If so, which and how?)	No	This tool is for increasing the efficiency and impact of activities. The data of other tools is a valuable input and feedback for this tool.

Steps 3 & 4: Define success and identify a framework to track success



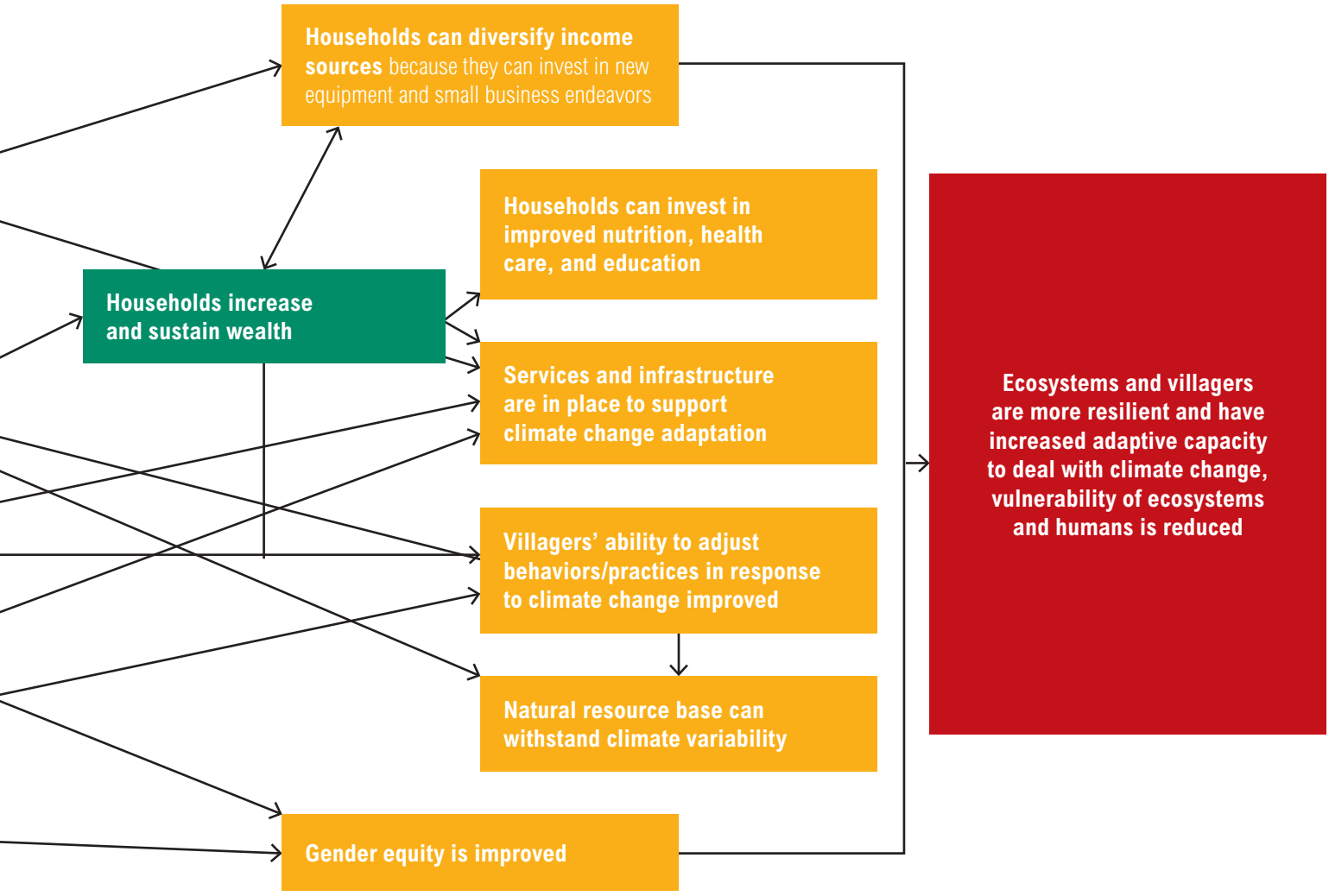

Households can diversify income sources because they can invest in new equipment and small business endeavors
Households can invest in improved nutrition, health care, and education
Households increase and sustain wealth
Services and infrastructure are in place to support climate change adaptation
Villagers' ability to adjust behaviors/practices in response to climate change improved
Natural resource base can withstand climate variability
Gender equity is improved
Ecosystems and villagers are more resilient and have increased adaptive capacity to deal with climate change, vulnerability of ecosystems and humans is reduced

Table A-5 | **Assumptions**

Activities	Milestone Outcomes (1)	Lynchpin Outcomes
All villagers (across socio-economic status, gender, and age groups) agree to interventions and participate in implementation of interventions over time	Villagers establish and participate in social and political groups (Village Watershed Committees, Self-Help Groups)	Improvements in ecosystem health result in an increased capacity of the watershed to provide ecosystem services (e.g., biodiversity, agricultural production, pollenation, water storage and filtration, etc.).
WOTR and villagers successfully implement interventions	Environmental and technical interventions have a high success rate and are effective at reducing erosion, improving soil health, and increasing surface and groundwater storage capacity	As household wealth increases due to increased land production, households reinvest in protecting and restoring ecosystem health.
Key vulnerability drivers include climate change (delay and shortening of the monsoon season), temperature flucuations (more hot days, wider temperature extremes), greater number of rain bursts	Capacity building efforts are successful at training villagers how to maintain interventions after WOTR completes project	Ecosystem health improves to a point where it is more resilient to climate shocks.
	Formation of SHGs and SMSs, combined with gender equity training improve both men's and women's vision of women's importance in the community.	
	Promotion of village committees and watershed planning activities results in increased collective action.	
	All households have real-time access to agro-met data, and participate in vulnerability assessments and disaster risk planning.	

KEY

Table A-5 | **Assumptions (continued)**

Milestone Outcomes (2)	Adaptation Outcomes	Impacts
Villagers are able to effectively work together to diversify crop and livestock choices to avoid flooding the market with cash crops; villagers are able to pool and sell crops together on the market to reduce transaction costs Villagers have access to a revolving fund for maintenance expenses. Women have improved indoor air quality from solar cooking technologies, and they spend less time traveling to find water. As a result women have more time to participate in SHGs, microfinance efforts, and educational and farming activities. Acceptance of women's importance in the community enables more women to participate in village decision-making activities. SHGs successfully manage microfinance efforts which improves access to finance.	Diversification of women's roles combined with reduced household drudgery results in improved gender equity in the watershed. Villagers are better able to adjust their behaviors and land-management practices due to improved access to information and increased household wealth. The natural resource base of the watershed is more resilient to climate variability as the ecosystem is restored and as villagers are able to better adapt their behaviors and land-management practices. Access to information, new technologies (e.g., renewable energy and agro-met), and increased financial capital result in improved services and infrastructure that allow villagers to respond to vulnerability drivers. Additionally improved collective action increases uptake and diffusion of adaptation activities. Increased household income results in villagers investing in improved social services (e.g, education and health care) and in improving household nutrition through household gardens. Household income increases as households diversify income sources by expanding agricultural operations and investing in small business endeavors. Additionally, diversification of income can lead to increased household wealth.	Adaptation outcomes combine increased physical, financial, human, social, and natural capital in the watershed and result in increased ecosystem and human resilience and adaptive adaptative capacity as well as reduced vulnerability

KEY

Activites

Mileston Outcomes

Lynchpin Outcomes

Adaption Outcomes

Impacts

Table A-6 | **Risks**

Activities

Maladaptive activities are promoted due to misaligned priorities between implementing agency and funders.

Milestone outcomes (1)

WSD and CCA activities are not able to improve ecosystem health fast enough to restore the watershed to a threshold level where it can withstand climate variability.

Lynchpin outcome

Ecosystem health improvements are not enough to sustain improvements in ecosystem services provision over a sufficient time frame to generate economic gains.

Milestone outcomes (2)

Villagers do not coordinate agricultural activities and begin growing the same cash crops or investing in crossbreed livestock that cannot withstand climate variability

Ecosystem services benefits are not distributed equally amongst villages and villagers, resulting in increased conflict which can undermine collective action benefits

Adaptation outcomes

Continued support from WOTR is not provided when needed (e.g, unexpected climate events), and villagers are not able to respond quickly enough or technologies are not maintained over time.

Income gains are not reinvested in social programs within the watershed but are spent outside the watershed

Villagers apply income gains only to agricultural and livestock activities which are still at risk due to climate change, instead of investing in less climate-risky income-generating sources.

Table A-7 | **Review of Milestone Outcomes and Indicators, and Adaptation Outcomes and Indicators for Pilot Watersheds**

MILESTONE OUTCOMES	MILESTONE INDICATORS	ADAPTATION OUTCOMES	ADAPTATION/OUTCOME INDICATOR	LIVELIHOOD CAPITAL
Outcome Area: Natural resource base is restored and can withstand climate variability.				
Ecosystem health improves due to reduced erosion, improved soil quality, increased groundwater and surface water storage, and improved biodiversity level.	Area treated by WSD interventions by intervention category OR # units put in place (e.g., for agro-met stations).	The vulnerability of natural resources and physical assets is reduced (e.g., water, agricultural yields, livestock, biodiversity, increased tree cover).	% households who believe they are better prepared to handle drought, extreme rainfall, and temperatures, etc., due to CCA and WSD interventions.	Natural
	Soil quality level (levels of key nutrients).		Percent of vegetation planted that is in good health.	Natural
	Biodiversity level (# species recorded by biodiversity registers).			Natural
	Water table levels for bore wells.	Water security is achieved even during periods of drought.	% households who needed a family member to travel for drinking water during periods of drought.	
			% households who have safe running drinking water within easy access.	
Households are better able to budget water, energy, and other agricultural/livestock inputs.	Number of farmers trained in sustainable/resource-budgeting practices by practice type.	Households are using sustainable and resource-budgeting agricultural and livestock practices to protect land production-related income during periods of stress.	Proportion of farmers practicing sustainable/resource-budgeting agriculture and livestock practices by practice type.	Human
	Number of farmers practicing integrated nutrient management.			Human
Outcome Area: Households have improved well-being in the face of climate change.				
Households increase and sustain wealth and begin to invest in the community.	Household meals consumed per day.	Food security and proper nutrition is achieved for all households.	Proportion of population (by caste) who feel they are able to maintain nutrition/food security levels during periods of stress.	Human
	Average childhood nutrition levels.			Human
	Proportion of children enrolled in primary, secondary, and tertiary education.	Overall education level of youth is improved.	# children (by gender) who must leave school for an extended period to assist with farm labor once or more a year (>2 days).	Human
	Proportion of population with 1+ year of college.			Human
	Ratios of girls to boys in primary, secondary, and tertiary education.			Human
	Under-five mortality rate.	Households have access to affordable health care services.	Quality of health care facilities—% households content with current health care provision/infrastructure.	Human
	Prevalence of underweight children under five years of age.			Human

Table A-7 | **Review of Milestone Outcomes and Indicators, and Adaptation Outcomes and Indicators for Pilot Watersheds (continued)**

MILESTONE OUTCOMES	MILESTONE INDICATORS	ADAPTATION OUTCOMES	ADAPTATION/OUTCOME INDICATOR	LIVELIHOOD CAPITAL
Outcome Area: Households have diversified income sources.				
Households increase and sustain wealth.	Proportion of population engaged in off-farm and non-farm (allied activities) livelihood activities.	Farmers are able to diversify and strengthen livelihood sources.	% annual income by household earned from off-farm and non-farm activities.	Financial
	#crop types grown in a single year by household.	Households are equipped to make agricultural and livestock production decisions that improve community welfare.	Farmer perception of income security for agriculture and livestock activities based on village activities—level of village crop level planning.	Financial
	Mix of indigenous vs. non-indigenous crops and livestock.			Natural
Access to finance improves, and villagers invest in new farming equipment and supplies and starting new businesses.	# loans given each year per household.	All households have access to long-term and affordable credit	Number of loan repayments made on time.	Financial
	Interest rate on loans.			Financial
	Number of new businesses/ operations initiated each year.		Proportion of farmers who are able to initiate new operations beyond traditional crop and livestock production (i.e., reduced dependence on the middle man to sell products).	Financial
Outcome Area: Services, institutions, and infrastructure are in place to support climate change adaptation.				
Villagers engage in social/ political groups, which increases potential for collective action.	# committees that have fair representation of castes and gender in social and political groups (# people by caste and gender within each group (village watershed committee, self-help groups).	Communities improve social cohesion and communications to reduce conflict and increase adoption rate of adaptation interventions.	# committees that have fair representation of various castes and women in social groups/political groups measured via # people by caste and gender within each social/political group (village watershed committee, self-help groups).	
	# active village- level organizations.		% community members who believe climate change concerns are discussed during committee meetings.	Social
Access to finance improves.	Use of village-level funds, such as maintenance fund.			Social
Access to information improves.	# people trained in disaster management/DRR.	Households have the information and training needed to prepare for disasters.	% people trained in DRR who believe it has helped with land-use planning and preparedness.	Human
	# awareness campaigns conducted in village.			Social
Access to renewable energy technologies improves.	# smokeless stoves, solar street lamps, etc.	Climate resilient technologies and practices are adopted and scaled up (e.g., renewable energy technologies).	Perceptions on reliability and availability of renewable energy sources.	Physical

Table A-7 | **Review of Milestone Outcomes and Indicators, and Adaptation Outcomes and Indicators for Pilot Watersheds (continued)**

MILESTONE OUTCOMES	MILESTONE INDICATORS	ADAPTATION OUTCOMES	ADAPTATION/OUTCOME INDICATOR	LIVELIHOOD CAPITAL
Outcome Area: Gender equality is improved.				
Women participate in social/political groups.	# active female self-help groups, # women in community participating in self-help groups.	Women have a stronger role in community development and planning.	Share of women in wage employment in the non-agricultural sector.	Social
			% women who believe they have an improved voice in village decision making.	Social
Ecosystem health improves to allow for greater surface and groundwater storage.	% women traveling for collection of safe drinking water annually (hours/week of labor per woman or household).	Women experience reduced drudgery (e.g., fetching drinking water and firewood).	Adolescent birth rate.	Human
Access to renewable energy technologies improves.	% women who have access to clean cooking mechanisms.			Human
		Women have equal access to information on climate change and adaptation.	% women who believe they use climate information provided by WOTR adaptation interventions in crop, livestock, and financial decisions.	
Outcome Area: Villagers' ability to adjust behaviors and practices and plan interventions in response to vulnerability drivers improves.				
Access to information on weather improves.	# agro-met stations installed per village. (There could be at least 1 agro-met station for about 5 villages. However, there should be at least 1 rain gauge per village.)	All households have real-time information on weather, climate, and pests and can incorporate it into agricultural and livestock planning.	%households with agro-met access that incorporate information into planning (by income bracket).	Physical
	# people with access to locale-specific meteorological information stations by income bracket.			Social
	#farmers attending training on new techniques and technologies focused on resource budgeting and climate change adaptation.	All households have up-to-date information on new production technologies (resource budgeting techniques) and techniques that are climate-adaptive (e.g., low input, organic, and climate resilient, prevent soil erosion) and can be incorporated to increase resilience to drought, market pressures, and other vulnerability drivers for livestock and agriculture.	# farmers using new production technologies and techniques that are climate-adaptive (e.g., water budgeting, irrigation systems, growing climate resilient crops and using contingent crop plans).	Human

Table A-8 | **Climate Context and Indicators**

CLIMATE CONTEXT	INDICATOR
Climate change	Number of days of flooding.
	Number of drought days.
	Monsoon start and end date.
	Trends in rainfall and humidity.
	Extreme weather events (hailstorms, cyclones, heat waves, etc.).
Market vulnerability	Crop prices.
	Costs of cultivation.
	# of local markets.
	Local perceptions of market changes.

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ABOUT WRI

WRI is a global research organization that spans more than 50 countries, with offices in Brazil, China, Europe, India, Indonesia, Mexico, and the United States. WRI's more than 450 experts and staff work closely with leaders to turn big ideas into action to sustain our natural resources—the foundation of economic opportunity and human well-being.

ABOUT WOTR:

WOTR is a non-profit that engages at the intersection of practice, knowledge, and policy across scales and in collaboration with stakeholders from across sectors. WOTR assists rural communities to assess their vulnerabilities to climate and non-climatic risks. It organizes them in a social- and gender-inclusive manner to help themselves out of poverty by regenerating their ecosystems in a holistic and integrated manner, conserving and optimizing resource use, especially water, and undertaking climate-smart sustainable livelihoods. Being a learning organization, WOTR undertakes applied research and closely engages with institutional and governance actors so that insights and good practices derived from ground experience contribute to shaping enabling policies and effective programs. With a view to scale up successful interventions, WOTR develops pedagogies for implementation and organizes a variety of knowledge-sharing and capacity-building events for stakeholders across the civil society and developmental and governance spaces from India and other countries.

Today WOTR has evolved into the "WOTR Group" consisting of four not-for-profit institutions—the Watershed Organization Trust; the Sampada Trust for women's empowerment and micro-finance; Sanjeevani Institute for Empowerment and Development—the implementation wing; and the Sampada Entrepreneurship and Livelihoods Foundation, which promotes social enterprise and livelihoods.

ABOUT SUGAP

The Scaling Up Good Adaptation Practices (SUGAP) project is a partnership between the World Resources Institute, the Watershed Organisation Trust (WOTR), and the Swiss Agency for Development and Cooperation (SDC) to further the development of climate resilience in semi-arid regions of India. The partnership conducts research, convening, and outreach to promote climate change adaptation policies and funding programs at national and international levels.