

From Watershed Development to Ecosystem-based Adaptation

A journey to systemic resilience



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Key messages

- 1 EbA strengthens community resilience while preserving ecosystems. The mainstreaming of EbA in different sectors and programmes can provide a holistic approach to climate adaptation and sustainable development.
- 2 An EbA approach to sustainable land management, watershed development and sectorial programmes can increase the resilience of agricultural systems to climate change while strengthening food and nutrition security.
- 3 EbA must be economically viable. It is imperative to strengthen the income of rural communities and provide ecosystem-based livelihoods.
- 4 Human well-being depends on healthy ecosystems. EbA can deliver cultural and health benefits.
- 5 Locally led EbA implementation requires strengthening the capacities of communities, fostering village-level democratic processes and institutions, and pooling different types of knowledge.
- 6 Effective management of ecosystems needs strong collaboration between local communities, civil society organisations, private sector, government and funding agencies, from village to state levels.

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List of acronyms

AFMU	Agriculture Field Monitoring Unit
BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
CBD	Convention on Biological Diversity
CRIDA	Central Research Institute for Dryland Agriculture
CSO	Civil Society Organisations
CSR	Corporate Social Responsibility
EbA	Ecosystem-based Adaptation
FEBA	Friends of EbA
FPO	Farmer Producer Organisations
GCA	Global Commission on Adaptation
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (German national development cooperation agency)
GSDA	Groundwater Directorate of Survey and Development Agency
ICAR	Indian Council of Agricultural Research
IKI	International Climate Initiative
IUCN	International Union for Conservation of Nature
KVK	Krishi Vigyan Kendra agricultural extension centre
LDN	Land Degradation Neutrality
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MoEFCC	Ministry of Environment, Forest and Climate Change
NABARD	National Bank for Agricultural and Rural Development
NDC	National Determined Contribution
NGO	Non-Governmental Organisation
NITI	National Institution for Transforming India
NRAA	National Rainfed Area Authority
NRLM	National Rural Livelihoods Mission
PoCRA	Project on Climate Resilient Agriculture
SAPCC	State Action Plan on Climate Change
SCI	System of Crop Intensification
SDC	Swiss Agency for Development and Cooperation
SDGs	Sustainable Development Goals
SHGs	Self-Help Groups
SLM	Sustainable Land Management
SMART	State of Maharashtra Agri-business and Rural Transformation Program
SWC	Soil and Water Conservation
TMG	Töpfer Müller Gaßner Think Tank for Sustainability
UN	United Nations
UNFCCC	UN Framework Convention on Climate Change
W-CReS	WOTR Centre for Resilience Studies
WOTR	Watershed Organisation Trust

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Introduction

The climate crisis is particularly acute in India. The latest research predicts a rise in average temperatures of 2.4–4.4 °C by the end of the century. Increase in average temperature is associated with greater occurrence of heatwaves, longer and more frequent droughts, and heavy irregular rainfall. (Krishnan et al., 2020; Yaduvanshi et al., 2019).

Approximately 80 % of the state of Maharashtra is classified as semi-arid (Kalamkar, 2011) and susceptible to land degradation (Mirzabaev et al., 2019). Agriculture is an essential livelihood source. About half of its people depend directly or indirectly on agriculture for their livelihoods; of these, 80 % are small and marginal farmers (DES, 2020). Over the past two decades, droughts and unseasonal rainfall have become more frequent and resulted in massive crop failures, rising debt, distress migration and suicide, especially among smallholders farmers (Kulkarni et al., 2020). The market-driven emergence of monocultures further adds to climate vulnerability in the agricultural sector.

India has been among the first countries to take measures to mitigate the effects of climate change, starting in 2007 with the foundation of the Prime Minister's Council on Climate Change. At state level, the State Action Plan on Climate Change (SAPCC) guides policies and programmes that address climate change. In addition to its SAPCC, Maharashtra has mainstreamed adaptation to climate change in several sectoral programmes. One example is the Project on Climate-Resilient Agriculture (PoCRA), which aims to enhance climate resilience and profitability of smallholder farms in selected districts of Maharashtra.

Ecosystem-based Adaptation: a systemic response to climate change

Several organisations have promoted nature-based solutions, including the Global Commission on Adaptation (GCA) and the United Nations Framework Convention on Climate Change (UNFCCC). These solutions are valued for their sustainability and higher cost-effectiveness compared to infrastructure-based solutions. The GCA has found that the overall return on investments in adaptation is high, with benefit-cost ratios ranging from 2:1 to 10:1, or even higher (GCA, 2019). Ecosystem-based Adaptation (EbA) is one example of a nature-based solution for adaptation. It is a systemic approach that focuses on increasing people's adaptive capacity through the sustainable use, conservation and restoration of ecosystems, their services, and biodiversity. It also aims for inclusive governance and improved coordination at different policy levels to create a sustainable development model (Epple et al., 2016). Further, EbA is regarded as a low-cost and no-regret option¹. Studies show that it can be used as an effective pro-poor approach in rural development, given its social co-benefits such as food security and poverty reduction (see Munang et al. (2013)).

Purpose and scope of the paper

EbA is a relatively new concept. The term was coined in 2008 by the International Union for Conservation of Nature (IUCN) and defined in the UN Convention on Biological Diversity in 2009. Though it covers a number of activities that have already been implemented in India, such as integrated watershed developments, the concept may be less well known at the state or central policy levels. There is, therefore, a need to examine innovative and locally successful initiatives through an EbA lens, to demonstrate the effectiveness and value of EbA in the context of Maharashtra. It is equally important to understand the enabling conditions under which EbA can flourish.

This report presents the results of case studies of two watershed projects in Ahmednagar district, Maharashtra, from an EbA perspective. The aim of sharing these results is to showcase how EbA can help to build systemic resilience of ecosystems and people. Further, the report provides recommendations on how EbA can be implemented across diverse sectors and at scale in Maharashtra. Although based on insights from Maharashtra, most of the key messages and recommendations can be applied to other states in India. The case study findings can guide the integration and scaling of EbA across different sectors and in different agro-ecological and climatic regions, and aid the formulation of more robust, science-based adaptation policies and legislation. It can also help the state of Maharashtra, and India as a whole, contribute to state action plans on climate change, conserve biodiversity, manage land degradation, and more generally make progress towards achieving the United Nations Sustainable Development Goals (SDGs).

The Convention on Biological Diversity defines EbA as

"... the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change"

Examples of EbA include restoring mangroves and wetlands, sustainable management of mountainous regions, and agroforestry. In semi-arid regions of Maharashtra, integrated watershed development involving soil and water conservation combined with sustainable agriculture, water budgeting, biodiversity conservation and inclusive village governance, is of particular relevance.

As shown in this report, due to its holistic nature, EbA can address several crises facing India. These include climate change, biodiversity loss, land degradation, and undernutrition. The recent COVID-19 crisis has shown that human development, at the cost of biodiversity and ecosystems destruction, tends to favour disease outbreaks (Gibb et al., 2020; Schmeller et al., 2020). Thus, in the face of these multiple crises, it is essential to scale up EbA and reap its full potential in "building forward" to transition to a green and just economy. Watershed development programmes, which have been implemented in India since the 1970s, provide an opportune context to scale up EbA.

¹ No-regret actions in the context of EbA mean "measures taken by communities [and/or facilitated by organisations] which do not worsen vulnerabilities to climate change or which increase adaptive capacities and measures that will always have a positive impact on livelihoods and ecosystems regardless of how the climate changes". (IUCN, 2014. *Ecosystem-based Adaptation: Building on No Regret Adaptation Measures. Technical Paper*; available here: https://www.iucn.org/downloads/iucn_eba_technical_paper_no_regret_actions_cop20_lima.pdf)

Methodology

Description of EbA-type interventions in Ahmednagar



Map 1: Location of the two case studies, Bhojdari and Purushwadi.

Watershed development projects were investigated to assess their effectiveness from an EbA perspective, in Bhojdari and Purushwadi villages, Ahmednagar district, Maharashtra (see Map 1).

Both villages are located in the west of the state, but differ in their agro-ecological context. Bhojdari lies in Sangamner block², in a semi-arid rain-shadow area of the Western Ghats mountain range, and is increasingly prone to droughts, with an average annual rainfall of about 550 mm (2010–2020). Bhojdari has about 1,000 inhabitants (INDAS, 2019), composed of a mixture of “tribal”, or indigenous people, and

“non-tribal” ethnicities³. The villagers are vulnerable to climatic risks, such as unseasonal and high-intensity rainfall, delayed monsoon onset, and droughts.

The village of Purushwadi is located in the Akole block, in the Western Ghats mountain range. It receives a significantly higher average rainfall of about 1,850 mm/year (2010–2020) and is surrounded by forest. Purushwadi has a population of about 700 inhabitants (Census 2011), who are predominantly tribal. As in Bhojdari, the villagers are vulnerable to unseasonal and extreme rainfall, frost and heatwaves. Drought is less of a concern in this village.

² Fourth administrative subdivision of the Federal Republic of India, also known as Tehsil, following the order 1. Country, 2. State, 3. District and 4. Block (Tehsil).
³ The Indian Census distinguishes citizens by ethnicity. ‘Tribes’ are characterised by distinctive geographical and cultural origins, and are generally marginalised socio-economically. The Indian Constitution officially identifies the group “Scheduled Tribes”, for which development policies are tailored to reduce the gap with non-tribal populations.

The Watershed Organisation Trust (WOTR) has led many large-scale watershed development projects across the state over the last 25 years. These include the Indo-German Watershed Development Programme, implemented in Bhojdari from 1996 to 2002, and the Community Based Natural Resource Management along Watershed Lines for Sustainable Rural Livelihoods, implemented in Purushwadi from 2002 to 2007.

This study looked at two more recent projects from an EbA perspective

WOTR has collaborated with TMG Research to examine two more recent projects from an EbA perspective:

- The Climate Change Adaptation project, implemented between 2009 and 2014,

enhanced the capacities of rural communities to adapt to climate change. Although based on the watershed concept, the project also included activities related to ecosystems. The project was funded by the National Bank for Agricultural and Rural Development (NABARD) and the Swiss Agency for Development and Cooperation (SDC).

- The Water Stewardship Initiative, which was active from 2015 to 2017, built community capacity to face droughts through water budgeting. The initiative was funded by the Hindustan Unilever Foundation.

An overview of both projects is presented in Table 1. The results examined in this report are those of these two projects, over the period 2009 to 2017.

Theme	Activities
Sustainable adaptive agriculture	Increase adaptive capacities of farmers through training, promoting soil health, crop diversification, increased crop productivity with low external inputs, and agro-met advisory services.
Water budgeting, demand-side management	Crop selection based on available water (rainfall and groundwater) after prioritising domestic and livestock drinking water needs and promotion of water-saving techniques.
Livestock management	Attention to indigenous livestock species and training in veterinary care.
Diversification of livelihood	Alternative farm-allied and non-farm income sources that are more climate-resilient (e.g., apiaries, value addition, oilseed processing, ecotourism).
Biodiversity protection	Improve ecosystem health, increase residents’ awareness of local biodiversity and ecosystem services, and facilitate indigenous knowledge (e.g., festivals, creation of biodiversity and forest protection committees) and protection of local rights (e.g., biodiversity registers for ownership and actions).
Governance	Capacity building, creation of inclusive local committees for natural resource management, women’s self-help groups.
Healthy and attractive villages	Reduce and better manage waste generated in the village, plant trees and vegetation in the area of settlement, improve quality of life (health and hygiene).

Table 1: Overview of interventions in both villages during the Climate Change Adaptation project and the Water Stewardship Initiative [Adapted from Gray & Srinidhi (2013)]

Conceptual framework

Following the definition of EbA in the Convention on Biological Diversity (CBD), the framework which guided the case study is based on three elements: EbA should improve i) communities' adaptive capacities, ii) ecosystems and biodiversity, and iii) participatory governance (see Figure 1).

The framework assesses EbA effectiveness in terms of the three elements outlined in Figure 1. Each element was further defined by sub-categories, which were in turn assessed in the case studies using a series of measurable indicators (see Table 2). Key results for each EbA element are reported in the Annex.

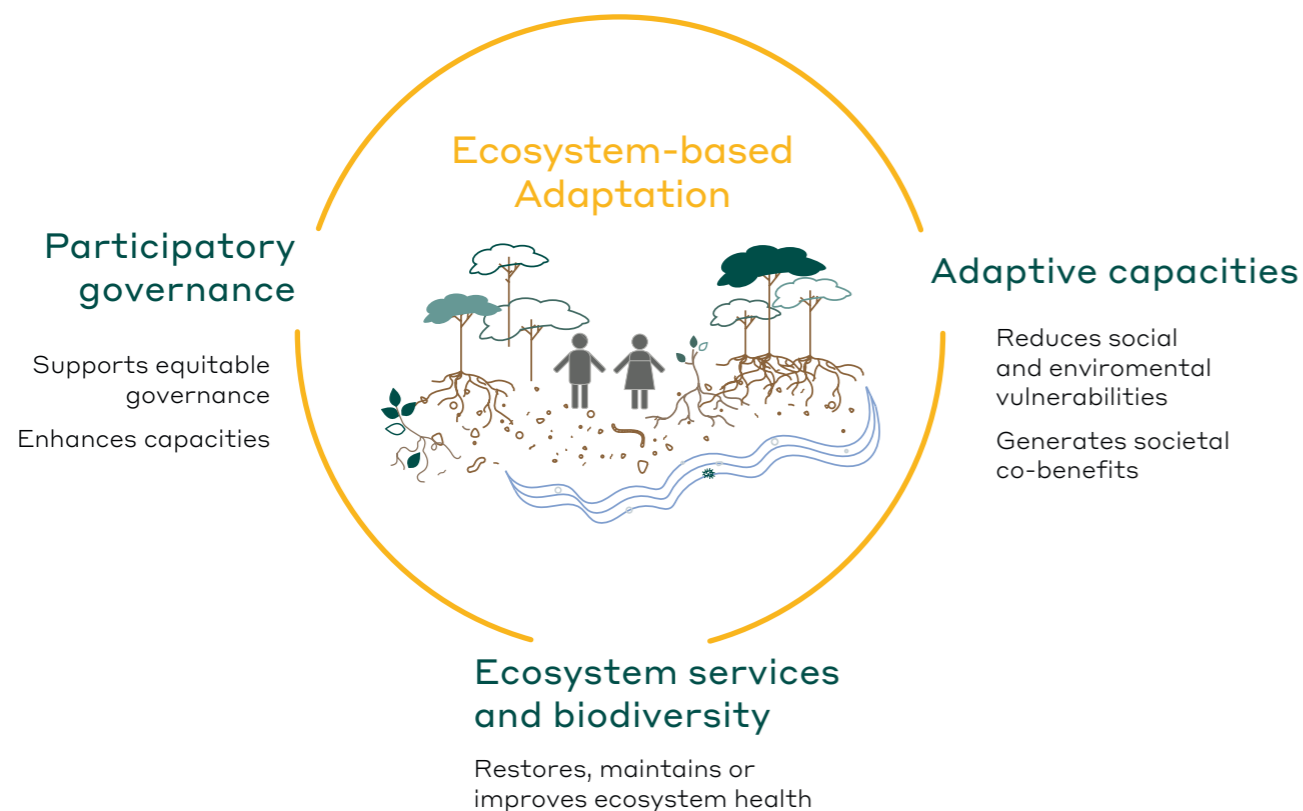


Figure 1: The three elements that constitute Ecosystem-based Adaptation, based on FEBA (2017). © P. Korneevea/TMG Research

EbA element	Sub-category	Indicators
Adaptive capacities	▶ Livelihood and income	▶ Increased income, enhanced agricultural production
	▶ Food security	▶ Increased food availability
	▶ Distress migration	▶ Decreased distress migration
Ecosystem services and biodiversity	▶ Forest and vegetation cover	▶ Increased forest and vegetative cover
	▶ Water resources	▶ Increased water availability
	▶ Biodiversity	▶ Increased biodiversity
	▶ Soil quality	▶ Improved soil health
Participatory governance	▶ Representation and participation in local institutions	▶ Increased representation of women and marginalised groups
	▶ Improved institutional collaboration	▶ Increased engagement in natural resource management
	▶ Equitable benefit-sharing	▶ Increased collaboration with local administration
		▶ Equitable distribution of benefits

Table 2: Framework used to assess EbA effectiveness in both case studies.

Data collection

Data was collected through a mixed-method approach, using quantitative and qualitative methods, between November 2019 and August 2020. Quantitative data provided information on the background context and on the situation before and after the project implementation. Secondary data was sourced from existing project documentation or land-use analyses based on satellite images. Qualitative data helped to link the observed changes to the EbA intervention, as well as to fill gaps in the quantitative data. They were collected

during field research using focus group discussions, community-based workshops, participatory rural appraisal methods, government network mapping exercises, and in-depth interviews with members of different social groups (e.g., farmers, landless farm labourers, pastoralists, community leaders, local administrators). A total of 90 and 31 people were interviewed in Bhojdari and Purushwadi respectively. The number in Purushwadi is smaller as the COVID-19 crisis limited the field research.

Ecosystem-based Adaptation in practice: an analysis of two watershed development projects in Ahmednagar district, Maharashtra

Research findings from the two project sites of Bhojdari and Purushwadi are analysed in the following sections. Key findings are presented regarding what EbA has delivered (environmental, social and economic effectiveness) and the conditions under which it can flourish.

Building on this evidence, the following chapters emphasise several key messages, supported by recommendations for successful implementation of EbA at scale in the context of watershed development and across diverse sectors.

► Key message 1: EbA strengthens community resilience while preserving ecosystems.

The mainstreaming of EbA in different sectors and programmes can provide a holistic approach to climate adaptation and sustainable development.

Climate change affects not only humans but also the functioning of ecosystems and the vital services they provide. Adaptation to climate change must therefore be multifaceted. The full potential of EbA is to build the resilience of human societies and ecosystems at the same time.

Evidence

Both village initiatives originated from the sustainable land management approach of watershed development, which was later extended to include ecosystem and biodiversity conservation. The communities' resilience to climate

change was reinforced by promoting more sustainable agricultural production systems, resulting in higher income, better food security and improved living conditions. Due to soil and water management measures, ecosystems and biodiversity have been partly restored. Particular attention was paid to improving participation, strengthening local governance, and benefit-sharing. This increased representation of women and marginalised groups, improved the management of natural resources and institutional collaboration with governmental agencies. These impacts highlight the value of implementing watershed development projects following an EbA approach, which yields multiple benefits for different sectoral agendas.

Upscaling EbA across Maharashtra by mainstreaming it in sustainable land management, watershed development and sectoral programmes can produce multiple benefits: economic benefits to local communities, along with large-scale adaptation to climate change, natural resource conservation, and improved alignment with the Sustainable Development Goals (SDGs).

Upscaling refers to “increas[ing] the geographic scale, policy scope or institutional scale by applying successful activities and approaches at different levels” (SOPAC/UNDP/UNEP/GEF, 2011). This includes both vertical (top-down or bottom-up, influencing policy reforms) and horizontal (replication across people and geographies) scaling, also referred to as outscaling. An essential instrument for (especially vertical, government-driven) upscaling is mainstreaming.

Mainstreaming in the development sector means the widespread adoption of a new policy, delivery method for public services, or method of programme management, taking full account of the state or country context.



Community meeting in Bhojdari, Maharashtra, India. © TMG Research

Recommendations

- 1. Endorse systems perspective centred around people and the natural environment.** Economies and societies rely on healthy ecosystems. EbA, as a holistic approach to adaptation, can boost the resilience of communities against climate change while conserving ecosystems, thus contributing significantly to sustainable development. EbA cannot be seen as a stand-alone adaptation strategy or activity but should become a core and transversal topic in policies and actions related to sustainable development.
- 2. Mainstream EbA in sustainable land management, watershed development and other relevant sectoral programmes and policies.** Sustainable land management (SLM) practices, such as watershed development, already include some components of EbA, due to their integrated approach to climate change adaptation (see Table 3). Therefore, it is opportune to extend this long-standing experience by mainstreaming EbA in SLM and watershed development programmes, for example, under the central government's Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) farm productivity programme. Additionally, to avail of the multiple and integrated benefits of EbA, the concept could be mainstreamed in sectoral projects related to biodiversity, forestry, water, agriculture and livestock farming. At the central level, EbA could feature in the "Doubling Farmers' Income" mission, the Aatmanirbhar Bharat self-reliance mission, and the National Rural Livelihoods Mission. Maharashtra is currently updating its State Action Plan on Climate Change (SAPCC), which provides an opportunity to mainstream EbA. Other programmes include the Atal Bhujal Yojana groundwater management scheme and NABARD's projects on natural resource management.
- 3. Develop a multisectoral monitoring and evaluation framework to assess EbA.** To ensure that EbA delivers multiple outcomes in different programmes, achievements need to be monitored and evaluated. A comprehensive framework is required, which includes progress in reporting on national and international agreements. The framework may be inspired by evidence of the resilience of socio-ecological systems (cf. Samuel et al., 2015), existing tools such as the guidebook for monitoring and evaluating EbA (GIZ et al., 2020), or the assessment framework used for this report.
- 4. Evaluate any EbA project in terms of its contribution to the Sustainable Development Goals, Paris Agreement and other commitments.** The implementation of EbA at a large scale can help achieve many of the Sustainable Development Goals (SDGs). NITI Aayog tracks progress towards the SDGs with a series of indicators used to compute the SDG Index. Efforts to upscale EbA would benefit from the use of SDG indicators monitored by NITI Aayog. Likewise, EbA can be used to contribute to India's Nationally Determined Contributions (NDC) to the Paris Agreement on Climate Change, as well as other international commitments, such as the UN Convention on Biodiversity and Combatting Desertification.

Integrated Watershed Development, including allied development activities	An EbA approach to watershed development
Soil and water conservation (area treatment, drainage line treatment), from ridge to valley with afforestation.	Soil and water conservation from ridge to valley, according to the respective ecosystem and respective land classification; attention to upstream-downstream needs of humans, flora and fauna, the promotion of local biodiversity and maintaining a People's Biodiversity Register .
Water harvesting and increase in groundwater levels; water management with farm ponds and micro-irrigation and water budgets.	Community-driven water management (e.g., a water stewardship approach) that includes understanding the aquifers, community plans for water harvesting, demand-side management through annual water budgets, crop choices appropriate to the ecosystem, water conservation technologies, and water sharing. Plans prioritise water for domestic use, livestock, livelihoods, and ecology/environmental flows.
The main focus is to increase agricultural production and secure agriculture-related livelihoods through attention to soil conservation and water availability.	In addition to enhancing agricultural production and agriculture-related livelihoods, an EbA approach seeks to achieve broader benefits through a focus on crop diversity and rotation, local agro-biodiversity, a package of practices for climate-resilient agriculture, nature-based solutions, and soil health.
Active engagement of local communities in project management. Some have Joint Forest Management Committees.	An EbA approach involves more active and inclusive community-based management of watersheds by Gram Panchayat (village councils) with relevant committees such as Joint Forest Management Committees, Village Development Committees, and Biodiversity Management Committees.

Table 3: Key differences between an EbA approach and Integrated Watershed Development

► **Key message 2:** An EbA approach to sustainable land management, watershed development and sectorial programmes can increase the resilience of agricultural systems to climate change while strengthening food and nutrition security.

Ecosystems provide essential services that support agriculture production. These include soil formation, water provision in quantity and quality, pollination, and biological pest control (Millennium Ecosystem Assessment, 2005). However, climate change is likely to negatively affect ecosystem health and the services that ecosystems provide to agriculture (Pedrono et al., 2016). Therefore, intact ecosystems that can buffer climatic hazards, such as droughts and heavy rainfall, are pivotal in making agricultural systems climate-resilient.

Evidence

The projects under study have been implemented Soil and Water Conservation (SWC) at the landscape scale to restore, sustain, and protect ecosystem services. SWC measures included construction of contour trenches, stone and farm bunds, and drainage line treatments, as well as reforestation. These activities have reduced the area of degraded land in Bhojdari by 27% while improving soil quality, in favour of scrub forest. The close collaboration WOTR maintained with the local government, the Gram Panchayat⁴ and the Department of Forestry enabled the implementation of SWC measures on a large scale, both on village commons and forest lands. Strengthened local governance was another decisive factor, creating a Village Development Committee that administered a fund to maintain the SWC structures. Improved soil moisture was

observed in both cases, which enabled the cultivation of an additional crop after the monsoon season. The projects also promoted organic fertilisers and bio-pesticides to enhance soil quality.

The secured and clear land rights villagers enjoy at the study sites provided an incentive for the community to undertake SWC works on a large scale, since adjacent farmlands would benefit. Even though the projects' SWC measures increased the groundwater recharge, as was observed initially with rising levels in open wells, external factors negated these positive effects. The heavy extraction of groundwater through borehole wells eventually lowered the groundwater levels, and the few perennial springs became intermittent.

The new water scarcity scenario caused by uncontrolled groundwater use triggered the *Water Stewardship Initiative* promoted by WOTR. This involved mobilising and informing the farming community about the principles of sustainable water management. It helped farmers understand the importance of sustainable water use for crop productivity, and strengthen capacity to manage water resources. A particular focus was on water budgeting, to ensure better cropping plans with the water available. Crop adequation was reinforced by other project activities such as installing real-time weather stations and building the communities' capacities to avail of weather advisory services. These measures helped farmers make their agricultural systems more resilient. The strengthening



Kitchen garden in Odisha, India. © WOTR

of village institutions (Village Water Management Team under the Gram Panchayat) and local knowledge-sharing were enabling factors for the success of the *Water Stewardship Initiative*.

The promotion of climate-resilient and sustainable agricultural systems helped to conserve local agro-biodiversity. For example, crop diversification, including the use of indigenous crop varieties, was implemented in Bhojdari as a buffer against threats from extreme weather events, disease and pests. The reintroduction of indigenous crops played a crucial role during the drought of 2018 when indigenous pearl millet was the only rain-fed crop that thrived. The System of Crop Intensification⁵ (SCI) was adopted in both villages for

various crops (e.g., rice, millet, pulses, wheat). This had the effect of raising yields, reducing water and input costs, and improving climate resilience. In Purushwadi, this was particularly the case for rice, where the yield increased by 50% between 2009 and 2017. Sustainable agroforestry was applied in both villages with the reintroduction of indigenous tree varieties. These provided additional fodder for livestock, fuelwood, and fruits. The local varieties largely replaced Eucalyptus, which was predominant before the initiatives. The improvement on private lands, such as tree planting, was made possible as land rights were secured, including for the vulnerable tribal households.

⁴ The Gram Panchayat is a village council composed of seven to seventeen members and headed by the Sarpanch, elected for five years by the Gram Sabha (village forum). It acts as the village-level government administration in charge of public works (water supply, roads, drainage, school buildings, and public infrastructure), local taxes, and government employment schemes.

⁵ Agricultural practice which involves four successive steps: soil preparation and management, ample and regular crop spacing, application of locally prepared organic inputs, and micro-nutrient foliar sprays.

In addition to developing more resilient agriculture, food security has improved. Food is now more reliably available in both villages and food shortages have been halved. One reason is an increase in cereals yields, largely because of the SCI practice. Another reason for improved food availability and nutrition are household kitchen gardens, introduced to the women's Self-Help Groups (SHGs) by WOTR in both villages. These backyard gardens produce more nutritious food to support a better diet. The production included a diverse range of vegetables such as spinach, cauliflower, cabbage, aubergine, tomatoes, and potatoes. Since indigenous crops tend to have higher nutritional value, the projects encouraged the cultivation of indigenous varai⁶, alongside groundnut and pulses for household consumption. Improved local governance and knowledge-sharing proved essential to food security. The women's SHGs sensitised the community and shared knowledge on the benefits of improved nutrition.

Alongside the multitude of positive outcomes associated with the EbA type interventions, trade-offs between agricultural production and the protection of ecosystems and biodiversity could be observed as well. In Bhojdari, there is a trend, independent of the projects' interventions, for indigenous cow breeds to be replaced by more productive crossbreeds. In Purushwadi, the implementation of the Forest Rights Act⁷ has led to forests being cleared to develop agriculture land. More generally and beyond the two cases examined here, the market draws farmers to cash crops and away from agro-biodiverse crops (Kahane et al., 2013). Agricultural projects also often pay less attention to measures preserving ecosystems. While they intend to improve food security and livelihoods, especially for vulnerable groups, such projects can adversely affect ecosystem health if not accompanied by sustainable natural resource management. An EbA approach can address the trade-off between agriculture and ecosystems by offering solutions that benefit both people and nature.

Contour Trenches across landscape, Ahmednagar District, Maharashtra, India. © WOTR



⁶ A category of millet, also known as Samo rice. ⁷ The Forest Rights Act (2006) protects the rights of Scheduled Tribes and other traditional forest dwellers to livelihoods and food security, while at the same time considering the needs of the environment. The Act grants land ownership rights to tribal communities who have been tilling the land.

Recommendations

- 1. Recognise the value of indigenous crops for climate-resilient agriculture and food and nutrition security.** Our understanding of food security must go beyond the measurement of calories and towards a more holistic perspective on varied diets. The two case studies testify to the value of indigenous crops in terms of nutritional value and resilience to weather variation. A scientific review, based on traditional knowledge of indigenous crops and cultivation practices can inform policy and promote the inclusion of indigenous crops in public distribution systems, the government's Midday Meal Scheme and the "Poshan Abhiyaan" (National Nutrition Mission). Women have an essential role at the village level to raise awareness about nutritious and sustainable food habits.
- 2. Promote mixed cropping as opposed to monocultivation.** Agricultural productivity is conventionally measured in term of a single crop yield, which twists agricultural development towards high-yielding single crops. Yet, these are particularly vulnerable to threats from droughts, diseases and pests. Crop diversification will be supported and duly recognised when agricultural metrics place emphasis on multi-crop yields.
- 3. Mainstream EbA in relevant government agricultural programmes.** Several existing government programmes promote sustainable agriculture. These include the "National Mission for Sustainable Agriculture" and Maharashtra's Project on Climate Resilient Agriculture (PoCRA). These programmes could benefit from the holistic approach EbA provides to address the trade-off between improving agriculture production and preserving ecosystems. Their scope should be expanded towards the whole ecosystem approach of EbA to include additional ecosystem services at the landscape scale and enable the pollination and biological pest control essential to agriculture.

► **Key message 3: EbA must be economically viable. It is imperative to strengthen the income of rural communities and provide ecosystem-based livelihoods.**

To ensure the longevity and sustainability of any EbA intervention, the local communities restoring and protecting the ecosystems must perceive their value and benefit. There are various ways of making EbA attractive, as illustrated by the evidence from Bhojdari and Purushwadi.

Evidence

Both EbA initiatives had a strong focus on improving livelihoods, which resulted in an increase in income of 38 % on average between 2009 and 2017. Thus, agriculture was not only made more climate-resilient but also more profitable due to greater diversity of cash crops, enhanced yields, improved market accesses, and a reduction in input costs. Increased dairy farming was another contributing factor to increased income. Fostering of good practices in agriculture and guidance provided by WOTR facilitated better market access. The local credit cooperative also facilitated access to agricultural credit and enabled the purchase of agricultural inputs.

Taking advantage of a scenic environment and unique local biodiversity, the project in Purushwadi promoted ecotourism as an ecosystem-based livelihood to supplement the income from farming.

This has proven to be a significant source of additional income, increasing from INR 1,150 per household per year in 2008 to INR 12,000 in 2019; it also benefits youth and women. Locally sourced natural products, such as indigenous rice, honey, wild fruits, poultry and handicrafts are also sold to tourists. Around 40–50 % of the money spent by tourists goes to local service providers. The implementation of EbA activities empowering the village institutions has been an enabling factor. The local Biodiversity Management Committee, which promoted the protection of local biodiversity through the People's Biodiversity Register⁸, has been instrumental in preserving ecosystems as a basis and requirement for the development of ecotourism in the village.

The projects also availed of the government payment mechanism MGNREGA⁹ to fund soil and water conservation works that provided guaranteed paid employment for the villagers of Bhojdari and Purushwadi.

Greater earnings in both villages led to a significant reduction in distress migration, which indicates improved living conditions. There is, however, room to augment incomes further from indigenous and nutritional crops, as well as other ecosystem-based products.



Ecotourism in Purushwadi, Maharashtra, India. © WOTR

Eco-tourism in Purushwadi: The firefly festival

Purushwadi is a scenic village situated 220 km from Mumbai. The local community belongs to the Mahadeo Koli tribe, which excels in rice cultivation. The village is perhaps best known today for the firefly festival that takes place in May and June. The festival is typically a 2-day event that consists of camping, hiking and sampling local cuisine, including green chilli thecha¹⁰ and sweet puran polis¹¹. During night-time walks tourists get to witness thousands of fireflies putting on their mating lights.

⁸ The aim of the People's Biodiversity Register is to record local and traditional knowledge, local biological resources and their medicinal or other uses, and pass these on to the younger generations (NBA, 2013) ⁹ The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is a governmental scheme that offers 100 days of paid manual labour per household per year on public works projects.

¹⁰ Spicy condiment prepared with chili peppers (green or red) and garlic, often tempered in oil and lemon. ¹¹ Sweet flat bread

Recommendations

1. **Promote income from indigenous and nutritional crops.** The efforts to strengthen farmers' income from agriculture must include the promotion of indigenous crop varieties by emphasising their nutritional value. This requires studying and selecting indigenous crops suited to different local contexts and developing their value chain. This should be followed by a proactive campaign to promote indigenous crops, emphasising their cultural and nutritional value, to foster consumer market demand.
2. **Promote income from sustainable, biodiversity-based products.** Conservation of local biodiversity can provide opportunities to generate additional income. Ecotourism and locally sourced non-timber forest products, such as honey, wax products, coffee, and medicinal plants can offer viable income sources. Starting with local biodiversity documentation in the People's Biodiversity Register, biodiversity and ecosystem benefits should be investigated for their potential commercial exploitation and promoted accordingly to stimulate market demand.
3. **Strengthen the role of Farmer Producer Organisations in developing sustainable value chains.** Various governmental schemes support Farmer Producer Organisations (FPOs). These schemes focus particularly on small and marginal farmers, to increase their negotiating power and access to investment, technology, inputs, and markets. The role of FPOs could be extended to exploit and commercialise indigenous crops, as well as ecosystem-based products. Support could help farmers build professional skills and entrepreneurship, reduce their losses post-harvest, and develop sustainable value chains, from harvest to fork. There are government schemes that could fund this support of FPOs. These include the national mission "Aatmanirbhar Bharat" (Self-reliant India and the State of Maharashtra's Agri-business and Rural Transformation Program (SMART), which supports agriculture value chains and facilitates business models that respond to climate change risks.
4. **Strengthen women's contribution to ecosystem-based livelihoods.** The inclusion of women in agricultural capacity building is often neglected. Dedicated effort to involve women in ecosystem-based farming, as well as ecotourism, can boost entrepreneurship, leading to increased family incomes and strengthened livelihoods. The government's National Rural Livelihoods Mission (NRLM), which aims to improve livelihoods through strengthened local institutions and women's SHGs, offers an opportunity to involve women in EbA.
5. **Make agriculture and EbA more attractive to local youth.** Youth may lack interest in agriculture and ecosystems, considering them antiquated and unattractive sources of livelihood. Therefore, it is important to add elements of modernity in practising agriculture and managing ecosystems. Sustainable agriculture could also be promoted as "Climate-Smart Agriculture" using agrometeorological services accessible through phone apps, as piloted by WOTR. Managing ecosystems could be associated with various apps, such as accessing a joint knowledge base, conducting surveys, and community mapping (e.g., OpenStreetMap). Ecotourism is another ecosystem-based activity to promote, as it has proven to attract youths and provide income.
6. **Mainstream EbA in the national "Doubling Farmers' Income" strategy.** At the time of writing this report, agrarian distress and proposed agricultural reforms are being widely discussed in India. Different perspectives have been debated but most stakeholders agree on the urgent need to make agriculture more economically viable. The evidence provided above suggests that an EbA approach, built on democratic inclusion of farmers and vulnerable groups, can make agriculture sustainable and economically viable in the long-term, thereby contributing to the national strategy of "Doubling Farmers' Income". Mainstreaming EbA in the strategy would involve sustainable farming, forest, farm-allied and non-farm livelihoods that would reduce risks and improve the incomes of rural households.
7. **Provide financial incentives and safety nets to support ecosystem-based livelihoods.** Ecosystem services are public services since the benefits go beyond the local community and extend to the broader society. Additionally, financing the inception of ecosystem-related activities is especially important as EbA benefits usually take time to unfold. Therefore, incentives or payment mechanisms should be created for local communities to maintain and restore certain ecosystem services. For instance, the MGNREGA scheme could fund ecosystem conservation works, as part of an EbA approach, while additional funds could be sourced from Corporate Social Responsibility (CSR) policies. Insurance mechanisms should also be explored to protect ecosystem-based entrepreneurship.

► **Key message 4: Human well-being depends on healthy ecosystems. EbA can deliver cultural and health benefits.**

The Millennium Ecosystem Assessment (2005) reviewed the consequences of ecosystem change for human well-being. The figure below illustrates how ecosystem services are vital to the different constituents of human well-being (see Figure 2). Both of the case study villages have addressed four

constituents of well-being defined by this assessment: security, basic material conditions, social relations, and health. The health constituent became particularly prominent in 2020 with the COVID-19 pandemic and recognition of the One Health concept.

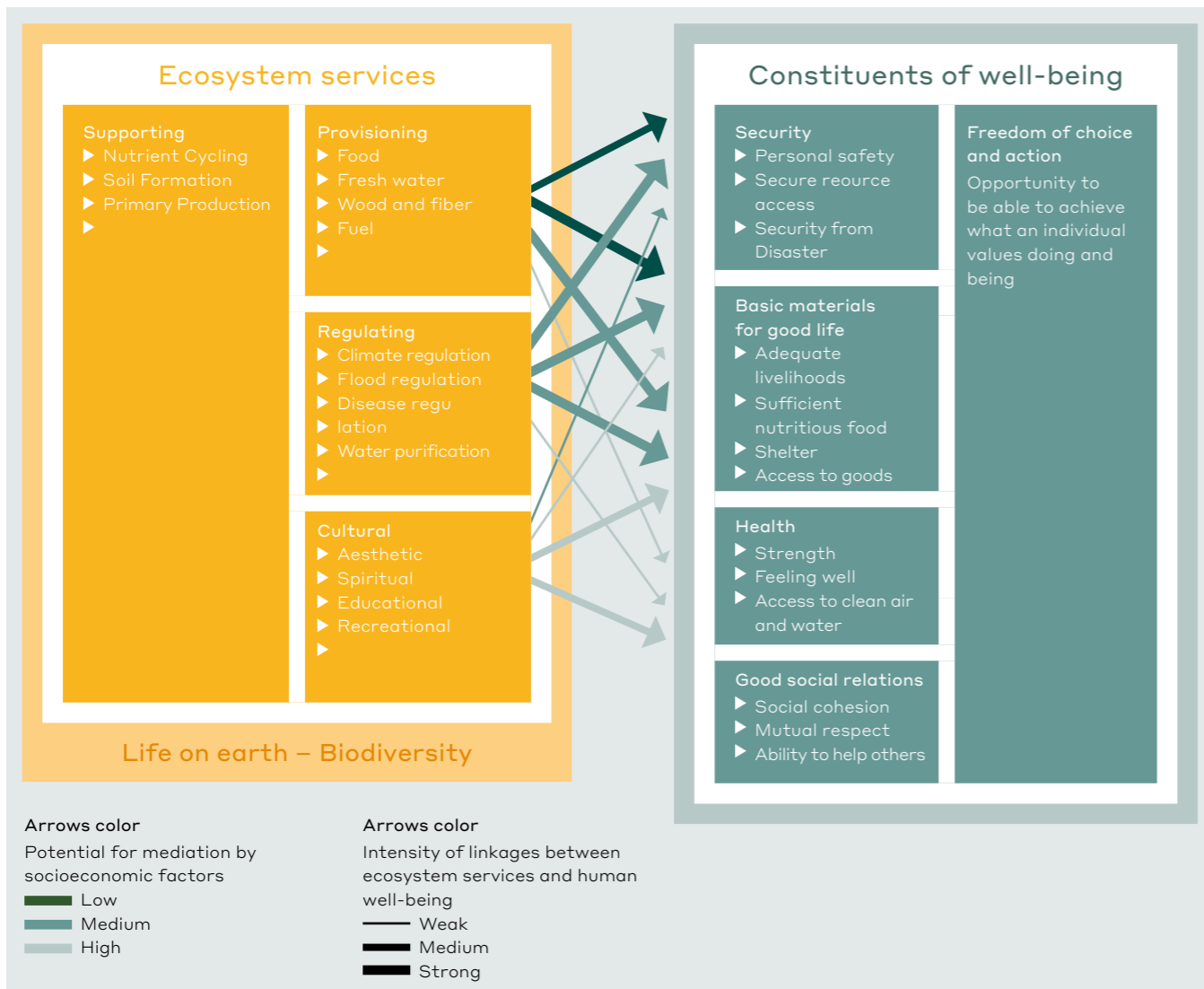


Figure 2: Linkages between ecosystem services and well-being (Source: Millennium Ecosystem Assessment (2005))

Evidence

In both villages, EbA-type interventions have improved basic material conditions for a good life and security. Income has increased, from agriculture and ecotourism, giving people a sense of security and satisfaction. The women's Self-Help Groups (SHGs) contributed by ensuring access to credit for consumption purposes. A better diet was also promoted by diversifying crops, and growing vegetables in kitchen gardens. Efforts were also dedicated to ensure solid waste management in the village.

Social relations have also improved. In both Bhojdari and Purushwadi, the formation of different local committees brought all households together to contribute to the development of their villages. Tribal households in Bhojdari are now participating in various village-level meetings and the Gram Sabhas, which was rarely the case before the projects. The number of women's SHGs has increased post-project, indicating the sense of cohesion they provide.

The health situation has also improved, with availability and better access to clean water due to a piped water supply and the women's SHGs raising awareness of the importance of clean water and hygiene. Piped water for domestic use has greatly reduced the workload of women. This was associated with efforts to improve sanitation by installing toilets to prevent contamination of the villages' natural environment. Given greater access to nutritious diets led to an observed reduction in undernutrition and healthier child development.



Kitchen Garden in Parner, Maharashtra, India. © WOTR

Ecosystems also provide cultural services, such as scenic beauty, education, recreation, tourism, and as a reminder and repository of traditional customs. Both projects beautified the villages through the planting of trees on roadsides and field bunds. While assessing the project's impacts, villagers commented on the greener landscape, with increased local flora and wildlife. The adoption of the People's Biodiversity Register and community-led protection of local biodiversity have augmented the notion of heritage. In Purushwadi, it has also fostered ecotourism and has become a matter of pride for the village when interacting with tourists.



Biodiversity Exhibition in Malegaon Pathar, Maharashtra, India. © WOTR

Beyond human well-being at local level, maintaining the health of ecosystems is equally essential to prevent the spread of zoonotic diseases that can have global impacts. The Covid-19 pandemic raised to prominence the concept of *One Health*. This concept emphasises the complex interrelationships of human, animal and environmental health. Thus, a *One Health* approach stipulates the need to safeguard ecosystem and animal health for human health¹². EbA provides a holistic framework to implement the *One Health* approach. This was illustrated in both case studies with activities that, in addition to improving communities' wellbeing, restored and protected their ecosystems, including other aspects, such as sustainable livestock rearing.

Recommendations

- 1. Adopt EbA as a path to implement the One Health approach.** Protecting and restoring forests and its biodiversity reduces interaction between wildlife and humans, with the consequent reduced risk of zoonotic pandemics. Including EbA in the livestock sector is particularly relevant. Thus, EbA is an essential building block of a One Health approach that promotes human and planetary health alike.
- 2. Promote EbA to improve well-being in rural areas.** EbA is essential to well-being in villages due to the benefits gained from essential ecosystem services. Besides water, nutrition and livelihoods, healthy ecosystems provide cultural services that contribute to human well-being. The “National Mission on Biodiversity and Human Well-Being” lends itself to mainstreaming EbA, which unites biodiversity, conservation and development with improved livelihoods.
- 3. Support tools to conserve traditional knowledge for future generations.** Traditional knowledge known to the village elders, for instance on local flora and fauna, indigenous crops, sacred groves and sacred ponds, is rapidly disappearing. Mechanisms are required to ensure the custody of traditional knowledge and its transmission to younger generations, to conserve the knowledge of the different services that local ecosystems provide. The People's Biodiversity Register framework is an example of an instrument that mobilises the community to draft a register of biodiversity and associated knowledge.

► Key message 5: Locally led EbA implementation requires strengthening the capacities of communities, fostering village-level democratic processes and institutions, and pooling different types of knowledge.

Ecosystem-based Adaptation can provide positive outcomes for local communities, provided they have the capacities, access and agency to manage their natural environment (Woroniecki et al., 2019). The projects in Bhojdari and Purushwadi undertook substantial efforts to make inclusive and effective community participation central to all EbA-type activities.

Evidence

At the village level, the Gram Panchayat does not typically manage natural resources but rather carries out government departments' plans at block or district level. Consequently, the projects in Bhojdari and Purushwadi supported the establishment of several village committees for different aspects of natural resource management. The Gram Panchayat capacity was augmented by a Village Development Committee and a Village Water Management Team. Other committees include the Biodiversity Management Committee, Forest Protection Committee, and the Rural Tourism Committee. These institutions create spaces for the community to learn, plan, discuss and share their interests and concerns regarding water, agriculture and biodiversity. Thanks to the activities of the committees (e.g., awareness-raising, mobilising people for community work), the residents of Purushwadi and Bhojdari enhanced their knowledge of sustainable natural resource governance.

Examples of successful natural resource management are plentiful. The Village Development Committee, which is officially registered as a village trust besides being a sub-unit of the Gram Panchayat, was trained to administer the projects' fund and consequently greatly increased the Gram Panchayat's capacity to manage funds. The committee also maintains a community fund, to which each household contributes INR 100/year to maintain soil and water conservation infrastructures. Further, because the committees were institutionalised, community members gained better access to funding schemes (e.g., agricultural seed loans) and agricultural inputs.

A significant achievement of the Biodiversity Management Committee was to establish the People's Biodiversity Register. In Purushwadi, the Maharashtra State Biodiversity Board recognised that the emphasis on biodiversity conservation clearly improved due to the initiation of the Register. The local community capitalised on the value of biodiversity in Purushwadi by developing ecotourism, which the Rural Tourism Committee now manages (e.g., fixing hospitality rates, quality control, conflict management).

In both villages, the capability to manage water resources also significantly improved because of the work of the Village Water Management Team. The water team from Bhojdari worked with the teams from surrounding villages to prepare a comprehensive water management plan for the entire

¹² s stated by the One Health Commission, cf. https://www.onehealthcommission.org/en/why_one_health/what_is_one_health/

landscape. The plan resulted in activities in Bhojdari which included (i) desilting existing trenches on 20 hectares, (ii) desilting of check dams, and (iii) micro-irrigation for economical water use. Similar interventions occurred in the other villages.

Given the historical underrepresentation of women and marginalised groups in decision-making related to land and water management, the projects also aimed at improving their representation in these committees, for example by supporting a women's membership quota of at least 40%. Women's and Tribal people's participation improved substantially, from being represented on a few local committees, and by a small number of members, to participating in Gram Sabhas¹³ and in all committees in greater numbers. Besides, women's self-help groups (SHGs) were formed to facilitate access to savings and credit. The groups addressed development needs, such as food and nutrition security by growing crops for self-consumption and healthy child development.

Lastly, the creation and running of local committees have popularised several democratic processes that were not widespread before the projects. These include elected membership, rotational leadership, and increased transparency and accountability for the maintenance fund. The Village Development Committee provides the space for representing all categories of households in the village, while the Gram Panchayat is seen as politically driven and non-inclusive. Thus, the community appreciated the work of the committee, as opposed to the Gram Panchayat which at times gives preference to its vote bank.

Several factors enabled these successes in local governance. The first is the legal backing that empowers some of the committees. The Forest Protection Committee and Biodiversity Management Committee are respectively mandated by India's Joint Forest Management Policy (1998) and the Biodiversity Act (2002). The latter mandates the creation of Village Development Committees and Village Water Management Teams under the supervision of the Gram Panchayat. This legal standing ensures legitimacy at the village level, enabling the implementation of soil and water management at large scale, on village common lands, and the adoption by the Gram Sabha of proposals by the water management team. It also helps to ensure a sense of ownership by the village community, which in turn reinforces the community's resilience. Lastly, but crucially, WOTR provided continuous support and capacity-building by bringing expertise from research institutes and businesses to support ecotourism, facilitation and local presence.

Along with these achievements, a few shortcomings were identified. The large number of committees resulted in some functional overlap. This was particularly the case between the Biodiversity Management Committee and the Forest Protection Committee, resulting in occasional conflict. In addition, in Purshwadi the Forest Committee negotiated the sale of non-timber forest produce without proper dialogue with community members. These examples show that local committees do not automatically function smoothly and transparently in managing natural resources.



Water Stewardship meeting in Sarole Pathar, Maharashtra, India. © WOTR

Recommendations

- 1. Strengthen local knowledge to embrace the ecosystem perspective.** Management of the ecosystem at the village level requires a geographical perspective at large scale. Local knowledge should be strengthened with upstream and downstream links, climate change adaptation and, more importantly, the multi-disciplinarity of managing soils, water, forests, vegetation, insects, and animals.
- 2. Enhance local governance to manage ecosystems.** The Gram Panchayat and the village committees require support to widen their concept of governance from a village-level perspective to a landscape-ecosystem perspective, uniting a cluster of villages to manage their shared natural resources effectively. Functional overlaps of committees need to be addressed, and active participation and benefit-sharing by all sections of the community, particularly women and marginalised groups, ensured.
- 3. Support the implementation of EbA by pooling practitioners' experience.** A great body of knowledge on natural resource management has been developed over several decades by all of the actors involved in implementation, from village to state level, among local communities, government officers, researchers, and non-governmental organisations. These different knowledge streams should be pooled to serve as a resource for the implementation of EbA. Existing internet platforms for sharing knowledge, such as Vikaspedia or Agrowon, provide an opportunity for widespread dissemination.
- 4. Involve researchers, extension services and media.** Research institutes, extension services and media are important actors in popularising, adapting and disseminating knowledge to village communities. Relevant research organisations include the Indian Council of Agricultural Research (ICAR) and the Central Research Institute for Dryland Agriculture (CRIDA). Extension services include the Krishi Vigyan Kendra (KVK), the Agriculture Field Monitoring Unit (AFMU) and the Groundwater Directorate of Survey and Development Agency (GSDA). Local and traditional media, such as radio, Bharuds¹⁴ and skit plays, have a vital role in disseminating knowledge to communities.

¹³ Forum at village level to discuss local governance and development issues and make need-based plans for the village. Its members are all the adults living in the village and registered on the electoral roll.

¹⁴ Type of Marathi poetry that can be used to educate people on various topics.

► **Key message 6: Effective management of ecosystems needs strong collaboration between local communities, civil society organisations, private sector, government and funding agencies, from village to state levels.**

Ecosystems are characterised by biotic (e. g., vegetation, animals, insects) and abiotic (e. g., soils, minerals, water, air) constituents. Effective ecosystem management requires a holistic understanding of these constituents and their interplay, and thus coordinated efforts across different sectors.

Evidence

Before WOTR's interventions, the Forest and Agriculture Departments, which do not have a village presence and are based at the block level, approached the village community only through the Gram Panchayat and the Gram Sevak¹⁵, with little interaction involving the rest of the community. This mode of consultation proved insufficient and often resulted in conflicts between local people and the Forest Department. When the village is not well organised and informed, benefits of the various government schemes managed by the Agriculture Department only reach those who have connections to Gram Panchayat members. The projects concentrated on resolving this problem. WOTR, which enjoys the trust of both the village community and the government departments, established a culture of collaboration and confidence between both parties and across different administrative levels, and facilitated convergence and access to government schemes.

While implementing the projects, WOTR fostered the development of committees with a government mandate, such as the Forest Protection Committee, decreed by the Joint Forest Management policy (1998), and the Biodiversity Management Committee, decreed by the Biodiversity Act (2002). In both villages, the forest committee secretary is a member of the Forest Department while a villager heads it; in Bhojdari the committee is chaired by the Sarpanch¹⁶.

WOTR also supported collaboration between the Forest Department and village committees to establish rules and regulations for managing natural resources. It ensured a ban on poaching, protected wildlife habitat, and regulated the extraction and sale of timber and non-timber forest products. In both villages, the Village Water Management Team collaborated with the Agriculture Department to carry-out rainwater harvesting activities. In Bhojdari, the collaboration led to water conservation extending to other surrounding villages.

The private sector also played a critical role in making EbA work. The social enterprise Grassroutes supported ecotourism in Purushwadi, training young people to become tourist guides. It also took on the task of marketing to attract tourists to the village and bringing financial benefits to the Rural Tourism Committee. Following a similar approach, Grassroutes now promotes and supports ecotourism in other parts of India.

Building a trust-based environment also helped in the funding and implementing project activities, in collaboration with the village committees, the Gram Panchayat, the block and district administrations, and funding agencies such as NABARD, SDC, and GIZ.

There is room to expand this collaboration further. Not all the committees were formally working in concert with the government departments and the Gram Panchayat. There was some functional overlap between the committees and government agencies. Consequently, the committees' viability was limited following the conclusion of the projects, as the government did not support their operation.

Recommendations

- 1. Build collaboration between the village committees, the government, donor agencies and the private sector to fund effective natural resource governance.** The effort to build capacity in local governance should be prolonged to strengthen collaboration with governmental agencies, donors and the private sector to fund natural resource management. Local governing bodies, namely the Gram Panchayat and the village committees, require information about the various funding opportunities and the know-how to access, utilise and be accountable for funds, both to the Gram Sabha and donors.
- 2. Strengthen collaboration through trust and mutual learning.** Absence of communication and active engagement between stakeholders generates mistrust between different actors. Building trust is an essential step for fruitful collaboration. At the same time, mutual learning is strongly encouraged, particularly among formal actors (government and donors) to recognise the experience and knowledge that local actors have.

Indigenous seed bank and People's Biodiversity Register in Bhojdari, Maharashtra, India. © WOTR



¹⁵ Also known as a Village Development Officer, this person is employed to liaise between the different levels of administration, to advise and assist villagers in matters of community welfare and development. ¹⁶ A villager elected for five years by the Gram Sabha to head the Gram Panchayat, with decision-making powers at the village level. The position is a liaison between the government and the village community.

3. Foster effective collaboration at all administrative levels. The appropriate scale of managing ecosystems goes beyond the village. At the local level, villages need to collaborate to manage resources. At the state level, the government and donors have a broader perspective to develop strategies and attract funding to manage ecosystems. Government and donors at the intermediate administrative level, namely block and district, are necessary to combine state-level strategies with local perspectives for the successful implementation of EbA. Therefore, it is recommended that collaboration between the government, research institutes, donors, and local actors is effective at all administrative levels, i.e. from village to state levels.

4. Involve civil society organisations and non-governmental organisations as crucial last-mile intermediaries to facilitate collaboration. The local communities, governmental and funding actors may not be capable of initiating collaboration, due to unfamiliarity, silos, different administrative levels, or distrust. It is recommended to involve Civil Society Organisations (CSOs) and Non-Governmental Organisations (NGOs) as third parties, to facilitate collaboration between actors. These organisations have an important bridging role due to their independent status, connecting various types of knowledge, experience and interest at different administrative scales.

Partners, stakeholders and roles for promoting EbA



Figure 3: Partnerships for Ecosystem-based Adaptation © WOTR 2020

The way forward: a roadmap to upscale EbA in Maharashtra

The findings of the case studies in Ahmednagar district demonstrate the multiple benefits that Ecosystem-based Adaptation can provide. These include, among others, sustainable agricultural production systems, strengthened income and food security, restored and conserved ecosystems and biodiversity, reinforced participatory governance at village level, and effective collaboration to manage natural resources. The analysis has shown that EbA provides benefits beyond climate adaptation, notably for sustainable development and biodiversity conservation. EbA has also been proven effective as an integrated approach to complement sustainable land management and watershed development programmes.

Scaling up EbA can help to ensure systemic resilience for people and ecosystems in the face of multiple crises, such as climate change, loss of biodiversity, land degradation, nutritional deficits, and pandemics. In terms of concrete action, EbA can simultaneously and synergistically contribute to the fulfilment of various national and international commitments. EbA can help India achieve its National Determined Contribution (NDC) as part of an overall climate adaptation strategy. With its emphasis on conserving biodiversity and ecosystems, EbA can also help India fulfil its commitment to the Post-2020 Biodiversity Framework of the United Nations Convention on Biological Diversity. Its

strong focus on restoring terrestrial ecosystems and combating land degradation can help meet the Land Degradation Neutrality (LDN) goal¹⁷. Due to its holistic nature, it can contribute to the achievement of several Sustainable Development Goals, for example SDG 1 (No Poverty) by improving income opportunities, SDG 2 (Zero Hunger) by strengthening Food Security, SDG 13 (Climate Action) by increasing adaptive capacities, and SDG 6 (Clean Water) and SDG 15 (Life on Land) through ecosystem restoration. The implementation of EbA contributes measurably to India's LDN targets of protecting its forests and agricultural land through soil health. Finally, EbA enhances human well-being by ensuring healthy ecosystems, providing a framework to implement the *One Health* approach.

A roadmap is currently being developed through a multi-stakeholder process to upscale EbA in Maharashtra over the next ten years. An essential pillar of this roadmap is the mainstreaming of EbA in sustainable land management, watershed development and sectorial programmes, both at state and central government levels. The roadmap also contains other streams of activities, such as funding, promoting a community of practice, capacity building, and developing monitoring and evaluation frameworks, in line with some of this report's recommendations.

¹⁷ Land Degradation Neutrality (LDN) is defined by the United Nations Convention to Combat Desertification (UNCCD) as "a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remains stable or increases within specified temporal and spatial scales and ecosystems."

Annex: key results on EbA effectiveness

The following table summarises the assessment for the two EbA cases. The table presents the results for each of the three elements of Figure 1 (p10). However, it has to be remembered that EbA is a holistic approach in which the attainment of an element depends on others. For instance, measures for adapting to climate change become

sustained when associated with strengthened participatory governance; vice-versa, reinforced governance has a purpose when it improves resilience to climate change. Similarly, restoration and management of the ecosystems are effective when associated with increased resilience and improved governance.

EbA element	Key results ¹⁸	
Adaptive capacities	Climate-resilient and sustainable agricultural production systems	<ul style="list-style-type: none"> ▶ In Bhojdari: crop diversification (3 to 10 crops), including indigenous crop varieties better suited to withstand drought ▶ Reduced costs and enhanced yields due to the adoption of the System of Crop Intensification (SCI) (ex. millet, pulses, wheat) ▶ Use of organic fertilisers and pesticides. ▶ Weather-responsive farming practices due to real-time, localised agro-meteorological services ▶ More indigenous trees are growing on farm bunds and barren lands, that provide additional fodder for livestock, fuelwood needs and fruits. ▶ Increase in soil moisture allowing additional crops in winter
	Income	<ul style="list-style-type: none"> ▶ Income from agriculture has increased by about 40 %. ▶ In Bhojdari, adoption of indigenous seeds and organic formulations reduced the cost of cultivation. ▶ In Purushwadi, higher income from selling rice due to increase in yield up to 50 % with productive rice varieties and the SCI. ▶ In Purushwadi, additional income from ecotourism and sale of local farm and non-timber forest products ▶ In Purushwadi, the sale of planted bamboo generated an additional income of INR 200,000 to the corpus fund of the Forest Protection Committee.
	Distress migration	<ul style="list-style-type: none"> ▶ Significant reduction in distress migration.
	Food security	<ul style="list-style-type: none"> ▶ Households experiencing food shortage have reduced by half¹⁹. ▶ Increase in yield (from 10 % to 50 %) for pearl millet, finger millet, pulses, rice and wheat ▶ Adoption of kitchen gardens for own-consumption of vegetables and more nutritious diets ▶ Promotion of backyard poultry improves nutrition. ▶ Cultivation of nutritious crops (ex. Varai, groundnut, pulses) for own consumption.
	Wellbeing	<ul style="list-style-type: none"> ▶ Awareness of nutritional and health advice. ▶ Beautified village (solid waste management, preventing runoff of chemical fertilisers, more trees on the roadside, greener landscape).

EbA element	Key results	
Ecosystem services and biodiversity	Soil	<ul style="list-style-type: none"> ▶ In Bhojdari, soil conservation and rainwater harvesting at the landscape scale (from ridge to valley) led to a 27 % reduction in the area of degraded lands, in favour of scrub forest. ▶ Better soil and water retention ▶ Improvement of soil quality due to use of organic fertilisers and pesticides
	Water resources	<ul style="list-style-type: none"> ▶ Rainwater harvesting at the landscape scale (from ridge to valley) led to more water stored in soils ▶ In Bhojdari, an increase of 87 % in surface water storage capacity²⁰.
	Forest and Vegetative cover	<ul style="list-style-type: none"> ▶ In Bhojdari, increase in forest/vegetative cover by 35 %, in particular 27% of degraded lands being transformed into scrub forest. ▶ More trees growing along farm bunds and barren lands²¹.
	Biodiversity	<ul style="list-style-type: none"> ▶ The number of tree species has increased by 8 and 25 respectively in Bhojdari and Purushwadi. ▶ In Purushwadi, two nurseries are growing indigenous saplings. ▶ In Bhojdari, crop diversification from 3 to 10 varieties, with a focus on indigenous species. ▶ Greater population of indigenous poultry in households. ▶ In Bhojdari, increase in observation of wild animals and birds. ▶ In Purushwadi, a greater presence of fireflies is observed, which is an attraction for ecotourism. ▶ <i>In Bhojdari, the number of indigenous cows has reduced, affecting the seeding of local vegetation</i> ▶ <i>In Purushwadi, growing market-driven rice varieties have partly replaced indigenous rice²².</i>
Participatory governance	Representation of women and marginalised groups	<ul style="list-style-type: none"> ▶ Better representation of women and Tribal people in decision-making processes of local institutions, thanks to a 40 % quota on women's membership. ▶ Women's self-help groups facilitate access to credit for consumption purposes
	Planning capabilities for managing natural resources	<ul style="list-style-type: none"> ▶ Strengthened local governance due to the establishment of local committees for natural resource management ▶ The Village Development Committee, officially registered as a village trust, keeps a fund to maintain water and soil conservation infrastructures. ▶ The Biodiversity Management Committee was instrumental in establishing the People's Biodiversity Register. ▶ The Village Water Management Team promotes water budgeting for a better adequation of cropping patterns with available water resources. ▶ In Purushwadi, the ecotourism is managed by the Rural Tourism Committee and the local for-profit social enterprise Grassroutes. ▶ <i>The multiplicity of committees has resulted in a functional overlap between them.</i> ▶ <i>In Purushwadi, committees do not penalise rules violators.</i>
	Democratic processes	<ul style="list-style-type: none"> ▶ The local committees follow daily democratic processes. ▶ Local institutions stimulate more frequent Gram Sabha meetings

EbA element	Key results
<div data-bbox="62 485 121 863" style="writing-mode: vertical-rl; transform: rotate(180deg);">Participatory governance</div> <div data-bbox="172 285 350 338">Institutional collaboration</div>	<ul style="list-style-type: none"> ▶ Improved collaboration between the local committees and the Agriculture and Forest departments leading to reduced conflicts over forest use ▶ Development of the Forest Protection Committee, mandated by the Forest Department for joint management of village forest resources. A villager heads it and its Secretary is from the department. In Bhojdari, the forest committee is headed by the Sarpanch²³. ▶ Development of the Biodiversity Management Committee, mandated by the Biodiversity Act (2002). ▶ The Village Development Committee and Village Water Management Team are sub-units of the Gram Panchayat. ▶ The recommendations from the Village Water Management Team are endorsed in Gram Sabha and taken-up by the Gram Panchayat. ▶ The local committees, in collaboration with local government, established rules making for managing natural resources. ▶ <i>The multiplicity of committees has resulted in functional overlap of roles and accountability with the Forest department.</i> ▶ <i>Some committees became defunct after the end of projects due to insufficient linkage with local and regional administration.</i>
<div data-bbox="172 915 379 947">Benefit-sharing</div>	<ul style="list-style-type: none"> ▶ Very few families have not benefited. ▶ In Purushwadi, ecotourism provides jobs to the youths and income to families from catering. ▶ <i>The inequity between tribal and non-tribal remains a challenge that needs to be given close attention.</i>

¹⁸ Results in italic refer to unintended negative outcomes, some of which are caused by external factors, i.e., beyond the the projects' influence. ¹⁹ Although crop yield has increased, households still avail of the government's Public Distribution Systems, which contributes to food security. The surplus is sold in the market or to tourists. ²⁰ Exploitation of groundwater for irrigation has increased substantially in the village, as is observed elsewhere and independently to the projects. As a consequence, groundwater levels have reduced in the village. ²¹ Albeit the progress achieved by the projects to increase forest and vegetation cover, both villages were exposed to the general trend in deforestation, which implied that the area under dense forest has reduced, towards open forest. The total area under forest has even reduced in Purushwadi, due to the implementation of the Forest Rights Act, which grants ownership of forest lands to Tribal people and enables them to develop agriculture fields. ²² Due to the general trend in reduction in forest cover and development of agriculture lands, beyond both villages and the projects' interventions, there are increased conflicts with wildlife (e.g., wild boars, langurs, leopards) as agricultural fields are getting close to forests. ²³ Decision-maker heading the Gram Panchayat, elected for five years by the Gram Sabha. The position is a focal point between the government and the village community.

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About us

WOTR

Established in 1993, the non-profit organisation Watershed Organisation Trust (WOTR) works at the intersection of practice, knowledge and policy to ensure food, water, livelihoods and income security for disadvantaged communities.

Headquartered in Pune, Maharashtra, WOTR has a physical presence in eight states and provides occasional services to agencies across all states of India and in twenty-eight countries. The organisation aims to develop integrated ecosystems for the well-being of poor communities.

TMG Research gGmbH

TMG Research gGmbH is a Berlin-based non-governmental organisation working on sustainability issues in relation to food systems, natural resource management, climate, and energy. TMG Research gGmbH brings sound knowledge and practical experience to the management of national, European and international processes and is dedicated to the analysis and solution of new and complex challenges. As an independent partner, TMG Research gGmbH works with actors from science, politics, the private sector, and civil society.

The project

Funded by the International Climate Initiative (IKI) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), the “Climate-SDGs Integration Project: Supporting the Implementation of the Paris Agreement and the 2030 Agenda Through Ecosystem-based Adaptation” project seeks to understand the criteria and preconditions for Ecosystem-based Adaptation (EbA) to contribute to both Nationally Determined Contributions (NDCs) and the United Nations Sustainable Development Goals (UN SDGs) through participatory, multi-stakeholder dialogues at local and state levels.

This project was envisaged for Maharashtra state, India, and aims to develop a roadmap for upscaling EbA in the state. This project entails the following steps: (a) a set of case studies that highlight effective EbA measures and conditions for creating an enabling environment; (b) workshops to raise awareness about the benefits and impacts of ongoing EbA-related actions in different parts of the state and to build the capacities of local communities to express their concerns and expectations of adaptation programmes; and (c) a series of participatory multi-stakeholder dialogues at the local and state levels to identify the enabling environment for the sustained implementation of EbA at a broader scale. These stakeholder dialogues are expected to contribute to building the required political and societal support for EbA at the national level.



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