

Impact assessment report

Mangroves Conservation Programme: Healthy mangroves for resilient planet and communities

Apple India

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Contents

Acknowledgements	3
1. Executive summary	4
2. Introduction	6
3. About the study	9
4. Findings	12
5. OECD-DAC analysis	19
6. Improvements made so far	22
7. Conclusion and way forward	26
8. Annexures	28

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1. Executive summary

Apple India partnered with the Applied Environmental Research Foundation (AERF) to implement the Mangroves Conservation Programme in Maharashtra.

Apple India partnered with Applied Environment Research Foundation (AERF) in order to implement the Mangroves Conservation Programme in Maharashtra. The programme titled 'Healthy mangroves for resilient planet and communities' follows a community-based conservation approach involving community members living around the mangrove of Raigad and Ratnagiri districts of Maharashtra. The major threats to the conservation of mangroves are being tackled through safeguarding mangroves growing on privately-owned lands in the villages along the estuaries. In this programme, the community members participate by entering into conservation agreements with AERF, building awareness and exploring alternate livelihoods to reduce dependency on the mangroves.

Apple India engaged Grant Thornton Bharat LLP to conduct impact assessment of the mangrove conservation programme with an objective to assess the impact of the programme activities. The study was conducted onsite in Raigad and Ratnagiri, Maharashtra to evaluate the programme's progress, impact and gather insights from relevant stakeholders.

Key findings of the study:

Relevance: India has 2.66% of the world's mangroves. On the West coast of the country, Maharashtra state, accounts for 6.31% of the country's mangrove cover, which is about 315.09 sq. km. The mangroves play an important role in the coastal ecosystems by providing protection against extreme weather conditions and harmful effects of climate change such as storms, cyclones, tsunami, and flood surges. They also protect the coastal villages against strong wave action and coastal bank erosion. AERF's activities are focused mainly on conserving the land where mangroves are growing in privately owned land areas, which are not covered by any other agency for conservation. The mangroves land and the giant mangrove trees are being brought under the conservation agreements to safeguard them against further degradation or destruction. The community members are mobilised with adequate scientific awareness about the importance of mangroves.

Effectiveness: In coastal Ratnagiri and Raigad districts, along 6 estuaries, a total of 1396 acres of privately owned mangroves land was conserved through 192 agreements across 56 villages. The landowners were given an amount of INR 800 per acre per year if the area was more than one acre. The agreements were made for a minimum of 3 years and up to 10 years. A total of 27,114 trees were covered through 53 agreements across 11 villages. These mangrove trees are known sequester 10 (ten) times more carbon than terrestrial trees. Further, a total of 637 households have moved to using bio-stoves and LPG gas cylinders for cooking and heating purposes. This would reduce the dependency on mangroves for fuel wood, reduce smoke and improve respiratory health of the community members.

Impact: The land and tree agreements will have a significant impact by extending the conservation and restoration of mangrove trees, promoting their further growth.

This in turn will protect and sustain the unique biodiversity of the ecosystem, ensuring its long-term health and resilience. The use of bio-stoves has resulted in reduced dependency on fuel wood from mangroves, and improvement in general health of the community. The mangroves function as natural coastal barriers, reducing erosion and shielding shorelines from storms. Their root systems trap sediments, improve water quality, and support rich biodiversity by serving as nurseries for marine species. The mangrove trees and lands provide safe and necessary nesting and breeding spaces for unique and rare flora and fauna.

Sustainability: Since the beginning of the programme, there has been a significant increase in the number of agreements, acreage covered, and term duration agreed upon for conserving mangroves growing on privately-owned land. This shows there is considerable increase in awareness, indicating increased willingness to conserving these unique species of trees and the ecosystem. Further, through various trust-building activities, the programme team has been able to encourage the community leaders to play the central role in conservating mangroves. These mobilised and aware leaders are the key persons who would ensure sustainability of the conservation of mangroves.

2. Introduction

A. Background and context

Mangroves are unique coastal ecosystems comprised of salt-tolerant trees and shrubs that thrive in intertidal zones of tropical and subtropical regions. These ecosystems are known for their complex root systems, which stabilize shorelines, reduce erosion, and provide essential habitats for diverse marine species. According to the Food and Agriculture Organization (FAO) of the United Nations and the International Union for Conservation of Nature (IUCN), mangroves play a crucial role in carbon sequestration, helping mitigate climate change, and support the livelihoods of millions of people by providing resources such as wood, fish, and other valuable materials. Protecting and restoring mangroves is vital for maintaining ecological balance and enhancing the resilience of coastal communities.

In its Global Forest Resources Assessment (FRA 2020), the FAO reported that mangrove forests cover 14.72 million hectares across 113 countries¹. The distribution is skewed with South and Southeast Asia dominating with more than 36% of global mangrove cover.

India has 2.66% of the world's mangroves. As per the India State of Forest Report (2023), the total Mangrove cover of the country is 4,991.68 sq. km, which accounts for 0.15 % of the country's total geographical area. In India, the entire mangrove habitat is broadly divided into three main regions: (i) the East Coast, (ii) the West Coast, and (iii) the islands of Andaman & Nicobar, along with the Lakshadweep atoll. On the West coast, Maharashtra state, accounts for 6.31% of the country's mangrove cover, which is about 315.09 sq. km. It is spread across the districts of Mumbai city, Mumbai suburban, Palghar, Raigad, Ratnagiri, Sindhudurg and Thane.

The State of Maharashtra has established a dedicated 'Mangrove Cell' to oversee conservation and management efforts. Furthermore, Maharashtra has declared '*Sonneratia alba*' as the State Mangrove Tree.

The mangrove ecosystems are known to provide several benefits such as water filtration, climate regulation, coastal protection, tourism, livelihoods, and other ecosystem services. However, they face threats mainly due to human activities which has resulted in annual mangrove loss globally. This destruction has threatened the faunal and floral biodiversity depending on the mangroves, alongside adversely impacting sources of food and income of many local communities. The UN Decade on Ecosystem Restoration 2021–2030, led by the United Nations Environment Programme and other international organisations have been striving to restore mangroves across the globe. Government of India, in-line with the above has announced the MISHTI program with an aim of increasing the mangrove cover along the coastline and on saltpans along the country.

¹ India state of Forest report, 2023: https://fsi.nic.in/uploads/isfr2023/isfr_book_eng-vol-1_2023.pdf

B. About the programme

Apple India supported Applied Environmental Research Foundation², an NGO based in Pune, Maharashtra, for conservation of the mangroves in the Western Coast of India. The programme titled **Healthy mangroves for resilient planet and communities** was started in 2021 in Raigad district of Maharashtra. The programme's primary goal is conservation mangroves through a community-based approach. Under this, the communities are encouraged to actively participate and conserve the mangrove areas and trees in their privately owned land, enabling the mangroves to continue to survival in their natural habitat, without disturbance from human activities.

Key components of the programme

The programme primary goal is to conserve the mangroves in coastal Maharashtra spread across Raigad and Ratnagiri districts. Some of the key components of the programme include:

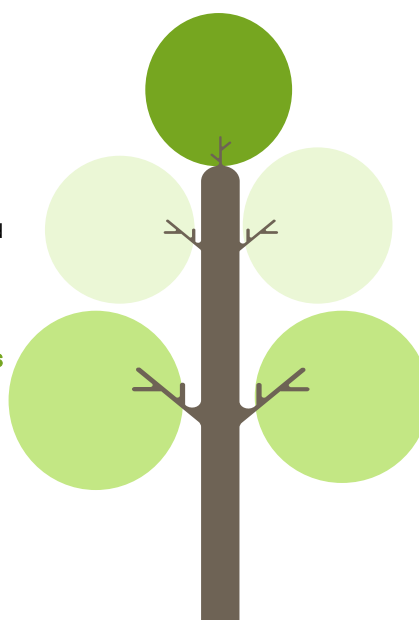
- Conserve continuous tracts of mangroves through land and tree conservation agreements with private landowners.
- Provide ways to reduce dependency on mangroves for firewood or other requirements.
- Community outreach and awareness initiatives to emphasize the benefits of mangroves and its services.
- Provide access to alternate livelihoods, that aid in the conservation of mangroves.

Mangroves Land Conservation

Conserving land areas covered with mangroves through conservation agreements

Distribution of Bio-stoves

Distributing improved cook stoves to community members to help reduce dependency on firewood



Mangroves Trees Conservation

Conserving individual mangrove trees through tree conservation agreements

Improved Livelihoods

Providing community members with alternate livelihood opportunities to conserve mangroves

² AERF was established as an NGO in 1994 to work towards biodiversity conservation on ground. The organisation works on the principles of community-based conservation and develops natural resource management models involving local communities. They have been working extensively in the Northern Western Ghats of India.

C. Theory of change

To gain a holistic understanding of the programme, a Theory of Change was developed to gain a deeper understanding of the programme. A theory of change outlines a programme's expected outcomes and the steps to achieve them, helping stakeholders understand the programme's rationale, clarify goals, and measure progress more effectively.

Table 1: Theory of change

Resources	Activities	Output	Outcome	Impact
• Financial resources • Human capital • Maps with spread and extent of mangroves • Technology	• Mobilizing community for execution of agreements for conservation of mangroves land and giant trees • Distribution of eco-friendly bio-stoves • Conducting research studies on socio-economic and biodiversity parameters • Providing alternate livelihood opportunities to mangrove communities	• Privately owned mangrove land and giant mangrove trees covered through conservation agreements. • Bio-stoves being used by households in the community. • Research studies for assessing Bleu Carbon and biodiversity in the target areas. • Opportunities made available for community members in alternate livelihoods	• Restoration and protection of mangroves in large privately owned land of community members. • Improved levels of awareness among the community about the importance of mangroves and use alternate resources for energy. • Creation of alternate means of income for community members. • Increased carbon sequestration through the conserved mangroves.	• Restoration and long-term conservation of 5000 acres of mangroves in along the coast of Maharashtra. • Increased resilience of local communities to face adversities due to impacts of climate change and extreme weather condition.

3. About the study

Grant Thornton Bharat LLP³ was appointed by Apple India to conduct an impact assessment study of the Mangroves Conservation Programme. To conduct the assessment, a collaborative approach using the Theory of change and some of the principles of OECD DAC framework was used to identify key areas of enquiry for each stakeholder group and to obtain a holistic understanding of the programme results. The study was executed by interviewing the beneficiaries of the programme to gauge an overall understanding of the outcomes and impact of the activities undertaken.

The assessment included discussions with stakeholders to understand the status of the programme and map the progress. The key objectives were:

- Evaluating the programme's impact.
- Gathering feedback of the stakeholders and beneficiaries of the programme.
- Analysing and reporting the data collected through interactions with the beneficiaries.

The study aimed to understand the overall process of the programme through analysis of the data collected, and further corroborating with inferences from stakeholder discussions.

A. Assessment approach

For the assessment, some of the principles of Organization for Economic Cooperation and Development - Development Assistance Committee (OECD DAC) framework was used to analyse the programme. To gather data for each of the principles, stakeholders were mapped enabling a robust data collection, analysis, and documentation of findings.

Table 2: Principles used for assessment of impact

Principles for assessment	Brief on the principles
Relevance	• Need for conservation of the mangroves and giant mangrove trees in the private land owned by community members. • Need for alternate sources of energy for cooking needs of community members. • Need for alternate livelihood options that are feasible in the study area.
Effectiveness	• Achievement of outputs / targets planned. • Community willingness of executing agreements for conserving mangroves, changes in perceptions related to community-based conservation, use of bio-stoves and other programme deliverables.

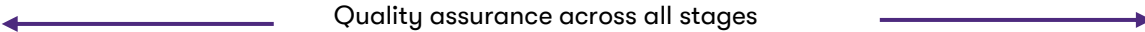
³ Grant Thornton Bharat LLP or GTBL is a member of Grant Thornton International Ltd. The firm is at the forefront of helping reshape the values in our profession. We are helping shape various industry ecosystems through our work across Assurance, Tax, Risk, Transactions, Technology and Consulting, and are going beyond to shape a more Vibrant Bharat. Our ESG practice constitutes of a dedicated team working to support efforts towards sustainable development. Our team understands the common challenges, and provides tailor-made solutions leveraging on our knowledge, experience, and enthusiasm.

Impact	• Increase in land area covered under conservation agreements. • Positive change in overall community's attitudes regarding protection of mangroves. • Overall feedback of the beneficiaries on the programme
Sustainability	• Community engagement with key programme goals • Implementation of the in the longer run • Exit strategy planned by the programme team

B. Methodology

The methodology followed to conduct the assessment was spread across three stages.

Table 3: Study methodology

Stage I: Planning	Stage II: Data collection	Stage III: Reporting
		
• Inception meeting to understand programme context, activities, and approach. • Review of documents to assess the current status of the initiatives. • Study design, identification of key stakeholders and areas of enquiries.	• Development of tools for data collection. • Conduct physical site visits to observe the programme's progress. • Conduct on-site discussions with relevant individuals and stakeholders.	• Data analysis to identify relevant trends and key statistics. • Prepare draft narrative report, obtain relevant inputs for final report. • Preparing and issuing final report.

C. Data collection

Stakeholder wise tools were created for primary interactions. Stakeholders such as community members (landowners) and AERF programme team were covered through Focused group discussions (FGD) and In-Depth Interviews (IDI). Physical visits were conducted to Raigad and Ratnagiri, Maharashtra and discussions were held with the following stakeholders.

Table 4: Stakeholder sampling and key areas of enquiry

S/N	Stakeholder	Sample covered	Type of tool	Key areas of enquiry
1.	AERF Programme team		FGD	• Identification and mobilisation of community members • Understanding mangrove and their challenges • Execution of agreements and their operations • Distribution of eco-friendly stoves

				• Providing alternate livelihoods and training • Challenges and suggestions
2.	Community members / Landowners / Farmers		FGD and IDI	• Awareness about mangroves and challenges • Execution of conservation and tree agreements • Status of mangroves in their landscape • Operational processes • Change in environmental and economic status. • Areas for improvement

D. Limitations of the study

During the field visit to the programme locations, limited stakeholders could be interviewed. Some of them were worked as daily wage earners and were unavailable for interactions.



Mangroves in Raigad district

4. Findings

This chapter on findings has been presented in different sections, with one section for each of the key components undertaken by AERF at the programme locations.

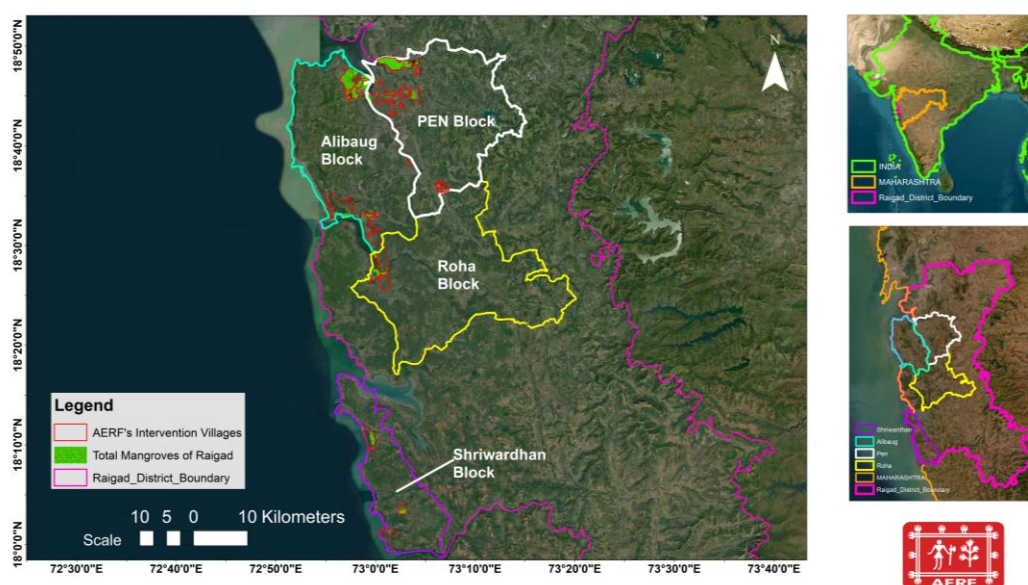
A. Conservation Land Agreements

In the coastal villages of Ratnagiri and Raigad, the lands privately owned by farmers or fishermen are covered with mangroves. While some of them are recent, most were covered by mangroves for a few decades. The mangroves are spread across 4 taluks of Alibag, Murud, Pen and Roha in Raigad. These mangroves face the following threats for clearing:

- Landowners clear the mangroves for creating ponds where they can cultivate prawns, crabs, and fishes for commercial purposes.
- Landowners sell the land to commercial entities for aquaculture.
- Community members cut down either whole trees or parts of trees for firewood and other domestic purposes.

Table 5: Rivers spread across 2 districts.

District Name	Name of river / estuary
Raigad	1. Amba
	2. Bhagavathi
	3. Kundalika
	4. Patalganga
Ratnagiri	5. Bharja
	6. Savitri



Map showing the programme locations in Raigad district

Under the programme, the landowners are encouraged to sign an agreement with AERF for conserving the land covering mangroves. The points below provide details about the agreements:

- Privately owned lands being brought under conservation agreements are owned by individual landowners. The lands are not included in any existing conservation programs or schemes by the Forest Department. The mangroves on these lands will be protected and safeguarded for specific periods, ensuring they are preserved from both internal and external threats.
- The agreements between private landowners and AERF, written in Marathi, are voluntary and guarantee a mutually agreed sum of money. **Land areas under one (01) acre receive INR 500 per year, while those over one (01) acre receive INR 800 per acre per year.** This incentive encourages landowners to preserve and restore the mangroves, protecting the flora and fauna within these areas.
- If the landowners are willing to break the agreement, they will have to pay back the amount that they are owed for the term agreed upon. If clause in the agreement puts them at ease, reassuring them that they continue to be landowners.
- The landowners also become aware of the biodiversity in their land, thereby developing a sense of pride and ownership towards the local environment and their components. A few of them have inspired their neighbours to sign similar agreements.

Total land agreements signed - 192

Total number of villages covered – 56 villages across Raigad and Ratnagiri districts

Area of land covered under agreements – 1396 acres of mangroves land



Mangroves and terrestrial landscape in Ratnagiri district

B. Tree Conservation Agreements

About the Mangrove trees

Mangroves comprise of salt-tolerant trees and shrubs that thrive in the intertidal zones of tropical and subtropical coastlines. They flourish in areas where freshwater blends with seawater, and the soil is rich with layers of accumulated mud deposits⁴. Across the globe, a total number of 69 species in 27 genera, belonging to 20 families are considered as true mangrove species. In Maharashtra, across all mangrove districts, a study identified occurrence of 20 typical mangroves, 10 halophytic species, 13 border line mangroves and 15 mangrove associates. Of these, species like *E. agallocha*, *A. ilicifolius*, *R. mucronata*, *A. officinalis* and *A. marina* showed maximum percentage of occurrence⁵.

Some of the more abundant species in the study area included *Avicennia marina*, *Sonneratia alba*, *Bruguiera gymnorhiza* and *Rhizophora mucronata*. The mangrove trees in the area have been growing for decades, in some of the privately land areas owned. In some cases, protecting these individual trees becomes critical. They are called giant mangroves trees – which are found along the mangroves, thriving on the brackish waters. They are known to form a strong network which safeguards the coastline from getting eroded or degraded during extreme weather conditions.

Total tree agreements signed - 53

Total number of villages covered – 11 villages across Alibaug and Pen in Raigad district.

Total number of trees covered under agreements – 27,114 trees

The mangrove trees are categorised as **giant trees when they reach a height of more than 12 feet and have a Girth at Breast Height (GBH) of more than 25 cms.** These giant trees are known sequester 10 (ten) times more carbon than regular terrestrial trees. These trees have unique adaptations such as tolerance to high levels of salinity, water logging in the soil, pneumatophores or the breathing roots, prop-roots for support in the marshy soil, and salt glands for releasing excess salt absorbed from the soil.

The landowners signing the tree agreements, agree that they will protect the tree against felling or any other form of degradation. **For each giant tree, the landowner is given INR 30 per tree per year for conserving it.**

⁴ Mangroves trees and shrubs, FAO: <https://www.fao.org/4/ai387e/ai387e06.htm>

⁵ Mangroves of Maharashtra State:

https://www.researchgate.net/publication/352360467_Mangroves_of_Maharashtra_State_India_Diversity_and_Sustainability

Adaptations of Mangroves

Breathing roots: Underground tissues of plant require oxygen for respiration. Since in mangroves environment, oxygen in soil is very limited or nil, the root systems have modified to intake oxygen from the atmosphere. Hence, they have specialized above-ground roots called pneumatophores. These have pores through which oxygen enters into the underground tissues. In some plants buttress roots function as breathing roots and also provide mechanical support to the tree.

Silt roots: In some mangrove species, from the main stem and its branches, roots develop to branch and penetrate into the soil, away from the main stem. They provide support to the trees. Pores on these roots help in respiration into the roots.

Vivipary: Seeds cannot germinate in saline environment where the mangroves thrive. Mangroves have adapted to vivipary, where the seeds germinate and turn into seedlings and stay attached to the tree. The seedlings continue to grow attached to the tree, which provides water and nutrients. Eventually they fall, float, and finally root themselves in a suitable location.



Mangrove tree - S. Alba with flower

The mangrove tree species provide safe nesting spaces for several birds, both resident and migratory, including - Eurasian Curlew, Black-headed Ibis, Curlew Sandpiper, Painted Storks, White-bellied Sea Eagle, and Lesser Flamingos.

C. Distribution of Bio-stoves

One of the threats that the mangroves face due to human activities is extraction of firewood. The communities living in villages around the estuaries used to depend mostly on the twigs and timber that the mangroves produced for firewood for domestic cooking, heating water and other purposes. This added pressure on the mangroves. In some locations, this led to over-extraction in an unsustainable

manner. Human activities in these areas have led to the disruption and degradation of the ecosystem. Regular passage of people into these fragile ecosystems disturbs the natural habitat of several species of local flora and fauna. Under the programme, the community members were encouraged to procure the eco-friendly Bio-stoves from AERF for reducing their dependency on firewood. In order to address the over-extraction of fuelwood for cooking and heating purposes from the mangroves, AERF team designed a low-smoke, low input, eco-friendly cooking stove.

Under the programme Bio-stoves were distributed in Raigad district of Maharashtra.

Total Bio cook-stoves distributed – 637

Total number of villages covered - 38 villages across Raigad district

Total number of beneficiaries covered – 2548 community members

Lesser fuelwood: It requires a significantly lesser amount of fuelwood, when compared to similar traditional stoves. The stoves are designed to harness heat from lesser quantity of burning wood. It requires about 500-600 grams of dried fuelwood for a cooking a one-time meal for a family of 4-5 members. This has reduced the consumption of fuelwood by about 75%.

Portable stoves: The bio-stoves are smaller and portable. They are light weight and can be carried by the farmers and fishermen, when they travel for work. They can also be used on boats or in farms where they work.

Subsidised cost: In order to encourage the community members to procure and use the stoves, they were delivered at very low cost. The bio-stoves are made available at INR 500 per stove, while the manufacturing costs were INR 3500 approximately (including transport costs from manufacturing unit to the villages).

Reduced time for fuelwood collection: The women who are primarily engaged in collecting fuelwood for cooking and heating purposes travel about 1-5 kms regularly. Since these bio-stoves require lesser fuelwood, their frequency of collection has reduced. This gives them time to focus on other domestic and income-generating activities in their households.

Reduced smoke: The Bio-stoves produce significantly lesser smoke than traditional ones. This has led to improved respiratory health for women and elderly individuals who cook. Since these stoves have been distributed, the number of reported cases of glaucoma and other eye conditions has decreased.

D. Alternate livelihood opportunities

Under the programme, during the assessment term, alternate livelihood opportunities were explored and implemented. Stingless Bees keeping was one such livelihood opportunity.

In Ratnagiri district, in Jawle Group Gram Panchayat, stingless beekeeping opportunities were explored. Stingless Bees (*Tetragonula iridipennis*) belong to the family of Apidae and order Hymenoptera. Under the programme, bee champions were identified – the community members who would be trained and take up beekeeping, in the pilot phase of the area. The bee champions were given beekeeping boxes in which the bees would build hives and collect honey. They were trained to fix and manage the boxes, with care. The champions would further, in the later stages of the programme, train other community members in bee keeping and harvesting of honey for domestic consumption and sales.

Bee Champions appointed - 05

Bee-keeping boxes provided – 09



Stingless Bee-keeping box in Jawle GP, Ratnagiri district

Under the program, in Ratnagiri district, experiments are being done to explore the feasibility of cultivating seaweed along the coastal areas. Permissions from the maritime board and the relevant fishermen leaders are being sought. This, if feasible and economically viable, could become a profitable and sustainable alternate livelihood opportunity.

E. Research studies and assessing carbon stock

The mangroves conservation programme is designed to operate as a research-backed execution of relevant activities. The programme team has continually explored newer geographies, strategies for conservation and sectors for exploring alternate livelihoods.

- A study was carried out to assess the biomass and vegetative carbon stock of giant mangrove trees located in Kurdus, Alibag block of Raigad district. Three important parameters GBH (Girth at Breast Height), height, and canopy cover were measured to obtain comprehensive data on the structure, composition, and productivity of mangrove ecosystems. This study provides valuable insights into the carbon sequestration capabilities of *Sonneratia apetala* - dominated mangrove ecosystems and emphasizes the need for further research to comprehensively understand carbon dynamics in diverse mangrove habitats.
- A study was conducted for Biodiversity assessment of mangrove vegetation and its associated flora and fauna in Washi Creek, Pen block of Raigad district. The study included sample data collection and analysis of micro-phytoplankton, Benthic algae, zooplanktons, Benthic Meiofauna (such as Nematodes, ostracods, turbellarians and isopods) terrestrial flora and fauna. During the study, physio-chemical parameters such as pH, TDS, transparency, salinity, and temperature were assessed.



Mangroves in Washi Creek, Raigad district

5. OECD-DAC analysis

As a part of the study, OECD - DAC principles (Organization for Economic Cooperation and Development - Development Assistance Committee) were used as a guide to assess the various programme activities. The table below illustrates the findings for the principles of relevance, effectiveness, impact and sustainability.

Table 6: OECD-DAC analysis

Relevance	- India has 2.66% of the world's mangroves. As per the India State of Forest Report (2023), the total Mangrove cover of the country is 4,991.68 sq. km, which accounts for 0.15 % of the country's total geographical area. On the West coast, Maharashtra state, accounts for 6.31% of the country's mangrove cover, which is about 315.09 sq. km. - The mangroves play an important role in the coastal ecosystems by providing protection against extreme weather conditions and harmful effects of climate change such as storms, cyclones, tsunami, and flood surges. They also protect the coastal villages against strong wave action and coastal bank erosion. - AERF's activities are focused mainly on conserving the land where mangroves are growing in privately owned land areas. The local govt owned land area is being conserved by the Mangroves Cell of the Forest department under the ministry (MoEFCC). There are no other agencies working towards conserving the mangroves in these areas. - The local communities living around the mangroves and with private ownership and limited awareness about the importance of mangroves on the local ecosystem, their lives, and livelihoods. - The mangroves land and the giant mangrove trees being brought under the conservation agreements are safeguarded against further degradation or destruction. - The community members are mobilised with adequate scientific awareness about the importance of mangroves. The programme team has been exploring alternate livelihood opportunities that can help the communities. - The bio-stoves which require lesser fuel wood, are helping reduce the dependency on mangroves. They have additional health benefits to the persons using the stove for cooking or heating purposes.
Effectiveness	- The conservation land and tree agreements are effective since they provide financial incentive to the signatories or landowners. - In coastal Ratnagiri and Raigad districts, along 6 estuaries, a total of 1396 acres of privately owned mangroves land was conserved through 192 agreements. They were made in Marathi, the local language, and 192 landowners across 56 villages were given an amount of INR 800 per acre per year if they pledged more than

	one acre of mangroves land. These land plots would see undisturbed growth of mangroves for a minimum of 3 years. In a few areas the agreed upon term is 10 years. • Another unique approach under the programme was conserving individual giant mangrove trees, where the landowners would get INR 30 per year per tree, for conserving them. A total of 27,114 trees were covered through 53 agreements across 11 villages. These mangrove trees are known sequester 10 (ten) times more carbon than terrestrial trees. • In order to safeguard the mangroves indirectly, through reduction in extraction as fuel wood, the programme distributed Bio-stoves which require significantly lesser wood and emits lesser smoke. A total of 637 households have moved to using bio-stoves and LPG gas cylinders for cooking and heating purposes.
Impact	• The land and tree agreements will have a significant impact by extending the conservation and restoration of mangrove trees, promoting their further growth. This in turn will protect and sustain the unique biodiversity of the ecosystem, ensuring its long-term health and resilience. • Mangrove trees provide crucial environmental and community benefits. They function as natural coastal barriers, reducing erosion and shielding shorelines from storms. Their root systems trap sediments, improve water quality, and support rich biodiversity by serving as nurseries for marine species. • The mangrove trees and lands provide safe and necessary nesting and breeding spaces for unique and rare flora and fauna. • The use of bio-stoves has resulted in reduced dependency on fuel wood from mangroves. The general health has improved due to lower smoke levels. • The team has been experimenting on stingless beekeeping, seaweed cultivation and developing mangrove apple products. They have been accepted well in the local community and could lead to increased income for the farmers and fishermen. • Overall, the communities living around mangroves have become more aware and have shown increased willingness to conserve mangroves. During interactions, it was observed that more than 95% of them willing to enter to into agreements with AERF to conserve their privately owned mangroves land and trees.
Sustainability	• The agreements made for conserving mangrove land and trees are done directly with the landowners. Since 2021, there has been a significant increase in the number of agreements, acreage covered, and term agreed upon. In the earlier years there were more takers for short term agreements (1 or 3 years). In 2024, all the agreements signed were long term (5 or 10 years). This shows there is considerable increase in awareness, indicating increased

willingness to conserving these unique species of trees and the ecosystem.

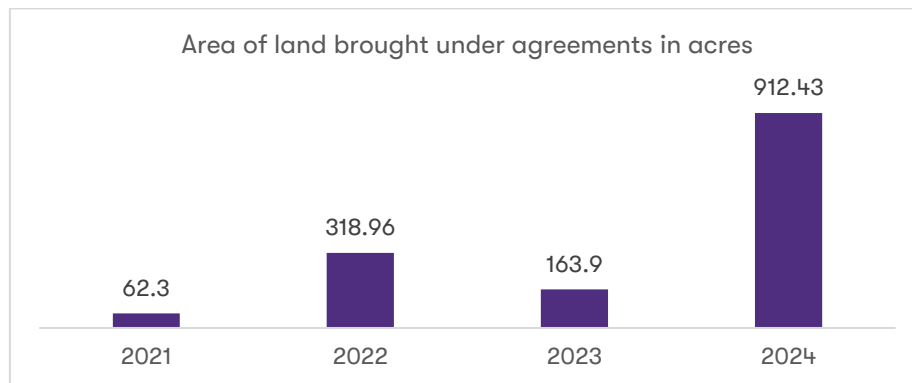
- The programme team has conducted several entry-level one-time activities in the past. This has allowed them to build trust in the community. Other activities such as regular meetings, seeking necessary permissions from gram panchayats, recruiting from within the community, recognising and rewarding active beneficiaries – have helped them remain active and trusted. This trust has translated into willingness to support the cause and purpose of the programme. The local leaders were observed to show interest and provide support to programme team in conservation efforts.
- The activities conducted in the programme are based on scientific research – including assessment of local biodiversity, carbon stock and other relevant parameters for gauging the feasibility. These research outputs would enable preparing for safeguarding the mangroves of Maharashtra.

6. Improvements made so far

A. Impacts of the programme

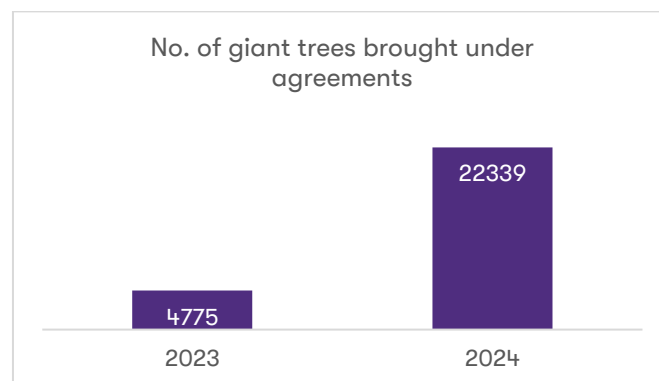
The programme has been operational since 2021 in Raigad district of Maharashtra, with the primary focus on conserving the mangroves. Foundational work has been carried out in all the programme villages. As per location-specific requirements, the programme team is formed with members from local communities, scientists, biologists, and programme coordinators.

Conservation of mangroves – In order to achieve the primary objective of the programme, the AERF team has been able to conserve large areas of mangroves land and giant mangrove trees. The below graphs show the consistent increase in the number of land conservation agreements signed between AERF and farmers for safeguarding the land on which mangroves are present. It can be seen that in 2024, 912.43 acres were brought under such agreements.



Further the term or duration for which agreements have been signed have been increasing. In the first year of 2021 – all the agreements were signed for one year only. From 2022 onwards agreements have been 3, 5, and 10 years. The payments to the signatories are made accordingly. This shows there is increased trust, awareness, and willingness to conserve the land on which mangroves are prevalent.

In case of conservation of mangrove trees, as indicated in the graph below, there was a sharp increase in the number of giant mangrove trees brought under tree conservation agreements. In 2024, a total of 27114 trees were conserved through agreements.



Distribution of bio-stoves - The team has distributed a total of 637 bio-stoves to reduce dependency on mangroves for fuelwood. These stoves have been easily accepted into the society and well used due to its several advantages.

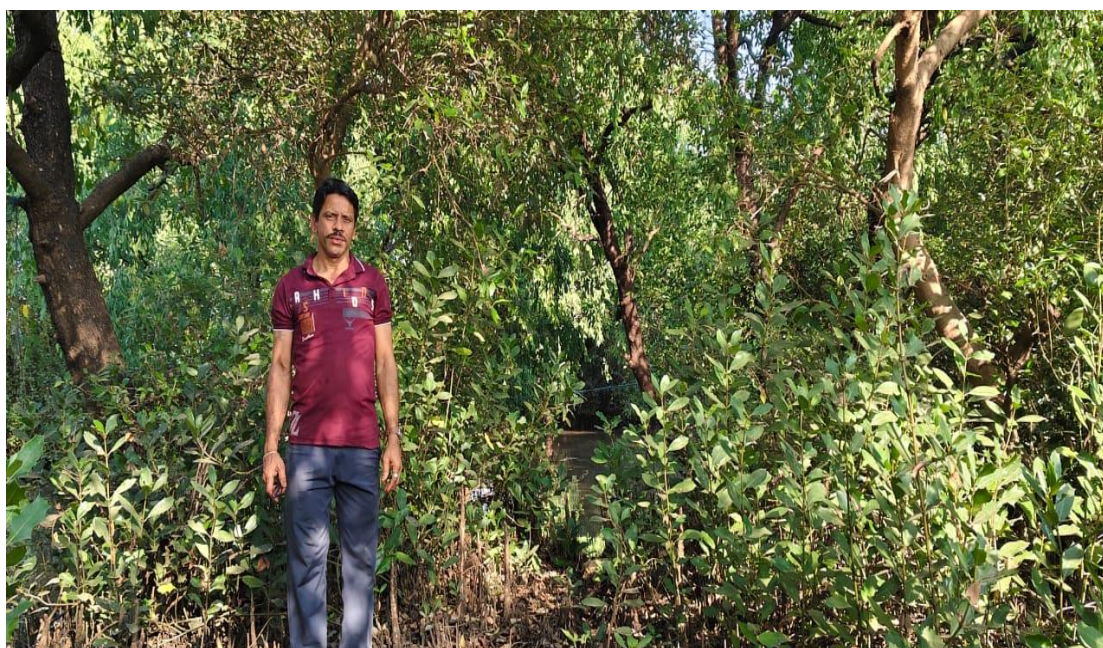
Expansion of programme area - The area of programme implementation has been expanded to include villages along 2 other estuaries of Bharja and Savitri in Ratnagiri district.

Livelihood opportunities - Alternate livelihood opportunities are being explored through stingless beekeeping, to help farmers with additional income. Other small experimental activities such as Seaweed cultivation and collection of mangrove apples for value addition, are being experimented under the guidance of experts.

Scientific research - Through research studies and scientific assessments, programme activities are planned. These studies help in expand geographically, and assessing feasibility of programme activities. Exploring carbon stock of the mangroves, one of the crucial components, is being studied.

Community involvement and support - By actively involving local government members such as gram panchayat members has helped the programme team to understand the local socio-cultural context and biological importance of mangroves. This has allowed to carry out their activities with ease and support from the community. The programme team has identified and appointed local members to lead certain activities at their village level.

Community awareness - It was observed that through a combination of above mentioned activities, the overall conservation awareness among the farmers and fishermen. This is indicated by the number of years the farmer is willing to include as a part of the land and tree conservation agreements. The community women are actively participating in the programme activities.



Sandeep Thakur, a farmer from Benauli village who has signed the giant mangrove trees conservation agreement with AERF.

B. Stories from the field

“We the fisherman at Pen from Shirki village decided to form a collective and start a society. As a leader of the commutniyt, at present, I am working as the chariman of the fisherman cooprative called ‘Sri Vijay Masoba Machi Vyavasaik Sahakari Sanstha Ltd’. We have a total of 227 active members in the society, who are all local fishermen.

I am 61 years old now, and for close to 14 years, I have been working towards to maximising efforts and increasing the income for the communtiy. I have been observing how the mangrove trees have been safeguarding our villages from harmful effects of cyclones and heavy rainfall.



Gowardhan Patil, Chairman,
Fisherman Cooperative

From the cooperative society, collectively, we have pledged to safeguard the giant mangrove trees in our privately owned lands – totally to about 20,000 trees. From the amount received, we have bought resrouces that help our office such as computer, printer, seating arragements and solar lights. I am very happy to be a part of this initiative and always encourage my juniors to find ways to continue similar work.”



Mahendra Ratale, President,
Jawle Group Gram Panchayat

“I have been the sarpanch or President of the Jawle Group Gram Panchayat (GGP), in Ratnagiri. I have always wanted to serve my community in all possible ways.

Under the GGP, we have have three villages of Jawle, Sakhri and Amboli. We have a total of 513 families living in these 3 villages. Unfortunately due to migration, several able-bodied members have left the villages looking for more lucartive employemnt in the nearby towns and cities.

Our community is moslty engaged in agriculre and fishing. We grow rice varieties such as rupali, karjat, ratna and suwarna – which have a cycle of 90-135 days. We have a lot of mango trees, which are famous for their sweetness. We also grow local vegetables for domestic consumption. Very few families rear livestock due to lack of agri labourers.

AERF team has built trust within the community and have been successful in signing agreements for conserving mangrove land areas privately owned by farmers. We saw how mangroves played a crucial role during the Nisarga cyclone. From the GGP, we welcome initiative that help conserve mangroves and help communities with alternate livelihoods such as beekeeping or seaweed cultivation.”

“I am Jyoti, a 44-year old mother and farmer. We live in Borge village of Pen block in Raigad district. Our village is located near the mangroves of Raigad.

In 2024, our family received the eco-friendly bio-stove from AERF under the programme. Several households in our village were already using it, and had mentioned its many benefits. We are three of us living in our house and thought we should try the low-smoke stove.

When I started using the stove, the first difference that I observed was much lesser smoke. My eyes were not water, I was able to breathe better while cooking. Further, we could carry this stove to the farm for cooking as well – it is not very heavy. This stove requires lesser fuel or wood when compared to our older stove. This reduced my burden of arranging for wood. I recommended this stove to several of my fellow villagers.”



Jyoti Borge, Farmer,
Borge village, Raigad



Pranali Patil, Farmer,
Washi village, Raigad

“I am Pranali Patil, a farmer living in Washi village from Pen in Raigad district. We are a large family with 7 members living together and farming our ancestral lands.

When we heard about the land agreement initiative with AERF, we were excited to learn more. Some of our land has mangroves growing. Ever since my marriage into this family, that is for 18 years, I have seen this land covered with mangroves.

We collectively decided to sign the land conservation agreement. We have signed off 2.25 acres of land for a term of 10 years.

At present, my 2 children have moved into the cities for their further education. We want

conserve our agricultural land – which is actually dependent on the mangrove trees for protection. I am happy my family has agreed to sign and we are safeguarding this land and the mangroves that are growing in it.

We have seen different bird species that live and nest in the mangroves. Our village members collect crabs from these areas, which is a local delicacy.”

7. Conclusion and way forward

The impact assessment study was conducted in January 2025 to assess the progress and impacts of the programme. The mangrove conservation programme's activities, and progress was found relevant and appreciated by its beneficiaries and other stakeholders.

The programme demonstrates alignment with the OECD-DAC principles of relevance, effectiveness, impact, and sustainability addressing critical requirements in the field of conserving mangroves in Maharashtra.

The private landowners of the mangroves, with whom conservation agreements are being signed, are satisfied with the terms and the incentives. The community leaders and members who receive the other programme benefits expressed that they were satisfied with the programme activities and efforts by the AERF team.

The programme's implementation field team and management are looking for ways to make the programme more efficient. Their scientific temperament and commitment to local communities were evident in the experimental alternate livelihood building activities.

For further improvement, Apple India may consider the following recommendations to make the programme more efficient.

Areas of improvement	Recommendation
It was observed that some of the programme's activities were not well documented and reported. With time, the recall ability community or the programme team could reduce.	It is recommended that a format be developed for documenting all the crucial activities of the programme. This would enable archiving of the details and could help the team to record key best practices and lessons learnt for future activities.
It was observed that some of the programme activities were not based on milestones or timelines. Due to this, tracking them or recording the flow of activities could get missed.	For long-term conservation programmes, it becomes imperative to have a list of activities prepared from the overall objectives. A milestone-based calendar of activities could be prepared that could help the programme implementing team and other stakeholders. The implementation of the programme could be planned in terms of phases, under which different objective are being met or covered through we-defined flow of activities. With this, Key Performance Indicators could be defined to track its progress. At present the

	dashboard covers a few indicators. This could be made more detailed and nuanced, reflective of the on-ground efforts.
Limited used of technology for standardisation and data management. This may hinder effective tracking of operations.	Implementing a centralised MIS that consolidates data across all aspects of the programme is recommended. Integrating this MIS with mobile apps or tools will enable real-time data collection and management. This could facilitate effective performance assessment and progress tracking. This would further enhance data accuracy, consistency, and reliability.

8. Annexures

List of abbreviations

AERF	Applied Environmental Research Foundation
FAO	Food and Agriculture Organisation
FGD	Focused Group Discussion
INR	Indian National Rupee (currency)
IDI	In-depth interview
KPI	Key Performance Indicator
LLP	Limited Liability Partnership
MIS	Management Information Systems
MoEFCC	Ministry of Environment, Forest, and Climate Change of India
NGO	Non-Governmental Organization
OECD-DAC	Organization for Economic Co-operation and Development - Development Assistance Committee
TDS	Total Dissolved Solids

List of interactions

Sl. No.	Category	No. of members
1	Programme team	07
2	Community members	21
	TOTAL	28

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- Owing to communication gap and the inherent human instinct to report everything as above-expectations and glitch-free, it was challenging to make interviewees understand the purpose of the survey and ensure that correct data was accordingly gathered. In the absence of baseline data, responses for retrospective questions are based on the respondents' ability to recall past information.
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