TechnoServe
Business Solutions to Poverty

IUCN

LEAP
LOCALLY EMPOWERED AREA PROTECTION

Scoping Study on Blue Economy Opportunities in Mozambique

Unlocking business solutions that benefit people, ocean and climate in Inhambane and Cabo Delgado seascapes

Final Report

February 2024

Supported by:

Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

based on a decision of the German Bundestag

IKI INTERNATIONAL CLIMATE INITIATIVE

IUCN Regenerative Blue Economy Context in WIO region

- The **Great Blue Wall (GBW) Initiative** was launched in 2021 with the objective of creating an Africa-driven response to the interconnected impacts of climate change, biodiversity loss, and economic crises aiming to achieve positive nature, livelihoods and transformation gains through seascapes that are linked through a living blue wall comprising critical ecosystems such as mangroves, seagrasses and corals.
- GBW is structured on three pillars: **blue planet** (strengthening governance of seascapes), **blue nature** (creating bold nature-based solutions and coastal and marine ecosystem valuation) **and blue economy** (creating blue jobs and leading a regenerative blue transformation). These are underpinned by **blue partnerships** and **bold political momentum.**
- The seminal **Blue Futures Ministerial Conference on Blue Economy and Climate Action**, held under the patronage of the Presidency of the African Union by the Union of Comoros, and enshrined in the "Moroni Declaration", explored the fundamental linkages between the Great Blue Wall, the Blue Economy and the African Continental Free Trade Area (AfCFTA).
- As its outcome, an **African High-Level Panel on Regenerative Blue Economy** was announced, endorsed at the highest level by WIO countries, signalling the key role that Mozambique will have to play in the regional regenerative blue economy agenda in Africa.
- Furthermore, a **Regenerative Blue Economy Framework** is being developed to guide policy and investment actions into key sectors of the blue economy that support regeneration and nature-positive transformation. The process, launched at the Ocean Innovation Africa Summit (OIAS) in Cape Town, intends to provide a framework that drives research and innovation, indigenous people and local community (IPLC) ocean empowerment, and blue investment and private sector action.
- The **LEAP Project (Locally Empowered Areas of Protection), funded by the International Climate Initiative (IKI)** of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) implements action in four countries (Kenya, Tanzania, Mozambique and Seychelles, aims to enhance coastal and marine socio-ecological resilience and biodiversity conservation in the Western Indian Ocean. At the core of the project is to open opportunities for renewed and equitable governance mechanisms for all in society to avoid further opportunity costs on local and indigenous communities living in and around target areas and their seascapes.
- This project supports the **assessment of blue economy opportunities across WIO countries**, informing government, private sector and local communities on blue value chains to be pursued based on a deep analysis of local context, market conditions, ecological and socioeconomic benefits to local communities as the ultimate beneficiaries of the project.

Executive Summary

The Blue Economy (BE) represents an opportunity to drive economic growth and development in Mozambique, where two thirds of the population lives in coastal areas. **This is especially true in Cabo Delgado and Inhambane** considering the unemployment, education and gender inequality challenges the two seascapes are facing.

Considering community integration, environmental protection and market dynamics criteria, we analyzed specific sectors in the BE strategy articulated by the Mozambique Government and first selected seven value chains. **Then analyzing the operational feasibility, we prioritized three value chains in each seascape.**

In Cabo Delgado, seaweed, sea cucumber and fresh fish cold storage and transport have the potential to generate **~$35 million** in revenue at scale. Realizing this potential requires supporting producers with inputs, establishing effective aggregation structures and creating new market linkages.

In Inhambane, seaweed, honey and tilapia aquaculture have the potential to generate **~$20 million** in revenue at scale. This requires transitioning producers from informal to commercial production, address input related challenges and improve infrastructure for enhanced market access.

Structure

1. Study objectives and research process
2. Blue Economy context
3. Prioritization framework
4. Value chain deep dives
5. Summary of recommendations
6. Appendix

Fishing equipment in Inhambane province, TechnoServe (2023)

The study aims to identify viable and inclusive value chains in the coastal provinces of Inhambane and Cabo Delgado in Mozambique

Background

- **The blue economy presents a promising avenue for countries to overcome some of their inherent economic challenges**, by developing blue businesses, and increasing economic sustainability. Currently, for most developing countries the traditional 'blue' sectors of fisheries, aquaculture and tourism play an important economic role and are key sectors for employment and foreign earnings.
- **Mozambique is in the process of developing its Blue Economy policies and frameworks**. A national Blue Economy strategy under development focuses on pillars: 1. Fisheries, 2. Renewable Energies and Marine Extractive Industry, 3. Natural Capital, Environment and Circular Economy, 4. Tourism and culture, 5. Maritime Transport, Ports, Logistics Infrastructure and 6. Maritime Security. New Blue Economy interventions should also respond to the Sea Policy Framework Mozambique, Five-Year Government Plan, and Government Development Plan.
- **The LEAP project which has established presence in Cabo Delgado is contributing to efforts to address the many challenges faced by the province**. Mozambique in general, and Cabo Delgado and Inhambane provinces in particular have an enormous and still untapped marine related economic development potential, which is further increased by recent advances in technology (e.g., aquaculture, renewable energy, biotechnology).

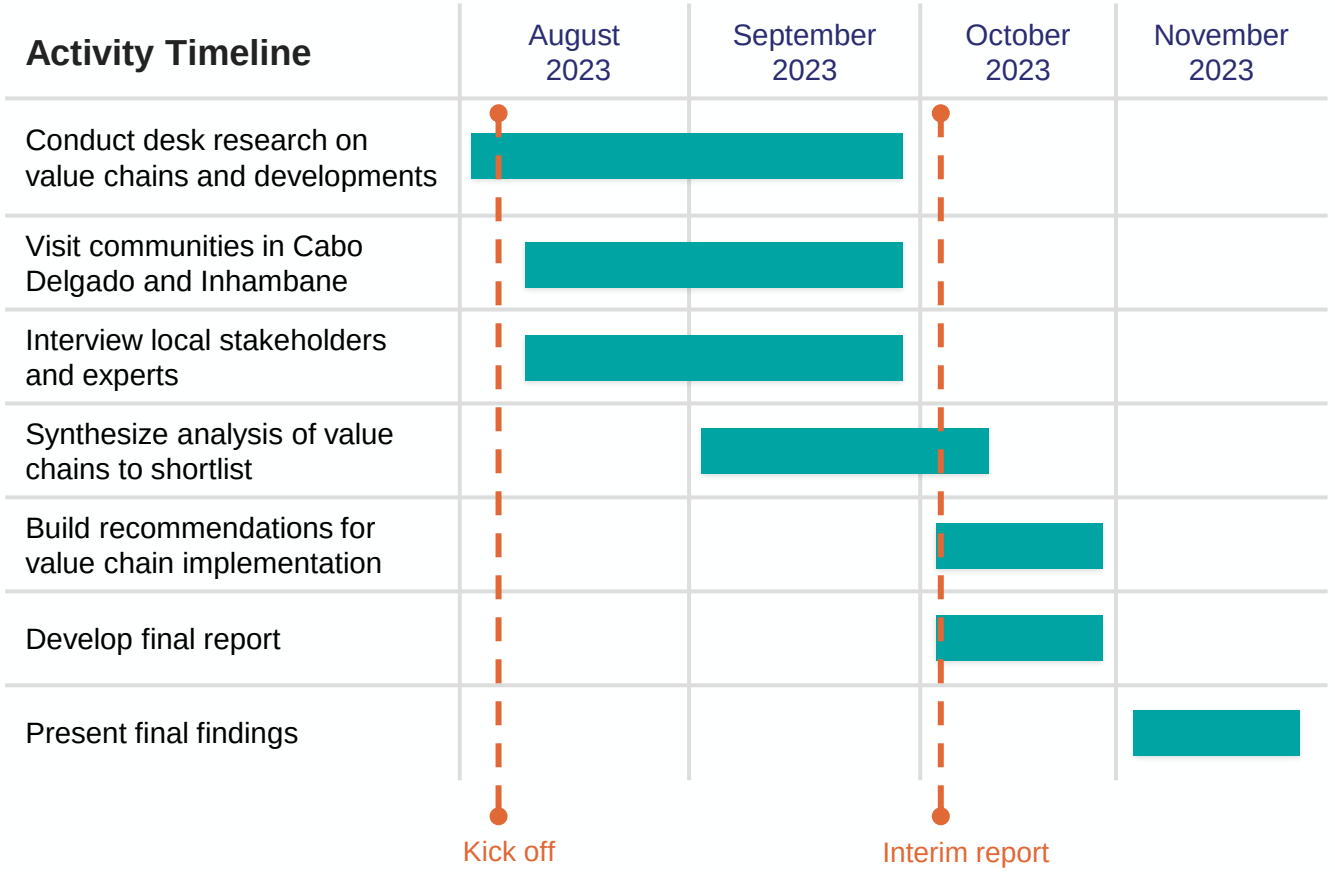
Objectives

- **The main goal of this project activity is to develop a strategic report** with recommendations that could be implemented as interventions to support the Blue Economy and sustainable development with a strong focus on local communities and in a manner that may be replicated in other communities.
- **Findings from the report will help build a baseline and recommendations** for blue wealth and productivity, policy and institutional frameworks, the constraints to developing a more productive blue economy, and assess the potential for generating greater value and creating better blue jobs.
- **This initiative will also create an opportunity to assist** the Governments of Cabo Delgado and Inhambane provinces and operational development partners to develop a robust Blue Economy action plan

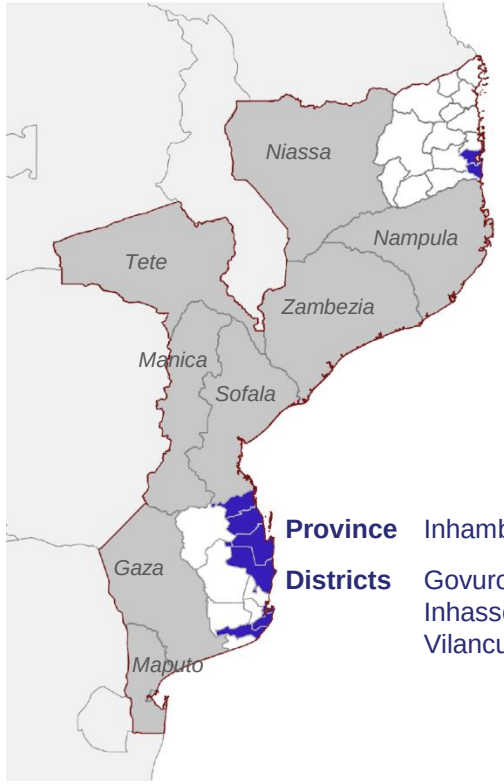
Approach

- **Establish the status of the key Blue Economy Sectors**: Advance knowledge on the key blue economy sectors and resources in Mozambique; have a clear understanding of how the key blue economy sectors currently operate, the opportunities and gaps in terms of competitiveness, the opportunities and challenges regarding inclusive supply and a clear map of current donor initiatives and government policies and legal framework supporting these sectors.
- **Prioritize Blue Economy opportunities**: Support the Provincial Governments of Cabo Delgado and Inhambane to prioritize high-potential sectors and strengthen its policy orientation towards the blue economy for wealth and employment creation, food security and reduction of poverty; Identify those 2-3 value chains within the fisheries sector and strategies that seem to offer the greatest potential for additionality in terms of i) Employment opportunities and income gains, iv) Climate and Biodiversity impact, iii) Feasibility .
- **Deliver key recommendations for strategic transformation**: bring the analytical components together into a broader sector vision. Detail the strategies required, how they would work, how they will close the competitiveness gap, how they will deliver climate and conservation impact, how they drive greater inclusivity, how they will leverage existing programs and policies and quantify the investment and impact benefits. Strategic pillars to achieve these visions and a roadmap over the next four years.

The research process encompassed a combination of field research, interviews with experts, and in-depth analysis



Districts targeted



Province Cabo Delgado

Districts Mecúfi, Metuge, Pemba

Province Inhambane

Districts Govuro, Inhambane City, Inharrime, Inhassoro, Jangamo, Massinga, Vilanculos

Over the course of the study, 50+ interviews were conducted with public and private actors involved in Mozambique's blue economy

Industry experts

- Universidade Lúrio
- Global blue economy specialists
- Southwestern Indian ocean experts
- Mozambican blue economy specialists

Government & IOs

- SDEA
- ProAzul
- World Bank
- FAO
- IUCN
- NorgesVel

Coastal communities

- Small-scale fishers
- Market traders
- Fish transporters
- Farmers
- Labourers

Development actors

- ACDI/VOCA
- Aga Khan
- Associação de Limpeza e Meio Ambiente
- Associação Moçambicana de Reciclagem
- AVSI
- DDB
- Enginyeria Sense Fronteres
- iDE
- Ocean Hub Africa
- ParCo
- RARE

Conservation actors

- African Parks
- Associação Natura
- BioFund
- Blue Forests Carbon
- Blue Ventures
- Instituto Oikos Onlus
- Marine Mega Fauna
- Ocean Revolution
- Peace Parks
- Wildlife Conservation Society
- World Wildlife Fund

Business entities

Fisheries

- AquaPesca
- Chicoa Fish Farm
- Mz Top Fish
- EmoPesca
- INDIMAR

Tourism

- Bahia Mar
- BlueOrb
- CMM
- Nuarro Lodge
- Inhambane Hotel School

Miscellaneous

- AbelhaMoz (honey)
- Mozambican Honey Company (honey)
- Selt Marine (seaweed)
- TerraMar (cold chain)
- Total Energies (LPG)

Structure

1. Study objectives and research process
2. Blue Economy context
3. Prioritization framework
4. Value chain deep dives
5. Summary of recommendations
6. Appendix

Aquaculture ponds in Cabo Delgado province, Technoserve (2023)

Situated in East Africa, Mozambique maintains a relatively flat annual GDP growth of ~2% with an economy defined by natural resources

Overview of Mozambique landscape & its coastal zones

	Mozambique overall	Coastal areas
Environmental	**Mozambique has a wealth of natural resources and landscapes** but is one of the most vulnerable countries to climate change, with intensification of extreme weather events (cyclones, storms, floods, droughts)	**The coast of Mozambique is vast and rich in natural resources** • 3rd longest coastline in Africa • 43% of the country's territory is sea-based, with one of the largest fisheries ground in the WIO region (Sofala Bank) • Largest mangrove forests in the WIO region, existence of Key Biodiversity Areas (KBAs)
Economic	**The country's economy is defined by natural resources** • 64% of the population lives below the poverty line (0.65$/day) • 27% national unemployment rate • Exported $8.5B in 2021; top exports included coal briquettes (21%), raw aluminum (17%)	**There is differential economic opportunity along the coast** • 26% of population works in fisheries or tourism • Only 0.7% of exports are from fish-related products • Primary exports from coast include petroleum gas, crustaceans, & fish
Social	**The population is young; many suffer from conflict in the north** • 40% of the population is under 14 years old • > 800K internally displaced people (IDPs)	**Many are reliant on the ocean for their livelihood** • 66% of the country' population lives in coastal zones • 27% of protein intake comes from fish

Source: IGC, OEC, Stakeholder interviews

Mozambique faces a complex landscape of economic, environmental, and social challenges

Environmental

Resource depletion

- **Fish catches have declined considerably** in recent years in part contributing to seagrass and coral reef degradation
- **Deforestation** driven by slash and burn agriculture and cutting trees for construction and fires

Pollution and habitat destruction

- **Pollution and inadequate waste management** harm marine ecosystems and threaten fish stocks
- **Investments in the offshore oil and gas sector** lead to environmental degradation and habitat destruction

Land degradation

- **Rising sea levels are causing coastline erosion**, which in turn damages seagrass and coral reefs
- **Concessions for sand mining** remain a risk

Inadequate regulation enforcement

- **Limited enforcement capacity of regulatory frameworks** has led to unsustainable resource exploitation & pollution
- **Illegal fishing persists**, costing Mozambique $36-67M each year

Economic

Poverty and inequality

- **Significant income inequality** between urban and rural areas
- **Coastal areas remain poor** despite abundance of resources

Lack of economic diversification

- **Economy is heavily dependent on natural resources**, making the economy vulnerable to commodity price fluctuations and natural disasters

Youth unemployment

- **Gradual increase of youth unemployment creates risk** of social unrest and further hindering economic development

Infrastructure development

- **Transportation and energy networks hinder economic growth** and access to services, particularly in rural and remote areas

Social

Political instability and conflict

- **Cabo Delgado has been subject to extreme violence** since October 2017
- **Displacement, loss of life, and disrupted development efforts** caused by armed groups and insurgent activities in these areas

Healthcare and public health

- **Limited access** to quality healthcare and basic medical
- **Diseases** like malaria, HIV/AIDS, and tuberculosis are major health concerns

Education

- **Inadequate infrastructure**, teacher shortages and low enrollment rates persist despite improvements

Gender inequity

- **Education, employment and political participation** have significant gender disparities
- **Women often have limited access** to resources, decision-making power, and economic opportunities

Source: WFF, Government documents, Stakeholder interviews

The Mozambique government has been advancing the its legal framework over the last 5 years to tackle those challenges

Introduced in 2018, the Blue Economy in Mozambique is a crucial component of a broader regional initiative championed by the country

The Sea Policy and other frameworks serve as the legal foundation within this comprehensive approach

Ministry of Sea, Inland Waters, & Fisheries (MIMAIP)

- Responsible for **legal framework, regulations, and development strategies**
- Establishes an **innovative legal framework** that integrates diverse resources, including a specialized marine sector uniting activities on the marine front.

POLMAR

- Mozambique introduced the "Policy and Strategy of the Sea" to enhance control over its waters and promote a sustainable, profitable blue economy, in alignment with the UN's Sustainable Development Goals.

REJUEM

- Regulation establishing the Legal Regime for the Use of the National Maritime Space adopted in 2021

ProAzul

- **Public fund institutionalized in 2019** to mobilize and delegate financial resources for the sustainable use of water, coastal and marine resources supported by the World Bank
- Innovative in the integration of the blue economy sector and its financing into the GDP
- Working with stakeholders across all sectors, specific focus on micro and small businesses enablement

Within this framework the government's blue economy strategy is under development[1]

Key sectors	
1 **Ports & Infrastructure**	Mozambique has four major ports in Maputo, Beira, Nacala, and Pemba
2 **Maritime Transport & Marine Industry**	Across the 3 main logistics corridors, the total cargo volume handled in 2022 was 26.7 million tons
3 **Fishing & Aquaculture**	20% of the population relies on fisheries for their income, only 49% of total fishery potential (940k tons) currently explored
4 **Culture, Tourism & Sport**	12% of the country's GDP; industry has high potential to grow
5 **Minerals & Hydrocarbons**	Mozambique is one of the largest exporters of liquefied natural gas after reserves were found in 2012
6 **Natural resources, environment & circular economy**	Prioritizes conservation of biodiversity, in part with Marine Protected Areas and Community Fishing Counsels

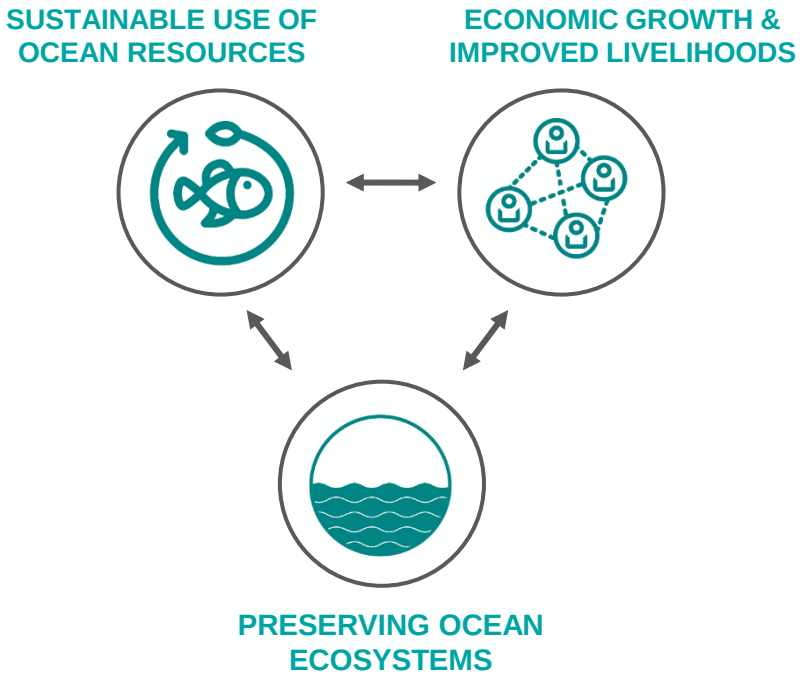
Highest potential to benefit rural communities

Source: POLMAR, MIMAIP, ProAzul, InOM, Stakeholder interviews

Note: 1. The pillars' designation may change based on potential refinement of the Blue Economy strategy under development

The Blue Economy represents an opportunity to drive economic growth and development in Mozambique

The Blue Economy integrates 3 components…



The Blue Economy is a sector that aims to develop ocean industries in a way that is inclusive of and beneficial to local communities while ensuring that ecological, economic and social needs are met and managed.

…that together can benefit the development challenges that Mozambique faces

	Challenge	*Blue Economy's potential to address challenge*
Environmental	Resource depletion	• Enable resource efficiency with more **sustainable methods**
	Pollution and habitat destruction	• Prioritize **nature-positive economic development**
	Land degradation	• **Move away from destructive practices** causing degradation
	Inadequate regulation enforcement	• Empower local communities to **self-regulate fishing stocks**
Economic	Poverty & inequality	• Develop **new and existing value** chains to benefit local communities
	Lack of economic diversification	• Develop **opportunities in new sectors** and encourage income diversification
	Youth unemployment	• Provide **training opportunities** and job connections for youth
Social	Education	• Initiate **environmental education** and conservation programs
	Gender inequity	• Develop sectors that are **inclusive of women**

Source: USAID, Stakeholder interviews

In selected sectors, integration of coastal community is key and need to be grounded on existing regulatory instruments and local practices

POLMAR sector	Fisheries & Aquaculture	Culture, Tourism & Sport	Natural resources, environ. & circular economy
Current state	• **~500K Mozambicans are employed in the fishing sector**, 97% of which are artisanal fishermen • In 2021, the catch of fisheries was **~450K tons** • Local fishing areas are managed by **local Community Fishing Counsels**	• Occupies **6% of the country's jobs** • Occurs throughout the country but is **most popular in Inhambane** • Activities include **accommodation**, diving, surfing, photography, & research • Recent **improvements** to ease of getting a **tourist visa**	• Natural resources for energy investment exist, however, **limited infrastructure and rural electricity** access persist • **Environmental issues**, including deforestation, pollution, illegal and unreported fishing and climate change necessitate management
Opportunity to grow	• Further improvement and implementation of **sustainable fishing practices** • Formalization of **processing mechanisms** • **Access** to nonlocal markets	• **Further inclusion** of local communities as staff • Demonstration of **local culture and traditions** • **Ecotourism** and sustainable practices	• Better **access to recycling** and waste services • **Protection** against sand mining and oil/natural gas extraction • **Replanting** of forest, corals, & seabeds**;** possible inclusion of **carbon-credits**
Community inclusion	• **90%** of all fish catch landed **comes from artisanal fisheries**, providing livelihoods for many coastal communities	• Made up of **local microbusinesses** embedded in coastal areas • High **potential for growth**	• Protecting environmental resources is key in **ensuring the continued provision of livelihoods** in local communities

Source: IHH, World Bank, Stakeholder interviews

Within these three sectors, there are several regulatory considerations

Fisheries & Aquaculture

Community Fishing Counsels (CCPs)
Counsels officially recognized by the government that are responsible for local fishery management

Fishing closures
Enacted periods of time when fishing for specific species or using certain techniques are prohibited

Prohibited & restricted species
Fishing for certain species is prohibited at all times; restricted species can only be caught up to a certain quantity per day

Fishing permits
As of 2017, any fishermen doing commercial activity must have a permit; this is loosely enforced

Beach seine ban – *Expected 2026*
Regulation likely to be implemented in coming years, prohibiting use of beach seines

Culture, Tourism & Sport

Regulatory bodies
The Ministry of Tourism (MITUR) is the responsible body for enforcement of tourism law

Licensing
Obtaining a license is required across several types of tourism businesses including accommodation, restaurants, & sport activities

Marine environment regulation
There are specified bathing beaches and restrictions on where motorized boats are used; all in legal effort to protect coast from damage

Implementation of eVisa
The country simplified its visa process to make it simpler for tourists and business traveler to enter for a certain period of days

Natural resources, environment & circular economy

Extended producer regulation (EPR)
Internal management system: refundable fee placed on consumer that is returned if used product is returned to the point of sale OR responsibility of producer can be transferred to licensed third party

Packaging environmental fee system: fee paid in accordance of the packaging's environmental impact

Packaging standardization system: packaging is produced with biodegradable, recyclable, reusable, or recoverable materials

Environmental regulation
Environmental impact assessments and licensing are required for activities that could have significant impact; special consideration for environmental protection zones and biodiversity considerations

Carbon credits
In early discussions to implement regulation

Source: FAO, REPMAR, MITUR, Lorax EPI, Fragomen, Stakeholder Interviews

Both Cabo Delgado and Inhambane rely on marine resources from their diverse ecosystems but face different challenges

This research focuses on Cabo Delgado & Inhambane provinces

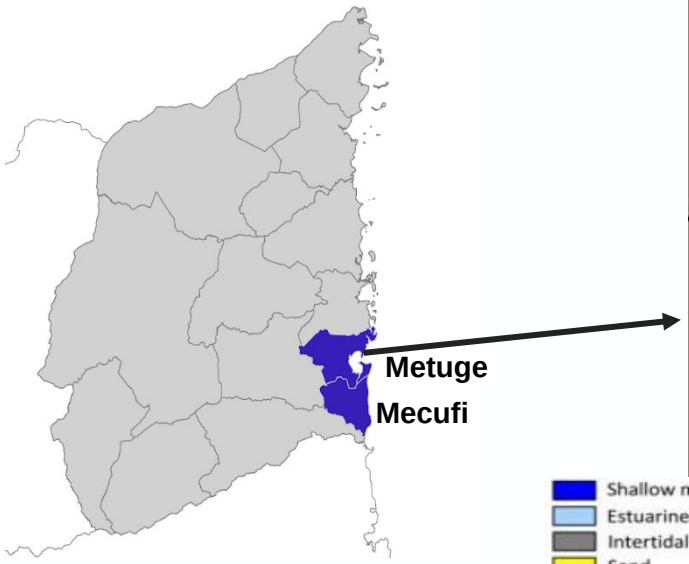
While the conflict in Cabo Delgado inhibits its development, Inhambane is at significant risk of climate change

	Environmental	Economic	Social
Cabo Delgado	• Fishing is abundant in conflict-affected regions, areas IDPs face significant overfishing pressure • Oil & gas deposits	• Highly disrupted due to conflict – many companies left area • Significant foreign aid investment for emergency relief	• Many internally displaced people (IDPs) • Male-dominant society, women have few rights
Similarities between provinces	• At risk of harmful natural resource extraction • Long coastlines, mangrove areas, sea grasses & archipelagos	• Economic growth impeded by weak infrastructure • Main market for sales is local	• Limited access to health services and education • Accustomed to quick profit turnaround from fishing
Inhambane	• Has a large peninsula and bay area in the south of the province • Several diverse ocean landscapes, including dunes and river deltas	• Significantly driven by tourism • Close to the capital, Maputo, with relatively better access to markets	• More inclusive of women, but still primarily male-dominant society • Extremely diverse dynamics within each community

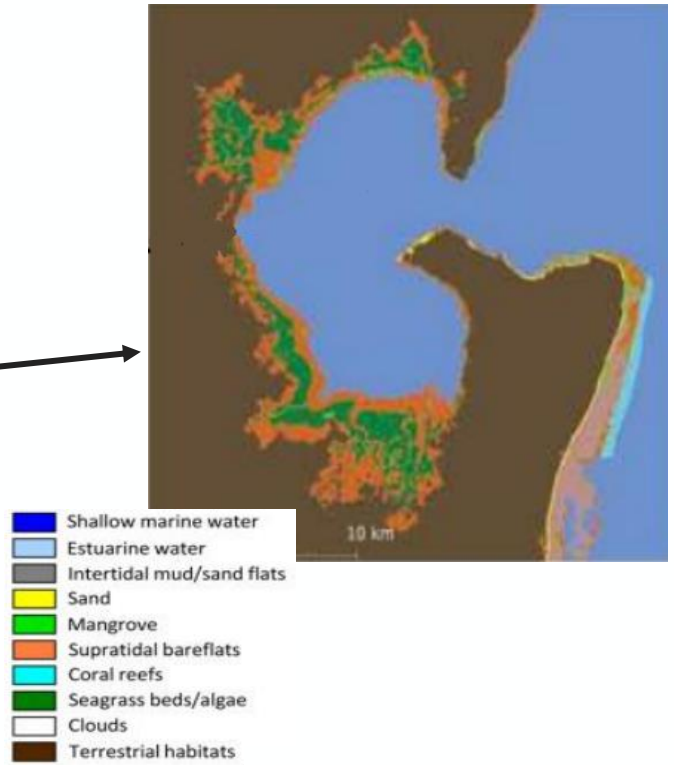
Source: Stakeholder interviews

Cabo Delgado: the province has a tropical climate with a vast coastline of mangrove forests and coral reefs

Map of Cabo Delgado Province



Zoomed-in seascape of Pemba Bay, published by UEM



Climate and geographic conditions are dynamic and need to be frequently reassess. Mozambique made significant progress to organize environmental and biodiversity data with the national inventory of forests, analysis of land use and coverage, the FNDS database, and the PNDT (National Plan for Territorial Development) also providing **trends which need to be considered for economic development planning**.

Source: Biofund, Universidade Eduardo Mondlane, Stakeholder Interviews

Climate

- Tropical climate with a rainy season in summer and dryer season in the winter
- Annual average temperature of 30 degrees Celsius

Cabo Delgado is highly vulnerable to tropical storms and cyclones

Landscapes

- Coral Reefs
- Mangroves
- Natural gas deposits
- Fish sanctuaries
- Archipelago
- Seagrass beds

Fishing stocks revitalized during conflict while inland resources such as mangroves were diminished

Protected areas

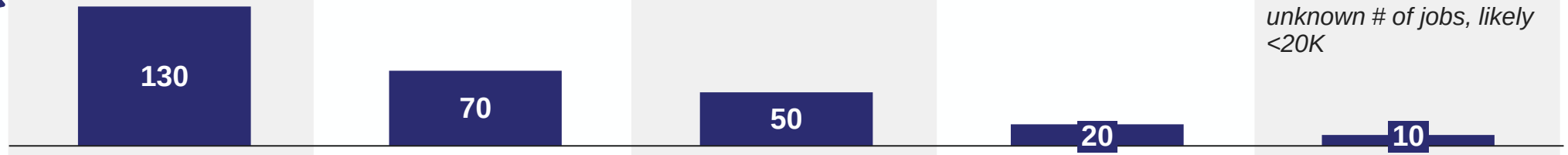
- Quirimbas National Park
- Niassa National Reserve
- Several marine protected zones

Throughout the conflict, conservation efforts have been reverted – for example, after years of growth, elephant populations have been reduced

DIRECTIONAL

Cabo Delgado: most people work in agricultural activities throughout the province and are highly dependent on natural resources

Adult population of 1.2M with ~25% unemployment



	Other food production	Mining	Fisheries	Tourism	Aquaculture
Number of jobs (in thousands)	130	70	50	20	*unknown # of jobs, likely <20K* / 10
Description	Typically subsistence farming, cashews and sesame seeds are main crops	Some of the large gas companies do CSR projects throughout the province	Evacuated areas have replenished fish life; overpopulated areas experience fish decline	Although it hosts landscapes attractive for tourism, the instability has hurt this sector	Many projects have been attempted and failed due to theft and lack of training
Key sub-industries	Agriculture & livestock	Natural gas	Artisanal fishing, shellfish gleaning (e.g., shrimp, crab, mussels)	Accommodation, tours, restaurants	Fresh water tilapia, seaweed, shrimp
Selected Stakeholders*	FAO, Aga Khan	International oil and gas companies, MIMAIP	CCPs, MPAs, Gov, UniLorio	Ulala Lodge, Mecufi Beach Resort, Avani Pemba Beach	Selt Marine, Indian Ocean Aquaculture, Gov
Challenges	Natural disasters & cyclones, sustainable techniques, sales	Unsustainable practices	Fish processing, boat availability, destruction of mangroves	Conflict drove away tourists	Expensive feed, difficulty of sale

Note: relative number of job analysis is highly directional and takes the whole province into account, not just the coastal area

*Selected stakeholders is non exhaustive as many other stakeholders are involved in those sectors in Cabo Delgado

Source: Brilho, Flanders, ILO, Food Security Cluster, FAO, Stakeholder Interviews

Cabo Delgado: the conflict has created further challenges across education, gender inequality, and unemployment

	Education	Healthcare	Gender	Employment
Overview	*School offerings are very basic with minimal resources; even in primary schools, there are more male students than female*	*Healthcare is relatively inaccessible as there is only one public hospital, located in Pemba, some districts in the province have no health facilities*	*Cabo Delgado has the greatest gender disparities in the country; women have few rights play a small role in the broader economy*	*Significant unemployment challenges and lack of skills development; instability & conflict caused companies to leave*
Key challenges	**Access**: most remote communities don't have secondary schools, and path is inaccessible during rainy season **Teachers**: the student to teacher ratio is very high **Infrastructure**: many schools do not have water, bathrooms or sound structures, some schools even occur outdoors **Illiteracy**: the illiteracy rate is 12.5% higher than the national average	**Access**: remote areas may only have access to clinics that are rarely active **Sexual & reproductive health**: lack of education, facilities, and equipment for proper health treatment **HIV/AIDS**: over 10% of the population has HIV/AIDS; limited access to support **Water**: only ~40% of the population has access to clean water **Sanitation**: 73% of households do not have a latrine	**Power over income**: typically, a woman must give the money she earns to her husband **Premature marriage**: most girls are married before 18, and situation has worsened in the conflict **Gender based violence**: is very common with little access to services **Access to credit**: is very limited for women, making entrepreneurial activity difficult	**Availability**: unemployment is extremely high and job availability has worsened with conflict **Training**: job training in rural areas is dominantly done by NGOs for farming and some vocational training **Youth employment**: unemployment is especially persistent for youth, impeding skill building

Source: AVSI, MozPArks, WHO, UNICEF, USAID, Stakeholder Interviews

Cabo Delgado: there are 50+ NGOs and multiple enterprises within the province; the following are some with active Blue Economy projects

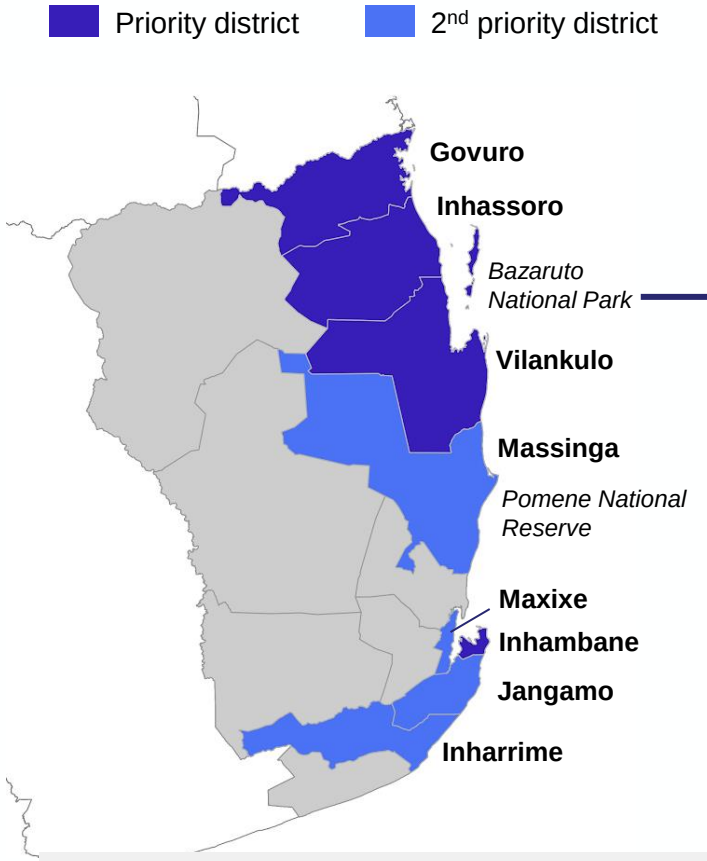
	Organizations	Sectors	Districts	Description
NGOs	FAO	Fish processing, fishing equipment, horticulture	All Cabo Delgado districts	Primarily focused on fishing and fish processing such as cold chain, packaging, and higher quality boats; they also want to focus on horticulture
	AKDN	Honey, aquaculture	Mecufi, Metuge, others	Enables alternative livelihoods to fishing, currently has honey project and wants to do aquaculture
	ama	Environmental studies & governance	Ancuabe, Montepuez, Chiure, Quissanga, Macomia, Ibo, Mocimboa da Praia, Palma	Focuses on environmental research and education as well as local governance of natural resources
	OIKOS	Horticulture, mangrove planting	Mecufi, Metuge	Designs projects to address needs of local communities, primarily horticulture and mangrove planting; had a failed mussels project
	AVSI	Gender equality	Pemba, Montepuez, Balama, Namuno, Ibo (completed project in Mecufi & Metuge)	Works in gender equality, surveying households and implementing women empowerment programs along with vocational training
Enterprises	TOTAL	Natural gas, agriculture, seaweed	Afungi, potential to expand to Mocimboa da Praia	Large scale liquidfied natural gas company with operations in Cabo Delgado; several CSR intiatives within the blue economy including agriculture, seaweed, & sea cucumber
	SELT MARINE GROUP	Seaweed	Pemba (other locations in Nampula)	Seaweed farming company located in Pemba and parts of Nampula, hires community members to care for farm; exported 32 tons in 2022 and sees potential to grow throughout Mozambique

This is not an exhaustive list of NGOs and enterprises.
Government and donors are also supporting project through grant funding and other mechanisms in the province.

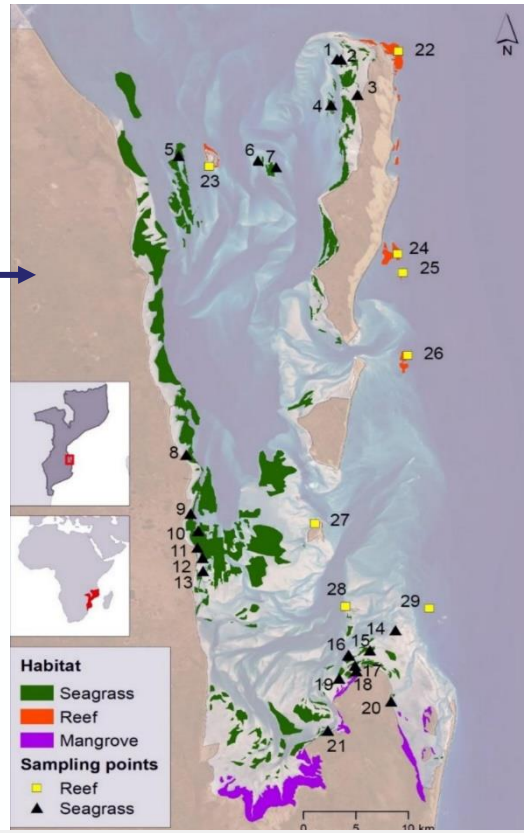
Source: OCHA, Organization websites, Stakeholder interviews

Inhambane: the geography across the province is extremely diverse varying in seascapes and marine life

Map of Inhambane Province



Zoomed-in seascape of Bazaruto National Park, published by MDPI



Climate and geographic conditions are dynamic and need to be frequently reassess. Mozambique made significant progress to organize environmental and biodiversity data with the national inventory of forests, analysis of land use and coverage, the FNDS database, and the PNDT (National Plan for Territorial Development) also providing **trends which need to be considered for economic development planning**.

Source: MDPI, Stakeholder Interviews

Climate

- Tropical humid climate along the coastline with a rainy and dry seasons
- Average temperature of 27 degrees Celsius

Specific areas of the province are susceptible to droughts, floods, and cyclones

Landscapes

- Bay area
- Archipelago
- Coral reefs
- River delta
- Sand dunes
- Seagrass beds
- Mangroves
- Miambo forests

The coastal landscapes across Inhambane vary greatly, requiring extra consideration for project implementation

Protected areas

- Bazaruto National Park
- Cabo Sao Sabastao
- Pomene National Reserve
- Zinave National Park

Protected areas are a hotspot for tourism and often have heightened NGO & government involvement

DIRECTIONAL

Inhambane: although known for tourism, most people work in agricultural activities throughout the province

Adult population of ~700K with 19% unemployment

	Other food production	Fisheries	Tourism	Mining	Aquaculture
Indicative number of jobs (in thousands)	*Likely >50K*				*Unknown # of jobs, likely <15K*
	50	30	25	20	10
Description	Many development organizations invest in food products as alt. livelihood	Primary type of job along coastal communities	Popular tourist destination, particularly along beaches and for diving activities	Mining poses a threat for destruction of the environment and excludes communities	Significant government investment in tilapia projects
Key sub-industries	Agriculture & livestock	Artisanal fishing, shellfish gleaning (e.g., shrimp, crab, mussels)	Accommodation, tours, restaurants	Natural gas, limestone, clay, salt, heavy sands	Fresh & salt water tilapia
Selected Stakeholders*	Boa Gente, Ocean Revolution, WWF, Gov	CCPs, MPAs, Ocean Revolution, MIMAIP	Inhambane Hotel School, Bahia Mar	Sasol, small-scale operators	Poelela Fisheries, Gov
Challenges	Salty soil, hot conditions, cyclone damage	Diminishing stock, erosion, fish processing	Community inclusion, training	Sand mining concessions, unsustainable practices	Fish theft, expensive feed, difficulty of sale

Note: relative number of job analysis is highly directional and takes the whole province into account, not just the coastal area

*Selected stakeholders is non exhaustive as many other stakeholders are involved in those sectors in Cabo Delgado

Source: Inhambane Government Profile, ILO, MZ News, Stakeholder Interviews

Inhambane: despite social influence from tourism, gender inequality, poor education and limited employment opportunities persist

	Education	Healthcare	Gender	Employment
Overview	*Most have access to primary education but secondary education remains largely inaccessible; older generations are more likely to be unable to read or write*	*Healthcare services are limitedly available, clinics are situated across the province that have doctors visit rotationally*	*Women are increasingly able to work and manage their income, however disparities exist in secondary education and career opportunities*	*Rural communities dominantly work in fishing or agriculture, youth seek professional / technical employment but getting a job is difficult*
Key challenges	**Access**: most remote communities don't have secondary schools, inhibiting education past 7th grade **Opportunity**: people don't have the opportunity to implement skills they learn in school **Teachers**: it is difficult to find teacher to teach in remote schools; the student to teacher ratio is very high **Infrastructure**: many schools don't have access to electricity **Environmental Ed**: no focus on environmental topics	**Access**: remote areas may only have access to clinics that are rarely active **Sexual & reproductive health**: communities are often uneducated about sexual & reproductive health and lack proper supplies **HIV/AIDS**: in 2020, ~13% of the population was positive **Water**: often, individuals must walk long distances to retrieve water, installation of pump are usually done by NGOs	**Decision-making power**: at times, women do not have discretion over their income **Premature marriage**: girls are married as early as 12 and begin to have children **Gender based violence**: considered a norm in communities with little access to help **Education**: by nature of secondary schools being far away, girls are more likely than boys to stop education after primary school	**Availability**: there is limited job availability, people revert to fishing when unemployed **Training**: there are several universities and training programs throughout the province, NGOs also provide select training opportunities **Youth employment**: many youth express interest in professional careers and complete training, however it is difficult to find a related job

Source: NIH, Stakeholder Interviews

Inhambane: there are 20+ NGOs and multiple enterprises within the province; the following are some with active Blue Economy projects

	Organizations	Sectors	District	Description
NGOs	WWF	Agriculture, honey, fish processing, mangrove restoration, oyster smoking	Massinga, Vilankulo, Inhassoro, Govuro	Works with local partners to implement development projects that vary between districts
	Ocean Revolution Moçambique	Agriculture, savings groups, technical training, tourism, conservation	Inhambane, Jangamo	Local NGO that is highly integrated with the communities; began advocating for local involvement in tourism, now works more in alternative livelihoods
	Marine Megafauna Foundation	Governance, agriculture	Inhambane, Inhassoro	Works with CCPs on community fishing conservation and some agriculture projects
	African Parks	Environment conservation	Vilankulo	Manages Bazaruto National Park, primarily does management, but also promotes environmental education on the island
	ParCo	Plastic recycling	Vilankulo	Does beach cleanup & plastic recycling
	Natura	Environmental education, honey	Massinga	Does youth environmental education and honey productions; hopes to grow into other alternative livelihoods
Enterprises	Bahia Mar	Tourism	Vilankulo	Hires and trains local communities in hotel activities
	IHE Inhambane Hotel Escola	Tourism	Inhambane	Private / public partnerships that works with local universities to train students and hire local community members
	Boa Gente	Agriculture	Inhambane, Inharrime	Producer of coconut and honey products in rural communities, Boa Gente packages and distributes is goods in broader markets
	Produto de Moçambique	Tilapia farming	Inharrime	Private tilapia farming company that is supported by the government, breeds tilapia, raises fingerlings to maturity, and sells fish
	AfriFruta	Dried fruit, coconut oil	Inhambane	Processes and exports products such as dried mangos and coconut oil that they buy from local growers in remote areas

This is not an exhaustive list of NGOs and enterprises.
Government and donors are also supporting project through grant funding and other mechanisms in the province.

Source: OCHA, Organization websites, Stakeholder interviews

Structure

1. Study objectives and research process
2. Blue Economy context
3. Prioritization framework
4. Value chain deep dives
5. Summary of recommendations
6. Appendix

Fishing catch in the process of being salted in nhambane. Technoserve (2023)

Our prioritization framework aims to identify value chains with greatest potential across economic, environmental and social dimensions

Research objective

- Support the Provincial Governments of Cabo Delgado and Inhambane to prioritize high-potential sectors.
- Support the strengthening of policy orientation towards the blue economy so as to improve wealth and employment creation, food security and reduce poverty.

Targeted outcomes:

- Identify 3-5 value chains that seem to offer the greatest potential for additionality in terms of
  - Employment opportunities and income gains
  - Climate and Biodiversity impact
  - Feasibility, recognizing the importance of other value chains
- Due to the prescribed goals of this study certain promising value chains could not be taken forward for in-depth analysis. This does not diminish their potential interest for further exploration; however, it falls beyond the scope of the present research.

Methodology

A combined approach of comprehensive research, analytical scoring, and targeted deep dives was used to identify key opportunities

1. **Research:**
   - **Desk Research:** Utilized existing literature and data to establish a foundational understanding of the blue economy landscape in Mozambique.
   - **Field Research:** Conducted on-site visits to targeted districts in Cabo Delgado and Inhambane provinces, engaging with community members and local businesses. This approach facilitated firsthand insights into the challenges and opportunities.
   - **Expert Interviews:** Engaged with a diverse range of stakeholders across Mozambique to gain in-depth perspectives and refine the focus of the research project.
2. **Analytics:**
   - A **scoring system was developed** to systematically evaluate and filter potential value chains. At each filtering level, around 10 questions were used to assess value chain viability. Points were allocated based on responses guided the selection of the most promising value chains.
   - **Exclusionary criteria**, such as gender dynamics, were applied to ensure a comprehensive and inclusive analysis.
3. **Deep Dives:**
   - Once high-scoring value chains were identified, market research was conducted which was specifically tailored to the selected value chains, gathering additional insights.
   - Further expert interviews were also conducted with relevant industry specialists. Desk research was used to complement the findings, ensuring a comprehensive understanding of the chosen value chains and their market dynamics.

Fishery based activities are central to coastal economies, however communities also rely significantly on land-based industries

Identified value chains in Cabo Delgado and Inhambane provinces*
Based on community and public & private actors' information

FISHERIES & AQUACULTURE

Aquaculture
- Tilapia aquaculture
- Shrimp aquaculture
- Fish feed creation

Mariculture
- Crab fattening
- Seaweed cultivation
- Sea cucumber aquaculture
- Mollusk farming

Fisheries use
- Sustainable fishing methods
- Fresh fish cold storage
- Seafood transport
- Octopus fishing and processing

CULTURE, TOURISM & SPORTS

Tourism
- Hospitality staffing and business
- Restaurants & bars
- Tourism guides
- Water transport

Culture
- Artisanal craft supply and sales

NATURAL RESOURCES, ENVIRONMENT & CIRCULAR ECONOMY

Environmental protection
- Blue carbon finance through environmental rehabilitation
- Community protected areas

Land-based production
- Horticulture production
- Mango drying
- Honey production
- Salt mining
- Livestock farming
- Cashew farming
- Coconut farming

Resource management
- Charcoal briquettes creation
- Waste recycling and repurposing

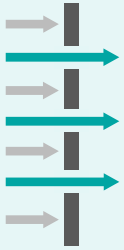
Due to their significant footprint land-based production value chains were also considered despite not being included in the POLMAR strategy

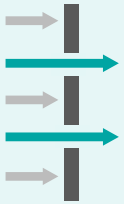
** Definitions of each value chain can be found in the appendix of the report*

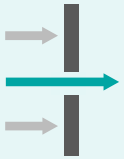
Value chains are evaluated through community, environment and market filters to identify the ones with the most potential impact

Value chains selection based on potential impact

Prioritization in each seascape



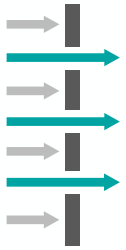




Analysis dimension	1 Community impact	2 Environmental Impact	3 Market conditions	4 Operational feasibility
Indicators	• Inclusive economic potential • Inclusion of women and youth • Food security support	• Ecosystem and biodiversity • Pollution sources • Climate adaptation potential	• Supply dynamics • Demand dynamics • Existing infrastructure	• Implementation requirements • Wider ecosystem considerations • Execution aspects
Scoring criteria	• **11 underlying scoring criteria** are used to assess each value chain • **Value chains scoring above 75%** advance to the next filter • **Inclusive economic potential dimensions carry higher weight**, with a mandatory requirement for women's inclusion (any value chain that excludes women is disqualified)	• **10 underlying scoring criteria** are applied to each value chain • **Value chains scoring above 50%** on average advance to the next stage • **Impact on the existing ecosystem** is considered the critical category	• **7 supply and demand criteria** are applied to assess each value chain • **Top scoring value chains are chosen** for in-depth analysis • **Value chains with pre-existing supply and production infrastructure** within the surveyed provinces are given additional weight	• Financial and technical assistance • Main cost drivers • Market linkages • Existing industry and environment • Private sector environment • Risks • Timeline

1 Filter 1: Community Impact

Identifying value chains with the most potential for community prosperity and inclusiveness



Category	Indicators	Assessment criteria	Relative weight	Rationale for inclusion
Community income	**Type and size of business** working in value chain	*Includes microenterprises or inclusive sourcing*	**33%** Highest weight given	Economic insecurity and high levels of poverty make improving socio-economic conditions a priority
	How **value creation benefits** the community	*Integration of individuals, employment potential, direct income and salary level*		
	Expected **timeline for profitability**	*Profitability reached in less than 9 months*		
Locally adapted	**Adoption potential** in the existing landscape	*Is re-conversion required*	**11%**	Focusing on known activities will capitalize on pre-existing skills and capacities in the community
Women inclusion	**Women's empowerment**	*Are women able to have ownership of the venture, participate in skill development and see income improvement*	**22%** Mandatory requirement	Existing gender roles are strongly entrenched in coastal economic activities; women's inclusion is challenging due to cultural dynamics
	Women's participation	*Do cultural considerations allow for women to participate*		
Youth inclusion	**Youth empowerment**	*Are youth able to have ownership of the venture, and see direct income improvement*	**22%**	High levels of unemployment and low levels of education make it difficult to find employment opportunities for youth
	Youth participation	*Do cultural considerations allow for youth to participate*		
Food security	Contribution to **food security**	*Is protein availability or food stock increased*	**11%**	Rural populations have limited capacity access food, that is both nutritious and sufficient
	Increase in food **accessibility**	*Is food brought to new areas, becomes locally or more consistently available*		
	Increase in food **affordability**	*Production costs are decreased, is it locally produced or is supply increase*		

Value chains need to score at least 75% across all 11 indicators to advance to the next stage

Filter 1: 13 value chains demonstrated positive impact on income and inclusivity, top performers also contributed to food security

Value chains that passed filter 1

POLMAR Sector	Value chain	Community income	Local integration	Women inclusion	Youth inclusion	Food security	Pass?	Rationale
Fisheries & Aquaculture	Tilapia aquaculture	🟡	🟢	🟢	🟢	🟢	Yes	Known and established industry, even if not yet well developed. Potential for inclusion and protein creation
	Shrimp aquaculture	🟡	🟢	🟢	🟢	🟢	Yes	
	Seaweed cultivation	🟢	🔴	🟢	🟢	🔴	Yes	Novel value chain in the area which do not create any food products that are consumed locally. Potential revenue can be high, and returns can be acquired quickly
	Sea cucumber production	🟢	🔴	🟢	🟢	🔴	Yes	
	Mollusk farming	🟢	🔴	🟢	🟢	🟢	Yes	Novel value chain with good potential for women and youth integration
	Crab fattening	🟡	🟢	🟢	🟢	🟢	Yes	Established value chain that contributes to food availability
	Fresh fish cold storage and transport	🟡	🟢	🟢	🟢	🟢	Yes	Potential to improve this process is high, it would contribute significantly to reducing post harvest losses
Natural resources & environment	Cashew farming	🟡	🟢	🟢	🟢	🟢	Yes	Existing and native cash crops that can provide solid but longer-term impact for communities given the time required for maturation
	Coconut farming	🟡	🟢	🟢	🟢	🟢	Yes	
	Honey production	🟡	🟢	🟢	🟢	🟢	Yes	Specialty products that have potential to provide income in various types of markets including providing a locally grown product and capitalizing on sustainable or organic markets
	Mango drying	🟡	🟢	🟢	🟢	🟢	Yes	
	Livestock production	🟡	🟢	🟢	🟢	🟢	Yes	Activities that are mostly conducted at subsistence level but have the potential to grow
	Horticulture	🟡	🟢	🟢	🟢	🟢	Yes	

🔴 Low score 🟡 Average score 🟢 High score

Filter 1: 14 value chains were de-prioritized based on income potential or women's participation, although improvement opportunities exist

Value chains that did not pass filter 1

POLMAR Sector	Value chain	Community income	Local integration	Women inclusion	Youth inclusion	Food security	Pass?	Rationale
Fisheries & Aquaculture	Fish feed creation	🟡	🟡	🟢	🟢	🟡	No	Low overall score given **low profitability potential, high re-conversion needs and no direct contribution to food security**
	Octopus fishing and sales	🟢	🟢	🔴	🟢	🟢	No	Little to no possibility for women's participation giving existing **gender roles in relation to open water fishing.** Likely low long term returns due to decreasing fishery stocks
	Seafood transport	🟢	🔴	🔴	🟢	🟡	No	
	Sustainable fishing methods	🟡	🔴	🔴	🟢	🔴	No	
Natural resources & environment	Salt mining	🟡	🟢	🔴	🟢	🔴	No	Little to **no possibility for women**'s inclusion. High neighboring competition from South Africa and Namibia
	Community protected areas	🔴	🟢	🟢	🟡	🔴	No	**No significant employment creation** potential. Would require significant training and valuation investment to be able to generate verified credits.
	Blue Carbon Financing	🔴	🔴	🟢	🟡	🔴	No	
	Charcoal briquette creation	🔴	🔴	🟢	🟢	🔴	No	
	Waste recycling	🟡	🟢	🟢	🟢	🔴	No	
Culture, tourism & sport	Hospitality staffing and business	🟡	🟡	🟡	🟢	🔴	No	Little existing absorption capacity in the current tourism industry, requires re-conversion to adapt to a tourism market. Challenging risk environment given conflict uncertainty in Cabo Delgado.
	Restaurants & Bars	🟡	🟢	🟢	🟢	🔴	No	
	Tourism Guides	🟡	🟡	🔴	🟢	🔴	No	Little to **no possibility for women**'s inclusion
	Artisanal craft sales and supply	🟡	🟢	🟢	🟢	🔴	No	Low overall score given **low profitability** and no direct contribution to food security
	Water Transport	🟡	🟢	🔴	🟢	🔴	No	Little to **no possibility for women**'s inclusion

🔴 Low score 🟡 Average score 🟢 High score

2 Filter 2: Environmental Impact

Promoting sustainable ecosystems and climate resilience through conservation efforts

Category	Indicators	Assessment criteria	Relative weight	Rationale for inclusion
Ecosystem impact	• **Habitat preservation**	*Protecting and restoring specific habitats that conserve biodiversity*	**50%**	Mozambique has an **incredibly diverse and rich coastal biodiversity**, offering significant ecological and economic value to the nation **Sustainable and long-term income opportunities** can be created through the development of regenerative value chains that focus on conservation and biodiversity
	• Provision of **ecosystem services**	*Enhances benefits that ecosystems provide to nature and society*		
	• Impact on **soils**	*Erosion rate, increase of soil organic matter content*		
	• Impact on **forests**	*Reduction of deforestation and dependence on wood products*		
	• Impact on **coasts and marine environments**	*Protection or destruction of habitats and marine environments (littoral and benthic)*		
	• Impact on **fish stocks**	*Reduction of pressure on wild fish stocks*		
Pollution sources	• **Greenhouse gas emissions**	*Significant new emission creation*	**25%**	**Coastal ecosystems are exceptionally fragile and face severe threats from pollutants** that can irreversibly damage the fragile ecological balance
	• **Air and water pollution**	*Effluent and nutrient pollution, discharge potential into water bodies, runoff potential*		
Climate adaptation and resilience	• **Resilience** to climate change	*Incorporates climate resilient crops, sustainable water use, supports coastal environments, sustainable harvesting*	**25%**	**Coastal areas are particularly vulnerable to climate change** due to changing weather partners, increased storm intensity and sea-level rise Given the **dependence on coastal resources for community livelihoods**, providing strong and adaptable value chains is critical
	• **Potential impact** of climate change	*Production and yield variability, resource availability and quality, supply chain disruptions*		

Value chains scoring above 50% on average across the 10 indicators to advance to the next stage

Filter 2: 11 value chains meet our regenerative and conservation objectives

POLMAR Sector	Value Chain	Ecosystem impact	Pollution sources	Climate change adaptation	Pass?	Rationale
Fisheries & Aquaculture	Tilapia aquaculture	🟡	🟢	🟢	Yes	Reduces dependence on wild caught fish stocks which could allow them to repopulate, inland aquaculture could be less affected by sea temperature change
	Shrimp aquaculture	🟡	🟢	🟢	Yes	
	Seaweed cultivation	🟢	🟢	🟡	Yes	Can sequester carbon dioxide, improve water quality, break down environmental pollutants (fish byproducts), acidification regulation, and provide habitat for marine species
	Sea cucumber production	🟢	🟢	🟡	Yes	Provides water filtration, nutrient cycling, and habitat conservation, benefiting coastal ecosystems
	Mollusk farming	🟢	🟢	🟡	Yes	
Natural resources & environment	Crab fattening	🟡	🟢	🟡	Yes	Reduces dependence on wild caught crab stocks
	Fresh fish cold storage and transport	🟡	🟢	🟢	Yes	Can increase the efficiency of fish utilization. Less waste is generated reducing the need for additional fishing efforts to compensate for discarded catch
	Cashew farming	🟡	🟢	🟡	Yes	Can provide ecosystem services such as carbon sequestration, water retention, agrobiodiversity and protection against soil erosion when managed with conservation practices
	Coconut farming	🟡	🟢	🟡	Yes	
	Honey production	🟡	🟢	🟡	Yes	Supports ecosystem services through pollination in mangroves and forests, no direct impact on coastal or marine life
	Mango drying	🔴	🟢	🔴	No	Can provide some positive nature potential if managed in a regenerative way. Otherwise, no significant positive ecosystem impact or climate mitigation by these value chains
	Livestock production	🟡	🟢	🔴	No	
	Horticulture	🟡	🟢	🟡	No	

🔴 Low score 🟡 Average score 🟢 High score

3 Filter 3: Market Conditions

Supply and demand criteria will determine the capacity for the value chains to thrive

Category	Indicators	Assessment criteria	Relative weight	Rationale for inclusion
Demand	• **National** demand	*Total demand for goods, services, or resources within country borders, reflecting the needs and preferences of the domestic population and businesses*	**45%**	Understanding demand ensures that the goods or services produced align with the existing needs and preferences. Businesses can tailor their offerings to better serve the market, leading to increased economic growth.
	• **International** demand	*Demand for goods, services, or resources on a global scale, considering trade and transactions influenced by market dynamics*		
	• International **market stability**	*Variation given exposure to certain factors (global prices of commodities, volume availability, regulations, consumer demand)*		
Supply	• **Competitive advantage** in targeted province	*Unique strengths and resources that arise from this specific geographic location*	**35%**	Assessing the availability of local resources and the capacity of community members to participate in the supply chain is critical to determining opportunities for local employment, income generation, and skill development.
	• **Quality and price competition**	*Can the targeted province compete with international standards when it comes to quality and price factors*		
Local infrastructure and experience	• **Supply chain and logistics** established for non-local demand	*Is the supply chain and logistics chain well established for this value chain in this province*	**20%**	Considering existing infrastructure will enable capitalization on existing structures to potentially allow the value chain to develop faster and more smoothly. It can also help determine existing bottlenecks and challenges
	• **Existing production** in country and/or in the targeted province	*What existing industries or businesses are already producing or working in this value chain in the province*		

Value chains scoring above 50% on average across the 7 indicators to advance to the next stage

Filter 3: Selected value chains present a strong existing local, national and international demand

POLMAR Sector	Value Chain	Demand	Supply	Existing infrastructure	Deep dive?	Rationale
Fisheries & aquaculture	Tilapia aquaculture	🟢	🟢	🟡	Yes	Supply and demand dynamics are strong for both value chains and will continue to grow given decreasing fish stocks and increasing demand
	Shrimp aquaculture	🟢	🟢	🔴	Yes	
	Seaweed cultivation	🟢	🟢	🟡	Yes	Strong natural advantage to grow this product in this province, cultivation has been initiated already with some success
	Sea cucumber production	🟢	🟢	🔴	Yes	Strong international demand for this product especially given the severe decline in wild stocks due to overfishing.
	Mollusk farming	🟢	🟢	🔴	Yes	Existing demand and natural advantage in this area to grow this product
	Crab fattening	🟡	🟡	🟡	No	While demand exists, the supply available is not particularly competitive
	Fresh fish cold storage and transport	🟢	🟡	🟡	Yes	A more stable post-harvest system would make fishing communities more competitive in pricing and sales
Natural resources & environment	Cashew farming	🟡	🟡	🟡	No	Supply has been severely affected by disease and low yields of both crops
	Coconut farming	🟡	🔴	🟡	No	
	Honey production	🟢	🟡	🔴	Yes	Existing competitive market, strong natural advantage to create quality product

🔴 Low score 🟡 Average score 🟢 High score

The most impactful value chains demonstrate women's inclusion, positive environmental impact, and robust demand-supply dynamics

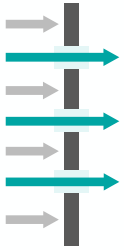
		1 Community impact					2 Environmental impact			3 Market conditions		
POLMAR Sector	*Value chain*	Community income	Local integration	Women inclusion	Youth inclusion	Food security	Ecosystem impact	Pollution sources	Climate change adaptation	Demand	Supply	Existing Infrastructure
Fisheries & Aquaculture	Tilapia aquaculture	🟡	🟢	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟢	🟡
	Shrimp aquaculture	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴
	Seaweed cultivation	🟢	🔴	🟢	🟢	🔴	🟢	🟢	🟢	🟢	🟢	🔴
	Sea cucumber production	🟢	🔴	🟢	🟢	🔴	🟢	🟢	🟢	🟢	🟢	🔴
	Mollusk mariculture	🟢	🔴	🟢	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🔴
	Fresh fish cold storage and transport	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡
Natural resources & environment	Honey production	🟡	🟢	🟢	🟢	🟢	🟡	🟢	🟡	🟢	🟢	🟡

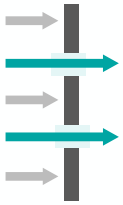
🔴 Low score 🟡 Average score 🟢 High score

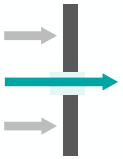
The operational feasibility is evaluated for each shortlisted value chain in each seascape

Value chains selection based on potential impact

Prioritization in each seascape







Analysis dimension	1 Community impact	2 Environmental Impact	3 Market conditions	4 Operational feasibility
Indicators	• Inclusive economic potential • Inclusion of women and youth • Food security support	• Ecosystem and biodiversity • Pollution sources • Climate adaptation potential	• Supply dynamics • Demand dynamics • Existing infrastructure	• Implementation requirements • Wider ecosystem considerations • Execution aspects
Scoring criteria	• **11 underlying scoring criteria** are used to assess each value chain • **Value chains scoring above 75%** advance to the next filter • **Inclusive economic potential dimensions carry higher weight**, with a mandatory requirement for women's inclusion (any value chain that excludes women is disqualified)	• **10 underlying scoring criteria** are applied to each value chain • **Value chains scoring above 50%** on average advance to the next stage • **Impact on the existing ecosystem** is considered the critical category	• **7 supply and demand criteria** are applied to assess each value chain • **Top scoring value chains are chosen** for in-depth analysis • **Value chains with pre-existing supply and production infrastructure** within the surveyed provinces are given additional weight	• Financial and technical assistance • Main cost drivers • Market linkages • Existing industry and environment • Private sector environment • Risks • Timeline

Analyzing operational insights allows us to determine which value chains are most likely to thrive in the existing ecosystem

Operational feasibility criteria described

Implementation requirements	• **Financing and Technical Assistance**: Identifying required financial and technical support to establish the value chain. • **Main Cost Drivers:** Identifying the primary cost components within each value chain. • **Market Linkages**: Evaluating the connections to markets and access requirements.
Wider ecosystem considerations	• **Existing industry:** Identifying existing businesses operating in this landscape. • **Regulatory Environment:** Analyzing the existing regulatory landscape. • **Certification Requirements**: Identifying any necessary certifications or standards. • **Private Sector and Partnership Interest:** Exploring private sector and partnership engagement.
Execution considerations	• **Risks:** Assessing potential risks associated with each value chain. • **Timeline:** Outlining the expected timeline for implementation. • **Scalability:** Determining the scalability potential of value chain options. • **Sustainability Practices**: Examining current and ideal sustainability practices.

We evaluate each value chain based on both operational feasibility and impact, selecting those in the top quadrant

Aggregation of the following:
- Inclusion of women
- Income potential
- Environmental impact

Value chains in this quadrant are prioritized

Aggregated Impact

High

Medium

Higher impact but lower operational feasibility

High impact and high operational feasibility

Lower relative impact and more challenging operational feasibility

High operational feasibility but lower relative impact

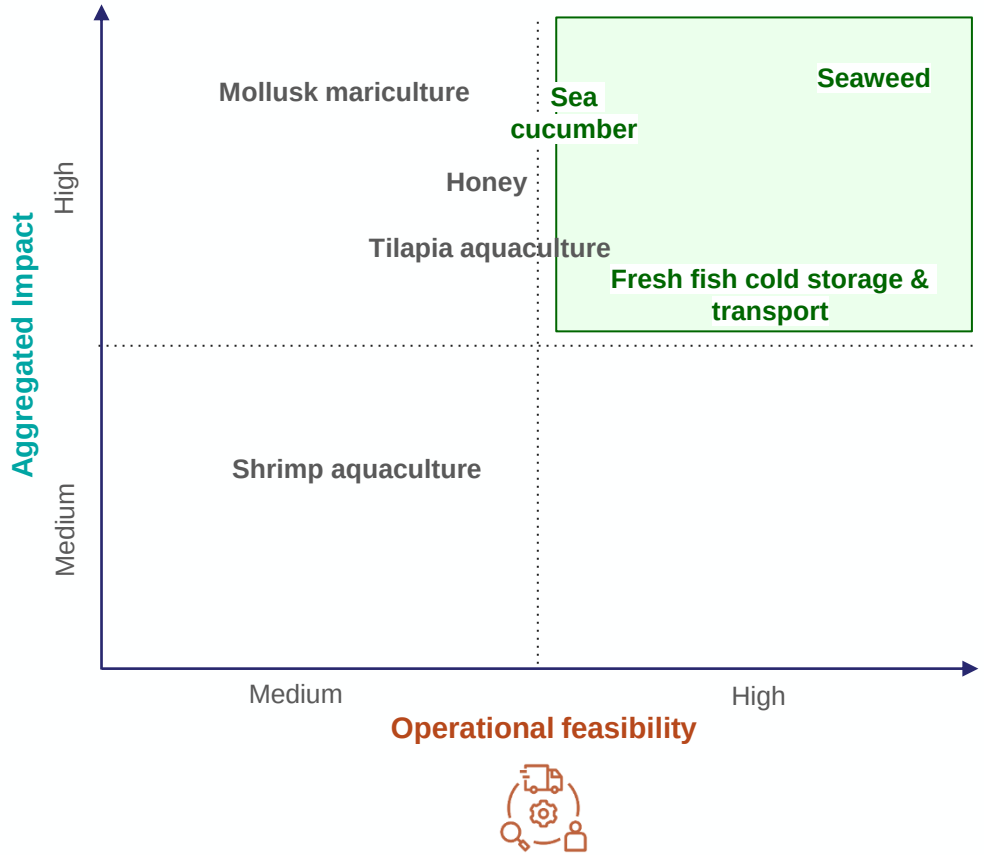
Medium

High

Operational feasibility

Aggregation of the following:
- Implementation requirements
- Wider ecosystem dynamics
- Execution considerations

In Cabo Delgado, value chains with the most feasibility and impact are seaweed, sea cucumber and fresh fish cold storage and transport



Selected value chains	Impact	Feasibility	Opportunity
Seaweed cultivation	• Low cost entry • Inclusive of women	• Ideal natural environment • Low input model	• Robust and growing global demand
Sea cucumber aquaculture	• Improves water quality • Tidal cultivation done by women	• Suitable natural environment • Require long growth period	• Luxury product in high demand • Processing is done on site
Fresh fish cold storage and transport	• Higher income generation from existing harvests	• Aligns with existing industry	• Strong demand for fresh fish in country

Non-selected value chains	Impact	Feasibility	Opportunity
Mollusk mariculture	• Strong income generating potential	• Requires existing cold chain infrastructure	• Strong global demand and suitable environment
Shrimp aquaculture	• Reduces pressure on wild stocks	• Significant financial investment required for start up	• Existing national and global demand
Tilapia aquaculture	• Reduces pressure on wild caught catch	• Lower demand due to availability of wild fish	• Can fill gap in demand for fresh fish
Honey production	• Incentivizes environmental preservation	• Lack of aggregation structures and commercial market	• Potential for high quality product creation

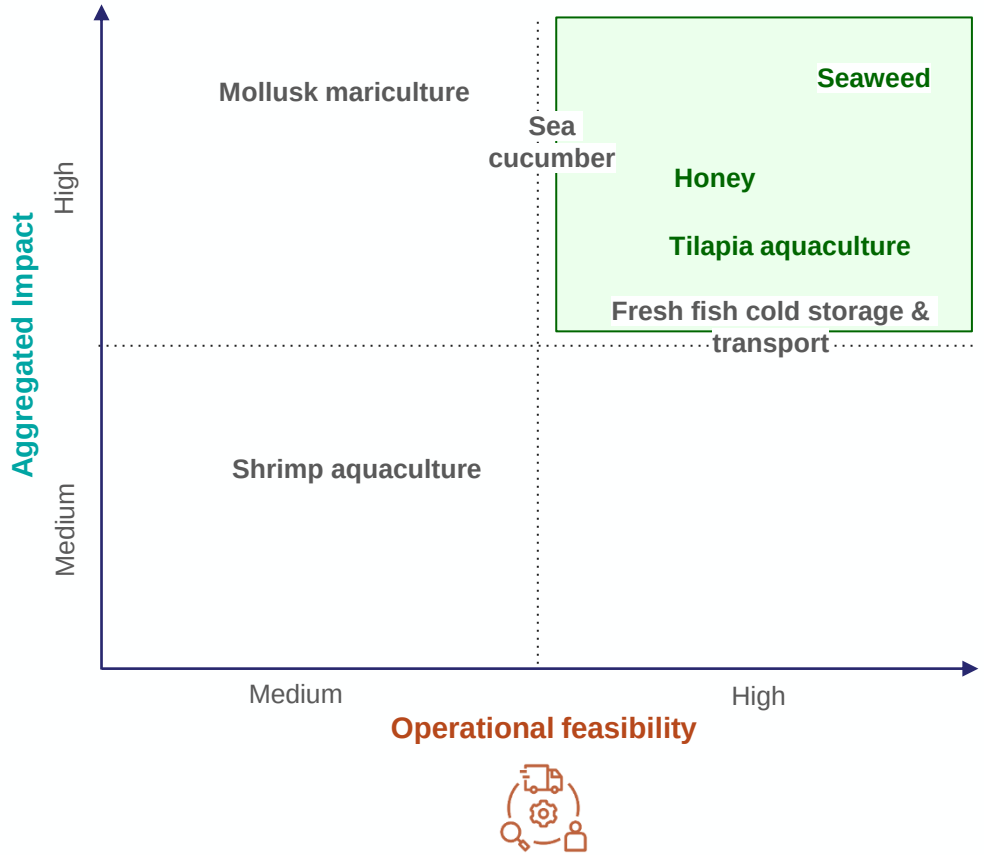
Note: *Primary focus on aquaculture value chain is aligned with Mozambique's Strategy for the Development of Aquaculture (EDA) in Cabo Delgado*

The operational and impact criteria enable us to compare each value chain's potential success in Cabo Delgado

Value chain	Recommended	Women's participation*	Capacity building	Access to finance and markets	Ecosystem support
Tilapia aquaculture	✘	30%	• **Technical support** is essential. • **Precision farming** is required for best results. • **Extension services** are nascent.	• Initial investment required is moderate. • **Feed is a significant operational cost** with no good supply at present. • Strong **demand for protein sources**.	• Government support exists for developing aquaculture. • **Limited infrastructure**. • **Competition from cheaper, imported fish.**
Shrimp aquaculture	✘	30%	• **Technical support** is essential. • High disease risk requiring close management.	• **High initial investment required** for tanks	• **Historically strong shrimp sector** decimated by disease in the 2010s.
Fresh fish cold storage & transport	✓	80%	• **Training on operation and maintenance** of infrastructure is critical. • **Building business skills is critical.**	• Investment varies depending on scale. • Links to local and regional markets are strong.	• **Low infrastructure** of roads and electrical network are an obstacle.
Seaweed cultivation	✓	80%	• **Existing players** are present in Cabo Delgado. • **Existing community knowledge**. • **Building business skills is critical**.	• **Low initial investment** required. • **Significant global market linkage** required. • **Reliance on export** to global markets for success. • **No existing local demand**.	• **Export routes and trade** agreements to be developed. • **Seedlings and broodstock** nursery industry to be developed.
Sea cucumber production	✓	80%	• **No existing industry** in country. • **Training** on technical aspects and business skills essential.		
Mollusk mariculture	✘	80%	• **Training** on technical aspects and business skills essential. • **Nascent industry in Mozambique** but no existing project in the province.	• **Low initial investment** required, seedlings and industry must be developed. • **Cold chain is critical** to bring product to market.	• **Export routes and trade** agreements to be developed. • **Seedlings** nursery industry to be developed.
Honey production	✘	40%	• **Few existing commercial players** in the province. • Less technical training required, transferrable skills available.	• **Aggregation and marketing is essential** to ensure success for farmer producers.	• **Strong competition** from imported honey and from non-commercial grade honey. • **Certifications** could help with quality perception and sales.

Note: * *Estimated women's participation based on existing industry analysis*

In Inhambane, value chains with the most feasibility and impact are seaweed, honey and tilapia aquaculture



Selected value chains	Impact	Feasibility	Opportunity
Seaweed cultivation	• Low cost entry • Inclusive of women	• Ideal natural environment • Low input model	• Robust and growing global demand
Tilapia aquaculture	• Steady revenue generation	• Historically farmed in Inhambane	• Meet growing demand for fresh fish
Honey production	• Requirement for unpolluted area incentivizes environmental protection	• Significant suitable natural area for production	• Unique, high quality product creation potential

Non-selected value chains	Impact	Feasibility	Opportunity
Mollusk mariculture	• Strong income generating potential	• Requires existing cold chain infrastructure	• Strong global demand and suitable environment
Shrimp aquaculture	• Reduces pressure on wild stocks	• Significant financial investment required for start up	• Existing national and global demand
Fresh fish cold storage and transport	• Would reduce waste in existing catches	• Aligns well with existing fish sale practices	• Existing market infrastructure to support improved sales
Sea cucumber aquaculture	• Reduces pressure on wild stocks	• Requires setting up the value chain from scratch	• Strong global demand

The operational and impact criteria enable us to compare each value chain's potential success in Inhambane

Value chain	Recommended	Women's participation*	Capacity building	Access to finance and markets	Ecosystem support
Tilapia aquaculture	✓	30%	• **Technical support** is essential. • **Precision farming** is required for best results. • **Strong historical knowledge of industry in province.**	• Initial investment required is moderate. • **Feed is a significant operational cost** with no good supply at present. • Strong **demand for protein sources.**	• Government support exists for developing aquaculture. • **Competition from cheaper, imported fish.**
Shrimp aquaculture	✗	30%	• **Technical support** is essential. • High disease risk requiring close management.	• **High initial investment required** for tanks.	• **Historically strong shrimp sector** decimated by disease in the 2010s.
Fresh fish cold storage & transport	✗	80%	• **Training on operation and maintenance** of infrastructure is critical. • **Building business skills is critical.**	• Investment varies depending on scale • Links to local and regional markets are strong.	• **Low infrastructure** of roads and electrical network are an obstacle.
Seaweed cultivation	✓	80%	• No existing players in Inhambane. • **Existing community knowledge.** • **Building business skills is critical.**	• **Low initial investment** required. • **Significant global market linkage** required. • **Reliance on export** to global markets for success. • **No existing local demand**.	• **Export routes and trade** agreements to be developed. • **Seedlings and broodstock** nursery industry to be developed.
Sea cucumber production	✗	80%	• **No existing industry** in country. • **Training** on technical aspects and business skills essential.		
Mollusk mariculture	✗	80%	• **Training** on technical aspects and business skills essential. • **Nascent industry in Mozambique** but no existing project in the province.	• **Low initial investment** required, seedlings and industry must be developed. • **Cold chain is critical** to bring product to market.	• **Export routes and trade** agreements to be developed. • **Seedlings** nursery industry to be developed.
Honey production	✓	40%	• **Existing players** already implementing. • Less technical training required, transferrable skills available.	• **Aggregation and marketing is essential** to ensure success for farmer producers.	• **Strong competition** from imported honey and from non-commercial grade honey. • **Certifications** could help with quality perception and sales, potential linkage with mangrove forests conservation

Note: * *Estimated women's participation based on existing industry analysis*

Structure

1. Study objectives and research process
2. Blue Economy context
3. Prioritization framework
4. Value chain deep dives
5. Summary of recommendations
6. Appendix

Industrial tilapia aquaculture in Inhambane province, TechnoServe (2023)

Three value chains are prioritized for each province, with detailed analyses covering impact, challenges, and recommendations

	Cabo Delgado	Inhambane
Seaweed cultivation	✓	✓
Sea cucumber aquaculture	✓	✗
Fresh fish cold storage and transport	✓	✗
Tilapia aquaculture	✗	✓
Honey production	✗	✓

Value chain deep-dive

- **Impact quantification** across relevant economic, social and environmental dimensions
- **Value chain overview** describing most important steps and key considerations
- **Key value chain facts** in the province(s), baselining existing activities and identifying key actors
- **Challenges and goals** for the development of the value chain based on existing capacity
- **Recommendations** associated with each goal identifying relevant stakeholders
- **Risks** related to the implementation of recommendations
- **Case study** to learn from another country

Seaweed Harvesting

Photo Credit: UnSplash Creative Commons

Developing Cabo Delgado and Inhambane's seaweed sector can yield economic, social, and environmental gains

High-level interventions

1 Create a cost-effective, sustainable and productive **seaweed harvesting system** led by smallholder producers

***Underlying challenges**: Limited production, no historical cultivation of this crop, scarce technical knowledge, raw material and financial resources not readily available*

2 Establish **seaweed aggregation structures** that consolidate quality production

***Underlying challenges:** Significant volumes required, no existing aggregation structures, few existing entrepreneurial skills among coastal communities*

3 **Establish strong offtake agreements** by providing business support and increasing national awareness

***Underlying challenges:** No existing processing capacity or demand in country, challenging business environment for off-takers*

Potential Impact

Economic	Social	Environmental
► **$15 to 18 million** sector revenue • *Based on production of 50,000 tons wet / 5,000 tons dry* • *~ $0.3 - 0.6 profit/kg dry* ► **15K** jobs created • *10K hectares exploited* • *80% of jobs in production* • *5% of jobs in training and quality control* • *15% of jobs in aggregation, value add and sales*	►**$85** monthly income • *Up to 6 cycles/year* • *500m^2 production area* • *125kg of dry harvest/cycle* • *Total costs/cycle: $283* • *Main inputs: wood stakes and netting, cuttings, spores* • *Profit/year: $1K* ► **80%** women participation • *Estimate from Zanzibar where majority of seaweed producers are women.* ► **Income diversification** away from overexploited fish stocks	► **Potential for 11 MT of CO2 sequestered** per year on 10k hectares of production ► Improved **water quality** ► **Coastal protection** through limiting coastal development and seabed destruction ► **Regulation of acidification** through absorption of CO2 ► **Biodiversity support** through creation of habitats for marine species

Within the global seaweed industry, seaweed farming dominates as the primary production method

Description of the seaweed farming value chain

Stage	Production		Aggregation		Processing and off taking	
	Seed collection and propagation	Plant seedlings in cultivation structure	Harvesting and drying	Transport	Processing	Sales
Description	Seaweed seeds or spores are collected and grown in a nursery.	Seaweed strands are attached to cultivation structures. Species dependent life cycle of 40 to 80 days.	Cutting of seaweed at maturity and drying in the sun or using mechanical dryers.	The dried seaweed is transported to a processing or packaging facility to be readied for onward sales.	Depending on its final use, seaweed undergoes further processing for extraction or packaging for consumption.	Sale to the following industries: food, fertilizer and pharmaceutical manufacturing, food service, cosmetics and retail.
Key Considerations	• **Harvesting and propagation is a technical process** that involves specialized equipment. • Most global production is red and brown seaweed with red seaweed having the highest value.	• **2 types of seaweed farms** exist: small scale farmers and large scale operators. • **Seaweed thrives in unpolluted waters** and requires few inputs to grow making it a sustainable crop.	• **Fresh to dry** weight ratio **10:1**. • **Sustainable harvesting practices** required for productive regrowth.	• **Drying, packaging, and storage facilities must be optimal** to prevent damage. • Inadequate drying or contamination can ruin the entire seaweed batch through bacterial infection.	• **Processing methods vary widely.** It ranges from milling to extraction through solvent based methods.	• 40% of cultured seaweed is **eaten directly**. • 40% is consumed indirectly through **processed foods.** • 20% is used **industrial applications.**

Source: TechnoServe analysis (2023), stakeholder interviews (2023), FAO, World Bank, Mordor, *Seaweed farming in Africa* - Msuya et al (2022)

The seaweed farming industry is at a nascent stage in Mozambique with few established production structures

Seaweed farming snapshot in Mozambique

	Production & Aggregation	Processing and off taking

Key actors	• **1 commercial farm production in Cabo Delgado**
	  • Selt Marine producing **~95%** of seaweed in Mozambique
	  • **500 to 1000 workers**
	  • **30 tons production** volume/year over < 10 hectares
	• **1 community project** in Cabo Delgado
	  • **Total Energies** supporting **~ 400 small producers** since 2022
	• **No aggregation structures** set up in Mozambique
		• **1 exporter** for current production: Selt Marine
		• **No industrial processing** capacity in Mozambique
		  • Exported production is processed in Tunisia by Selt Marine
		• **No local demand** for seaweed in Mozambique

Key indicators - Mozambique	• **10.5K+ hectares** identified as suitable growing area • **~50,000 tons** of FW seaweed (5000T dried) production potential • **~ US$ 0.30/kg production costs**	• **32T exported** in 2022 by Selt Marine • Regionally, **>5 large companies interested in purchasing** seaweed
Key indicators – global markets	• **96%** of global seaweed production comes from **harvesting** • **5 ton/hectare** average annual yield • **35M tons** produced annually; largest production volumes from **Asia** • **In Africa, ~13K tons (dry) produced annually,** from Tanzania, Madagascar and South Africa • **In 2022, Zanzibar exported 8K tons of dried seaweed** from 16k hectares of farmed land, sustaining 25k seaweed industry jobs	• **$17B global market** • **Primary uses:** food consumption, pharmaceuticals & cosmetics • **~8% CAGR through 2028**, driven by increases in consumption and new product uses (e.g. biostimulants) • Key players include P.L Thomas and Co. Inc., Cargill Foods, Snap Alginates, Kimica Alginates

Source: TechnoServe analysis (2023), stakeholder interviews (2023), *Seaweed farming in Africa* - Msuya et al (2022)

Despite challenges, Mozambique's seaweed industry offers a compelling opportunity, driven by natural advantages and global demand

	Challenges	Existing capacity
Production	• **Small production** and limited historical cultivation • Limited technical **production knowledge** • Spores and raw **material unavailable** • **Limited funding for new ventures**	• **High-quality seaweed possible** • High female **knowledge of coastal zone** • **Simple crop production;** low maintenance • **Low inputs** required
Aggregation	• **Significant volumes** required for off-taker interest and market set up • **No existing aggregation structures** for small-holder producers • **Few existing entrepreneurial skills** among costal communities	• **Stakeholders** could serve as aggregators ◦ Micro aggregators, intermediary traders, social enterprises, seafood traders • Largest **seaweed harvester** may consider **consolidating** from smaller producers
Processing and offtake	• **No existing processing capacity** • **No domestic demand** for seaweed • **Challenging business environment** for new off takers • **Competitiveness** with established producers	• **Existing seaweed off taker** established in Cabo Delgado and seeks to expand • **Government engagement** could offer support through Blue Economy pillar • **Domestic milling or grinding potential** through milling machinery

Key goals

1. Create a cost-effective, sustainable and productive **seaweed harvesting system** led by smallholder producers
2. Establish **seaweed aggregation structures** that consolidate quality production
3. **Establish strong offtake agreements** by providing business support and increasing national awareness

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

Developing Mozambique's seaweed industry requires a strong focus on quality production and efficient aggregation

Key goals	Recommendations	Type of support	Key stakeholders
1 Create a cost-effective, sustainable and productive **seaweed harvesting system** led by smallholder producers	1. Provide **technical production training** for farmers	Capacity building	Training & entrepreneurship organizations
	2. Establish a **network of local experts** to support producers in monitoring and troubleshooting	Capacity building	MIMAIP, UEM, global seaweed exports
	3. Facilitate access to **financing for start up costs** for producers	Access to finance	Micro-finance institutions
	4. Develop a **local supply industry for raw materials (seedlings and spores)**	Capacity building, Ecosystem support	Technical experts
2 Establish **seaweed aggregation structures** that consolidate quality production	5. Support the development of **farmer-led aggregation structures** in production areas	Capacity building, Access to market	Traders, aggregators, community leaders
	6. Establish **contracts with aggregators** to purchase local production	Access to market	Seaweed exporters, Selt
	7. Explore access to funding to **support drying and processing facilities** in the province	Access to finance	Impact investors
3 **Establish strong offtake agreements** by providing business support and increasing national awareness	8. Facilitate establishment of **seaweed industry players**	Access to market, Ecosystem support	Ministry of Trade Ministry of Industry MIMAIP
	9. Invest in **marketing and branding** to establish Mozambique seaweed as a high-quality option	Ecosystem support	
	10. Develop **water quality regulations** to protect the environment for optimal seaweed growth	Ecosystem support	

Capacity building *Access to finance* *Access to market* *Ecosystem support*

Source: TechnoServe analysis (2023)

Setting up seaweed aquaculture has inherent risks at production, aggregation and offtake stages but mitigation is possible

Goals	Risks	Impact	Likelihood	Mitigation
1	**Past mariculture projects faced challenges** with low production, weak market connections, and limited infrastructure.	🔴	🟡	• Invest in processing and transportation **infrastructure.** • Promote **modern mariculture practices** to enhance production efficiency.
	Seaweed diseases have been on the rise globally, affecting yields and preventing future production due to contamination.	🔴	🟡	• Implement **strict biosecurity measures**, develop protocols for regular checks. • Identify and use **disease resistant varieties**.
	Coastal communities have no financial capital for start up costs or operating costs while awaiting revenue generation.	🔴	🔴	• Facilitate **access to microfinance** and loans for small-scale coastal farmers. • Create **community financial support and capacity building** for resource and risk sharing.
	Establishing technical expertise is challenging due to lack of pull factors in seaweed production areas.	🟡	🟢	• **Partner** with universities and research institutions to provide technical support. • Engage women and youth through **scientific and tech. training** • Offer **incentives for experts** to work in remote regions.
2	**Fair prices for producers** are not guaranteed given the disparate quantities and possible unreliable supply produced.	🟡	🟡	• Create transparent pricing mechanisms and encourage collective bargaining through aggregation. • Implement **quality and quantity standards** to maintain reliable supply.
	Competition from other countries with established industries could deter interest.	🔴	🟡	• Produce **high-quality and organic or ASC certified** seaweed with unique characteristics.
3	**Cumbersome licensing process** hinders off-takers from easily entering the market and engaging with production.	🔴	🔴	• **Advocate for regulatory reforms** and streamlined licensing procedures. • Offer assistance and **guidance to navigate the licensing process**.
	Limited community and government awareness of seaweed may hinder production and industry growth.	🟡	🟢	• **Promote seaweed awareness** with outreach and education. • Partner with government and NGOs for seaweed industry growth, developing **regulations and incentives** to diversify/increase market access

Level of risk 🔴 High 🟡 Medium 🟢 Low

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

Case study: Other SWIO countries have experienced success in seaweed farming, particularly in Zanzibar, Tanzania

Zanzibar seaweed sector at a glance….

90% Percentage of Africa's seaweed production coming from Zanzibar

88% Percentage of seaweed farmers that are women

8K MT Seaweed produced in 2022. Zanzibar's production has dropped by 50% since 2015 due to diseases affecting yields

25K Number of people employed in seaweed production

	Development of Zanzibar's seaweed industry	Current state in Mozambique
Opportunity	• Zanzibar has **a suitable climate** to produce seaweed commercially. • Seaweed offered **economic diversification** in an area dependent on agriculture and tourism. • **Government recognized the potential** of seaweed and supported its development. • Community based farming and intimate knowledge of the intertidal zones existed in communities.	• Communities in need of economic diversification and with deep knowledge of coastal zones
Approach	• Seaweed production development began in the 1980s. **Small-scale farms in intertidal zones** were implemented. • Seaweed farming required **low initial capital investment** and a **short farming cycle.** • Harvest is **dried** on ground **and sold to exporters**. Price fluctuations and low pricing power hampers further growth.	• Selt Marine has a concession to use up to **500 hectares** for seaweed farming • Selt hires community to tend to farms, but the company owns the product through export
Impact	• **2nd biggest export crop** in Zanzibar after cloves valued at $2.8 billion in 2022. • Provides **employment to 25k people**, over 80% being women. • Depending on harvest, incomes dramatically ranged from **$9 – 70 a month.**	• So far, **32 tons** per produced per year • **~300 people** temporary employed, **most are women**
Lessons learned and risks	• **Seaweed disease are spreading** and have impact on yields and production. **Biosecurity protocols** are essential. • Climate change **mitigation** will require investment and attention • Competitiveness of international market and the **middlemen pricing make it difficult for small producers**. • When challenges occur, many **farmers move away from seaweed** to pursue other livelihoods.	• **Partnerships with other orgnizations** are necessary (i.e., Instituto Oikos, Universidade Lurio, Universidade Eduardo Mondlane)

Source: Panorama, IUCN, Msuya et al, The Nature Conservancy, The Resilience Relief Network, stakeholder interviews (2023)

Sea Cucumber Aquaculture

Photo Credit: National Geographic

Cabo Delgado's environment is well-suited for sea cucumber aquaculture, creating market value and employment opportunities

High-level interventions

1. **Develop a sea cucumber production base** by establishing best practices to support successful cultivation

   ***Underlying challenges**: no production knowledge, extended timelines to profitability*

2. **Create a sea cucumber aggregation structure** to streamline the supply chain and reduce competition with wild-caught sources

   ***Underlying challenges:** No existing aggregation structures, price competition, risk of theft*

3. **Enhance regulations for sustainable sea cucumber harvesting** to prioritize high-quality cultured sources

   ***Underlying challenges:** Competition with wild captured stocks, no local demand*

Potential Impact

Economic	Social	Environmental
► **~$1 million** sector revenue • *Based on production increase to 70,000kg over 50+ hectares* • *Profit/kg: 1$* ► **1K** jobs created • *80% of jobs in production* • *5% of jobs in training and quality control* • *15% of jobs in aggregation, value add and sales*	►**~$50** monthly income • *4 cycles/year* • *1000 m² production area* • *120kg dry harvest/cycle* • *Total cost/cycle: $170* • *Key consideration: theft prevention* • *Profit/year: ~$500* ► **80%** women participation ► **Possible synergy with other mariculture crops** such as seaweed allowing production efficiencies	► **Reduced pressure on wild sea cucumber stocks** which are near extinction ► **Improved water quality and environment** due to sea cucumbers acting as filter feeders ► **Habitat protection** and habitat enhancement of production areas ► **Maintenance of the important ecosystem services** provided by sea cucumbers

Aquaculture is the sustainable solution to meet high demand for sea cucumbers, a valuable species threatened by severe overfishing

Description of the sea cucumber aquaculture farming value chain

Stage	Production		Aggregation and processing		Off taking	
	Juvenile rearing	Grow out	Harvesting	Drying	Grading and export	Sales
						
Description	Broodstock are bred for spores, then larvae are raised in nursery. Sustainable broodstock management required to prevent overexploitation of wild stocks.	Juvenile sea cucumbers are moved to grow-out ponds. In open water environments, they rely on natural food sources and don't require inputs.	When desired size is reached, they are harvested from grow-out ponds. Harvesting methods vary and may include manual collection or the use of pumps.	Processing must be conducted within hours after harvest to avoid perishing. Processing goal is to achieve low moisture content. Ratio of wet to dry is close to 10:1.	Species, size and weight are used to determine grading price. Prices vary considerably depending on species, size and quality.	It is eaten raw, boiled, or pickled mostly in Asian markets. Small niche markets also exist in the pharmaceutical and cosmetic industries.
Key Considerations	• **Wild stocks are severely overfished.** • **To avoid predation,** larvae are grown to a size of 20g before grow-out transfer.	• The **methods for culturing** include pond farming, pen culture, sea ranching, and tank culture. • **Monitoring of water quality** and pollutants is required.	• Sea cucumbers can take **1 to 4 years to grow to a market size** depending on the species. • **Theft prevention** is key to avoid loss of production.	• Primary processing involves gutting, brushing, boiling, smoking and sun drying for several days. • Once correctly processed its **shelf life can last many years**.	• The **most prized species** include the **white teatfish** Holothuria fuscogilva and the **sandfish** Holothuria Scabra.	• Sea cucumber is known as ***bêche-de-mer*** or trepang in retail markets. • Sea cucumber is in **high demand as a luxury product** in Asian markets**.**

Source: TechnoServe analysis (2023), stakeholder interviews (2023), WorldFish Center, Center for Sub-Tropical Aquaculture

Although sea cucumber aquaculture is absent in Mozambique, the market receives significant volumes of wild-caught specimens

Snapshot of the sea cucumber market in Mozambique and globally

Stage	Production	Aggregation and processing	Off-taking
Key dynamics	• **Overharvesting of sea cucumbers is a worldwide phenomenon** and in the past two decades, many sea cucumber fisheries have collapsed. **Recovery of depleted populations is slow** due to their population dynamics. • **Illegal poaching abounds** despite restrictions. • Cabo Delgado, Nampula, and Inhambane provinces offer favorable conditions for production and past experiences to learn from.	• **Sea cucumbers from African** shores contribute to at least a **third of world sea cucumber stocks**. • Cumulative catches in Asia and the Pacific range from 20,000 to 40,000 tons per year. Catches in Africa and the Indian Ocean are comparatively lower, at 2,000 to 2,500 tons per year.	• Due to high exploitation levels**, three species were listed in CITES Appendix II meaning international trade must be regulated** with an export permit and sustainability findings. • In recent years, **the global market price for dried sea cucumber has surged**, leading to heightened fishing pressure in numerous less regulated African fisheries.
Key indicators – Mozambique	• **Mozambique has a suitable environment** for sea cucumber aquaculture including favorable environmental conditions and a diverse marine ecosystem which is conducive for sea cucumber growth.	• **In 2019, 57 tons** of total dry mass imported into Hong Kong from Mozambique. This has increased x4 since 2012. • Reports of 65 tons exported from 1980 to 1990.	• **$20/kg import value** in Hong Kong in 2020. This peaked in 2018 at $80/kg due to decline in exports from Africa. • **$50 - $800/kg retail price** in Hong Kong.
Key indicators – global markets	• **Sea cucumbers are produced in more than 70 countries worldwide** in semi-industrial fisheries to small artisanal fisheries. • **Dried sea cucumber is considered a high-value product** in the international seafood trade alongside shark fins, abalone, and fish maws.	• Worldwide, there are at least **600 firms from about 40 countries supplying sea cucumber products** (dried, fresh, frozen and preserved).	• Global Dried Sea Cucumber Market size was valued **at $1,100 million in 2021** and is expected to reach $1,1600 million by 2027. • CAGR of 5.3% from 2021 to 2027.

Source: TechnoServe analysis (2023), stakeholder interviews (2023), WorldFish Center, Traffic, FAO

In Cabo Delgado, establishing a competitive and dependable cultured sea cucumber supply would need to start from the ground up

	Challenges	Existing capacity	Key goals
Production	• **No existing knowledge** of sea cucumber production • **Wild stocks can be impacted** in the initial stages of starting hatchery and juvenile development programs • **Extended timelines to achieve profitability** due to slow growth	• **Sea cucumbers farms are non-technical** to maintain • **Sea cucumbers production areas are easily accessible** in shallow waters • **Collection and processing methods require no specialized skill or equipment**	1 **Develop a sea cucumber production base** by establishing best practices to support successful cultivation
Processing and aggregation	• **No existing aggregation structure** for producers to feed into • **Price competition** with wild caught sea cucumbers • **High risk of theft** • **Achieving sustainability certification** is challenging	• **Existing understanding of sea cucumber processing** based on the processing of wild-caught specimens. • **Aggregation can utilize structures already in place for other products**, whether established or emerging.	2 **Create a sea cucumber aggregation structure** to streamline the supply chain and reduce competition with wild-caught sources
Offtake	• **Ongoing wild capture of sea cucumber** stocks can discourage purchase of cultured products • **No local demand** for sea cucumber	• **Off takers present in country** purchasing wild stocks • **Growing global demand** for sea cucumbers. • **Existing regulation** to limit the illegal poaching of wild captured sea cucumbers	3 **Enhance regulations for sustainable sea cucumber harvesting** to prioritize high-quality cultured sources

Cultivating a sustainable sea cucumber industry will require collaborative initiatives to pave the way to production and markets

Key goals	Recommendations	Type of support	Key stakeholders
1 **Develop a sea cucumber production base** by establishing best practices to support successful cultivation	1. **Set up a commercial hatchery** in partnership with experts or research institutions.	Ecosystem support, Access to finance	Technical experts, donors
	2. **Provide training programs and materials** to sea cucumber farmers and hatchery operators to ensure implementation of best practices.	Capacity building	Technical experts, NGOs
	3. Explore multitrophic sea cucumber farming with crops like seaweed	Capacity building	MIMAIP, NGOs, technical experts, CCPs
	4. **Establish dedicated conservation areas** for the harvesting of sea cucumbers.	Ecosystem support	MPA, MIMAIP
2 **Create a sea cucumber aggregation structure** to streamline the supply chain and reduce competition with wild-caught sources	5. Invest in **aggregation and processing facilities** for distribution preparation.	Access to finance	NGOs, commercial partners, donors
	6. Promote **farmer aggregation** for collaborative harvesting and centralized processing.	Access to market, Capacity building	Local leadership, community councils, CCPs
	7. **Build connections with seafood markets, buyers, and distributors** for a steady and profitable sea cucumber market.	Access to market, Ecosystem support	Commercial actors, local government
3 **Enhance regulations for sustainable sea cucumber harvesting** to prioritize high-quality cultured sources	8. Develop **more regulations** to restrict wild sea cucumber harvesting.	Ecosystem support	MPA, MIMAIP, local government
	9. **Set sustainability certification standards** for sea cucumber products and promote industry compliance.	Ecosystem support	MIMAIP, certification bodies
	10. **Promote the benefits of sustainably cultured sea cucumbers**, creating demand for them.	Capacity building, Ecosystem support	MIMAIP, communication channels

Capacity building *Access to finance* *Access to market* *Ecosystem support*

Source: TechnoServe analysis (2023)

To establish the sea cucumber industry successfully, carefully consider capital, security, and market engagement

Goals	Risks	Impact	Likelihood	Mitigation
1	Capital needs for setting up a commercial hatchery and a ranching model are not attained; inhibiting production start up.	🔴	🟢	Develop detailed business plans to attract funding and seek support from impact investors.
	Sea cucumbers can be susceptible to diseases leading to loss. Disease management protocols can be challenging to follow.	🔴	🟢	Implement biosecurity measures, engage with experts, research institutions, and organizations to develop management protocols.
	Mature sea cucumbers are easily targeted by poachers for their value and the large surface area they are grown in.	🔴	🔴	Enhance security measures, employ surveillance and monitoring, and consider protecting sea cucumber farms with legal safeguards and local authorities' support.
2	Little success in establishing relationships with seafood markets, buyers in areas where sea cucumber farming is a new venture.	🔴	🟡	Collaborate with industry associations, engage in promotion efforts, and educate potential buyers on the benefits of cultured sea cucumbers.
	Processing facilities are not efficiently set up, run or managed leading to wastage and low value sales.	🟡	🟢	Invest in modern processing facilities, ensure proper training for facility staff, and adopt best practices for processing and handling sea cucumbers to minimize wastage.
3	Seafood industry stakeholders are not interested in cultured sea cucumbers as much as in wild-captured sources.	🔴	🟡	Conduct awareness campaigns and information-sharing with seafood industry stakeholders to highlight the quality and sustainability of cultured sea cucumbers.
	Creating certification standards is a challenging process that involves consensus-building and ongoing industry monitoring for compliance.	🟢	🟡	Collaborate with regulatory authorities and industry experts, to create certification standards. Establish mechanisms to ensure compliance.
	Meeting the regulatory requirements for trading and selling sea cucumbers may be a complex process with potential legal and bureaucratic hurdles	🟡	🟡	Work closely with regulatory bodies, legal advisors, and local authorities to navigate the legal and regulatory landscape, ensuring compliance throughout the trading and selling process.

Level of risk 🔴 High 🟡 Medium 🟢 Low

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

Case study: Sea cucumber aquaculture was successfully implemented in Madagascar to provide supplemental income to communities

Madagascar sea cucumber sector at a glance….

40% Percentage of Africa's sea cucumber exports are from Madagascar	**60%** Percentage of sea cucumber farmers that are women
$16K Earned for every 40K sea cucumbers sold to the Chinese market	**200+** People employed in sea cucumber production

Development of Madagascar's sea cucumber industry		Current state in Mozambique
Opportunity	• Coastal communities are heavily **dependent on fisheries** and suffer from a decline in wild catch • **Arid landscapes** make agriculture extremely difficult	• Communities are also highly dependent on fisheries
Approach	• First pilot in 2007 failed, but a second pilot was started in 2010 through a collaboration with **Blue Ventures** and **Indian Ocean Trepang** – the organizations provided an **industrial hatchery**, **training**, **equipment**, and **technical support** • Expectations were set among community that this would only act as **supplementary income** to other livelihoods • Since then, the organizations have been adapting the model to **further integrate farmers into paying operational costs, maintenance, and managing their farm**	
Impact	• **Over 80K sea cumbers** have been harvested • **81 farms** (2X since 2015) Average **$35 in monthly earnings** • Likely to build a **2nd sea cucumber hatchery in the near term**	*No active projects in Mozambique*
Lessons learned and risks	• **Theft of farmed cucumbers** – mitigated by setting up community-developed governance system and involving more communities • Use of **land conflicts** can create tension with fishermen and other industries • It takes **9-14 months to produce a first harvest of sea cucumbers** which deters many farmers who will not wait to make an income • **Local communities do not consume sea cucumber**, so the work does not improve food security	

Source: The Nature Conservancy, Blue Ventures, Global Seafood

Fresh Fish Cold Storage and Transport

Photo Credit: ShutterStock

Developing Cabo Delgado cold storage capabilities can create higher incomes and mitigate post harvest losses

High-level interventions

1

Develop cold chain infrastructure through cost effective and sustainable solutions accessible to small producers

***Underlying challenges**: High amounts of post harvest loss, unreliable and costly electricity*

2

Improve transportation and aggregation networks to reduce post-harvest loss and reach new markets

***Underlying challenges:** Difficulty aggregating sufficient fish quantity to sell with cold chain, underdeveloped infrastructure*

3

Enhance market access opportunities and revenues by capacitating communities

***Underlying challenges:** Weak pricing power, inhibited market linkages*

Potential Impact

Economic	Social	Environmental
► **$15-20 million** additional value creation from fisheries • *Money earned from reduced post-harvest lost* • *Income earned in selling to new markets* ► **30% increase in income** • *Dominantly from higher volumes sold from same catch purchases* ► **Over 3,000 local intermediaries impacted in Cabo Delgado**	►**$70** monthly income • *Based on an estimated 40% increase in income* • *Additional sales from 20kg more fish products saved from loss* ► **Women make up ~50%** of the fisheries workforce • *Most often in selling of fish* ► **Access to protein** likely increased by more efficient use of catch	► **Potential to prevent 11K tons** of post harvest loss each year in Cabo Delgado ► **Potential to help reduce overfishing** by more efficient use of catch

Source: TechnoServe analysis (2023), stakeholder interviews (2023), Rosian, Ocean Risk

Analysis of the fresh fish value chain identified stages where post-harvest waste reduction and pricing improvement is possible

Artisanal fishing value chain description

Highest identified impact potential for coastal communities

Stage	Fishing process	Fish harvesting	Fish landing	Pre-market storage	Transport	Sale of fresh fish	Processing for commerce or export
Description	Fishing at sea using line or nets to capture fish in the pelagic zone. Artisanal fishing boats are typically low powered and stay <8 miles from shore.	Captured fish is stored in the boat until the end of the fishing excursion. Can be stored in cooler boxes or in non-cooling containers.	When the fishing boat comes to the beach, market intermediaries (majority women) meet the boat and negotiate a price for the catch and take it for further sales.	Fish is often taken directly from shore to market for immediate sale or packaged in cooler boxes for transport to further markets	Transport is done by foot, on public transport or private transport (motorcycle or vehicle)	Fish is sold to intermediary traders, on tabletops at local or regional markets or door to door	Fish is processed through filleting and freezing for long-distance transport or shelf life. Other processing includes transformation into value-add products.
Key considerations	• **Male dominated activity** embedded with traditional techniques	• Prolonged sun exposure reduces quality and pricing power	• **Women are often responsible for sale and transport to market** • **Cold storage allows for extended market access and quality preservation**, which is essential for securing favorable prices. • **Quality of storage has a direct impact on the final sale price** • A lot of post harvest waste occurs at this stage			• Sale price is also dependent on cold-chain capacity upstream of sale	
Main source of post-harvest loss	• Fishing techniques • Discards	• Lack of chilling on board	• Lack of appropriate storage infrastructure • Lack of ice • Predation			• Delays in sale or price negotiation • Discards • Spoilage	• Low processing capacity • Infestation • Low quality

Source: TechnoServe analysis (2023), stakeholder interviews (2023), Global Food Sec

Selling higher quality fresh fish at premium prices due to enhanced cold storage increases the economic viability of artisanal fisheries

Fresh fish cold storage and transport: the parts of the fishing value chain with highest impact potential for coastal communities

Stage	Fish harvesting	Landing and pre-market storage		Transport and sale of fresh fish	
Cold storage link	On-boat cooler boxes 	Portable cooler boxes 	Stationary cooling systems 	Cold chain transport system 	Sale of fish products 
Description	Artisanal fishing boats will often take cooler boxes with or without ice inside to store the catch during fishing. Access to an ice machine is required to fill coolers.	Upon arriving on shore, the catch is transferred to portable cooler boxes for the first land-based trip. May also be used in transport of fish	Enterprises can rent out space in a freezer or cooling room to fishermen to store their products, usually charged by amount of space occupied	In some instances, cooling systems are necessary to carry fish products between markets Cold chain is often used for transport of products in high volume	Fish in cold chain can be sold at markets at relatively good quality and with little pressure to sell quickly Enables salesperson to maintain a higher price for longer
Key Considerations	• Artisanal fishing typically occurs within 0 to 7 miles offshore, often using small, low-powered boats	• Ice machines for supply require electricity to operate • Often, cooler boxes are made of unsustainable materials such as Styrofoam	• Some cooling system companies buy fish from fishermen in addition to traditional space rental business • Requires dependable electricity systems	• This requires a strong transport and market infrastructure • Aggregation would likely be required to sell fish in this quantity	• Fish is viable for sale for a longer period and can maintain a good price • If frozen, there must be verified demand for frozen fish • Margins on a frozen fish may be slightly smaller

These stages are at times bypassed to go directly to sales depending on the target market

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

Mozambique's artisanal fishing industry, a key contributor to the economy, grapples with fish waste and limited storage facilities

Snapshot of fresh fish cold storage value chain in Mozambique

Stage	Fish harvesting	Fish landing and pre-market storage	Transport and sale of fresh fish
Key actors (Not exhaustive)	**Generally done by men when going out to sea.** **Artisanal fishermen**: when ice is available, fishermen will back boats with ice to preserve catch at sea and slow spoilage. **Industrial fishing**: freezers on ships to immediately preserve catch at sea.	**From when fish arrives on shore, typically, women will purchase it to resell in markets** • **InspiraFarms:** Sells cooling rooms that can provide quality storage for up to 20 tons. • **FAO**: distributed bicycles and cooling boxes to support transport to markets in Cabo Delgado. • **RARE**: provided some fishing communities cold storage to help efficiencies and increase income.	Rural communities tend to **sell on the local market** only. Fish markets: often have no cold storage, when it is available, parts are often broken or not used efficiently. • **SUSTENTA Initiative:** Supported by the World Bank, initiative of $60M to improve value chains, including cold storage • **TerraMar:** Wholesaler, retailer, and distributor of frozen and chilled food; has one of the largest cold storage capacities in Mozambique
Key indicators in Mozambique	• **95%** of national production **is landed by artisanal fishermen**, over **350K tons** per year • **90%** of catch goes to **local markets** • Over **500K individuals** engaged in fishing through1,200 fishing hubs of which **50% are women** • Fish stocks are **declining measurably**	• **~30% of fisheries output is wasted** • There are three types of food storage: – **Frozen**: Mostly commercial use, often used with large quantity of product from larger enterprises – **Chilled**: Often the type of storage when ice machines and ice boxes are available – **Fresh**: 90% of food sale in rural areas	• **$790 million of total revenue** from small scale fisheries production (2017) • Fisheries contribute **3 to 4% of national GDP** • **Total export value of fish dropped 58%** from 2004-2013 • **50-60% of catch must be dried** because it can't be sold within the window of freshness
Key indicators – global markets	• **~50% of worlds fish stocks are overfished**, 10% are near collapse; however, there are many initiatives combatting overfishing • Several food regulatory agencies (FDA, EFSA) have **regulation regarding fish freezing standards**	• Fish **waste on a global scale is** estimated to range from **30% to 40%** of the annual catch. This includes up to **12 million tons per year.** • Post harvest loss occurs due to **high ambient temperatures**, **fishing methods**, **distance to markets** and **inadequate storage** facilities	• **Large scale cold chain companies gain interest** in investment as economies grow. • Several actors are **donating to development of cold chain** (Norfund, USAID, others)

Source: TechnoServe analysis (2023), stakeholder interviews (2023), FAO, WorldFish, Freight News, ITA, RARE, Winrock, UNCTAD, Minderoo Foundation

Improving equipment, transport links and market access is key to better fish preservation and higher income for local intermediaries

	Challenges	Existing capacity
Fishing and Storage	• **Cold storage options are an expensive investment** for small producers • **Unreliable and costly electricity supply** causes waste and equipment damage due to outages • **Lack of maintenance/upkeep skills and training** for cold storage equipment	• **Some existing ice making capacity in communities** • **When available, ice is used in cooler boxes** to preserve catch while on sea or going to market • **Significant community interest** in cold storage capabilities
Transport	• **Insufficient organization to aggregate fish** to a volume suitable for cold chain actors • **Underdeveloped infrastructure** impedes cold chain vehicles from reaching rural areas • **Costs for transport** to destination of sale may chip away at the margin	• **Cold chain transport intermediaries with vehicles** present (small and large actors) • **Cooler boxes** already in use on existing transportation options • **Government support for cold storage facilities** in ports
Sale	• **Pricing power diminishes** quickly, pressuring sale below optimal price • **New market linkages inhibited** by lack of capacity to preserve fish during transport • **Acceptance of lower prices** from farm-gate intermediaries due to fear of spoilage	• **Significant existing demand for fresh fish** • When fish cannot be sold or frozen, it is usually **salted and dried** for preservation

Key goals

1. **Develop cold chain infrastructure** through cost effective and sustainable solutions accessible to local intermediaries
2. **Improve transportation and aggregation networks** to reduce post-harvest loss and reach new markets
3. **Enhance market access opportunities and revenues** by capacitating communities

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

To effectively implement cold storage opportunities, there must be governance of the equipment and proper maintenance routines

Key goals	Recommendations	Type of support	Key stakeholders
1 **Develop cold chain infrastructure** through cost effective and sustainable solutions accessible to local intermediaries	1. **Facilitate financing** for environmentally friendly and cost-effective options for ice making machines and portable or stationary coolers or freezers		Microfinance institutions, impact investors
	2. **Create accessibility of cold storage facilities** by developing community-based initiatives that enable shared use		Community, NGOs
	3. **Provide training for fishing communities** to operate and maintain cold storage equipment		Technical experts, community
	4. **Advocate for government support and funding** for the establishment of cold chain infrastructure, particularly in ports and areas with high fishing activity.		Government, cold storage companies, communities
2 **Improve transportation and aggregation networks** to reduce post-harvest loss and reach new markets	5. **Advocate for improved infrastructure and road networks** to facilitate access to markets		Government, cold storage companies, communities
	6. **Promote the use of refrigerated transport vehicles** to ensure the preservation during transit		CCPs, cold storage companies
	7. **Identify and connect cold chain purchasers** with aggregated volumes in communities		CCPs, large volume purchasers
3 **Enhance market access opportunities and revenues** by capacitating communities	8. **Support the creation of efficient, producer-led fish catch aggregation** systems		CCPs, large volume purchasers
	9. **Develop two-sided cold storage business models** where fishers rent storage space and enterprises purchase aggregated fish volumes		CCPs
	10. **Train communities on proper preservation** of fish for higher-priced sales		CCPs, NGOs, technical experts

Capacity building *Access to finance* *Access to market* *Ecosystem support*

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

There are risks associated with implementing cold storage capabilities, there are innovative mitigation tools that could help

Goals	Risks	Impact	Likelihood	Mitigation
1	**Electricity shortages** destroying machinery or causing significant post harvest loss.	🔴	🔴	• Select **solar-operated machinery** when financially feasible. • Otherwise, have back up **generators accessible** for use.
	Tension regarding revenue mechanisms and 'ownership' of cold storage equipment.	🟡	🟡	• **Identify community leaders** that are well respected to facilitate governance • Create **governance structures** that articulate financial processes and adherence.
	Limited financial flexibility to respond to maintenance requires of machinery.	🔴	🔴	• Facilitate **access to microfinance** and loans for small-scale coastal farmers. • Establish **community-based financial support programs** for resource pooling/risk sharing.
	More efficient use of catch **does not translate to less fishing**, therefore not providing environmental benefits.	🟡	🟡	• Place **quota on space allotted** per fishermen per a certain timeframe • Only accept fish caught using **proper environmental controls**
2	**Extensive lead time** to reach sufficient aggregated quantity while supply is fresh, causing quality issues.	🔴	🟢	• Create **incentive models** that encourage supply delivery from fishermen to cold storage within a certain timeframe. • Ensure that freezing mechanisms are **built to sustain long lasting quality.**
	Difficulty **competing with the import market.**	🟡	🟢	• Sell to **markets that are not saturated** with imported product. • Market fish as **local and high quality.**
3	**Pricing power** dynamics do **not grow** as expected with the availability of cold chain.	🟡	🟢	• **Research optimal markets** to enter and customer desires before pursing sale there through cold chain.
	Dependence on third parties for market linkages may put communities at risk if the third party leaves.	🔴	🟢	• Seek partners with intention to stay for an **extended time.** • **Delegate responsibilities** of the market linkages among community members.

Level of risk 🔴 High 🟡 Medium 🟢 Low

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

Case study: Nigeria's fisheries sector greatly benefited from introduction of cold storage

Nigeria cold storage at a glance….

70% Increase in gross sales by fishermen who used cold storage units

50% Of fish capture is often wasted to spoilage when cold storage is unavailable

30K MT Of fishing post harvest lost expected to be saved annually

$600+ Marginal earnings per year when cold storage is used

Development of Nigeria's availability of cold storage		Current state in Mozambique
Opportunity	• **$268B was estimated to be lost** from post harvest waste, largely due to lack of cold storage • More than half of those losses **occur during transport** of products • Smokers used to dry fishing products expose women to **carbon monoxide pollution**	• Many communities **do not have access** to any cold storage • When cold storage is provided **governance and maintenance become challenges**
Approach	• Coldbox: company that has solar powered **cold rooms and rents space** in them to fishermen for storage; also will **buy fish off fishermen** and process for sale themselves • ColdHubs: **solar powered food storage units**, working on creating units that can create ice – storage costs $0.25 a day per crate used • **$40K investment required** per cold storage room with **$180 monthly** operational costs	• **RARE started a project** in 2017 • Other development actors provide **ad-hoc cold storage facilities** in markets in and around fishing communities
Impact	• Incomes from catch **increased by 30%** • **>5K individuals** used ColdHubs products in 2021 and stores **over 40K tons of food** • **Over 60 women** have been employed by ColdHubs • Products stay **fresh for up to 21 days** rather than just a couple	• Unclear total impact • Some **equipment no longer functioning** / in use
Lessons learned and risks	• People who opted to use cold storage were often **more educated and access to credit**; however, they also were people with little access to electricity, and lived far from piped water sources • Better results were achieved when users of the cold storage **participated in a 5-day training** on storage best practices	• Need to make sure to equip community with **resources to upkeep** cold storage equipment

Source: Rocky Mountain Institute; USAID, CNN, ColdHubs, Food Security Portal

Tilapia Aquaculture

Photo Credit: TechnoServe (2023)

Despite value chain challenges, tilapia can meet rising fish demand, create income, and reduce reliance on wild caught fish stocks

High-level interventions

1

Resolve production obstacles that are impeding the expansion of tilapia farming, particularly concerning inputs

***Underlying challenges**: expensive feed costs, requires technical knowledge and investment*

2

Enhance capacity to meet market demand by improving transportation and processing infrastructure

***Underlying challenges:** Complicated market linkages due to low infrastructure set up, preference for fresh fish*

3

Accelerate the pace of market acceptance of tilapia

***Underlying challenges:** Strong competition from imported fish, customer preference for tilapia not unanimous*

Potential Impact

Economic	Social	Environmental
► **$20-25 million** sector revenue • *Based on production increase to 10,000 tons* • *Profit/kg: $1 - $1.5* ► **10K** jobs created • *~8000 producers* • *80% of jobs in production* • *5% of jobs in training and quality control* • *15% of jobs in aggregation, value add and sales*	►**$87** monthly income • *Total costs/year: ~ $1.3k* • *Main inputs: fish feed, fingerlings* • *Profit/year: ~ $1k* ► **40%** women participation ► Significant capacity to contribute to the **provision of alternative protein sources**	► **Reduced pressure on wild fish** stocks by providing an alternative source of fish protein ►**Reduced bycatch** due to tilapia fish being specifically raised for consumption. ►**Efficient land use** of areas not suitable for agriculture or other activities ► **Potential to set up integrated aquaculture systems** that allow for efficient use of resources and reduce environmental impact

Navigating the tilapia aquaculture journey from genetic enhancement to market success

Description of the tilapia value chain

Location	Hatchery		Aquaculture farm		Farm or processor	Market
Stage	Genetic development	Breeding and hatching	Grow out	Finishing	Processing	Sales
Description	Genetic enhancement to adapt the tilapia to environment and market conditions. Provides quality genetic material for the local aquaculture industry.	Breeding tilapia fry and raising fry to fingerlings. Each of the steps involved has specific techniques and can require specific equipment.	Raising tilapia from fingerling to harvest size. The feeding process is key for a cost-efficient farm. Protocols need to be strictly implemented to avoid waste and loss.	Selecting tilapia for harvesting then moving to finishing ponds. Using appropriate harvesting methods, minimizes stress and injury to the fish.	Cleaning and processing of fish to add economic value. Fresh fish can be sold whole or gutted. Frozen fish can be filleted which has the highest value add.	Transport of fish product to markets for sale in either frozen or fresh form. Sales are mostly to individuals, supermarkets and restaurant operations.
Key Considerations	**Resource intensive process** that requires high technical knowledge and long timelines.	Maintaining **water quality and temperature** is crucial to ensure growth. Selecting **good genetic diversity** will allow for a more robust and disease-resistant stock.	**Tilapia cultivation systems** include: • Earthen ponds • Freshwater net-pens • Raceways • Re-circulating systems • Polyculture fish farming	Typically, tilapia are harvested when they reach a **size between 200-400 grams**, depending on market demand.	**Fresh fish processing can be done locally** near the farm. Freezing into fillets requires an intensive processing environment.	The **cost of producing tilapia** influences the marketing strategy. **Ensuring high quality and safety standards** are met and shared with customers can be a key selling point.

Source: TechnoServe analysis (2023), stakeholder interviews (2023), TechnoServe Tilapia Industry Strategic Plan (2017).

Despite a high demand for fresh fish and quality production capabilities, Mozambique's tilapia industry struggles to take off

Tilapia aquaculture snapshot in Mozambique

	Hatchery	Aquaculture farm	Farm or processor	Market
Key actors	• CEPAQ and **other hatcheries have the capacity to provide over 3 million fingerlings**. • CEPAQ has developed quality genetic material for tilapia production.	~ 500 to 1000 producers in Inhambane. National production landscape: • **< 4000 Small producers with small ponds**, 1-2 tons per year. • **<50 medium sized producers**, 20 to 60 tons per year. • **1 large operation**, producing over 1.2K tons/year (Chicoa Fish Farm)	**Processing in Mozambique is minimal** with a focus on selling fresh or gutted fish. **Low sales of frozen fillets and value-add processed fish products**	There is an extremely **high demand for fish protein** in Mozambique. Market traders selling on local, regional and export markets in neighboring countries.
Key indicators in Mozambique	• **Primary farmed species is Nile tilapia** (Oreochromis niloticus) • Tilapia mossambicus has been explored for its **saltwater adaptability** in the local environment.	• **Formulated feed for fish is not available** in country and primarily imported from South Africa. • Smaller producers use agricultural byproducts as feed affecting growth efficiency.	• **~ 3K tons of tilapia produced/year** but data likely does not capture the entire production. • Freezing processing factories are located in ports, inaccessible for small-scale producers.	• **Sale price of tilapia varies hugely**, 2.8$ to 4.7$ per kilo but can be higher. • **Direct competition from high quantities of cheaper imports** of other fish (horse mackerel & imported tilapia)
Key indicators – global markets	• Tilapia farming globally is carried out in fresh or low salinity waters.	• Global tilapia production was almost 7 million tons in 2020. • Egypt accounts for 90% of Africa's tilapia production, producing 200,000 metric tons annually.	• Global fish processing market was valued at US$ 200 billion in 2022 however this includes value-add processing	Tilapia is the most widely grown farmed fish, with aquaculture production in at least 120 countries.

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

Despite the challenges in establishing a complete value chain, Mozambique's tilapia production can fulfill rising demand for fresh fish

	Challenges	Existing capacity
Production	• **Expensive feed costs** • **Not a suitable career for all**, prior experience required • **Little technical knowledge** from extension workers • **Complex land tenure** rights in Mozambique limiting investment	• **History of aquaculture production** in Inhambane province • Strong **existing government interest** in developing this industry • **Ideal natural environment** to produce farmed fish
Processing and aggregation	• **Expensive transport costs** makes aggregation impractical and unprofitable • **Challenging to achieve rapid point-to-point delivery** due to distances • **Customers preference for fresh fish** • **Few freezing facilities** in central locations which require significant volumes to access	• **Some cold chain development projects** are starting and will facilitate supply chain movements • **Local processing makes fish market-ready** through a straightforward procedure • As markets develop, **preference for value-added processed fish products can grow**
Offtake	• **Strong competition from cheaper imported fish** (carapau and imported tilapia) • In some areas **taste for tilapia is not well established**	• **Increasing demand and high pricing** for fresh fish on all local markets • **Mozambican tilapia variety** has a resemblance to marine fish which suits consumer preference

Key goals

1. **Resolve production obstacles** that are impeding the expansion of tilapia farming, particularly concerning inputs
2. **Enhance capacity to meet market demand** by improving transportation and processing infrastructure
3. **Accelerate the pace of market acceptance of tilapia**

Increasing quality tilapia production, supporting market access and encouraging consumption will allow for key goals to be met

Key goals	Recommendations	Type of support	Key stakeholders
1 **Resolve production obstacles** that are impeding the expansion of tilapia farming, particularly concerning inputs	1. Advocate for a **rapid solution for affordable fish feed provision** in country		MIMAIP, Ministry of trade, industry experts
	2. Support **research into locally produced, high quality fish feed**		CEPAQ, Chicoa, aquaculture associations
	3. Provide **training and technical knowledge to farmers** for improved production		MIMAIP, CEPAQ
	4. Support in improving **land tenure for securing suitable land** for aquaculture		MIMAIP
2 **Enhance capacity to meet market demand** by improving transportation and processing infrastructure	5. Advocate for **infrastructure improvements**, such as better roads and electricity in remote areas, to reduce transportation and operational challenges.		Impact investors, development actors
	6. Facilitate **business environment** for set up of trading markets beyond small-sized producers		Traders, aggregators, associations
	7. Invest in the **establishment of cold storage facilities** locations to ensure more options for distribution of tilapia products.		Cold chain actors
3 **Accelerate the pace of market acceptance of tilapia**	8. Conduct **education and marketing campaigns to promote the taste** and benefits of tilapia, expanding its appeal and demand		Ministry of Health, MIMAIP, communication experts
	9. Explore **possibilities to make tilapia more affordable as a protein source** to populations by supporting producers with input costs		MIMAIP, Ministry of Health, Ministry of Trade

Capacity building *Access to finance* *Access to market* *Ecosystem support*

Source: TechnoServe analysis (2023)

Substantial ecosystem-related risks present potential barriers to the success of tilapia aquaculture

Goals	Risks	Impact	Likelihood	Mitigation
1	Without **affordable fish feed**, smallholder producers cannot establish profitable aquaculture farms.	High	High	Invest significantly in options for affordable fish food creation.
	Not respecting strict production or biosecurity protocols will lead to production loss, contamination or financial loss.	High	Medium	Implementing training programs and quality control measures, which include a routine verification system to encourage adherence to protocols, can help maintain control over biosecurity possibilities.
	Inexperienced individuals transitioning from fish farming to tilapia production may lack the motivation to persist, potentially resulting in income loss and discouragement.	Medium	Low	Ensure only selection of experienced fish farmers for support. Account for possible attrition in the program design.
2	The **inadequate transport infrastructure** creates a physical separation between production areas and potential markets.	High	Medium	Emphasize the possibility of selling tilapia on local markets and adjust production to local demand.
	Lack of **established cold chain network** results in wasted production due to rapid deterioration of fresh fish.	High	Medium	Develop a local cold chain and invest in refrigeration and preservation facilities.
3	A **slow increase in market demand** may hinder the demand for existing production, particularly if production scales up too rapidly.	Medium	Medium	Align production with market demand and scale production gradually.
	Continued competition from imported fish will make locally produced tilapia incapable of competing.	High	High	Emphasize the unique qualities and benefits of locally produced tilapia to distinguish it from imports.

Level of risk High Medium Low

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

Case study: Fiji used tilapia aquaculture as a means of women empowerment and economic development

Fiji's tilapia sector at a glance….

3X Demand growth for tilapia fingerlings between 2018 and 2021

~20% Of tilapia farmers are women

80% Of tilapia farmers do so in-part for subsistence

500+ Tiliapia farms throughout the country

Development of Fiji's tilapia aquaculture industry		Current state in Mozambique
Opportunity	• Fiji did not have sufficient amounts of fish to feed its population • Tilapia aquaculture already had existed in Fiji for 50+ years	• Several fresh water lakes • Lack of protein intake across the country • Government-financed and enterprise fish farms
Approach	• Development of artisanal and semi-industrial production • Local hatcheries and sale of fingerlings • Existing government mechanisms to disburse financing for tilapia farming pools start up and scholarships for women entrepreneurship	• Government provides some startup capital to implement tilapia farms • Enterprises work on training and employing community members
Impact	• Women participate in feeding, selling, and harvesting fish, but men still play a dominant role in the overall fish farm; women gain more responsibility in the fish farm when men need to divert attention to agriculture • A few women-led committee farms exist in which women indicate they feel a level of empowerment and sense of self worth • Local taste for tilapia has increased over time and tilapia farms have slowly helped food insecurity	• Several have been trained in aquaculture and understand the business dynamics • Most beneficiaries have been men so far
Lessons learned and risks	• Trainings tend to exclude women, special attention must be given to ensure their inclusion • It is difficult to scale micro-farms, added business development training and investment is needed • Cluster farming to increase supply to markets has been successful to bring farmers together	• Organization across tilapia farmers is nascent and has proved difficult

Source: Pacific Community, Waqairatu-Waqainabete et al, FAO, JICA

Honey production

Photo Credit: UnSplash Creative Commons

Boosting the honey sector in Inhambane has the potential to deliver economic, social, and environmental benefits

High-level interventions

1. **Shift artisanal producers to commercial grade production**, enabling entry into a more profitable market while maintaining cost-effectiveness

   ***Underlying challenges**: Damaging traditional practices, varying production quality, long term harvest cycles and investment*

2. **Establish processing capacity and market connections** for efficient distribution of honey production to target markets

   ***Underlying challenges:** Poor infrastructure, few existing players, quality variance risk for aggregators*

3. **Enhance infrastructure and certification capabilities** to position mangrove honey as a high-quality product in domestic and international markets.

   ***Underlying challenges:** Expensive processing equipment, market competitiveness, need for excellent product marketing*

Potential Impact

Economic	Social	Environmental
► **~$7 million** sector revenue • *Based on production increases ten-fold to 5,000 tons.* • *Mozambique's environmental landscape positions the country to compete in high end honey* ► **20K** jobs created • *90% of jobs in production* • *5% of jobs in training and quality control* • *5% of jobs in aggregation, value add and sales*	►**$30** monthly income • *Harvests/year: 1.5* • *Start up costs: ~ $200* • *Profit/year: $300* ► **Part time activity** • ~350hrs labour/year for average size production ► **~40%** women participation • *Based on current enterprises in Mozambique* ► **Income diversification** away from overexploited fish stocks and other agriculture & livestock activities	► **Environmental protection of forest areas** to provide food sources for bees ► **Coastal protection** through protection of mangroves and inherent coastal resilience ► **Biodiversity support** through pollination by bees in surrounding environment

Source: TechnoServe analysis (2023), stakeholder interviews (2023), Rosian, More Trees ECO

Fostering honey production incentivize environmental preservation while yielding a high-quality, premium product

Description of the honey production value chain

Stage	Production		Aggregation	Processing & off taking	
	Apiary establishment	Honey production	Honey harvest	Honey processing	Product sale
Description	Apiaries are set up in areas with rich biodiversity like mangroves or forests to attract a swarm of bees to inhabit it, the process to attract bees can be lengthy.	Worker bees collect pollen from local wildlife, particularly mangroves, and return to apiary where it is used to produce honey.	Beekeepers collect capped honey combs from the hive. They are placed in a honey extractor to spin the frames whereby honey is forced out of the combs and collects at the bottom of the extractor.	Extracted honey is filtered to remove impurities or debris and in some cases, heated. Mangrove honey needs to be minimally processed to maintain its unique properties.	Product is put on market for end consumer sale; common sales channels include markets, supermarkets, souvenir shops, and online.
Key Considerations	• **The surrounding environment must be healthy** with limited pollution to ensure a quality production of honey. • **Specialized apiary design is necessary** to host bees and ensure safety.	• **Mangroves are fragile ecosystems** so honey production should not harm or disrupt the mangrove environment. • **Routine maintenance** through water supply and upkeep of the apiary is required to support the beehive.	• **Bee-friendly hives allow easy extraction of honey** without harming the bees or their habitat • **Honey can be harvested in annual or semi-annual intervals** depending on production rate of bees.	• **Well equipped aggregation facilities** ensure that honey is processed efficiently and hygienically meeting quality and safety standards. • Final packaging requires **proper equipment and strategic** packaging	• **Final honey products vary significantly**, including plant type used to produced & quality • Obtaining **organic or sustainability certifications**, such as Fair Trade or organic certification allow access premium markets.

Source: TechnoServe analysis (2023), stakeholder interviews (2023), IFT

Shifting artisanal production in Mozambique to contemporary, sustainable practices could yield a premium, competitive product

Honey production snapshot in Mozambique

Stage	Production	Aggregation	Processing and off taking
Key actors	**Traditional, artisanal beekeepers** • Common practice, traditional methods are damaging to the environment • Produces lower quality honey sold on local markets or roadsides • Most production is individual **Modern, artisanal beekeepers** • Use apiaries and modern techniques • Often trained by a NGO or social enterprise Experience remains mainly limited to terrestrial forests, investments are required to expand to coastal forests including mangroves	**Socially minded honey enterprises** • AbelhaMoz (Inhambane): Company that hires community members to care for apiaries; ~22 tons annually • Mozambique Honey Company (Niassa): hires community members to care for apiaries; ~30 tons annually • Gorongosa Honey (Sofala): Company that hires community members in a national park to care for apiaries; ~6 tons annually • MICAIA (Manica): supports >200 community members and sells 2 tons annually to national and international markets	• **Differences in processing methods exist** among traditional farmers, potentially resulting in unhygienic products • **Improved processing results in higher quality** but requires specialized equipment • **Significant local demand**: particularly for low priced honey, higher quality honey faces competition from cheaper, imported honey • **Some export of honey**: branded products already on sale, typically regionally
Key indicators in Mozambique	• **60% of the country's natural forest is suitable** for beekeeping • **3K square km of mangroves** across the country • **50-500 kg in annual sales by beekeeper**	• **Several enterprise entrants** in the past 6 years throughout the country that act as aggregators • Honey production can increase by 10x per hive with modern techniques	• National production estimated at 500 tons/year, partly targeting international markets • Honey used for **food**, **medicine**; byproducts are valued as well • Existing production competes **with imported products**
Key indicators – global markets	• Mangrove honey is **gaining popularity** with for its natural properties and flavor and chemical composition providing health benefits	• Commercial **buyers expect supply of at least 20 tons** • Companies are either **small** with quality production from ~100-200 hives or **commercial sized** with larger, cheaper production	• **$9B** honey market size in 2022 • Exports to Rotterdam receive **~$5/kg** • **CAGR of ~5%** expected through 2030 • Average global price of **$2/kg**

Source: TechnoServe analysis (2023), stakeholder interviews (2023), Issuu, Feed the Future, Grand View Research

Honey production in Mozambique encounters challenges but the existing capacity can contribute to achieving key success goals

	Challenges	Existing capacity	Key goals
Production	• **Traditional beekeeping practices are damaging** to the environment • **Production quality control is dependent** on project-based support, usually too short-term • Harvest only happens **1-2 times per year** and harvest amounts may be **unpredictable**	• Historical **knowledge of production already exists** among communities • **Several landscapes are well suited to produce honey** • Traditional beekeepers **demonstrate interest** in learning sustainable techniques	1 **Shift artisanal producers to commercial grade production**, enabling entry into a more profitable market while maintaining cost-effectiveness
Aggregation	• Access to markets is **inhibited by local infrastructure** • **Aggregation from remote producers is costly** and time consuming • **Quality and environment vary** greatly among apiaries, making aggregation of like products difficult	• Remote areas can be reached with **proper vehicles**, making access possible • **Some actors already act as aggregators** • Vast **landscapes of forests** under protection in which like product can be strategically harvested	2 **Establish processing capacity and market connections** for efficient distribution of honey production to target markets.
Processing and offtake	• **Traditional processing reduces quality** • **Difficult market access** limits scalability potential for commercial honey players • **Commercial grade honey deemed too expensive** in local markets • Costly certification process	• Growing demand for sustainably produced and certified honey in country and globally • Some honey companies **hire beekeepers to produce honey** on their land • Certifications allow for **sale internationally** and often **increase the price** of honey	3 **Enhance infrastructure and certification capabilities** to position mangrove honey as a high-quality product in domestic and international markets.

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

For the honey market to thrive, robust support is vital for high-quality production to compete against low-quality supply

Key goals	Recommendations	Type of support	Key stakeholders
1 **Shift artisanal producers to commercial grade production**, enabling entry into a more profitable market while maintaining cost-effectiveness	1. Analyze **forest capacity and honey demand** to prioritize locations	Access to market, Capacity building	Industry actors, NGOs, government
	2. Provide **training and skill development** on modern beekeeping techniques to beekeepers, introducing bi-product concepts to increase production value	Capacity building	Technical experts, NGOs, industry aggregators
	3. Facilitate **access to financing** for start up costs for producers	Access to finance	Microfinance institutions
	4. Create a **transparent pricing model** to factor in production costs and align with selling prices	Access to market, Ecosystem support	Government, industry actors
	5. Establish **quality control metrics** to ensure consistency in production outcomes	Ecosystem support	Technical experts
2 **Establish infrastructure and market connections** for efficient distribution of remote honey production to target markets.	6. Establish **connections with aggregators** for forward contracting in commercial sector	Access to market	Industry actors
	7. Support the establishment of a **producer-driven aggregation system** to consolidate volumes and facilitate sales and supply to commercial actors	Access to market, Capacity building	Industry actors, NGOs, government
	8. Establish an efficient and sanitary system for bottling and filtering products locally	Access to finance, Capacity building	Industry actors
3 **Enhance processing and certification capabilities** to position mangrove honey as a high-quality product in domestic and international markets.	9. Prioritize **domestic honey production** and brand local honey as a premium choice, reducing dependence on cheaper imports.	Ecosystem support, Access to market	Impact investors
	10. Explore funding for local processing facilities in the province **to reduce transport costs**	Ecosystem support	Honey social enterprises, certification bodies
	11. Work with certification bodies for a path to **achieve certification status**	Ecosystem support, Access to market	Industry actors, Ministry of Trade

Capacity building *Access to finance* *Access to market* *Ecosystem support*

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

The challenges from prior unprofitable honey initiatives necessitate diligent risk mitigation

Goals	Risks	Impact	Likelihood	Mitigation
1	**Cultural change** from traditional beekeeping to modern techniques might be difficult to create buy in	Medium	Low	• **Identify community leaders** o be first adopters to modern techniques and facilitate growth through **community advocates**
	Limited financial capital to invest in environmentally sustainable apiaries and beekeeping equipment	High	High	• Facilitate **access to microfinance** and loans for small-scale beekeepers.
	Historically, **above-market payments to producers** in nonprofit-led aggregation projects have fostered high price expectations among producers.	High	High	• Educate producers about realistic pricing models and encourage transparent pricing practices to align production costs with selling prices.
	Income is only earned once or twice a year depending on harvest, risking **fluctuation in community engagement**	Medium	Medium	• Ensure beekeepers have **other revenue streams** • Build in **resilience mechanisms** to recover from natural disasters or unforeseen circumstances
2	Examples of **producer-led aggregation systems are not well established** and will require significant efforts for take off	Medium	Medium	• Provide **long-term and detailed support** to establish aggregation systems.
	Weak infrastructure in remote honey-producing areas hinders market access**.**	Medium	High	• **Advocate for government investment** in infrastructure such as roads
	Dependence on third parties for market linkages may put communities at risk if the third-party leaves	High	Low	• Seek partners with intention to stay for an **extended time period** • **Delegate responsibilities** of the market linkages among community members
3	**Poor access and liability of electricity** may impact the ability to use processing equipment	High	High	• **Advocate for government investment** in infrastructure, particularly electricity in remote areas and explore alternative energy sources.
	Strict regulation in international markets require certifications that are expensive to earn	Medium	High	• Support beekeepers in obtaining cost-effective certifications by sharing resources, knowledge, and potentially partnering with certifying bodies

Level of risk ● High ● Medium ● Low

Source: TechnoServe analysis (2023), stakeholder interviews (2023)

Case study: Honey produced in protected mangroves areas have flourished in Vietnam under the Kim Son honey brand

Vietnam mangrove honey sector at a glance

~$40K In sales per year from the honey produced in this project

$700 Earned per year by trained beekeepers

12K liters Of honey produced each year; production likely to continue growing

5X Growth of number of bee colonies in just 8 months of operations

	Development of Vietnam's mangrove honey industry	Current state in Mozambique
Opportunity	• 4000 hectares of mangroves are being restored in Vietnam; protections on newly planted areas prevent fishermen from collecting there • Each year 60K houses along coastlines are destroyed or damaged by floods • Vietnam's government implemented a 5 year plan to improve resilience of coastal communities	• Important untapped potential considering mangrove coverage and productivity of honey production • Protection and restoration of mangroves a priority in Mozambique, but continues to be a challenge
Approach	• 40 families were trained on beekeeping in the Kim Son mangrove forest • Beyond production, training included quality verification, brand development, and market expansion • Families were give ~2 colonies of bees & food necessary for them to settle into the apiary	• Several NGOs have set up beekeeper training and act as a honey aggregators, and a few social enterprises exist harvesting mangrove honey (engaging youth and women) • Engaging private sector, especially local aggregators, is critical • Experiences in Beira, Zambezi, Maputo National Park, etc.
Impact	• Honey creates supplemental income for fishermen in mangrove areas • Many families grew their 2 colonies up to 10 bee colonies • Mangrove forests also benefit from pollination by the bees • Earnings of $8.70 per kilogram of honey	• Supplemental income for families (bi-products as incremental) • Prevention of cutting down mangroves • Some conversion of harmful traditional practices
Lessons learned and risks	• Helpful to implement an optional cooperative for beekeepers to participate in • Select bee breeds that tend to be less vulnerable to diseases • In seasons with few mangrove flowers, colonies might need to move to other areas	• Infrastructure and market competition remain a challenge

Source: World Economic Forum, UNDP, Vietnam Agriculture

Structure

1. Study objectives and research process
2. Blue Economy context
3. Prioritization framework
4. Value chain deep dives
5. Summary of recommendations
6. Appendix

Salted fish in Inhambane province, TechnoServe (2023)

Opportunities for value creation in Cabo Delgado include seaweed harvesting, fresh fish cold storage and sea cucumber production

Value Chain	*Goals*	*Market value creation*	*Job creation potential*	*Average monthly income*	*Challenge and risks*
 Seaweed harvesting	1 Create a seaweed harvesting system led by smallholders 2 Establish seaweed aggregation structures 3 Establish strong offtake agreements	$ 15 – 18 million in sector revenue	15,000 80% women's participation	$85	• Limited existing production • Significant volumes required for offtake • No existing aggregation structures • No processing capacity
 Fresh fish cold storage and transport	1 Develop cold chain infrastructure 2 Improve transportation and aggregation networks 3 Enhance market access opportunities and revenue	$15 – 20 million additional value from reduced post harvest loss	n/a	$70	• Expensive start up costs • Unreliable and costly electricity • No existing aggregation structures • Weak infrastructure
 Sea cucumber production	1 Develop a sea cucumber production base 2 Create a sea cucumber aggregation structure 3 Enhance regulations for sustainable sea cucumber harvesting	$ 1 million in sector revenue	1000 80% women's participation	$50	• Inexistant production knowledge • Extended timelines to profitability • No existing aggregation structures • Competition with wild captures stocks

To ensure success for Cabo Delgado's prioritized value chains, specific actions require support from the broader ecosystem

Stakeholder engagement	• Engage with coastal communities to identify individuals ready to engage with new value chain development, with a focus on women and youth participation in innovation. • Long term agreements, including business and legal coverage, with relevant local authorities, private sector and implementation partners, including incentives for private sector actors to participate and invest • Long term financing to provide start up support to establish value chains that will meaningfully create profits.
Ecosystem support	• Invest in upgrading transportation, energy, and storage infrastructure to reduce post-harvest losses, improve logistics, and enhance the overall efficiency of the value chains. • Secure long-term land concessions with a conservation approach and the right governance mechanisms through a public-private partnership that will allow for the development of new production activities (seaweed, sea cucumber). • Develop and support shared aggregation and processing facilities that enable producers to collectively negotiate with buyers, add value to their products and increase the market appeal of locally sourced goods.
Access to finance and knowledge	• Establish financial support mechanism that offers accessible loans and grants to aspiring entrepreneurs and small businesses. • Develop a centralized supply and distribution system for high-quality inputs (feed, seeds, spores, and hatchery materials), collaborating with local producers and international partners to ensure a consistent and reliable source of inputs. • Establish training programs for existing and new producers focusing on best practices, focusing on efficiency, quality, and sustainability, management, finances & marketing/access to markets
Access to markets	• Facilitate the establishment of long-term contracts and partnerships between local producers and buyers, promoting trust, stability, and mutual growth in the value chains. • Implement certification programs and sustainable practices, including regular monitoring of wild stocks, to enhance the environmental responsibility of value chains. • Launch a nutritional education, marketing and branding campaign that highlights the unique attributes of sea cucumber and seaweed, emphasizing quality, authenticity, and the positive impact on local communities of Cabo Delgado's production.

Opportunities to unlock value in Inhambane exist by developing seaweed harvesting, tilapia aquaculture and honey production

Value Chain	Goals	Market value creation	Job creation potential	Average monthly income	Challenge and risks
 Seaweed harvesting	1 Create a seaweed harvesting system led by smallholders 2 Establish seaweed aggregation structures 3 Establish strong offtake agreements	$ 15 – 18 million in sector revenue	15,000 80% women's participation	$85	• Limited existing production • Significant volumes required for offtake • No existing aggregation structures • No processing capacity
 Tilapia aquaculture	1 Resolve production obstacles that impede expansion 2 Improve capacity to meet market demand 3 Accelerate the pace of market acceptance of tilapia	$ 20 – 25 million in sector revenue	8,000 40% women's participation	$87	• Feed costs are extremely expensive • Strong technical knowledge required • Competitive market landscape
 Honey production	1 Shift artisanal producers to commercial grade production 2 Establish processing capacity and market connections 3 Enhance infrastructure and certification capabilities	$ 7 million in sector revenue	20,000 40% women's participation	$30	• Transitioning away from damaging traditional practices • Poor infrastructure for aggregation • Expensive processing equipment

To ensure success for Inhambane's prioritized value chains, specific actions require support from the broader ecosystem

Stakeholder engagement	• Engage with coastal communities to identify individuals ready to engage with new value chain development. • Long term agreements, including business and legal coverage, with relevant local authorities, private sector and implementation partners. • Long term financing to provide start up support to establish value chains that will meaningfully create profits.
Ecosystem support	• Simplify regulatory processes, and create welcoming and fostering environment for new businesses to establish themselves • Secure long-term land concessions with a conservation approach through a public-private partnership that will allow for the development of new production activities (seaweed, sea cucumber). • Allocate resources for the construction and maintenance of processing and storage facilities to support economies of scale.
Access to finance and knowledge	• Establish financial support mechanism that offers accessible loans and grants to aspiring entrepreneurs and small businesses. • Offer comprehensive training programs and extension services to equip local producers with the knowledge and skills necessary for efficient and high-quality production, trading and marketing • Develop a streamlined supply chain to ensure consistent access to inputs, while promoting sustainable production methods through incentives and education.
Access to markets	• Facilitate the establishment of long-term contracts and partnerships between local producers and buyers, promoting trust, stability, and mutual growth in the value chains. • Invest in nutritional education, marketing and branding campaign specifically for tilapia consumption. • Develop transparent and fair pricing structures that benefit both producers and buyers, fostering trust and stability in the value chains while ensuring profitability. Establish business links with tourism industry demand.

Opportunities to unlock regenerative blue economy approach in Mozambique and across WIO region

- Alignment with Mozambique Blue Economy Strategy (to be published in 2024)
- Support local market opportunities and sustainable blue economy practices at seascape level
- Contribute for blue economy market opportunities in Mozambique
- Support development of regional fisheries/blue food value chains in Mozambique and across WIO region – continuity to ongoing work in Tanzania, Madagascar, Mozambique and other WIO countries
- Contribute for the Regional marine biotech sector (especially pertinent considering that the Africa group is very keen to understand and unlock MGR/DSI potential especial under BBNJ approach)
- Support regional R&I framework
- Contribute for regional innovative blue finance mechanisms
- Support a strong regional position against harmful blue economy practices

Structure

1. Study objectives and research process
2. Blue Economy context
3. Prioritization framework
4. Value chain deep dives
5. Summary of recommendations
6. Appendix

Description of identified fisheries and aquaculture value chains in Mozambique

Sector	Value Chain	Description
Aquaculture and mariculture	Tilapia aquaculture	Farming of tilapia (*Oreochromis niloticus*) through intensive, semi-intensive, and extensive methods. The variability comes in the choice of habitat (pens, cages or tanks) and in the food input level. There is also existing potential via polyculture or integrated multitrophic aquaculture.
	Shrimp aquaculture	To date, shrimp aquaculture in Mozambique is only conducted intensively. Potential exists for extensive shrimp aquaculture, characterized by low-intensity management and minimal external inputs. Shrimp are typically raised in large, open ponds that are connected to natural water sources like estuaries or coastal areas.
	Fish feed creation	Creation of pelletized fish feed that can be used in aquaculture production. The process involves blending various ingredients such as fish meal, soybean meal, vitamins, and minerals to create a balanced nutritional mixture. This mixture is then processed through pelleting techniques to form the final pellets or flakes.
	Crab fattening	Raising and fattening crabs in cages submerged in mangrove environments. This includes creating cages and introducing young crabs into them then feeding them a specific diet until the desired size is reached.
Intertidal mariculture	Seaweed cultivation	Seaweed farming in the intertidal zone takes advantage of the area between high and low tide. Seaweed can be grown on various types of cultivation structures, including ropes, lines, nets, or frames. Structures are anchored to the seabed. Harvesting is done when the seaweed reaches the desired size and quality.
	Sea cucumber production	Sea cucumber ranching involves the cultivation of sea cucumbers in coastal areas, typically in enclosed or semi-enclosed ranching structures like pens, ponds, or tanks. Juvenile sea cucumbers are introduced into the ranching structures and left to grow. After harvest they may undergo processing, which can include cleaning, boiling, and drying.
	Mollusk farming	Mollusk farming in intertidal areas involves the cultivation of various shellfish species like oysters, mussels, and clams in coastal regions affected by tidal changes. As the tide cycles, the mollusks feed on naturally occurring plankton and nutrients, promoting growth.
Fisheries use	Sustainable fishing methods	Promoting fishing methods that ensure the long-term viability of fish populations and minimize negative environmental impacts. This can include preventing overfishing by adhering to catch limits, promoting responsible harvesting practice and reducing bycatch.
	Fresh fish cold storage	Post-harvest fish processing can be improved to ensure better preservation of the quality and freshness of the catch. This can include cleaning, gutting, filleting, freezing, canning, smoking, drying, and other methods to ensure that fish and seafood products reach consumers in a safe and marketable condition.
	Seafood transport	Purchase of fish and seafood catches when they return to coast, refrigeration or freezing during transport towards bigger regional hubs for sale to consumers.
	Octopus fishing and processing	Artisanal fishing of octopus, sun drying and vacuum packing into packaging for easy transport and packaging.

Description of identified culture, tourism and sport value chains in Mozambique

Sector	Value Chain	Description
Tourism	Hospitality staffing and businesses	Engaging community members in the workforce and management of hospitality businesses. Includes training and managing a proficient workforce for hotels and hospitality businesses.
	Restaurants and bars	Creation of local dining establishment to meet the needs of the tourist population.
	Tourism guides	Individuals with deep knowledge of local attractions and history provide informative and engaging tours to travelers. They play a vital role in enhancing tourists' experiences, offering insights into cultural, historical, and natural aspects of a destination while contributing to the local tourism industry's growth. Can also provide guiding for deep sea fishing or other water-based activities.
	Water transport	Use of existing community fishing vessels that can be retrofitted to provide tourism transport to various areas of interest along the coast for leisure, fishing or ecological education like water safaris.
Culture	Artisanal craft supply and sales	Production of handmade goods, often rooted in local traditions and culture. Artisans source raw materials, craft items, and market their products, connecting consumers with unique, culturally rich creations while supporting local economies and preserving traditional craftsmanship.

Description of identified natural resources and environment value chains in Mozambique

Sector	Value Chain	Description
Environmental protection	Blue carbon finance through environmental rehabilitation	Blue carbon credit income through planting and conserving mangroves and seagrass is still at the nascent stage in Mozambique. These projects aim to provide direct income to community members that engage in mangrove and seagrass beds rehabilitation through replanting.
	Community protected areas	Community protected areas are established where local communities play a significant role in conserving biodiversity and managing natural resources. These value chains involve sustainable use of resources, ecotourism, and other activities that protect coastal ecosystems while generating income.
Land based production	Horticulture	Horticulture value chains involve the cultivation of a wide variety of fruits and vegetables. Farmers grow produce, which is then sold in local markets or distributed to other regions. Horticulture not only provides fresh, nutritious food but also supports livelihoods and promotes agricultural diversity.
	Mango drying	Mango drying value chains in coastal areas focus on processing and preserving mangoes. Mango farmers harvest ripe mangoes, dehydrate them through sun-drying or mechanical methods, and package the dried fruit for sale.
	Honey production	Beekeepers place hives in mangrove areas to harvest honey produced by bees foraging on mangrove nectar. This practice promotes both mangrove conservation and honey production, supporting livelihoods and offering a unique, environmentally friendly product for markets.
	Salt mining	Salt production is a significant value chain in coastal areas, where salt flats are used to extract salt from seawater through evaporation. The extracted salt is processed, cleaned, and packaged for distribution. Salt flats are essential for local consumption and various industrial applications.
	Livestock production	Livestock farmers raise animals for meat, dairy, and other products. The value chain includes animal husbandry, veterinary care, and marketing of livestock and related products, contributing to the livelihoods of coastal communities and supplying local and regional markets with fresh meat.
	Cashew farming	Coastal regions in Mozambique are known for cashew cultivation. The cashew value chain involves planting, harvesting, and processing cashew nuts. Nuts are collected from cashew trees, sun-dried, and processed to remove the shell and husk. The final product is sold locally and globally.
	Coconut farming	The coconut value chain encompasses planting and harvesting coconuts, processing coconut products such as coconut milk, oil, and desiccated coconut, and marketing these items for domestic consumption and export. Coconuts play a vital role in the local diet and offer various income opportunities.
Resource management	Charcoal briquette creation	Charcoal briquette production could be sustainable energy value chain where briquettes are created using biomass waste, such as coconut shells or sawdust, as a clean alternative to traditional wood charcoal. These briquettes provide an eco-friendly energy source while reducing deforestation pressures on forests.
	Waste recycling and repurposing	Waste recycling value chains focus on collecting, sorting, and recycling various materials like plastics, glass, and metals. Local communities participate in waste collection and recycling, contributing to cleaner environments and generating income through the sale of recycled materials.

Opportunity for further study exists across high potential value chains, primarily within customer demand and implementation

	Knowledge Gaps	Learning opportunities
Tilapia aquaculture	• Market access • Effective aggregating production across small farmers • Creating market acceptance of tilapia	→ Identify campaigns to grow market acceptance, identify key markets with feasibility to access, research governance and aggregation models of existing aquaparks
Shrimp aquaculture	• Prevention of disease techniques • Expectations of global market and buyer volume expectations • Market entrance strategies for small scale aquaculture producers	→ Case studies of success in other markets including mitigation of risks, market access, pricing power, and community benefits (particularly for women)
Seaweed cultivation	• Environmental impacts of seaweed • Key variances in harvest cycles • Accessing global market and setting up export routes	→ Conducting a seaweed-specific market landscape, mapping out the interests of each stakeholder, identify location for implementation, determine processing mechanisms & transportation logistics
Sea cucumber aquaculture	• Market entrance • Quality standards • Implementation challenges and governance models • Effective processing and export	→ Interview players in Madagascar sea cucumber work, contact buyers in key markets to understand KPIs, work with production experts to identify farming business development plans
Mollusk mariculture	• Production capabilities and risks • Key markets and quality • Experience of successfully implemented projects	→ Interview existing enterprises, desktop research global market, find synergies with existing projects in Mozambique
Fresh fish cold storage and transport	• The extent of electricity limitations and potential of solar • Ideal governance and ownership structures • Community capacity for maintenance and financing possibilities	→ Interview more buyers of cold chain products, identify key suppliers of cooling systems, interview successful projects in neighboring countries, research history of investment
Honey production	• Volume needed to commercialize • Requirements for export • Intricacies of government processes for business startup	→ Interview existing players that have started up recently, research and interview to identify customs considerations

TechnoServe
Business Solutions to Poverty

IUCN

LEAP
LOCALLY EMPOWERED AREA PROTECTION

Supported by:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
based on a decision of the German Bundestag

IKI INTERNATIONAL CLIMATE INITIATIVE

Thank you

For more information contact:
Denise Nicolau denise.nicolau@iucn.org