

## **A brief on the potential impacts of Climate Change on Small-Scale Fisheries of the coastal states of the Southwest Indian Ocean**

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Small-scale marine fisheries can be differentiated into two distinct segments based on their interconnectedness to specific coastal fisheries ecosystems; they are sedentary and oceanic fisheries. The sedentary fisheries include the demersal and benthic aquatic marine resources such as the reef and herbivorous fishes, molluscs and crustaceans that live in the coral reefs areas, mangroves forests, sea-grass beds and shallow waters of the lagoons, estuaries and wetlands. These coastal fisheries ecosystems are mostly over-exploited and polluted by land-based and maritime effluents in densely populated areas across the countries bordering the SWIO. The coastal oceanic or pelagic fisheries target tuna and associated large pelagic fishes in the nearshore open sea or around artificial fish aggregating devices. Some small pelagic fishes are also caught seasonally in the lagoon. The coastal tuna fisheries are not evenly developed in the region. The artisanal fisheries of Comoros and Reunion Island are overly dependent on their coastal tuna resources due to the limited extent of the lagoon and shallow continental shelves. Mauritius is also developing artisanal tuna fisheries as an alternative to relieve its lagoon from overfishing. Over the past decades, coastal tuna fishing with the deployment of FAD has been tested by several programmes in Kenya, Mozambique, and Tanzania. Still, it has not been promoted as a commercial fishery so far. Most of the SSF is impacted diversely by the different climate change pathways.

As a point of reference for the SSF in the SWIO, it is acknowledged that the Paris 21<sup>st</sup> Conference of Parties on Climate Change, commonly known as the “COP 21”, is committed to limiting global warming at +2°C and eventually to +1.5°C to relieve the low lying least developed countries and the Small Island Developing States (SIDS) from unavoidable collateral damages by the turn of this century. In the Indian Ocean, during 1998 - 2010, the Net Primary Productivity decreased by 10 % and is predicted to decline further. It will impact the presence and abundance of marine living aquatic resources in the region. The average sea surface temperatures (SST) and sea-level rise (SLR) in the SWIO are within the range of global trends. However, they differ significantly across the local coastal marine ecosystems, with diverse consequences on the productivity of the artisanal fisheries. However, coastal fishing communities still perceive the effects of climate change as seasonal and inter-annual climatic variations. They have developed some adaptation strategies over time to cope with these changes, but these measures are not adequate to develop proactive climate change adaptations and long-term resilience in the SSF. Scientific evidence points to positive interactions and mutually reinforcing systems between ocean warming and climatic variations, including the inter-annual phenomena such as El Nino and La Nina that would further aggravate the conditions of the marine fisheries. The fisher folks and those dependent on the coastal fisheries for their livelihoods must be well informed of the silent threats of climate change to fisheries ecosystems for their economic activities. A bottom-up approach is necessary to document the current effects of climate change and variations in the local socio-ecological environment. The mainstreaming of climate change adaptation measures has not been fully captured by the national policy and institutional frameworks of the fisheries sector, particularly the SSF, because of a lack of reliable scientific and observational information on the potential climate risks.

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It is scientifically documented that the drivers of climate change undermine the food chain and prey-predator relationship, directly affecting the productivity of the fisheries ecosystems and fish production. Fish stocks tend to move steadily towards cooler waters, and heat-tolerant and pH-resistant species are driving away from the endogenous fish species from their traditional habitats. The migratory pattern of tuna stocks is also changing subtly across the oceans. A peer-reviewed study shows that the surface tuna resources in the SWIO are moving farther easterly at approximately one kilometre per decade. These climatic impacts will have severe socio-economic consequences on the coastal and oceanic fisheries of the region. Collecting sufficient scientific and techno-economic information on the current and future climate threats in the fisheries sector is crucial to inform proactive policy actions at national and regional levels.

The sustainability of the socio-economic benefits derived from the coastal fisheries in the SWIO countries is seriously challenged by the poorly regulated open-access regime; lack of basic socio, economic and dedicated fisheries infrastructure; outdated fishing assets and fishing technologies; neglected fish value chains, value addition activities and market infrastructure and supply chain logistics, trained workforce as well as ineffective fisheries management and governance systems. The climate and non-climate (environmental and human-induced) factors are also culprits of current affairs, but they are adequately documented. Under the present business-as-usual scenario, the human and environmental stresses on SSF will intensify until they reach the tipping point. It will be an ultimate catastrophe for approximately 50 million people of the region dependent on the coastal fisheries for their livelihoods and food and nutrition security. In general, the direct impacts of climate change and variations on the coastal fisheries are observed by a decrease in the availability and accessibility or catchability of the fish stocks. A decline in the total catch, species mix, and spatial distribution of the marketed fish species affects the fishing costs and revenue of the fishing communities. The operating costs tend to increase because of a decrease in the landings and changes in the catch composition, an increase in the number of non-fishing days due to bad weather at sea, longer fishing trips as more time is required for cruising to more distant fishing areas, increase in post-harvest losses in the absence of adequate preservation practices and higher cost of repair and maintenance. The market demand for fresh/chilled fish and seafood is driven by other factors such as the quantity and quality of the landed products, the purchasing power of the consumers and the availability of cheaper substitutes, particularly from inland or farmed fish products. Though it is expected that the prices of food, including fish, would increase on the world markets, the escalating cost of fishing in the SSF coastal fisheries might not be compensated fully in the developing countries of the SWIO region due to the absence of structured primary markets, the low purchasing power of the consumers, widespread subsistence fishing and open access as a social safety net against poverty and malnutrition, poorly value chains and marketing networks and direct competition with cheaper imported wet fish.

The impacts of climate change will also hit fish and seafood exports to the SWIO countries. However, the involvement of artisanal fisheries in regional or international trade is insignificant, if not inexistent, in some of these countries. Except for Madagascar, the bulk of the production of the artisanal fisheries in these countries is meant for domestic consumption. It is a paradox that ocean states like Mauritius, and Reunion Island are overly dependent on imported fish and seafood to satisfy their domestic consumption. Comoros, Madagascar and Seychelles are self-sufficient, but there are different fish per capita consumption levels. For instance, in 2014, the per-caput fish consumption in Madagascar was 7.4 kg, much lower than the African average of 9.6 kg. Over 90 per cent of the fish production in Africa, including the countries boarding the SWIO, is

harvested from the continental waters. Seychelles, with a per-caput fish consumption of 50 kg, has the highest rating in the SWIO. It has significant export potential for high-value reef fishes but is constrained by geo-economic factors common to the SIDS. The SSF of Comoros is overly dependent on tuna resources and is about to launch the first export-oriented vertically integrated tuna fishing and processing project. However, this development has not systematically anticipated potential climate risks.

Given that the SSF is the leading supplier of affordable food fish to the local population of the region, it is critical to mainstream climate change adaptation measures into the fisheries management governance system in a proactive way. If appropriate measures are not taken promptly, it is most likely that the per-caput fish consumption will follow a downward-sloping curve in the future. Since locally harvested marine fish would become scarce, these coastal countries might resort to imports and/or restrict fish and seafood exports to satisfy domestic demands.

The regional industrial tuna fishing and canning value chains, which are an extended segment of the European tuna markets, are under climate risks due to the observed subtle but steady change in the migratory patterns of the tuna stocks in the Indian Ocean. They are moving away from the traditional surface tuna fishing grounds of the SWIO. The multi-million-dollar canned tuna industry is at stake as these environmental changes would affect its competitiveness at this critical time when the ACP-EU Preferential Trade Agreement is being challenged by the World Trade Organisation. It is most likely that the supply of raw tuna from the region will decline in the future, and it will eventually impact the future Fisheries Partnership Agreement between the EU and the ACP countries of the SWIO. To anticipate these long-term climate-induced changes and to make their comparative advantage on export markets, some tuna packers are planning to delocalise their operations in countries closer to emerging tuna fishing grounds, such as Bangladesh and Sri Lanka. Fish and Seafood exporters of the SWIO region might face tougher competition on their traditional markets from exporters from other regions whose fisheries are less affected by ocean warming and/or are managed more efficiently.

Over the past decades, the countries of the SWIO have participated in over 30 regional and national climate-related programmes focusing on Research, Policy Formulation, Dissemination of Knowledge and Awareness building, Capacity building and Community-based adaptation. Most of them have undertaken a Vulnerability Analysis of their key economic and environmental sectors. However, the national climate policies have focused more on the land-based sectors than the marine counterparts. Generally, the Ministries of Environment and/or the Integrated Coastal Zones Management looks after the social and environmental issues of the coastal and marine areas. These interventions have no direct interest in the socio-economic and ecological aspects of the artisanal fisheries. To cope with this policy gap, the relevant public agencies must integrate climate-smart strategies into the existing coastal marine fisheries policy and regulatory frameworks. Formulating a regional climate change adaptation strategy for the fisheries sector of the SWIO, which has two renowned large marine ecosystems, would be necessary.

The combined effects of climate and non-climate stressors are wicked problems affecting the socio-ecological sustainability and long-term resilience of coastal marine fisheries. Some of those factors are manageable, while others are unmanageable. It is, therefore, critical to relieve the coastal marine ecosystems from human-induced stressors, including overfishing and unsustainable fishing practices, including IUU fishing, and maritime and land-based pollution, so that these environments may uphold their natural resilience to the pathway of ocean warming

and extreme weather events. When anticipated well in advance, climate adaptation strategies can be based on a no-regret or triple-win approach. This proactive approach is more attractive to all stakeholders and may unfold tremendous opportunities for the SWIO countries in modernising their SSF. The following points have to be included in any Climate Change Adaptation Strategy in the coastal marine fisheries:

- i) Awareness building on the potential impacts of climate change and the possible proactive adaptation measures in the fishing communities;
- ii) A Regional Climate Change Adaptation Strategy for the SSF of the SWIO region can be done on a back-to-back basis with the existing regional fisheries management strategies at the EA-SA-IO level;
- iii) Improved communication and coordination among the various Environment, Sustainable Development and Ocean Governance policies and programmes at national, regional and international levels
- iv) Participatory ecosystem-based management and governance in coastal fisheries emphasise integrated coastal management that incorporates various interrelated multilateral environment agreements, including climate change and biodiversity protection, under the same umbrella.
- v) Smart public and private investments in climate-proofing fisheries infrastructure and fishing assets;
- vi) Development of smart aquaculture and fish farming projects to boost the supply of fish;
- vii) Social security and Insurance Scheme to protect the fishing communities;
- viii) Alternative/ Complementary Sustainable livelihoods for the fishing communities include blue carbon projects and environmental stewardship.
- ix) Science-Technology and Innovation lead in promoting climate-resilient fishing operations;
- x) Improved safety at sea through training and sharing of real-time weather information.
- xi) Review of marine protected areas and reserves strategies to integrate climate risks;

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Illustration 1 – Landscape of the Marine Fisheries in the SWIO Region

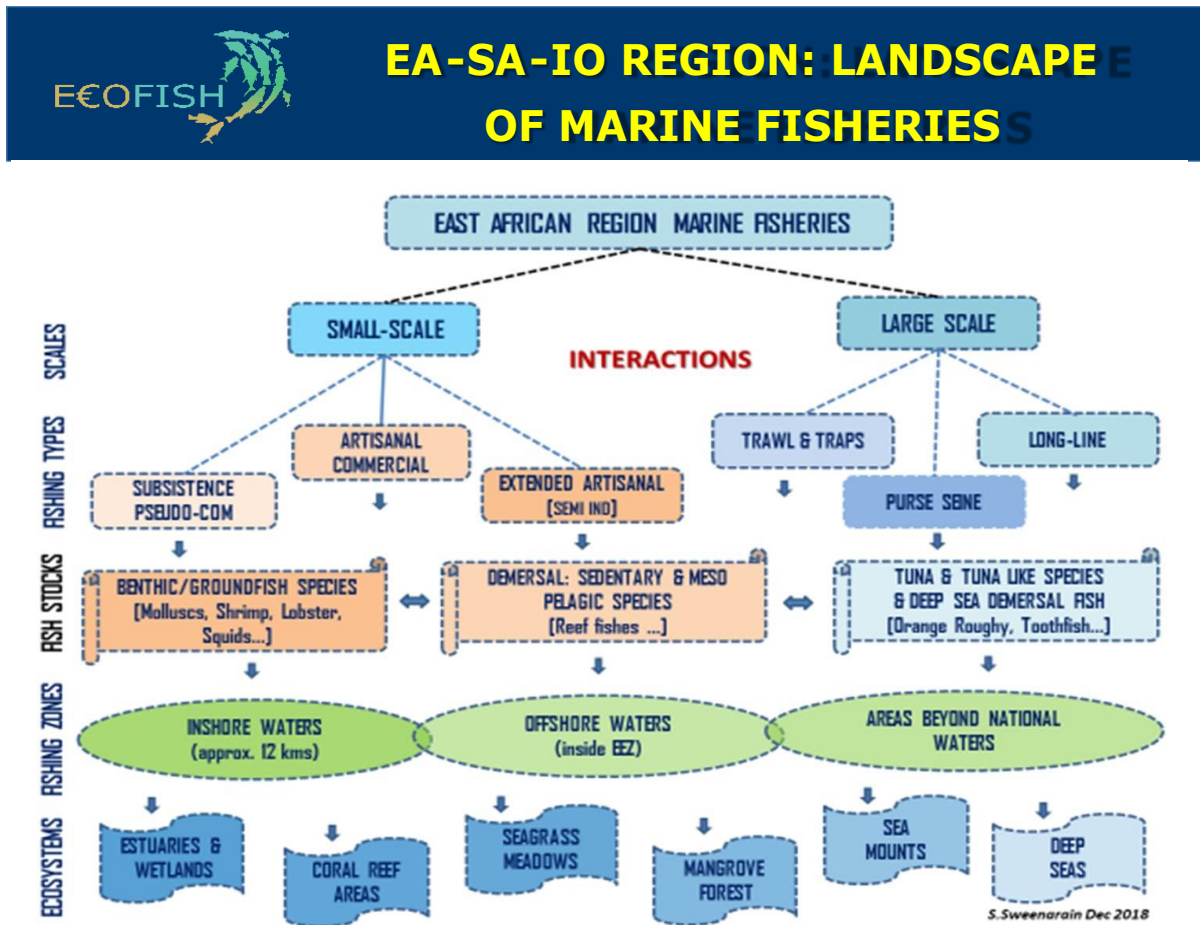


Illustration 2 – Simplified Sustainable Fisheries Development Model

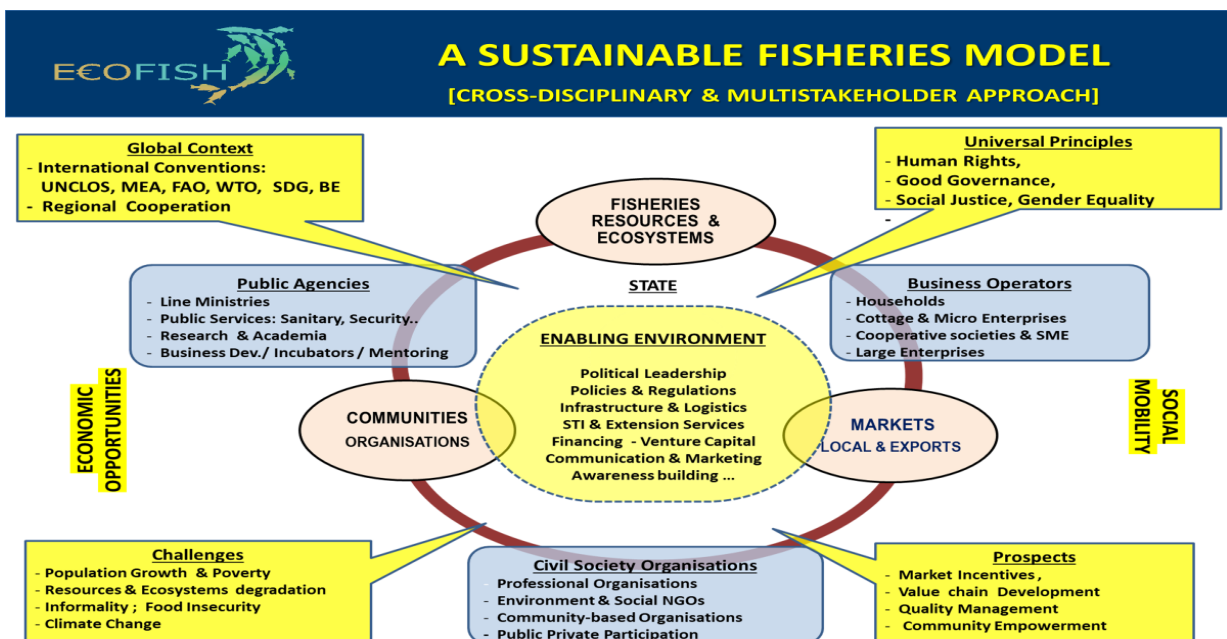


Illustration 3 – Main Entry Points of Sustainable Development



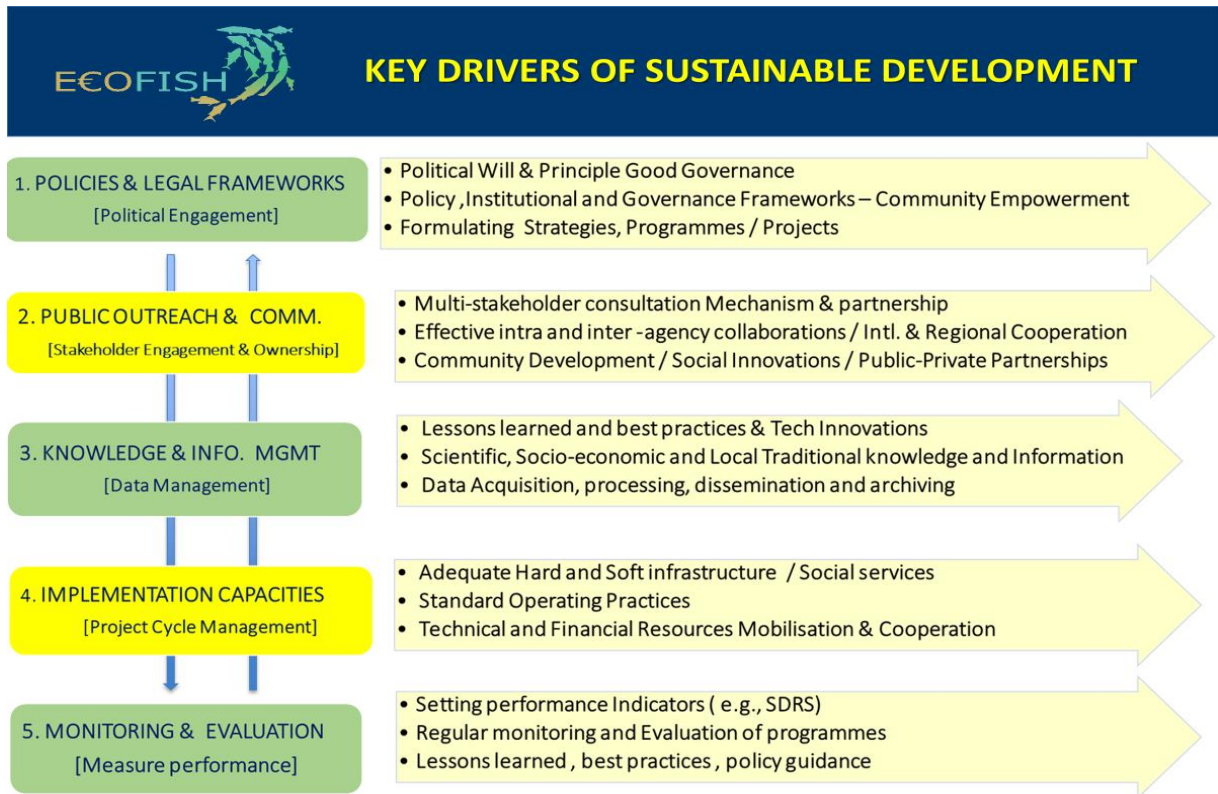


Illustration 4 – Synopsis of Climate Change – Small-Scale Fisheries Conundrum

