

Social and Economic Impacts of Capture Fisheries and Mariculture

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Opposite page: Improvised fishmarket at landing site, Inhaca Island, Mozambique. © José Paula.

INTRODUCTION

Several countries of the SW Indian Ocean are classified as Least Developed Countries (LDC) by the UNDP, and have a low Human Development Index (HDI) (UNDP 2014). High levels of poverty and rapid population growth is pervasive, and in coastal communities along the mainland (Mozambique, Tanzania, Kenya), Madagascar and on small islands (Comoros, Seychelles, Mauritius) capture fisheries are integral to food security (see Chapter 21) and the functioning of social and economic systems. In recent years, mariculture initiatives have taken root in some areas, such as seaweed farming in Zanzibar, but at a regional scale it is still in an early developmental phase (see Chapter 22).

Fish is rich in essential nutrients for human health (in particular iron, iodine, zinc, calcium, vitamins A and B), and is especially important in the diets of infants, children and pregnant women (Satia 2011). On a worldwide scale, *per capita* fish consumption continues to rise – up from 10 kg in the 1960s to more than 19 kg in 2012, driven by higher demand from a growing population, rising incomes, and more efficient distribution channels (FAO 2014). However, the opposite trend is apparent in the SW Indian Ocean, where *per capita* fish consumption is the lowest in the world, and declining. A decrease in fish availability in coastal waters, increasing poverty levels, and a rapid increase in human population size can partially explain the decline in fish consumption in this region. Another factor is

that some species with a higher economic value (namely tuna, prawns and lobsters) are exported, and these species are therefore scarce on local markets, or are prohibitively expensive (FAO 2014).

Environmental degradation caused by fishing and mariculture activities (see Chapters 21 and 22) can reduce potential harvests and food security, affect economic growth and reduce the quality of life in coastal communities. Domestic sewage and agricultural waste runoff, chemical contaminants and microbial run-off increase the risk of disease (see references in European Marine Board 2013). Food safety systems for fish products, such as Standard Sanitary Operation Processes (SSOP) and Hazard Analysis Critical Control Point (HACCP) programmes have been developed in some SW Indian Ocean countries, mainly to comply with export regulations of foreign markets. For instance, the European Union (EU) requires established risk management processes that comply with regulations on food safety and quality control. These measures may safeguard large producers against the impacts of changes to international trading standards, but ignore small-scale producers that deliver to local markets (Satia 2011).

This chapter focuses on the social and economic impacts of capture fisheries and mariculture on coastal communities, their scale and significance for employment, role in social structure, and their contributions to livelihoods.

SOCIO-ECONOMICS OF CAPTURE FISHERIES

Scale of capture fisheries

Trends in capture fisheries have been described in detail in Chapter 21. Estimating the scale of the fisheries sector is notoriously complex, because it employs both fishers and a large number of people involved in related activities, such as fish processing, distribution and marketing. Enumeration is particularly difficult at the community level, where these activities are largely informal. Consequently there are many different estimates of the numbers of artisanal fishers per country and regionally. The actual numbers are difficult to discern because of the highly dynamic nature of fishing activities and data collection limitations. The numbers of fishers can vary seasonally and between years. Fishers often have more than one occupation (for instance fishing and farming) and may switch between them depending on opportunity and perceived gain. Furthermore, women and children also participate in gathering marine organisms in the intertidal zone, but are not generally counted as fishers. Estimating the number of fishers based on the number of fishing licenses issued also has limitations because licensing requirements tend to be weakly enforced. Even where fisheries censuses are conducted, the above constraints can lead to considerable underestimations of the artisanal fisheries sector. Estimates for the comparatively smaller industrial fisheries sector tend to be more accurate than for the artisanal sector,

because the number of fishing units and employment is more consistent (van der Elst and others, 2005).

Some estimates of the numbers of fishers by country and their relative importance are as follows (see Figure 23.1):

- Comoros (population est. 850 000 in 2008): There are 127 coastal villages around three habitable volcanic islands. In 2012 and 2013, traditional fisheries comprised 3 961 small wooden boats and 7 922 fishers, catching mainly demersal fishes. Artisanal fisheries, catching mostly tunas, comprised an additional 1 794 boats and 4 062 fishers. Fishing is seasonal, declining during the ‘kusi’ period of strong SE monsoon winds (June-August), and increasing during the ‘kashkasi’ period of weak NW monsoon winds (December-April) (Mahamoud 2013).

- Madagascar (population est. 21 million in 2011): Madagascar has a coastline of 5 600 km, and the maritime fisheries sector is structured into traditional fisheries (on foot or using dugout canoes), artisanal fisheries (motorised boats with engines <50 hp) and industrial fisheries (mainly shrimp trawl, with engines >50 hp). Industrial prawn fisheries had 35 vessels in 2013-2014 and about 4 500 fishers. Estimates of artisanal fishers (including traditional) are 55 000-70 000 fishers, using 8 000 boats (with engine) and roughly 22 000 canoes (Soumy 2006; WIOFish 2013).

- Mauritius (population est. 1.3 million in 2010): Mauritius (1 864 km²) is surrounded by 150 km of fringing reef and small outer islands at Rodrigues, St Brandon and

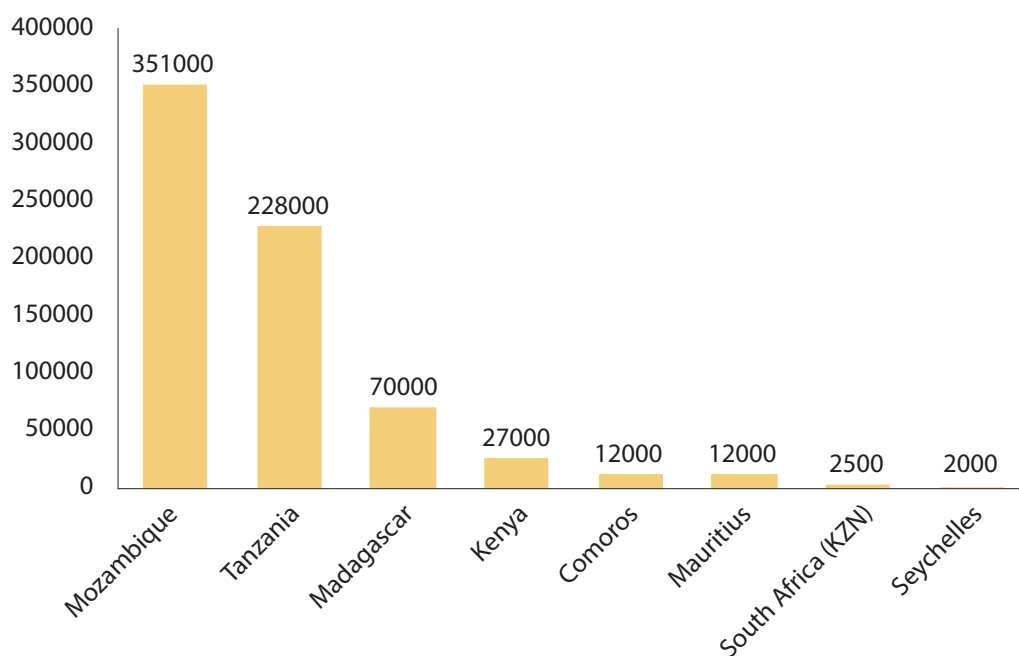


Figure 23.1. Number of commercial fishers per country, including artisanal and industrial sectors.



Figure 23.2. Fisherman scouring intertidal reef in southern Madagascar. © Johan Groeneveld.

Agalega. Fisheries provide employment to about 12 000 people (full-time fishers and employees in processing, for example freezing, salting, smoking, canning and ancillary services). There are about 4 000 artisanal fishers using >2 000 boats, and 700 industrial fishers using 15 boats. Recreational fishing lands a low volume of fish, compared to the other sectors, but 24 000 fishers using >1 000 boats was reported by Jehangeer (2006). Production is insufficient to cover local demand for fish products.

- Seychelles (population est. 88 300 in 2012): Seychelles is an archipelago of 115 tropical islands spread over 1 374 million km² of ocean, and is classified as a high-middle-income country. Fisheries are the economic mainstay, contributing more to GDP than tourism. Fish products contribute 90 per cent of all exports. Around 80 per cent of the tuna catch in the Western Indian Ocean is landed or trans-shipped in the Seychelles, where one of the largest tuna canneries in the world is the main employer of locals. Consequently, the Seychelles economy depends heavily

on the cannery, which in turn depends on the EU export market. The industrial fleet is foreign owned, comprising purse seiners and longliners. In 2011-2014, licenses were given to 48 purse seiners and >200 longliners, from the EU, Taiwan, China and Japan. Not all vessels were active (Martín 2011). Artisanal and semi-industrial fishing employs about 1 800 local fishers using 417 licensed small boats, and most of the catch is consumed locally.

- Mozambique (population est. 25.7 million in 2015; www.ine.gov.mz): The fishing sector makes up about 1.4 per cent of GDP and has grown by ca. 13.4 per cent per year between 1997 and 2011, through diversification of the species caught. According to the 2012 artisanal fisheries census, 351 000 people are employed, of which approximately 90 per cent are artisanal fishers or involved with fish processing and marketing. Small-scale fisheries are crucial to rural economies, but face pressures from illegal and overfishing, habitat degradation and climate change effects (Benkenstein 2013). Industrial fishing by Mozambican

companies and joint ventures between the state, Japanese and Spanish companies is focused on catching prawns. Fishing ports, storage, boatyards and workshops are located in Maputo, Beira, Quelimane, Nacala and Angoche. Prawns are the principal export product, but other exports are spiny lobster, langoustine and fish (www.mbendi.com).

- Kenya (population est. 42 million in 2011): Fish production is dominated by freshwater fish from lakes (96 per

cent of approx. 150 000 tonnes per year), with marine fish contributing only 4 per cent, averaging around 8 800 tonnes. Marine fisheries are divided into industrial, artisanal and recreational fishing sectors, and together they employ around 27 000 people in sea and shore-based activities. The artisanal sector employs over 13 700 fishers (Department of Fisheries 2012), and these fishers remain mainly within or near the fringing coral reef. Limited industrial

BOX 23.1

RESOURCE USER CONFLICT IN KENYA



Boats in Malindi at sunrise. © Xiaojun Deng.

An artisanal fishery has been active in Malindi Ungwana Bay for hundreds of years, and presently comprises about 3 500 fishers and 600 traditional boats that fish in nearshore waters. These fishers compete for finfish and prawn catches with a commercial trawl fishery, active since the 1970s. Trawling takes place close to the coast (within 5 nautical miles, in contravention of the fisheries act) because most prawns occur in shallow waters near river mouths. This brings them into direct conflict with artisanal fishers, when trawling damages artisanal fishing gears, or when retained fish bycatch competes with artisanal catches on local markets. The artisanal fishery targets some of the finfish species caught and dis-

carded overboard by trawlers – these catches include juvenile fish considered to be too small or of low economic value. Therefore artisanal fishers attributed declining catches to the effects of trawling, albeit without direct scientific evidence. Trawling was banned in Malindi Ungwana Bay in 2006, and artisanal catches increased roughly two years after the trawl ban took effect. The trawl fishery resumed in 2011, subject to a Prawn Fishery Management Plan (2010). The plan restricts the fleet to four trawlers that may only operate during daytime, further than 3 nautical miles from the coast, and it includes a closed fishing season between November and March.

prawn trawling in Malindi-Ungwana Bay has resulted in conflict between artisanal and trawl fishers (see Box 23.1). Offshore resources in the Exclusive Economic Zone (EEZ) are exploited by Distant Waters Fishing Nations (DWFN) through a licensing system (FAO 2007a). Essential legislative components are in place, but governance in the offshore sector is limited to collecting licensing fees, without adequate enforcement.

- Tanzania (population est. 51 million in 2014). Marine fishing is concentrated near the mainland shore, within the fringing reef and near estuaries such as the Rufiji delta, and in territorial waters around Zanzibar, Pemba and Mafia islands. Artisanal fishers land >90 per cent of the catch, through foot-fishing and gleaning in the intertidal or using dugout canoes, or dhow-type planked boats (FAO 2007b). Many foot-fishers are women and children. Coastal fisheries are essentially unrestricted, although licenses are theoretically required (Groeneveld and others, 2014). Some species are exported, for instance octopus. Various estimates place the number of fishers between 35 000 (2009 frame survey), and 228 000 (WIOFish 2013). Industrial fisheries include a prawn trawl fishery (presently suspended) and fleets of foreign longliners and purse seiners that target tuna and tuna-like species under license in EEZ waters. Recreational fisheries are restricted to the tourism sector.

- South Africa (KwaZuluNatal province, which forms the southwestern boundary of the SW Indian Ocean; population est. 10 million in 2012): The coastline is exposed with few bays and inlets, and fisheries are less extensive than further north. Twenty-three communities are presently involved in subsistence and artisanal fishing, with approximately 2 500 people participating in five fisheries: estuarine fish traps (Kosi Bay); marine and estuarine rod and line fishing; marine rocky and sandy shore invertebrate harvesting (mainly brown mussels); estuarine sand and mud prawn harvesting (bait harvesting); and traditional spear fishing (handheld spears, at Kosi Bay) (Everett 2014, Goble and others, 2014). Together, these fisheries produced about 150 tonnes of food in 2010. Oyster-gathering in the intertidal, beach seine-netting, industrial trawling for crustaceans, and a line fishery from ski boats form the commercial sector. Between 1999 and 2008, an average of 3 800 to 5 500 people purchased recreational permits to harvest lobster, mussels and other marine invertebrates. Recreational shore angling comprised 55 000 participants in 2009, and a collective 800 000 angler

days of fishing. Shore angling effort is high near urban areas, and annual catches range between 250 and 600 tonnes. At least 10 000 recreational boat fishers undertake over 30 000 recreational boat launches per year, reporting annual catches of between 400 and 470 tonnes per year. Many anglers fish in both marine and estuarine environments (Everett 2014).

Role in social structure

Social structure is defined as a system of geographically dispersed rules and practices that influence the actions and outcomes of large numbers of social actors. The importance of capture fisheries in coastal communities as a source of food and economic activity makes it a major determinant of social structure. Key actors are the fishers, mainly men in the formal fishing sectors. Women, and sometimes children, play a significant role in collecting seashells, sea cucumber and octopus in the intertidal for a few hours each day, usually during low spring tides, using hands and sticks or rods (Jiddawi and Ohman 2002). They also use mosquito nets close to the shore to catch shrimps and small fishes. In addition to collecting marine products, women play a prominent role in the processing and marketing of fish (Jiddawi and Ohman 2002; Ochiewo 2004). The 2012 artisanal fisheries frame survey estimates that about 18 per cent of the fishers are women. Other industries that support fishing are artisans that make and repair boats and fishing gear.

Middlemen and traders play an important role in the artisanal fishery, by providing opportunities for fishermen who cannot afford to buy their own gear or vessels (Jiddawi and Ohman 2002; Ochiewo and others, 2010). Middlemen usually own gear (seine or gill nets) or vessels (dhows or boats with engines), which they rent to fishers. The money obtained from the catch is typically divided into three parts: one for the middleman, one for boat and gear maintenance, and one for all fishermen on the boat, regardless of their number. Traders then distribute the fish inland. Consequently the fishermen themselves receive the smallest return.

Fisher migrations along the East African coast is centuries old, and illustrates social adaptation to a complex environment (Fulanda and others, 2009; WIOMSA 2011)(see Box 23.2). Migrations are either temporary or permanent, and patterns vary tremendously, both within and across country borders, and from a few days to several months or years. Drivers are a search for better catches and increased

income. Fisher migrations are seasonal, and associated with social and economic challenges at home and host destinations.

Contribution to livelihoods

To illustrate the dependence on marine resources, an estimated 50 per cent of Mozambicans rely primarily on fish for protein intake. In Tanzania, up to 70 per cent of protein intake may comprise fish from freshwater or marine origin. Population densities along the coast are high (>50 per cent of 21 million people in Madagascar; >20 per cent of 51 million people in Tanzania), and many of them are intimately linked to the sea for food security and jobs. Although precise data are lacking, surveys suggest that 400 000 to 700 000 fishers engaged in marine fishing in the region between 2004 and 2013 (van der Elst and others, 2005, WIOFish 2013), and considering that there is a dependency ratio of about 7: 1 (UNEP 2001), this means that almost 5 million people are directly dependent on fishing for their livelihood. Dependence on fisheries varies among countries, and is highest in Mozambique, Tanzania and Madagascar, and lower in eastern South Africa, where the economy is more diverse.

Economic benefits and contribution to GDP

On a world scale, fish production generally contributes 0.5 – 2.5 per cent of GDP (Bene and Heck 2005). However, the contribution can be much higher in developing countries, where fisheries play a more central role in economic development, poverty reduction and food security (often > 5 per cent of GDP in many west African countries; Bene and Heck 2005). Most assessments measure only the value of fish production, but if processing, trade and services are added (these mostly fall in other sectoral accounts), the overall contribution of fisheries can be much higher (WorldFish Center 2011). Estimates of the contribution of capture fisheries to GDP (without any value adding) show exceptionally high contributions for small island states (30 per cent for Seychelles and 15 per cent for Comoros) and above the world average for Mozambique (4 per cent) and Tanzania (2.7 per cent). Contributions to GDP were much lower for Madagascar (1.4 per cent), South Africa (1 per cent) and Kenya (0.5 per cent).

Fisheries governance

Fisheries co-management and the development of co-management institutions is a promising trend in the SW

Indian Ocean region. Beach Management Units (BMU) have recently been established in Kenya and Tanzania to co-manage fisheries within a system with broader stakeholder participation (Oluoch and others, 2009, Japp 2012). Each BMU has jurisdiction over a geographical area that constitutes a fish-landing point, which it manages jointly with fisheries department officials. BMUs are empowered to levy fees against members for services provided, for day-to-day expenses. Although a clear addition to the social structure of fishing communities, it is not yet clear whether BMUs will succeed over the long term. In Mozambique, co-management takes place through Community Fishing Councils (CCPs).

At the international level, SW Indian Ocean countries are signatories to many fisheries agreements, such as the 1982 UN Convention of the Law of the Sea; 1995 FAO Code of Conduct for Responsible Fisheries; 2000 UN Millennium Declaration and Millennium Development Goals; 2002 Johannesburg Declaration on Sustainable Development and Plan of Implementation; 2005 Rome Declaration on Illegal, Unreported and Unregulated (IUU) fishing; and the FAO Ecosystem Approach to Fisheries (EAF). Unfortunately, most countries do not have the capacity or infrastructure to effectively implement the administrative and enforcement tasks brought by these agreements. Most governance issues, at national and regional levels, are explained in Chapter 33 and policy analyses in Chapter 34 of this report.

SOCIO-ECONOMICS OF MARICULTURE

Scale, role in social structure and contribution to livelihoods

Contrary to the global trend in which aquaculture production outstrips that from capture fisheries (FAO 2014), capture fisheries still dominate production in the SW Indian Ocean, with low dependence on mariculture. An exception is seaweed farming in Zanzibar, where the scale, role in social structure, and contributions to livelihoods is substantial. The seaweed sector in Zanzibar has grown continuously since the early 1990s, and now extends over 80 villages, where 23 000 people are involved, of which 90 per cent are women.

About 30 per cent of those directly employed on prawn farms in Madagascar are women who work in the post-harvest operations or administration (FAO 2006). Small-scale seaweed farming in southern Kenya employs

BOX 23.2.**MIGRANT FISHERS – ADAPTING TO A CHANGING ENVIRONMENT**

Fishing boats waiting for the tide in northern Zanzibar, Tanzania. © José Paula.

From time immemorial, migrant fishers along the coast of East Africa have followed fish movements, to increase catches and income. These fishers often cross geopolitical borders, and their movements are highly variable, the duration ranging from a few days to several years. Migrations are seasonal, mostly in synchrony with the milder sea conditions of the North East Monsoon, when sea travel in wooden boats is easier. Fisher migrations can be seen as a social adaptation to a complex environment of fluctuating resource availability. Migrations have social and economic implications for both home and host destinations. Most migrants are young men, leaving behind wives and children. They tend to increase host

populations, placing pressure on village infrastructure and social functioning, through competing for fish resources and market share. Although migrant fishers save part of their earnings to send home, they may also boost host economies through increased clientele for food stuffs, accommodation, provision of social amenities, and increased revenues for Beach Management Units (BMUs) from fish levies, especially in Kenya. On the down side, local fishers may complain that fish markets are flooded with cheap fish, thus reducing the value of their own fish catch. Fisher migrations may in future be affected by shifting fish distribution patterns caused by climate change.

mainly women. Over half of the sea cucumber farmers supported by Blue Ventures in Madagascar are women; they use the income to help pay for their children's school fees and supplement their family's diet (www.blueventures.org). Mariculture therefore contributes to empowering women as owners of farms, or as important actors in the fisheries value chain and marketing; in this way they participate in societal decision-making (Hecht and others, 2006, Wakibia and others, 2011).

Chapter 22 showed that mariculture of most species in the SW Indian Ocean have not progressed past the pilot phase over the past two decades, and apart from the examples above, it only contributes little to livelihoods and economic activity. The lack of growth occurred in spite of technically successful pilot results, and apparently suitable environmental conditions for expansion, such as suitable land and warm productive waters throughout the year. Presumably the constraints imposed

by the remoteness of the region, distance from markets, and absence of infrastructure and technological skills were initially underestimated. These constraints need to be overcome before mariculture can expand in scale and economic impact on a more sustainable basis. Furthermore, full development of mariculture in the SW Indian Ocean will require effective governance and strong support from governments and NGOs (Troell and others, 2011).

Marketing and export

The success of mariculture depends heavily on the availability of markets for its products as well as availability of inputs such as quality fish seed, feed and water. Products are generally perishable and require ice plants, cold storage and suitable transport facilities to ensure their quality at the point of sale. These requirements restrict farms to the vicinity of urban centers. An exception is seaweed,

which can be sold and exported dry.

The seaweed harvest in Zanzibar is dried and sold to buyers (middlemen) who deal directly with processing companies in the US, France, Denmark and Spain (Msuya 2009). The buyers have a monopoly and set low prices for seaweed. Farmers can stockpile dry seaweed to increase the price by restricting supply, but villages depend strongly on the income. Value-adding in Zanzibar through processing has often been mentioned as an option to increase the income from seaweed farming.

The principal fish marketing information services in the region are INFOPECHE (Intergovernmental Organization for Marketing Information and Cooperation Services for Fishery Products in Africa) and COMESA (Common Market for Eastern and Southern Africa). These organizations publish a directory of fish importers and exporters annually. Stringent export requirements make small-scale producers less competitive. To overcome potential marketing hurdles, producer associations can be formed to assist farmers with technical and marketing aspects. One such example is provided by the community-based culture of sea cucumbers in Madagascar, where an established network of business and research partners provide assured access to markets, hatchery technology and supply, and technical expertise (see Chapter 22; www.blueventures.org).

Gaps in capacity to engage in socioeconomic of capture fisheries and mariculture

The most obvious gap is a lack of hard information on the importance of capture fisheries and mariculture to the food security and local economies of households near the coast. There is a lack of alternatives to capture fisheries, even when catches from coastal areas are declining, and the populations are increasing.

A common trend across much of the SW Indian Ocean is to provide better boats and gear to enable artisanal fishers to exploit resources further away from the shore. These policies are, however, being promoted without adequate knowledge of deep-water fisheries. A recent study (Everett and others, 2015) suggested that deep-water crustacean stocks may be smaller than formerly thought in Kenya and Tanzania – it is important to investigate their fisheries potential before overcapitalizing on fishing fleets.

Mariculture, as an alternative to capture fisheries, has not taken root as expected, presumably because of the constraints brought by the remoteness of the region, lack of infrastructure and technical know-how. These limitations can only be overcome through a synchronised effort by governments, private operators, and NGOs. What this synchronised effort should entail, and the capacity necessary to implement it, needs to be determined first.

References

- Bene, C. and Heck, S. (2005). Fisheries and the millennium development goals: solutions for Africa. *Naga, Worldfish Center Quarterly* 28 (3-4), 14-18
- Benkenstein, A. (2013). Small-scale fisheries in Mozambique. *SAIIA Policy briefing* 72, 1-4
- BlueVentures. *Aquaculture - Pioneering viable alternatives to fishing*. <http://www.blueventures.org/conservation/aquaculture.html>
- Department of Fisheries (2012). *Marine waters fisheries frame survey 2012 Report*. Ministry of Fisheries Development. Republic of Kenya
- European Marine Board (2013). *Linking Oceans and Human Health: A Strategic Research Priority for Europe*. Position paper 19 of the European Marine Board. Ostend, Belgium. <http://www.marineboard.eu/images/publications/Oceans%20and%20Human%20Health-214.pdf>
- Everett, B.I. (2014). *Marine and estuarine fisheries along the KwaZulu-Natal coast: An inventory and Brief Description*. Oceanographic Research Institute. Special Publication No. 11. South African Association for Marine Biological Research. Durban
- Everett, B.I., Groeneveld, J.C., Fennessy, S.T., Dias, N., Filipe, O., Zacarias, L., Igulu, M., Kuguru, B., Kimani, E., Munga, C.N., Rabarison, G.A. Razafindrakoto H. and Yemane D. (2015). Composition and abundance of deep-water crustaceans in the Southwest Indian Ocean: Enough to support trawl fisheries? *Ocean Coast. Manage.* 111, 50-61
- FAO (2006). *State of world aquaculture: 2006*. FAO Fisheries Technical Paper. No. 500. FAO, Rome
- FAO (2007a). *Fishery Country Profile - Republic of Kenya*. FAO, Rome

- FAO (2007b). *Fishery Country Profile – The United Republic of Tanzania*. FAO, Rome
- FAO (2014). *The State of World Fisheries and Aquaculture*, Fisheries and Aquaculture Department. FAO, Rome. <http://www.fao.org/3/a-i3720e.pdf>
- Fulanda, B., Munga, C., Ohtomi, J., Osore, M., Mugo, R. and Hossain, M.Y. (2009). The structure and evolution of the coastal migrant fishery of Kenya. *Ocean Coast. Manag.* 52(9), 459-466
- Goble, B.J., van der Elst, R.P. and Oellermann, L.K. (2014). *UguLwethu – Our Coast. A profile of coastal KwaZulu-Natal*. KwaZulu-Natal Department of Agriculture and Environmental Affairs and the Oceanographic Research Institute. Cedara
- Groeneveld, J.C., Fennessy, S.T., Everett, B.I. and Robey, J. (2014). *Rapid Assessment of the state of commercial fisheries and main species exploited in Tanzania*. Specialist Report for World Bank Project Development team; SWIOFish Project. Dar es Salaam, Tanzania
- Instituto Nacional de Estatística (INE). www.ine.gov.mz
- Hecht, T., Moehl, J., Halwart, M. and Subasinghe, R. (2006). *Regional Reviews on Aquaculture Development 4. Sub-Saharan Africa – 2005*. FAO Fisheries Circular No. 1017/4 FIRC/1017/4. Rome
- Japp, D. (2012). *Programme for the implementation of a Regional Fisheries Strategy for the Eastern and Southern Africa and Indian Ocean Region*. Kenya Fisheries Governance. <http://transparentsea.co/images/e/ed/Kenya-fisheries-Governance2011-Smartfish.pdf>
- Jehangeer, I. (2006). Country review: Mauritius. In *Review of the state of world marine capture fisheries management: Indian Ocean* (ed. de Young, C.) FAO Fisheries Technical Paper.No. 488. Rome.
- Jiddawi, N.S. and Öhman, M.C. (2002). Marine fisheries in Tanzania. *AMBIO* 31(7), 518-527
- Mahamoud, K. (2013). *Summary of Fisheries in Comoros*. Ministry of Agriculture, Fisheries, Environment, Industry, Energy and Artisanat. Directorate-General for Fisheries Resources. Comoros.http://www.iotc.org/sites/default/files/documents/2014/04/SWIOFC-IOTC-2014-WoE01-13_-_Comoros.pdf
- Martin, J. (2011). *Fisheries in the Seychelles and fisheries agreements with the EU – Note*. Directorate-General for internal policies of the Union Policy: Department B - Structural and cohesion policies. Brussels. <http://www.europarl.europa.eu/studies>
- Mbendi Information Services. *Marine Fishing in Mozambique*. <http://www.mbendi.com/indy/agff/fish/af/mz/p0005.htm>
- Msuya, F. (2009). *Development of seaweed cultivation in Tanzania: the role of the University of Dar es Salaam and other institutions*. Sustainable Aquaculture Research Networks in sub-Saharan Africa (SARNISSA), EC FP7 Project, University of Stirling, UK <http://aquaculturecompendium.wiki.zoho.com/Case-Studies.htmlf>
- Ochiewo, J. (2004). Changing fisheries practices and their socioeconomic implications in South Coast Kenya. *Ocean Coast. Manag.* 47, 389-408
- Ochiewo, J., de la-Torre Castro, M., Muthama, C., Munyi, F. and Nthuta, J.M. (2010). Socio-economic features of the sea cucumber fishery in southern coast of Kenya. *Ocean Coast. Manag.* 53, 192-202
- Oluoch, S.J., Obura, D.O. and Hussein, A. (2009). The capacity of fisherfolk to implement beach management units in Diani-Chale. In *Advances in coastal ecology: people, processes and ecosystems in Kenya* (eds. Jan Hoorweg & Nyawira Muthiga) 20, 99-110
- Satia, B.P. (2011). *Regional Review on Status and Trends in Aquaculture in sub-Saharan Africa – 2010*. FAO Fisheries and Aquaculture Circular No. 1061/4. Rome
- Soumy, M. (2006). Country review: Madagascar. In *Review of the state of world marine capture fisheries management: Indian Ocean* (ed. de Young, C.) FAO Fisheries Technical Paper. No. 488. Rome
- Troell, M., Hecht, T., Beveridge, M., Stead, S., Bryceson, I., Kautsky, N., Ollevier, F. and Mmochi, A. (2011). Mariculture in the WIO region – Introduction and some perspectives. In *Mariculture in the WIO region “Challenges and Prospects”* (eds. Troell, M., Hecht, T., Beveridge, M., Stead, S., Bryceson, I., Kautsky, N., Ollevier, F. and Mmochi, A.) WIOMSA Book Series No 11. 1-5
- UNDP (2014). *Human Development Report 2014 – Sustaining human progress: Reducing vulnerabilities and building resilience*. United Nations Development Programme. New York
- van der Elst, R., Everett, B., Jiddawi, N., Mwatha, G., Afonso, P.S. and Bouille, D. (2005). Fish, fishers and fisheries of the Western Indian Ocean: their diversity and status. A preliminary assessment. *Philos. T. Roy. Soc. A.* 363 (1826), 263-284
- Wakibia, J.G., Ochiewo, J. and Bolton, J. J. (2011). Economic analysis of *Eucaemoid* algae farming in Kenya. *Western Indian Ocean J. Mar. Sci.* 10(1), 195-212

WIOFISH (2013). *Western Indian Ocean Fisheries Database: A catalogue of small-scale fisheries*. www.wiofish.org, accessed on 7 October 2014

WIOMSA (2011). *Migrant fishers and fishing in the Western Indian Ocean: Socio-economic dynamics and implications*

for management. Final Report of Commissioned Research Project

WorldFish Center (2011). *Aquaculture, Fisheries, Poverty and Food Security*. Working Paper 2011-65. http://www.worldfishcenter.org/resource_centre/WF_2971.pdf



