



PROSPECTS FOR DEVELOPING GREEN AQUACULTURE IN AFRICA:

The promising case of sea cucumbers (Holothurians)

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This note on sea cucumber farming is part of a series to analyze the different forms of green aquaculture, assessing potential environmental, economic, and social benefits. Aquaculture offers advantages on several levels closely aligned to the Bank's strategy. Not only helping to feed Africa, green aquaculture can also contribute to Africa's industrialization, enhance local added value and improve the living conditions of African people by providing livelihoods and the long-term skills to provide resilience. This note is based on the most recent research and proposes recommendations to the Bank's Regional Member Countries to promote this promising sector in Africa.

Slowly growing African aquaculture with strong potential for diversification

According to FAO's latest report on the subject, (FAO, 2020) world aquaculture, or farmed seafood, produced 82.1 million tonnes of aquatic animals in 2018, almost as much as capture fisheries (96.4 million tonnes), and significantly more than the 32.4 million tonnes of aquatic plants. Global aquaculture has been growing at an average annual rate of 5% over the past 20 years and this growth is expected to continue in the coming decades. In several Asian countries and in Egypt, aquaculture has overtaken capture fisheries to be the main production source of aquatic organisms.

In this global dynamic, Africa still occupies only a minor place (Table 1). Indeed, African aquaculture production is a modest 2.3 million tonnes or 2% of world production. African production is dominated by fish farming (2.2 million tonnes or 4% of world production) and Africa accounts for less than 1% in all other forms of aquaculture. According to a recent study (Chan et al., 2019), development prospects are not very optimistic with a production of 4 million tonnes predicted by 2050 if African aquaculture remains dominated by tilapia farming. However, according to the study's authors, rapid diversification into other categories could transform Africa's prospects and enable it to produce up to 15 million tonnes by 2050, which would make a significant contribution to food security and the development of regional and international exports.

TABLE 1. Global production and Africa's share in the different aquaculture categories in 2018 (based on FAO data, 2020).

Aquaculture Production 2018 (1,000 tonnes)	World	Africa	% Africa
Marine Animals	30 756	328	1,1%
• Marine Fishes (including Mulletts)	7 328	316	4,3%
• Marine Crustaceans	5 734	6	0,1%
• Marine Molluscs	17 304	6	0,0%
• Other Marine Invertebrates	390	0	0,0%
Fresh Water Animals	51 339	1 868	3,6%
• Fresh Water Fishes	46 951	1 868	4,0%
• Fresh Water Invertebrates	4 388	0	0,0%
Sub-total Animals	82 095	2 196	2,7%
Aquatic Plants	32 386	112	0,3%
Total	114 481	2 308	2,0%

To ensure this level of diversification, it is necessary to analyze the distribution of forms of aquaculture globally and on the continent. At the global level, the number of farmed organisms is constantly increasing with more than 620 animal species in 2018 (an increase of over 30% since 2006) thanks to extremely dynamic applied research. However, most of this farming still involves freshwater fish, which represent 62% of the global aquaculture production in 2018 compared to 38% for marine organisms. The potential is undoubtedly stronger for marine farming development.

However, some forms of marine aquaculture present significant challenges in technical, environmental and economic terms. This is particularly the case for crustaceans (shrimps) and carnivorous fish (sea bream, sea bass, meagre) which require constant care and expertise to cope with various pathogens and a regular and high-quality external feed¹. It is therefore beneficial to explore lower-risk alternatives among the non-fed species, summarized in Table 2.

- Among aquatic plants, algae (mainly red algae) is really developed only in Tanzania, but it has a very important potential in all the countries bordering the Indian Ocean, the Atlantic coast and the Mediterranean Sea.
- At least two groups of marine fish species can be farmed without being fed: mullet, whose production is traditional in Egypt and reached 210,000 tonnes in 2018, and milkfish (1.3 million tonnes in 2018 globally) where production is still in its infancy and so far limited to Tanzania and Kenya.

¹ According to the FAO, the share of fed-fish farming in the world reached 70% in 2018 but represents 86% of African aquaculture.

- The world production of molluscs reached 17.5 million tonnes in 2018, but farming is mainly restricted to temperate areas, which explains the predominant position of North Africa (for oysters and mussels) and South Africa (for abalones).

A multitude of invertebrate species are the subject of a very strong growth demand, especially in the Asian market. African invertebrate farming today is only concerned with sea cucumbers, or holothurians, but there are other species with further potential including sea urchins, sponges and some corals. In some cases, the farming communities do not traditionally consume these animals themselves, but they can become an important source of export income. In this note, particular attention will be paid to holothurian farming, which is already well developed in some countries, notably in Madagascar and Tanzania and whose potential is currently one of the most promising.

TABLE 2 – Marine aquaculture production in Africa in 2018 by species group (based on FAO data, 2020).

Production (tonnes)	Non-fed Species					Fed Species		Total
	Red & Green Algae	Mullet & Milkfish	Bivalves	Gastropods	Holothurians	Crustaceans	Carnivorous Fishes	
Algeria		11	154				1 882	2 047
Egypt		210 700				155	80 038	290 893
Kenya	400	4						404
Madagascar	5 337				50	4 947		10 334
Morocco	130		356				121	607
Mauritius			18			1	2 048	2 066
Namibia	130		294	5				429
Nigeria						90		90
Senegal	300		530					830
South Africa	1 687		2 648	1 522			0	5 858
Tanzania	104 550	352			13	373		105 286
Tunisia			183			1	20 761	20 945
Total	112 534	211 067	4 203	1 527	63	5 577	104 869	439 839

Current situation and prospects for sea cucumber fisheries and aquaculture

With more than 1,200 species, holothurians exist in all the seas of the world where they play a similar role to that of earthworms in the soil. They are animals with very little mobility that feed on the organic detritus present in sediment, thus facilitating the decomposition of bacteria and the recycling of non-organic nutrients, while helping to limit eutrophication (pollution caused by excessive accumulation of nutrients, mainly nitrogen) and the proliferation of certain microorganisms (competing with corals, for example). These essential functions of holothurians have only recently been well understood (Purcell, 2010), while their abundance is decreasing extremely rapidly, and some twenty species are now considered endangered (IUCN Red List 2013).



FIGURE 1 – (Left) Several species of sea cucumbers and (Right) high quality sea cucumbers in a Hong Kong market. (Source: S. Purcell)

The countries consuming holothurians are mainly Hong Kong, Taiwan, China and Singapore. Holothurians are eaten dried and their price varies, depending on the species, size and quality, from \$30 per kilogram to more than \$3,000 (Figure 1). World trade has grown exponentially from less than 2,000 tonnes of product in the 1980s to more than 20,000 tonnes in the last decade, and is worth more than \$600 million (Figure 2). Africa's share in this trade is around 200 tonnes of dried products in 2018 for a value of \$5.5 million.

This demand has been the driving force behind a multiplication of fisheries throughout the world, first in the countries bordering the Pacific and Indian Oceans, then at the beginning of the 2000s in the Caribbean, and since the

2000s in the Mediterranean and West Africa. At present, sea cucumber fishery occurs in about 80 countries in the world. In almost all countries, overexploitation becomes systematic after only three or four years of fishing, leading to the local extinction of some species. Figure 3 shows that the total catch exceeded 50,000 tonnes in 2018, but the share of each continent reveals the depletion of the resources in Oceania and Asia, while the fishing effort has now shifted elsewhere to North and South America and Europe. Africa is also experiencing a decline in fisheries production from 3,500 tonnes in 2013 to 1,200 tonnes in 2018.

In Africa, three regions are mainly concerned: the Mediterranean, Red Sea and Indian Ocean, although fisheries have recently emerged in West Africa (in Mauritania, Cabo Verde and Senegal). Egypt, where the fishery started in 1996, had to impose a moratorium as early as 2000 due to the disappearance of the resource in the Red Sea, and then in 2003 in the Mediterranean. The same situation prevails in Morocco with a moratorium on fishing and exports in force since 2010. In Tunisia and Algeria, where exploitation started in 2010 and 2013 respectively, the state of the resources is poorly known but there are indications of the beginning of over-exploitation. The situation is also becoming very critical in Mozambique and Madagascar with many populations collapsed. The status of the fisheries is less well documented but also concerning in Tanzania, Kenya, Mauritius and Seychelles (Figure 4).

Sea cucumber fishery management measures are only well developed in a few countries (mainly Australia and Indonesia) and consist of drastically limiting and controlling the number of fishers and the level of catch per fisher. In fact, it has been demonstrated that the safe limit to operate a fishery in a sustainable manner is very low, of the order of a few kilograms of dry weight per hectare per year. This extremely low threshold explains why all the unmanaged commercial fisheries are in a state of over-exploitation. In addition, as soon as the density of a holothurian population falls below 50 individuals per hectare, reproduction becomes impossible and extinction follows rapidly. In this situation, the possibility of farming sea cucumbers appeared as an alternative to commercial fishing but also as a means of repopulating overexploited areas.

FIGURE 2 – Holothurian Global Trade from 1981 to 2018.
(Based on FAO FishStatJ, v2020.1.1)

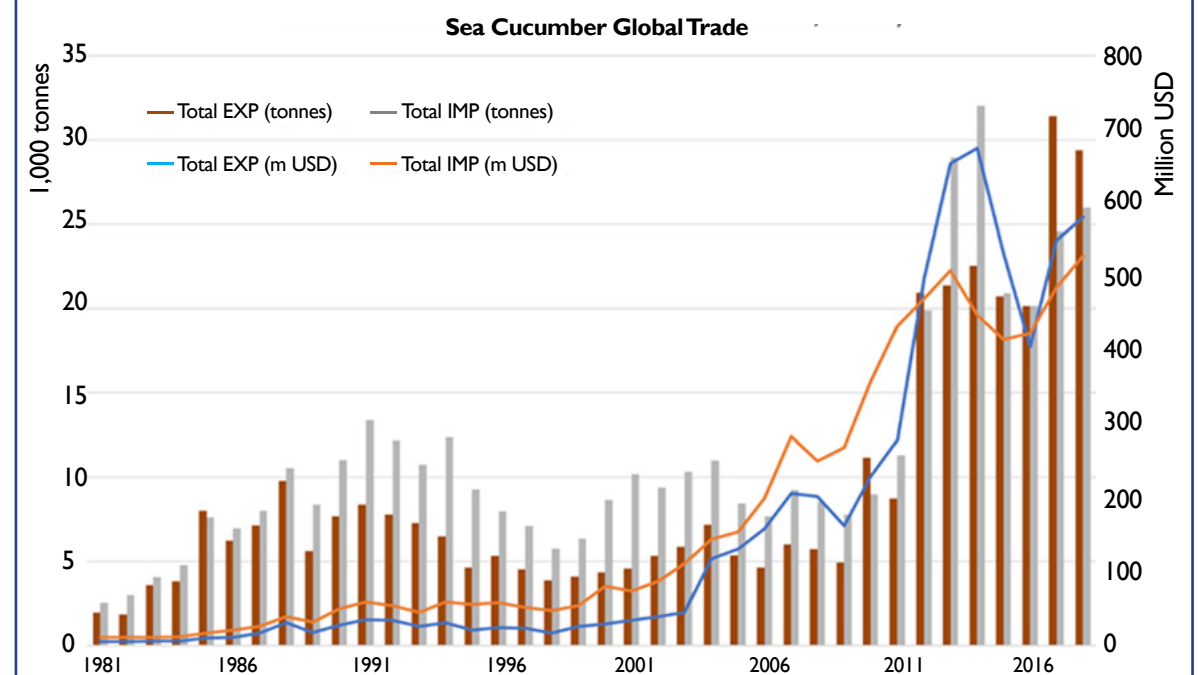


FIGURE 3 – World Production of Holothurians (Capture fisheries and Aquaculture). (Based on FAO FishStatJ, v2020.1.)

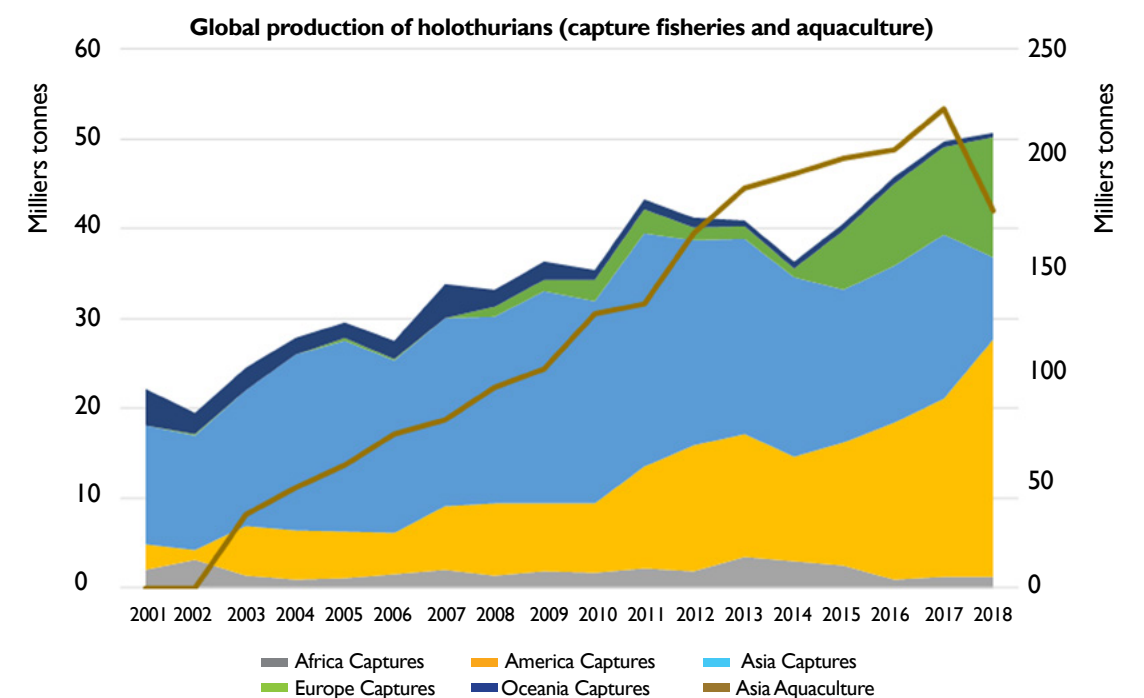
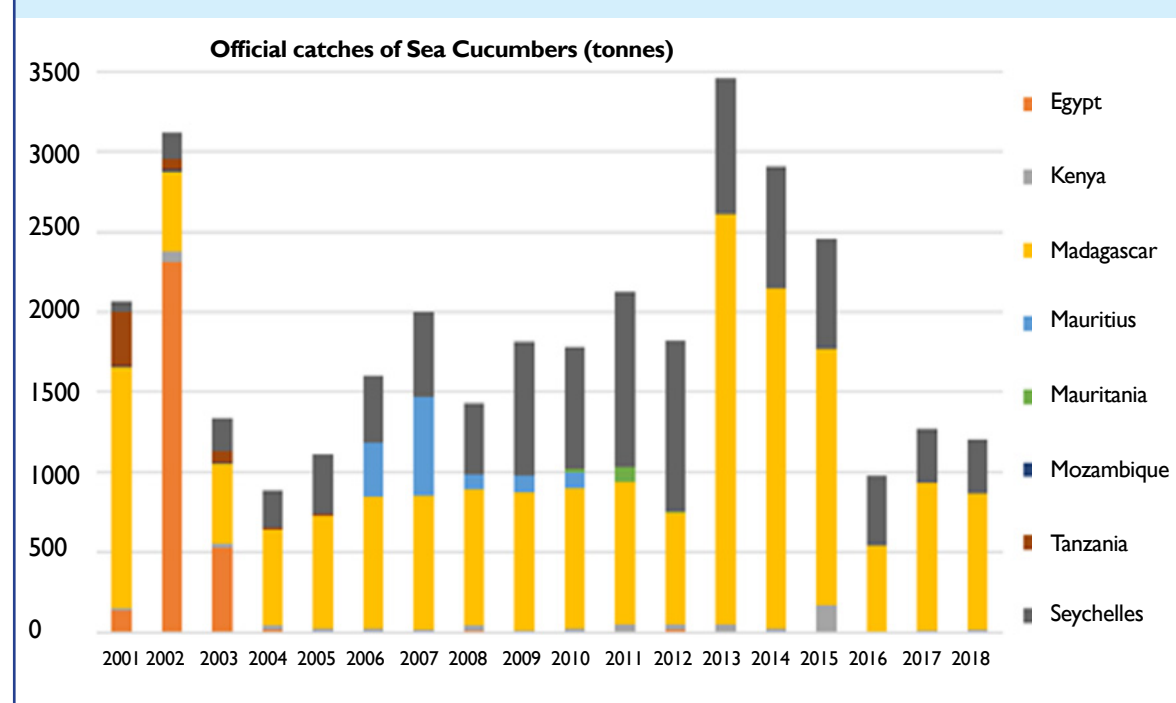


FIGURE 4 – Evolution of sea cucumber catches in the main African producing countries since 2001. (Based on FAO FishStatJ, v2020.1.1)



Sea cucumber aquaculture really started in the early 2000s in China, and this country remains by far the world's leading producer. Aquaculture production has now far exceeded the production levels of capture fisheries, reaching 200,000 tonnes (Figure 3) with an estimated value of more than \$5 billion. This production is 99% focused on a single species, the Japanese sea cucumber (*Apostichopus japonicus*), which lives only in temperate waters. Other species are farmed, but the reproduction techniques are only mastered for one tropical species, the sandfish (*Holothuria scabra*).

In Europe, sea cucumber farming only started in the 2010s and remains very cautious with an estimated production of 2,300 tonnes in 2018. In Africa, production reached 100 tonnes in 2017 and dropped to 63 tonnes in 2018. The main producer is Madagascar, where sea cucumber farming started in the 1990s as part of a partnership originally involving universities and the private sector. The sector is currently made up of two categories of enterprises: a private branch of firms integrating the entire reproduction cycle according to patented processes, and a community branch focusing on the development of juveniles produced in private hatcheries. A small production base has started in Tanzania and a project is currently under way in Mauritius. In North Africa, sea cucumber breeding is still at the experimental stage, particularly in Egypt, Algeria and Tunisia, with prospects that may involve four or five Mediterranean species, suitable both for restocking and commercial production.

Constraints and opportunities for the development of sea cucumber aquaculture in Africa

The constraints mainly concern:

- The technical mastery of the breeding cycles of local species. Indeed, apart from *Holothuria scabra* (sandfish), reproduction (whether sexual or asexual) is not totally controlled for the other important species from the Indian Ocean area and the Mediterranean.
- The overexploitation of wild populations which may prevent the availability of broodstock and juveniles in the wild for species whose reproduction is not well managed.
- Farm security, guarding against theft and predation which has emerged as a problem in some farms managed by rural communities.
- Process control to ensure the highest possible market value for the production.
- The lack of policy support to promote aquaculture is also a hindrance to public and private investment in many countries.

Among the most important opportunities are the following:

- The considerable demand from the Asian market for tropical species (whose prices can exceed \$1,000/kg for *Holothuria scabra* for example) is an important potential source of income for exporting countries.
- The possibility of restoring overexploited populations and the natural ecological services provided by holothurians, especially in areas important for fishing and in coral reefs.
- The pipeline of regular significant income for coastal communities, which could be especially helpful for women and young people, through an activity with low barriers to entry and very high value-added processing.
- Significant prospects for public-private partnerships to master the reproduction techniques of new species and develop efficient hatcheries.
- Encouraging prospects for the further development of integrated aquaculture, consisting of simultaneously raising sea cucumbers and other organisms, each facilitating the growth of the others and protecting them against certain risks of pathology. This approach safeguards against the risks associated with a drop in sea cucumber prices and offers diversified income streams for farmers.

Conclusions and Recommendations

Holothurians are little-known marine organisms that play an essential role in coastal ecosystems. Demand from the Asian market has led to the over-exploitation of several species in all regions of the world. Today, sea cucumber farming is emerging as a very promising sector of green aquaculture, particularly in North and East Africa, where it can provide a predictable income-generating activity for fragile fisheries-dependent communities and contribute to the restoration of ecosystems. To encourage the development of this activity, the following recommendations would support coastal countries to maximize the opportunities from this resource.

- Coastal countries with sea cucumber resources should formulate supporting fisheries management policies taking into account the ecosystem protection approach defined by FAO in order to preserve sea cucumber populations and strengthen ecosystem resilience.
- Measures should be taken to avoid the perils of population collapse seen in other regions by ensuring that sea cucumber populations are not depleted by over-fishing, including the development of strong measures to combat illegal, unreported and unregulated fishing. Where appropriate, moratoria on exploitation and trade should be established and programs to restock overexploited populations should be developed.
- Countries with favorable natural conditions should actively engage in the development of green forms of aquaculture, i.e. those with a triple positive impact on the environment, society and the economy. Among these forms of aquaculture, sea cucumber farming has the greatest number of comparative advantages.
- The countries concerned should create the legal and regulatory conditions to enable an incentivized environment for public-private partnerships to engage in long-term research and development programs on sea cucumber aquaculture. This could include objectives to diversify the types of production, increase the added value of the products and provide technical services to the communities and SMEs involved. Support for technical innovations should be provided, including the protection of intellectual property.
- SMEs and communities involved in sea cucumber aquaculture should benefit from favorable conditions, including security of land (maritime concessions), their facilities and products. Support should also be provided for the promotion of products and their access to the most remunerative markets.

References

- Chan, C.Y.; N. Tran; S. Pethiyagoda; Ch.C. Crissman; T.B. Sulser; M.J. Phillips. 2019. Prospects and challenges of fish for food security in Africa. *Global Food Security* 20 (2019) 17–25. <https://doi.org/10.1016/j.gfs.2018.12.002>
- De San, M. 2018. (mimeo) *Aquaculture verte dans la région du sud-ouest de l’Océan Indien : repères historiques et perspectives*
- Drakeford, B.M. ; P. Failler; A. Nunes; M. Hossain; P.T. Van; Y. Xinhua; F. Ayson; P. Marinda; B. Nyandat. 2020. On the relationship between aquaculture and food security: Why does aquaculture contribute more in some developing countries than it does in others? *International Journal of Fisheries and Aquatic Studies* 2020; 8(4):12-17
- FAO. 2020. *La situation mondiale des pêches et de l’aquaculture 2020. La durabilité en action*. Rome. <https://doi.org/10.4060/ca9229fr>
- Han, Q. ; J.K. Keesing and D. Liu. 2016. A Review of Sea Cucumber Aquaculture, Ranching, and Stock Enhancement in China. *Reviews in Fisheries Science & Aquaculture*. 2016, Vol.24, NO.4, 326–341. <http://dx.doi.org/10.1080/23308249.2016.1193472>
- Kara, M.H.; D. Lacroix; S. Sadek ; J.P. Blancheton ; H. Rey-Valette and M. Kraiem. 2016. *Vingt ans d’aquaculture en Afrique du Nord: évolutions, bilan critique et avenir*. *Cah. Agric.* 2016, 25, 64004. DOI: 10.1051/cagri/2016044
- Purcell, S.W. 2010. *Managing sea cucumber fisheries with an ecosystem approach*. Edited/compiled by Lovatelli, A.; M. Vasconcellos and Y. Yimin. FAO Fisheries and Aquaculture Technical Paper. No. 520. Rome, FAO. 2010. 157p
- Purcell, S.W.; D.H. Williamson and P. Ngaluafe. 2018. Chinese market prices of beche-de-mer: Implications for fisheries and aquaculture. *Marine Policy* 91 (2018) 58–65. <https://doi.org/10.1016/j.marpol.2018.02.005>
- Robinson, G. 2018. (mimeo) *Holothurian resource management in Northern Africa and the potential for sustainable aquaculture development*
- SADC. 2020. *Profiling the SADC Aquaculture Value Chains*. Southern African Development Community (SADC) Secretariat & Advance Africa Management Services



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