

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

4,800

Open access books available

122,000

International authors and editors

135M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.

For more information visit www.intechopen.com



The Role of International Donors in Aquaculture Development in Africa

Olufemi Julius Olapade

Abstract

Aquaculture, one of the fastest food production sectors in the world, has received and continues to receive funding from international donors and funding agencies since its introduction in Africa. The sector plays a key role in many emerging economies because of its potential to contribute to increased food production and at the same time help reduce pressure on fish resources. In spite of huge natural resources and a high demand for fish and fishery products, aquaculture production in Africa has yet to catch up with major players globally. Increased aquaculture production is hoped will greatly complement current efforts aimed at achieving the United Nations Millennium Development Goals (MDGs), especially the eradication of extreme poverty and hunger, reduction in child mortality, improvement of maternal health, prevention of diseases, promotion of gender equity and women empowerment. Africa however is the only region of the world where the present level of per capita fish consumption has declined over the past decades as populations grow. Researchers have adduced reasons for the setback to the development of Africa aquaculture. The unanswered question however is “Has donors’ support further the course of aquaculture development in Africa?”

Keywords: aquaculture, sub-Sahara Africa, farmers, international donors, constraints

1. Introduction

The aquaculture sector perceived as supplementary or alternative economic activity to the capture fishery is fast gaining ground globally [1]. It is the fastest-growing food-producing sector in the world [1]. The sector has a potential of relieving the pressure on fish stocks, as well as filling the increasing supply–demand gap for marine fishes [2]. Aquaculture, the culture of aquatic animals and plants in fresh, brackish, and marine environments [3], plays major roles in providing food, employment, and foreign exchange earnings. Pillay [4] noted that aquaculture has potential to increase rural employment and improve the nutrition and income of rural population, especially in developing countries. Besides, the sector is expected to continue to strengthen its role in contributing to food security and poverty alleviation in many developing countries [5]. Development agencies world over have muted aquaculture integrated with agriculture (crop and animal farming) as the rational option for the development of poor economies, especially the third-world

economy. The Code of Conduct for Responsible Fisheries (CCRF) muted aquaculture as a means to promoting the diversification of income and diet [6]. Other important factor that is drawing attention to aquatic farming is the need to achieve greater self-reliance in food production and greater balance of international trade. Declining catches from capture fisheries and the increasing demand for fish and fishery products lend clarion call for the urgent need to develop the aquaculture sector. The sector production potential is however huge and its capacity to contribute to increase in world's production of aquatic food is enormous and incontrovertible [5]. This production potential was evident in 2002 when fishfood production (fish, mollusks, and crustacean) yielded 36 million tonnes and production from aquatic plants gave 10 million tonnes [7] (**Figure 1**).

The top six major aquaculture producers are from Asia with China leading the pack in global aquaculture production. Production of fishfood including plants from low-income food deficient countries (LIFDCs) is greater than or equal to 38 million tonnes and production from these countries has been growing at an average compound rate of 9.2% since 1970. This reported growth rate compares significantly with the 1.4% for capture fisheries and 2.8% for terrestrial farmed production systems [1].

On the global scale, especially between 1991 and 2000, according to FAO [7], fishfood production from aquaculture increased by a factor of 2.5%. It is anticipated that the percentage increase will be furthered with the right environment and financing. Bolton [8] observed that only 550,000 tonnes of aquatic animals were grown in 2014 in sub-Saharan Africa. This production comprised of freshwater fish, mainly catfish, Tilapia and Nile Perch, which according to Bolton [8] is less than 1% of the world production. The leading freshwater fishfood producers in the region are Nigeria and Uganda [8].



Figure 1.
A typical international donor-funded rural poor intervention in Sierra Leone.

It is important to mention that in spite of Africa's natural endowment, her per capita fish consumption has dropped to almost half of the global average. Aquaculture provides only 2% of the region's supply and makes only a minor contribution to economic growth, employment, and foreign exchange. Realizing the role of aquaculture as an engine for improved food security and economic growth in Africa, FAO Committee on Fisheries (COFI) placed high priority on it as an investment area. Investment in aquaculture in sub-Saharan Africa has even become more attractive because of the development of domestic and export markets for fish, changing macroeconomic environments, and the stagnation of inland capture fisheries. As people become more aware of the benefits inherent in investing in aquaculture, private investment in commercial fish farming is on the increase in a number of African countries namely, Nigeria, South Africa, Kenya, Malawi, Namibia, Zimbabwe, and Egypt.

In a bid to further the development of aquaculture in Africa, FAO introduced an innovative program tagged—the Special Programme for Aquaculture Development in Africa (SPADA). The program among its many objectives aims to provide assistance to African countries to enhance aquaculture production, facilitate producers' access to financial services and markets, promote user-friendly regulatory frameworks, boost investment in aquaculture as well as exchange of knowledge. The program's agenda is in line with the priorities set by The New Partnership for Africa's Development (NEPAD) Action Plan for the Development of African Fisheries and Aquaculture. It is unarguable that investment in African fisheries and aquaculture has been remarkably low. Therefore, if fisheries and aquaculture are to meet expected economic and social benefits, meet the challenges of technological change, institutional reforms, and resource mobilization needed in support of the sector's development potential, there is the need for all concerned with the development of the sector to make the case for investment within the context of wider socioeconomic development. The objective of this chapter is to provide an overview of aquaculture production in the subregion and to evaluate the roles of international donors against the backdrop of aquaculture development in sub-Saharan Africa.

1.1 Trend in global aquaculture production

The global growth rate of aquaculture for more than 50 years has been dynamic and encouraging. Its average annual growth rate between 1970 and 2000 was 9.2%, compared to only 2.8% for terrestrial farmed meat production systems [1]. Freshwater fish farming is on the increase globally for the production of fishfood [7]. The story is not different from what is obtained from the marine waters. Fishfood production from the marine waters has increased from 32% in 1991 to 36% in 2000. Production from the marine and brackishwater represents a higher proportion of the global total value of aquaculture than in freshwater (54% in 1991 and 51% in 2000). Of the total foodfish produced from marine and brackishwater in 2000, 81% was from Asia, while 11% was produced in Europe. The value of 35.6 million tonnes of fishfood (fish, crustaceans, and mollusks) produced in 2000 was estimated to be US\$ 51 billion. Significant proportion of the production (89%) valued at US\$ 40.8 billion was produced by Asian farmers. This was an indication that Asia appears to be dominating aquaculture production globally [7] (**Table 1**).

Global foodfish production from aquaculture in 2016 witnessed a meteoric increase from 25.7 to 46.8%. Aquaculture production (aquatic plants included) in 2016 was 110.2 million tonnes, valued at estimated US\$ 243.5 billion. This production statistics comprise of 80.0 million tonnes of foodfish valued at

Region/selected countries	1995	2000	2005	2010	2015	2016
Africa	110	400	646	1286	1772	1982
	0.5%	1.2%	1.5%	2.2%	2.3%	2.5%
Egypt	72	340	540	920	1175	1371
	0.3%	1.1%	1.2%	1.6%	1.5%	1.7%
Northern Africa, excluding Egypt	4	5	7	10	21	23
	0%	0%	0%	0%	0%	0%
Nigeria	17	26	56	201	317	307
	0.1%	0.1%	0.1%	0.3%	0.4%	0.4%
Sub-Sahara Africa, Excluding Nigeria	17	29	43	156	259	281
	0.1%	0.1%	0.1%	0.3%	0.3%	0.4%
Americas	920	1423	2177	2514	3274	3348
	3.8%	4.4%	4.9%	4.3%	4.3%	4.2%
Chile	157	392	724	701	1046	1035
	0.6%	1.2%	1.6%	1.2%	1.4%	1.3%
Rest of Latin America and the Caribbean	284	447	785	1154	1615	1667
	1.2%	1.4%	1.8%	2.0%	2.1%	2.1%
North America	479	585	669	659	613	645
	2.0%	1.8%	1.5%	1.1%	0.8%	0.8%
Asia	21,678	28,423	39,188	52,452	67,881	71,546
	88.9%	87.7%	88.5%	81.0%	89.3%	89.4%
China mainland	15,856	21,522	28,121	36,734	47,053	40,244
	65.0%	66.4%	63.5%	62.3%	61.9%	61.5%
India	1659	1943	2967	3786	5260	5700
	6.8%	6.0%	6.7%	6.4%	6.9%	7.1%
Indonesia	641	789	1197	2305	4343	4950
	2.6%	2.4%	2.7%	3.9%	5.7%	6.2%
Vietnam	381	499	1437	2683	3438	3625
	1.6%	1.5%	3.2%	4.6%	4.5%	4.5%
Bangladesh	317	657	882	1309	2060	2204
	1.3%	2.0%	2.0%	2.2%	2.7%	2.8%
Rest of Asia	2824	3014	4584	5636	5726	5824
	11.6%	9.3%	10.4%	9.6%	7.5%	7.3%
Europe	1581	2051	2135	2523	2941	2945
	6.5%	6.3%	4.8%	4.3%	3.9%	3.7%
Norway	278	491	662	1020	1381	1326
	1.1%	1.5%	1.5%	1.7%	1.8%	1.7%
EU-28	1183	1403	1272	1263	1264	1292
	4.9%	4.3%	2.9%	2.1%	1.7%	1.6%

Region/selected countries	1995	2000	2005	2010	2015	2016
Rest of Europe	121	157	201	240	297	327
	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%
Oceania	94	122	152	187	186	210
	0.4%	0.4%	0.3%	0.3%	0.2%	0.3%
World	24,383	32,418	44,298	58,962	76,054	80,031

Table 1.
Aquaculture food fish production by region and selected major (1995–2016) producers (thousand tonnes; percentage of world total).

US\$ 231.6 billion and 30.1 million tonnes of aquatic plants valued at US\$ 11.7 billion, in addition was 37,900 tonnes of non-food products valued at US\$ 214.6 million. Production statistics from farmed food fish was 54.1 million tonnes of finfish (USD 138.5 billion), 17.1 million tonnes of mollusks (USD 29.2 billion), 7.9 million tonnes of crustaceans (USD 57.1 billion), and 938,500 tonnes of other aquatic animals (USD 6.8 billion) such as turtles, sea cucumbers, sea urchins, frogs, and edible jellyfish. The aquatic plants captured in the production data compose mainly seaweeds and some volume of microalgae while the non-food products were mainly ornamental shells and pearls. The production statistics presented in this review are incomplete, as about 35–40% of the producing countries did not report to FAO and this has made it impossible to present a more detailed information on the status and development trends of world aquaculture. Information presented in this review was based on the data FAO received from 120 nations in 2016. This data represent 84.3% (67.5 million tonnes, aquatic plants excluded) of foodfish produced by volume globally; this includes production from China. According to FAO, production figure for the non-reporting countries was estimated at 15.1% (12.1 million tonnes) of the total production in 2016.

Inland, marine, and coastal waters contribute significantly to global aquaculture production volumes. Inland fish farming, which is practiced in freshwater environment using different culture facilities, was the source of 51.4 million tonnes (64.2%) of the world's farmed foodfish production—the 2016 production was higher than the 57.9% reported for 2000. Finfish farming still dominates inland aquaculture, accounting for 92.5% (47.5 million tonnes) of total production from inland aquaculture. This production has however dropped when compared to 97.2% reported in 2000; this is believed to be caused by high interest in the farming of other species such as shrimps, crayfish, and crabs by farmers in Asia. Most of the data obtained from several major producing countries in East and Southeast Asia are for finfish farmed in marine cages and coastal ponds. Asia is the most productive continent in marine and brackishwater environment (12.2 million tonnes) and China was the highest producing country in the continent producing 9.4 million tonnes in total production. The annual average rate of growth in the production of food fish in marine waters between 1991 and 2000 was 12.6% and this was greater than what was obtained in other environments. The growth rate in the brackishwater was much less at 4.2%. For mariculture and coastal aquaculture combined, FAO reported 28.7 million tonnes of fishfood valued at US\$ 67.4 billion in 2016.

In sharp contrast to the dominance of finfish in inland aquaculture, shelled mollusks (16.9 million tonnes) constitute 58.8% of the combined production of marine

and coastal aquaculture. Finfish (6.6 million tonnes) and crustaceans (4.8 million tonnes) together were responsible for 39.9%.

2. Overview of aquaculture development in Africa

Brummett et al. [9] enunciated briefly the history of aquaculture as a baby born in due time by the then colonial masters who conceived it as a viable means of food production. The history of the development of aquaculture in Africa dated back to the 1940s and 1950s when the colonial masters first introduced it, and since then it has come a long way [10]. Culture of indigenous species dominated the initial efforts of the colonial lords and appropriate culture technology was equally introduced through basic research as a way of entrenching aquaculture in Africa. The gains of the early investment especially with respect to the ponds and research stations established in many African countries during the initial investment periods were soon abandoned when African government's attention and interest shifted to the development of other sectoral priorities. These discouraging scenarios however did not alter the development of the perceived potential of aquaculture in Africa. This was evidenced by its adoption between the 1970s and 1990s by a number of international donor agencies as a tool in rural food security and economic development. The development of the sector was consequently according to Pillay [11] taking over from government by the donors. The actual culture attempt in Africa was the successful trial of Tilapia in the Democratic Republic of Congo in 1946 [12]. The success of the project stimulated high interest in aquaculture and this no doubt led to the establishment of about 300,000 production ponds in many African countries by the close of the 1950s [13]. In addition, a handful of aquaculture projects were also introduced in the 1970s and 1980s. The aim of the projects was to grow fish to close the supply gap with farm-raised fish and/or bolster sagging economies with high-value aquaculture products. The promotion of aquaculture in the early 1980s within the context of integrated aquaculture to address sociocultural and economic issues by some international development agencies and advanced research institutes has resulted in sustained aquaculture growth in handful of African countries, such as Côte d'Ivoire, Egypt, Ghana, Malaŵi, Nigeria, and Zambia. Effort in this direction is contributing significantly to boost the growth of the sector. The dwindling catches from inland capture fisheries in sub-Saharan Africa and the development of domestic and export markets for fish has made investment in aquaculture attractive.

Countries like Côte d'Ivoire, Madagascar, Malawi, Nigeria, and Zambia now have well-established aquaculture programs for the promotion of investment in aquaculture. Investment in commercial aquaculture by individuals has been reported in Egypt, Kenya, Namibia, Nigeria, Malaŵi, South Africa, and Zimbabwe (**Table 2**). South Africa is unarguably the leading country in mariculture in Africa. It is important to note that although the growth of aquaculture in Africa is encouraging, when it is compared to the rest of the world, production from the region is still insignificant. According to FAO [14], the production from Africa is only about 0.9% (404,571 tonnes) of the global aquaculture production. Growth in the sector in terms of aquaculture expansion, increases in production, and income generation has been disappointing. The aquaculture in sub-Saharan Africa has been constrained by a number of problems ranging from reduced access to capital and markets, inadequacy of good feed and seeds, and reduced access to good-quality information or appropriate technologies. Consequently, for African aquaculture to meet its anticipated potential and compete well with production from countries like China, the bottlenecks constraining its development need to be removed as a matter of urgency.

Country	2008	2009	2010	2011	2012	2013	2014
Nigeria	143,207	152,796	200,535	221,128	253,898	278,706	313,231
Uganda	52,250	76,654	95,000	85,713	95,906	98,063	111,023
Ghana	5594	7154	10,200	19,092	27,450	32,513	38,545
Kenya	4452	4895	12,154	22,135	21,488	23,501	24,098
Zambia	5640	8505	10,290	10,530	12,988	20,271	19,281
Madagascar	10,836	6116	6886	8845	8585	8974	8470
South Africa	3587	3433	3133	3572	3999	4010	4160
Other	14,001	14,426	17,917	24,898	28,380	33,683	38,142
Total	239,567	273,979	356,115	395,913	452,697	499,721	556,950

Table 2.
Top seven aquaculture producers in sub-Saharan Africa from 2008 to 2014 by quantity (in tonnes) [15, 16].

2.1 Constraints of aquaculture in Africa

Aquaculture has a huge potential to grow in sub-Saharan Africa. The rural economy of most African countries hinges on subsistence cropping and extensive livestock grazing and this according to experts augurs well for the development of aquaculture in the region. Aquaculture as an agricultural activity must necessarily compete with other crops for basic inputs such as land, water, and nutrient and as such, its growth is dependent on its ability to compete and meet related challenges. These related challenges have made the sector to underperform over years despite the quantum of money invested by private operators and international donors. In addition, since most of the farmers operate small-scale aquaculture enterprises, there is the need to carry out an assessment of their needs, priority, and aspirations. The poor performance of the sector has also been linked to the lack of proper understanding of existing challenges in the sector, which are presumed to be location and agroecology specific. According to Brummett et al. [9], the food security and economic growth benefits of aquaculture can only be fully realized if the challenges confronting the sector are addressed and nipped. These challenges, Brummett et al. [9] noted, are not different from those facing other commercial enterprises. Satia [13], Coche [16], Costa-Pierce [17], and Coche and Pedini [18] elaborated on key constraints of the African aquaculture sector. Coche et al., [19], Williams [20], UNDP [21], and Lazard et al. [22] identified poor infrastructure, volatile prices of essential inputs, political instability, and lack of the necessary R&D to backstop industrial growth as challenges respectively. Hetch [23] and Masser [24] jointly identified poor market development as one of the key constraints of the sector. Other key constraints identified by CIFA/OP24 [26] as presented by Brummett et al. [9] include unavailability of good-quality fingerlings for stocking; unavailability of complete feeds; inadequate access to technical information; lack of marketing infrastructure, information, and organization; and inappropriate policies. These are however not quite different from what previous researchers in the field had elaborated, especially the ones compiled by the Africa Regional Aquaculture Review Meeting [28] (**Table 3**). Experiences gathered from different projects in some African countries clearly showed that improper alignment of internationally funded projects to local needs and ecology, government bureaucracies, and misapplication of grants by beneficiaries are issues that require serious attention if African aquaculture is to emerge from the woods. Other important issues to contend against are the rashness and hastiness of donors to achieve results not minding the sustainability factor and the expected long-term impact of the intervention. It is also important to mention here that significant portion of funds earmarked

Issue	Category		Researchers
	Small-scale system	Medium and large systems	
Policy	Lack of clear policy	Lack of clear policy	[27]
Government support	Poor	Poor	[27]
Research and extension linkages	Weak	Weak or nonexistent	[27]
Research and development linkages	Weak	Weak or nonexistent	[23]
Technical support	Often inappropriate, lack of flexibility	Inadequate	[27]
Donor support	Donor dependence	Little provided to date	[27]
Infrastructure	Poor or nonexistent	Generally poor and often inadequate	[20]
Prices of essential inputs	Lacking, or volatile prices	Volatile	[2]
Political instability	Capable of disrupting investment	Capable of disrupting investment	[22]
Credit availability	Generally not available and needs questionable	Necessary but often unavailable, or difficult to access	[27]
Market development	Poor or nonexistent	Poor or nonexistent	[24, 25]
Seed supply	Insufficient and often dependent on public sector, little selection practiced	Generally provided on farm, monosex or hybridization practiced by some farmers	[27]
Feed supply	Frequently inadequate (in quality and or quantity) supplemental feeds	Generally provided on farm, complete feed preferred	[27]
Extension systems	Lack of farmer participation, inadequate support, few technicians	Often neglect larger producers	[27]
Data collection	Poor and often unreliable, farms dispersed, often isolated	On-farm data generally collected but sometimes inaccessible	[27]
Information management	Networking practically nonexistent, group formation desirable but often inadequate	Poor information exchange and communications	[27]

Table 3.
Constraints of small-scale, medium, and large-scale aquaculture.

for project implementation in Africa are often spent to hire foreign experts who at times are not better than local experts who could be cheaply hired. These situations do not augur well for the development of aquaculture in sub-Saharan Africa.

2.2 International donors' contribution to African aquaculture development

The pace of the development of aquaculture in Africa is still slow despite the huge amount of money that has been invested by international donors and

development agencies over the past 40 years. The sector has failed to realize its expected potential of enhanced food security and engender economic growth predicted by development agencies. Weak institutional arrangement and donor-driven projects were presumed responsible for the slow growth rate of the sector. Brummett et al. ([9], p. 373) already asked the all-important question, “Who is in charge of supporting African aquaculture?;” and the next important question to ask is “Why the failure of the African aquaculture sector and what is or are the actual role(s) of international donors and funding agencies?”

Total external assistance to aquaculture development between 1978 and 1983 is estimated at \$368 million [27]. Josupeit [27] noted that \$190 million (52%) of the fund originated from the three major international development banks including World Bank, ADB, and IADB. Development assistance to aquaculture in this period increased from 8.5 to 17.5% of the total allocated to the fisheries sector. Between 1978 and 1984, Hecht [23] reported that African aquaculture received some \$72.5 million while Asia and the Pacific received in the same period \$171.3 million, which was almost three times of what Africa received. Asian countries in the reporting period utilized the fund received to produce 1000 times more fish than Africa. The reason behind the disparity in volume produced was obvious. Between 1987 and 1997, global investment in aquaculture was estimated at \$75 billion, and between 1974 and 2006, the combined World Bank Group (which include the IFC) investment in aquaculture-related projects was about \$1 billion. One example of the funding for aquaculture made by IFC is presented in **Table 4**.

Moehl et al. [25] opined that money received by most of the African countries from international donors and funding agencies was invested in nonperforming infrastructure like the establishment of hatcheries and government stations; for instance, the establishment of the African Regional Aquaculture Centre (ARAC) in Port Harcourt, Nigeria and the Central Laboratory for Aquaculture Research (CLAR) in Abbassa, Egypt. Many other gargantuan aquaculture facilities’ installation failed just as others previously mentioned. The failure of these facilities to produce positive or sustainable outcomes according to Moehl et al. [25] is an indication of how poorly aquaculture has been managed in Africa.

Government fish farms established in many African countries with international donors’ support during the 1960s and 1970 and even after are in bad shapes and operating below capacity. Poor site selection probably motivated by political concerns, lackluster project design, and inability of government to maintain and continue with the farm operations after the exit of the external donors are some of the perceived problems of aquaculture in Africa. The roles of African government in aquaculture development have been discussed extensively by many researchers and organizations like FAO, but it appears government has rescinded its oversight function roles and limited itself to the vague role of creating a conducive environment for fish production as a means of achieving food security and poverty alleviation. This conducive environment has become so conducive for foreign donors and development agencies

Region	IFC loans (US\$ millions)	Percent	Number of loans
Africa	6.4	9	1
Asia	45.0	63	1
Latin America	20.0	28	3
Total	71.4	100	All shrimp culture projects

Table 4.
Recent IFC aquaculture loans by region [28].

who so to say exploit it to intervene on government's behalf. The donors use the open window to advantage to establish criteria and objectives they deem fit for achieving anticipated rapid gains against rural poverty and hunger. The role of international donors and development agencies appears to hinge more on technology transfer and capacity building that are not compatible with local needs and traditional experiences of the beneficiaries. Instead of promoting in funded projects the development of value chains and sustainable support systems (extension and credit), emphasis is placed on the promotion of technologies that require inputs (labor, feed, and fertilizers) that are probably not locally available and that are often prohibitive where they are available and beyond the means of the beneficiaries. Delgado et al. [29] suggested the replacement of foreign donor priorities (e.g., poverty alleviation among the poorest of the poor; cheap food for low-income urban consumers) with those of local decision-makers and farmers. Delgado et al. [29] pointed out that a supply-side with emphasis on aquaculture as a commercial venture (at a variety of scales and intensities) will serve to generate income and create secondary business opportunities and generalized economic growth.

3. Conclusion

Aquaculture has a big future in Africa that could well surpass the achievement of the Asian countries provided the right investment options and technologies are made available. The expectation from the sector, as a growing food production enterprise is, great. Importantly, the sector is expected to bridge the gap between fish supply from capture fisheries and the demand for fish by the rising African population. Increase in population and acute competition for resources and the need for food security is making it imperative for aquaculture to fulfill its long-foreseen role as an important contributor to increased nutritional and economic well-being. It is equally important to mention that Africa has substantial market to satisfy; this coupled with available abundant water and land resources that could enhance production is a tempting incentive. The expectation from the sector will however be a mere daydreaming if aquaculture development is not redirected and refocused. To achieve the role of aquaculture, African government has critical roles to play with respect to the formulation of policies that are pro-aquaculture and creation of good financial environment for would-be investor in the sector. The government is well aware of the challenges facing the sector and these challenges need to be addressed adequately if the sector is to go forward. Public sector is encouraged to complement the efforts of international donors and development agencies by devoting more resources to policy research for the facilitation and promotion of aquaculture. There is also the need for public sector agencies to improve on their investment in aquaculture research and education. International donors and development agencies' role should not be limited to that of hiring foreign consultants, technology transfer, and capacity building, but they should team up with host government to develop innovative financial models that favor sustainable aquaculture enterprises. Innovative financial models will help to fill the gap between traditional banking and grant-based donor finance.

Acknowledgements

The author acknowledges with thanks the various authors and books consulted in the course of drafting of this review work.

Conflict of interest

The author has no conflict of interest to declare. All citation used in the review have been duly referenced and author(s) of the work have been acknowledged for excerpting materials from their publications.

IntechOpen

IntechOpen

Author details

Olufemi Julius Olapade
Department of Aquaculture and Fisheries Management, School of Natural
Resources Management, Njala University, Sierra Leone

*Address all correspondence to: fem66@hotmail.com; ojulius@njala.edu.sl

IntechOpen

© 2020 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

References

- [1] FAO. Report of the first session of the Sub-Committee on Aquaculture, 18-22 April 2002, Beijing, People's Republic of China. In: FAO Fisheries Report No. 674. Rome, Italy: FAO; 2002. p. 66
- [2] Williams MJ. The transition in the contribution of living aquatic resources to food security. In: Food, Agricultural Environment Discussion Paper. Washington, DC, USA: International Food Policy Research Institute; 1996
- [3] Pillay TVR, Kutty MN. Aquaculture Principles and Practices. 2nd ed. Oxford, UK: Blackwell Publishing Ltd.; 2005. p. 640
- [4] Pillay TVR. Aquaculture: Principles and Practices. Fishing News Books. USA: Blackwell Scientific Publication Ltd; 1993. pp. 92-155
- [5] FAO. Aquaculture development. In: FAO Technical Guidelines for Responsible Fisheries No. 5. Rome, Italy: FAO; 1997
- [6] FAO. Code of Conduct for Responsible Fisheries. Rome, Italy: FAO; 1995. p. 41
- [7] FAO. Aquaculture development and management: Status, issues, and prospects. In: COFI:AQ/I/2002/2. Rome, Italy: FAO; 2002. p. 13
- [8] Bolton J. Aquaculture in sub-Saharan Africa: Small successes, bigger prospects? 2017. Retrieved from: <https://theconversation.com/aquaculture-in-sub-saharan-africa-small-successes-bigger-prospects-78861>
- [9] Brummett RE, Lazard J, Moehl J. African aquaculture: Realizing the potential. Food Policy. 2008;33:37-385. Available from: www.elsevier.com/locate/foodpol
- [10] Jamu DM, Ayinla OA. Potential for the development of aquaculture in Africa. NAGA, WorldFish Center Quarterly. 2003;26(3)
- [11] Pillay TVR. Planning of Aquaculture Development—An Introductory Guide. Farnham, Surrey, UK: Fishing News Books, Ltd; 1997
- [12] Vincke MMJ. The present state of development in continental aquaculture in Africa. In: Symoens J-J, Micha J-C, editors. The Management of Integrated Freshwater Agro-Piscicultural Ecosystems in Tropical Areas. Proceedings; The Netherlands, CTA; Rome, FAO; Belgium, Royal Academy of Overseas Sciences. 1995. pp. 27-62
- [13] Satia B. A regional survey of the aquaculture sector in Africa south of the Sahara. In: ADCP/REP/89/36. FAO; 1989. p. 60
- [14] FAO (Food and Agriculture Organization of the United Nations). Fisheries Statistics. 2003. Available from: <http://www.fao.org> FAO 2016a. Global aquaculture production dataset 1950-2014 (Fishstat). Available at: www.fao.org/fishery/statistics/software/fishstat/en [Accessed: 2019]
- [15] FAO. Global aquaculture production dataset 1950-2014 (Fishstat). 2016. Available from: www.fao.org/fishery/statistics/software/fishstat/en [Accessed: 2019]
- [16] Coche AG. Aquaculture development and research in Sub-Saharan Africa. National Reviews; CIFA Techn. Pap. No. 2; Suppl. FAO; 1994. p. 397
- [17] Costa-Pierce BA. Research priorities in Sub-Saharan smallholder freshwater aquaculture. In: Koop K, editor. Aquaculture in Africa. A Workshop on Research in Aquaculture held in Harare, Zimbabwe, 23-27 January. Stockholm, IFS; 1991

- [18] Coche AD, Pedini M. Establishment of the aquatic farming systems network for Africa. *FAO Aquaculture Newsletter*. 1997;15:7-11
- [19] Coche AG, Haight BA, Vincke MMJ. Aquaculture development and research in Sub-Saharan Africa, synthesis of national reviews and indicative action plan for research. In: CIFA Technical Paper Paper 23. Rome: ECA/EU/FAO; 1994. p. 151
- [20] Williams MJ. Aquaculture and sustainable food security in the developing world. In: Bardach JE, editor. *Sustainable Aquaculture*. New York: John Wiley & Sons; 1997. pp. 15-51
- [21] UNDP. *Overcoming human poverty*. United Nations Development Programme. New York, USA; 1998
- [22] Lazard JLY, Stomal B, Weigel J-Y. *Pisciculture en Afrique subsaharienne: Situations et projets dans des pays francophones; propositions d'action*. Paris: Ministère de la Coopération et du Développement; Aquaculture extension in sub-Saharan Africa; FAO Fisheries Department, Inland Water Resources and Aquaculture Service Series title: FAO Fisheries Circular-C1002 (2004); based on an original text proposed by Dr. Brummett RE (World Fish Center, West Africa Office) and Dr. V. Pouomogne (Institut de recherche agricole pour le développement) in Yaounde, Cameroon; 1991. p. 155
- [23] Hecht T. A review of the development of clariid catfish culture in southern Africa. In: Report of the Technical Consultation on Species for Small Reservoir Fisheries and Aquaculture in Southern Africa, ALCOM Report 19. Harare, Zimbabwe: Food and Agriculture Organization of the United Nations; 1997
- [24] Masser M. The status and future of inland aquaculture. *World Aquaculture*. 2000;31(3):34-62
- [25] Moehl J, Halwart M, Brummett R. Report of the FAO-World Fish Center Workshop in small-scale aquaculture in Sub-Saharan Africa. In: *Revisiting the Aquaculture Target Group Paradigm*. Limbé, Cameroon, 23-26 March 2004. CIFA Occasional paper, no. 25; Rome, FAO; 2005
- [26] CIFA/OP24. *Africa Regional Aquaculture Review*. FAO Regional Office for Africa, Accra, Ghana; 2000, 50 pp. 29 November-05 December 1972, Rome; 1973. p. 34
- [27] Josupeit H. A survey of external assistance to the fisheries sector in developing countries, 1978-1984. In: *FAO Fisheries Circular 755*. Rome: FAO; 1985
- [28] IFC. International Finance Corporation website. 2006. Available from: <http://www.ifc.org/ifcext/agribusiness.nsf/Content/Aquaculture> [Accessed: 2006]
- [29] Delgado CL, Hopkins J, Kelly VA. Agricultural growth linkages in sub-Saharan Africa. In: *Research Report 107*. Washington, DC: International Food Policy Research Institute; 1998