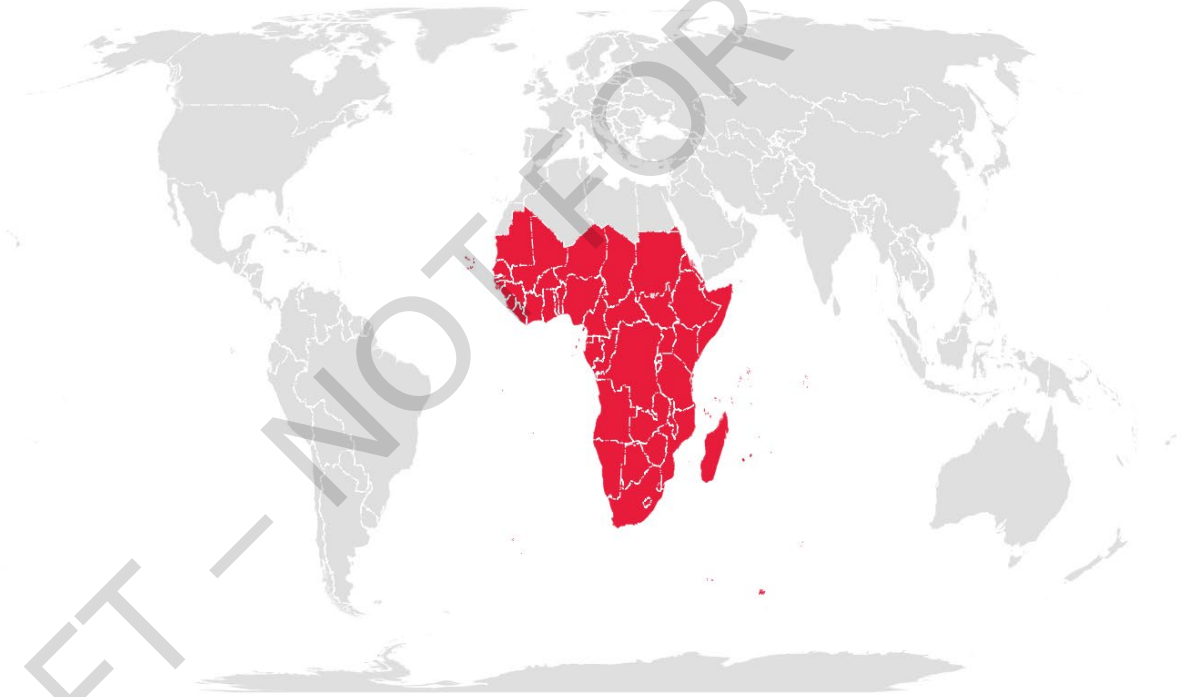
Food and Agriculture Organization of the United Nations

NFIAP/C1232/4

FAO Fisheries and Aquaculture Circular

ISSN 2070-6065

REGIONAL REVIEW ON STATUS AND TRENDS IN AQUACULTURE DEVELOPMENT IN SUB-SAHARAN AFRICA – 2020



REGIONAL REVIEW ON STATUS AND TRENDS IN AQUACULTURE DEVELOPMENT IN SUB-SAHARAN AFRICA – 2020

by

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2021

FAO. 2021. *Regional review on status and trends in aquaculture development in sub-Saharan Africa – 2020*, by Blessing Mapfumo. FAO Fisheries and Aquaculture Circular No. 1232/4. Rome, Italy.

Preparation of this document

This review was prepared by Blessing Mapfumo, fisheries and aquaculture advisor based in South Africa. The author greatly appreciates the valuable reviews and edits of Ana Menezes and Pierre Murekezi of the FAO Fisheries and Aquaculture Division, as well as edits by Joachim Carolsfeld and Devin Bartley (World Fisheries Trust) and Brian Harvey. Other FAO staff from Rome and the regional offices provided valuable input, including Nathanael Hishamunda, Junning Cai, Melba Reantaso, Ansen Ward, Aina Randrianantoandro, Omar Riego Penarubia, Buba Bojang, Rebecca Metzner, Stephania Vannuccini, Adrienne Egger, Xinhua Yuan, Graham Mair, Matthias Halwart, Vasco Schmidt, Lionel Kinadjian, Martinus VanDerKnaap, and Uwe Barg. Particular thanks to Xiaowei Zhou for the preparation of the FishStatJ database used in the review. Final editing and layout was carried out by Malcolm Dickson and Chorouk Benkabbour, respectively.

Data used in this global aquaculture overview, as well as in the regional aquaculture reviews, derive mainly from the different FAO fisheries and aquaculture statistics (FishStat), accessible through different tools, including the FAO Yearbook Fishery and Aquaculture Statistics, online query panels and FishStatJ. A discussion of FAO data is included in Appendix 1.

In continuing the global efforts to achieve aquaculture sustainability through dissemination of up-to-date information on the status and trends of the sector, FAO publishes Aquaculture Regional Reviews and a Global Synthesis about every 5 years, starting in 1995. Previous reviews, along with recordings of virtual webinars held 26–29 October 2020, can be found on the dedicated website here: www.fao.org/fishery/regional-aquaculture-reviews/aquaculture-reviews-home/en/

Abstract

This review provides an overview of the status, trends, challenges and projections for aquaculture in sub-Saharan Africa (SSA) and evaluates the major trends during previous five years. While the sector still faces various internal and external challenges, the inherent natural potential of the region and rapidly increasing demand for fish has resulted in increased prioritization of aquaculture in almost all SSA countries and the African Union and subsidiary bodies have given special attention to the sector development. In order to realize its full potential, the SSA region needs to address a combination of overarching factors limiting aquaculture development so far, such as ineffective development approaches, weak governance frameworks, underdeveloped value chains and low availability as well as the high cost of key production inputs. Strengthened value chains for tilapia and catfish, promotion of new species, improved biosecurity, continued development of certification and associated harmonized best practices, improved information systems and innovations to address climate-change related impacts are some of the matters to be addressed.

Financial institutions and private sector (national and international) have equally started investing, even though in the global picture such interventions may seem negligible, which makes the continent to call for more and higher levels technical and financial assistance from international partners. Upscale the status of production and productivity via healthy investments would help the sector to generate a variety of benefits including food security, livelihoods, employment, domestic and intra-regional markets, foreign currency income and other socio-economic benefits.

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Abbreviations and acronyms

AAH	Aquatic animal health
ACP	Africa, Caribbean and Pacific
AfCTA	African Continental Free Trade Area
AfDB	African Development Bank
AfriMAQUA	Research Network for Sustainable Marine Aquaculture in Africa
AMR	Antimicrobial resistance
ANAF	Aquaculture Network for Africa
AquaFish	The Aquaculture and Fisheries Science Centre of Excellence
ARSO	African Organization for Standardization
ASC	Aquaculture Stewardship Certification
ATLAFCO	Ministerial Conference on Fisheries Cooperation among African States bordering the Atlantic Ocean
AU	African Union
AUDA	African Union Development Agency
AU-IBAR	African Union InterAfrican Bureau for Animal Resources
BCLME	Benguela Current Large Marine Ecosystem
BFT	Biofloc technology
BGI	Blue Growth Initiative
BMP	Best management practices
CAADP	Comprehensive Africa Agriculture Development Programme
CBD	Convention on Biological Diversity
CCRF	Code of Conduct for Responsible Fisheries
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement
COMESA	Common Market for Eastern and Southern Africa
COVID-19	Coronavirus disease 2019
CSR	Corporate social responsibility
DEFF	Department of Environment, Forestry and Fisheries (South Africa)
EAA	Ecosystem approach to aquaculture
EAC	East African Community
ECOWAS	Economic Community of West African States
EMA	EcoMark Africa
EU	European Union
EUS	Epizootic ulcerative syndrome
FAO	Food and Agriculture Organization of the United Nations

FCWC	West Central Gulf of Guinea
FishStatJ	FAO tool for fishery statistics analysis
FMM	Ferme Marine de Mahebourg
FoS	Friend of the Sea
GDP	Gross domestic product
GEF	Global Environment Facility
GIFT	Genetically Improved Farmed Tilapia
GIS	Geographical Information System
HDPE	High density polyethylene
ICT	Information and communication technology
IFAD	International Fund for Agricultural Development
IFTZ	Industrial free trade zone
IGAD	Intergovernmental Authority on Development
ILO	International Labour Organisation
IOC	Indian Ocean Commission
ISKNV	Infectious spleen and kidney necrosis virus
KHV	Koi herpes virus
LNDC	Lesotho National Development Corporation
LVFO	Lake Victoria Fisheries Organization
LVHD	Low volume high density (aquaculture cage system)
LUANAR	Lilongwe University of Agriculture and Natural Resources
NACA	Network of Aquaculture Centres in Asia-Pacific
NGO	Non-governmental organization
NRCS	National Regulator for Compulsory Specifications (South Africa)
NSA	Non-state actors
NSAAH	National Strategy on Aquatic Animal Health
OiE	World Organisation for Animal Health
PFRS	Policy Framework and Reform Strategy for fisheries and aquaculture in Africa
PMP/AB	Progressive management pathway for improving biosecurity
PRNFAA	Policy Research Network for Fisheries and Aquaculture in Africa
RABS	Regional aquatic biosecurity strategy
RAS	Recirculating aquaculture system
R&D	Research and development
REC	Regional Economic Communities
SADC	Southern African Development Community

SARNISSA	Sustainable Aquaculture Research Networks in sub-Saharan Africa
SDG	Sustainable Development Goals
SME	Small and medium-scale enterprise
SPS	Sanitary and phytosanitary
SSA	Sub-Saharan Africa
SVC	Spring viraemia of carp
TAAD	Transboundary aquatic animal disease
TAAT	Technologies for African Agricultural Transformation
TCP	Technical Cooperation Programme
TiLV	Tilapia lake virus
UN	United Nations
UN DESA	United Nations Department of Economic and Social Affairs
UNSD	United Nations Statistics Division
USD	United States Dollar
USSEC	United States Soybean Export Council
WAFICOS	Walimi Fish Cooperative Society
WAPI	World aquaculture performance indicators
WAS AC	World Aquaculture Society (African Chapter)
WSSV	White spot syndrome virus

Executive Summary

This review provides an overview of the status, trends, challenges and projections for aquaculture in sub-Saharan Africa (SSA). It is part of a series of regional reviews that the Food and Agriculture Organization of the United Nations (FAO) carries out globally every five years, and is largely based on 2018 or 2019 data, depending on availability, with evaluation of trends focused on the previous five and ten years.

Key messages of the review include:

- There has been a significant increase in the prioritization of aquaculture in SSA in government policies and strategies, linked to increased public understanding.
- Aquaculture production growth rates have decelerated in recent years, with some exceptions.
- Strengthened mainstreaming is required for disaster risk reduction, mitigation and resilience in aquaculture development strategies.
- Long-standing aquaculture challenges remain including tenure issues, the cost of inputs, inadequate technologies, genetic and environmental integrity, biosecurity and access to financing.
- Special programmes are needed to foster aquaculture development and implementation of the Blue Economy Agenda including addressing the participation of women and youth in aquaculture and strengthening continental networking institutions.
- Technical and financial assistance from international partners needs to continue.

The SSA is a region with diverse geography and environmental landscapes, ranging from tropical rainforests and rift valleys with some of the largest and most ecologically diverse freshwater systems in the world, to highland plateaus, semi-arid plains, deserts, and cool temperate, marine environments. In general, the environmental potential for aquaculture could be considered as unfulfilled in most areas of SSA. However, the inherent natural potential of the region and rapidly increasing demand for fish has resulted in increased prioritization of aquaculture in almost all SSA countries.

In 2019, the population of SSA was 1.1 billion, around 44 percent of whom live in urban centres, and the region had the fastest population growth rate in the world meaning that the population is expected to double by 2050. Millions of these inhabitants live in extreme poverty, hunger and malnutrition while youth unemployment in 2020 was 13.4 percent. Of the 55 countries and territories in SSA, 25 are classified as low income, 18 as lower middle income, five as upper middle income and only two as high income. Average Gross Domestic Product (GDP) per capita in 2019 in the region was USD 1 585, or 14 percent of the world average GDP per capita, but with high variability between countries.

Fisheries and aquaculture play a significant role in SSA region, which has resulted in increased attention and public interest. They are considered as pathways to fulfil the goals of the African Union (AU) Agenda 2063 and the African contributions towards the Sustainable Development Goals (SDGs), as well as seeing increased participation by small and large enterprises. An Aquaculture Action Plan for Africa (2016-2025) has been adopted by the AU, a variety of country and sub-regional strategies, plans and funding streams have been established and aquaculture associations and societies have grown although they are often challenged by funding and management constraints. The sector generates a variety of benefits including food security, livelihoods, employment, foreign currency income and other socio-economic benefits.

Capture fisheries still dominate fish production statistics in SSA, with over eight million tonnes fished in 2018, representing 92 percent of total fish production. Aquaculture has nevertheless grown significantly over the last decade, from production of 106 000 tonnes in 2000 to 719 000 metric tonnes in 2018 with a farm-gate value of USD 1.70 billion. However, the relative contribution of Africa towards global aquaculture production, dropped from 0.75 percent in 2014 to 0.62 percent in 2018.

Freshwater aquaculture of tilapias and African catfish represented 73.2 percent of SSA production volume in 2018, aquatic plants 15.7 percent, while other freshwater species, shrimp, shellfish and other marine species make up the remainder, in decreasing order.

Nigeria continued to dominate production, as its aquaculture industry was responsible for 40.5 percent of total SSA volume in 2018, followed by Uganda (14.4 percent), United Republic of Tanzania, Zanzibar (14.4 percent), Ghana (10.7 percent) and Zambia (3.4 percent) while the remaining SSA countries and territories produced 16.7 percent. However, there has been a general slowdown in growth from key producer countries such as Nigeria and Kenya, largely due to an increase in the cost of doing business in aquaculture.

Domestic and intra-regional markets for farmed fish products are expanding. This has fostered the establishment of large-scale aquaculture ventures in several SSA countries, particularly for tilapia. Tilapia production has nearly trebled in the last decade, with Nile tilapia by far the main species. Seaweed production, on the other hand, has continued to decline due to climate-change related disease issues and oyster production in Namibia has not yet recovered from problems caused by red tides in 2008. Other marine aquaculture activities have grown modestly, continuing to serve export markets with high-value products.

Aquaculture employment in SSA was estimated at 300 863 people in 2018. Large-scale aquaculture ventures have created significant employment and local economic development opportunities in several countries while small-scale aquaculture has also created livelihoods for many. There is growing evidence of women and youth actively involved in aquaculture business activities, although much needs to be done in this area.

Technical assistance continues to come from FAO and other international and bilateral development partners, donor organizations and investors, including the African Union agencies, European Union, World Bank, African Development Bank (AfDB) and WorldFish.

SSA faced a number of challenges in the last five years, including poor national economies, high costs of inputs and other business costs, aquatic animal diseases, climate change impacts and, most recently, the impacts of the COVID-19 pandemic.

Looking forward, in order to realize its full potential, the SSA region needs to address a combination of overarching factors limiting aquaculture development so far, such as ineffective development approaches, weak governance frameworks, underdeveloped value chains and low availability as well as the high cost of key production inputs. Strengthened value chains for tilapia and catfish, promotion of new species, improved biosecurity, continued development of certification and associated harmonized best practices, improved information systems and innovations to address climate-change related impacts are needed.

1. Social and economic background of the region

1.1 STATUS AND TRENDS

1.1.1 Scope

This review covers the status and trends in aquaculture development in sub-Saharan Africa (SSA) for the past ten years (between 2010 and 2020) with an emphasis on outstanding issues over the last five years. Although the review complements earlier reviews published by FAO and particularly the 2015 SSA review (FAO, 2017a), it highlights some of the key recent developments and provides perspectives on the future of the sector. It also takes into account salient issues highlighted in the African Union ten-year aquaculture action plan for Africa 2016–2025. This has become, in part, the blueprint for the transformation of the African aquaculture sector to generate economic growth, create wealth, increase the supply of food and improve nutrition, as well as highlighting some of the guiding and support efforts by FAO and other parties.

The review covers all 55 African countries and territories south of the Sahara. These are divided into subregions, as shown in Table 1.

TABLE 1. Subregional classification of countries and territories in sub-Saharan Africa

Middle Africa	Southern Africa	Eastern Africa	Northern Africa	Western Africa
Angola	Botswana	British Indian Ocean Territory	Sudan*	Ascension, Saint Helena and Tristan da Cunha
Cameroon	Eswatini	Burundi		Benin
Central African Republic	Lesotho	Comoros		Burkina Faso
Chad	Namibia	Djibouti		Cabo Verde
Congo	South Africa	Eritrea		Côte d'Ivoire
Democratic Republic of the Congo		Ethiopia		Gambia
Equatorial Guinea		French Southern Territories		Ghana
Gabon		Kenya		Guinea
Sao Tome and Principe		Madagascar		Guinea-Bissau
		Malawi		Liberia
		Mauritius		Mali
		Mayotte		Mauritania
		Mozambique		Niger
		Réunion		Nigeria
		Rwanda		Senegal
		Seychelles		Sierra Leone
		Somalia		Togo
		South Sudan		
		Uganda		
		United Republic of Tanzania		
		United Republic of Tanzania, Zanzibar		
		Zambia		
		Zimbabwe		

Source: UNSD, 2019.

* Sudan and South Sudan separated in 2011 and in the 2015 series of FAO regional aquaculture reviews, South Sudan was included in the sub-Saharan Africa region while information on Sudan was reported in the Near East and North Africa regional review (FAO, 2017b). In the 2020 reviews, Sudan has been assigned to the "Northern Africa" subregion within the sub-Saharan Africa region.

1.1.2 Geographical characteristics

Sub-Saharan Africa is a region with a variety of geographical and environmental landscapes. Tropical rainforests dominate west and central Africa, whereas the rift valleys in central and eastern Africa contain some of the largest and most ecologically diverse freshwater systems in the world including the three largest lakes in the continent; Lake Victoria, Lake Tanganyika and Lake Malawi. SSA also contains a number of highland and plateau regions as well as large, tropical basins, the largest of which is the Congo Basin in central Africa.

The northern reaches of the SSA region include the semi-arid Sahel, located immediately south of the Sahara and the Horn of Africa, a protruding peninsula on the north eastern corner of Africa. Most of SSA has a tropical climate. However, the southern tip of the continent and highland areas are generally cooler, whereas the Horn of Africa and desert areas, including the Sahara, Kalahari and the Namib are the driest parts of the continent.

1.1.3 Regional demographics

According to the United Nations Department of Economic and Social Affairs (UN DESA), sub-Saharan Africa will account for most of the growth in world population over the coming decades, with an estimated annual rate of 2.7 percent while several other regions will begin to experience population declines. In 2019, the SSA population was estimated at 1.108 billion and was projected to reach approximately 2.2 billion by 2050 (UN DESA, 2019a).

In 2020, the region accounted for 14 percent of world population, compared to 13 percent in 2014, and is expected to reach 17 percent in 2030, rising to 23 percent (2.2 billion people) in 2050 (Table 2) which will present unprecedented demographic changes for the region. Despite strong and rapid trends towards urbanization, SSA remains a predominantly rural continent. However, as the rural population continues to grow, challenges will arise from higher population densities in rural areas with impacts on rural livelihoods. This translates into a massive increase of the labour force, representing not only an opportunity for social and economic growth but also a challenge for SSA countries which will need a conducive environment to foster economic diversification, boost job creation and absorb new labour market entrants in the coming decades (Mercandalli and Losch, 2017).

High population growth is due to high fertility rates, as life expectancy in SSA is still only 61 years, significantly lower than the world average of 71 years and 79 years in Europe and North America. Meanwhile, the SSA average infant mortality rate of 78 infant deaths per 1 000 live births is the highest in the world (global average of 40) (UN DESA, 2019b).

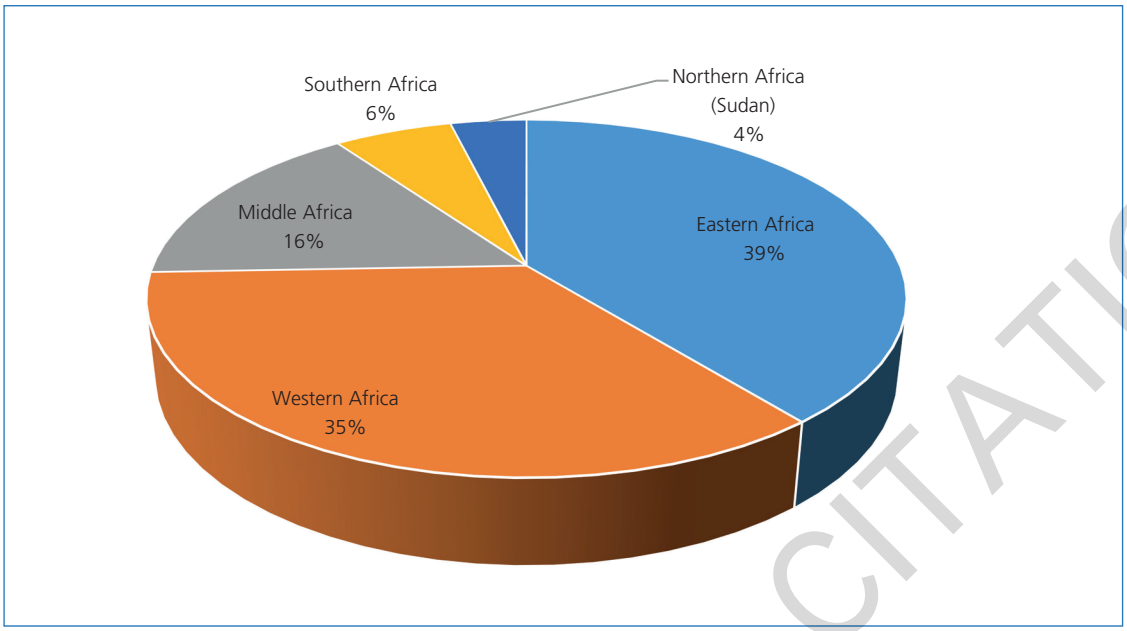
In terms of population distribution by subregion (UNM49 classification of regions), the Eastern African block has the largest population, representing 41 percent of the total SSA population while Southern Africa has the least, at around six percent (Figure 1).

TABLE 2. Key population indicators for sub-Saharan Africa and the world

	Mid-year population (thousands)			Birth rate (births/1 000 population)	Death rate (deaths/1 000 population)	Total fertility rate (live births/ woman)	Life expectancy at birth (years)	Infant mortality (deaths per 1,000 live births)	Average annual net migration (thousands)	% of population under 25 years
Year:	2019	2030	2050	Average over period 2015-2020						
World	7 713 468	8 548 487	9 735 034	18.0	8.0	2.5	72	40	0.0	41
Sub-Saharan Africa	1 108 813	1 455 142	2 198 924	36.0	9.0	4.7	61	78	-405	62

Source: Derived from UN DESA (2019b).

FIGURE 1. Population distribution by sub-Saharan Africa subregion (2019)



Source: UNSD, 2019.

1.1.4 Economic conditions

In 2019, the average GDP per capita in sub-Saharan Africa was USD 1 585 (Table 3), which was 14 percent of the global average. This had fallen significantly from historic highs in previous years due to a combination of global and internal economic circumstances, which were particularly acute in Northern Africa (Sudan) and Middle Africa where GDP per capita fell by 74 percent and 39 percent respectively, from 2014 to 2019. Most of the countries in Middle Africa are oil producing and exporting countries, that were negatively impacted by falling oil prices over the last five years. In contrast, GDP increased by 16 percent in Eastern Africa over the same period.

The World Bank estimated pre-COVID-19 economic growth in SSA to be around three percent for the year 2020. However, this figure may reduce as the COVID-19 pandemic is expected to take a heavy toll by impacting agricultural productivity, weakening supply chains, increasing trade tensions, limiting job prospects and exacerbating political and regulatory uncertainty. With such challenges, economic growth is expected to significantly contract in 2020, possibly entering into recession, then rebound in 2021 subject to effective management of the pandemic by SSA governments and the dynamics of reopening their economies (Vorisek, 2020).

In 2019, several SSA countries were among the poorest in the world, yet a few have some of the fastest-growing economies in the world. The top five countries in terms of average GDP per capita in 2019 were Seychelles (USD 17 402), Mauritius (USD 11 203),

TABLE 3. Sub-Saharan Africa subregional GDP trends

	GDP per capita (USD)		
	2014	2019	% increase
World	10 952	11 429	4%
SSA	1 885	1 585	-16%
Eastern Africa	2 484	2 882	16%
Middle Africa	4 747	2 889	-39%
Southern Africa	4 982	4 783	-4%
Western Africa	1 312	1 325	1%
Northern Africa (Sudan)	1710	441	-74%

Source: World Bank, 2020a.

Box 1. COVID-19 drives sub-Saharan Africa toward first recession in 25 years

Growth in sub-Saharan Africa has been significantly impacted by the ongoing Coronavirus outbreak and is forecast to fall sharply. COVID-19 is expected to cost the SSA region between USD 37 billion and USD 79 billion in lost output for 2020 due to trade and value chain disruption, reduced foreign financing flows from remittances, tourism, foreign direct investment, foreign aid, as well as capital flight. There are expected to be direct impacts on health systems as well as disruptions caused by containment measures and the public response.

Real GDP growth is projected to fall sharply as a result of persistently weak growth and investment, particularly in the three largest economies, Nigeria, Angola, and South Africa. In general, oil exporting-countries will also be hard-hit, while growth is also expected to weaken substantially in the two fastest growing areas, the West African Economic and Monetary Union and the East African Community, due to weak external demand, disruptions to supply chains and domestic production. The tourism sector is expected to contract sharply due to severe disruption to travel. There is also the potential for a food security crisis in Africa, with agricultural production potentially contracting between 2.6 percent and seven percent while food imports would also decline substantially due to a combination of higher transaction costs and reduced domestic demand.

Source: World Bank, 2020b.

Equatorial Guinea (USD 8 132), Botswana (USD 7 961), Gabon (USD 7 667) and South Africa (USD 6 001) whereas the average GDP in each of the five lowest countries (Somalia, Burundi, Malawi, Central African Republic and Sudan) was below USD 500 per capita (World Bank, 2020a).

1.1.5 Trends in social development

Many governments have prioritized the integration of the Sustainable Development Goals (SDGs) in their national plans and policies and are creating institutional arrangements that will help drive and monitor progress towards transformation of their economies and societies. The results have generally been positive, according to a recent UN report on SDG Progress (UN DESA, 2019c).

Hunger is still very prevalent in SSA and malnutrition continues to affect millions of children while one-fifth of the population in the region is considered to be undernourished. Major progress has been made to improve the health of millions of people, increasing life expectancy, reducing maternal and child mortality as well as fighting leading transmissible diseases. HIV/AIDS incidence among adults aged 15 to 49 declined by 37 percent from 3.37 per thousand in 2010 to 2.14 per thousand in 2017 (UN DESA, 2019c).

In 2019, 62 percent of the SSA population was under the age of 25 (Table 2), making it the youngest region in the world (UN DESA, 2019a). However, a recent report indicates that almost 16 million young Africans, around 13.4 percent of 15-24 year-olds, face unemployment, which is a cause for concern for most governments (Ibrahim Forum Report, 2019). In response, the AU has developed various youth policies and instruments, including the African Youth Charter, the Youth Decade Plan of Action and the Malabo Decision on Youth Empowerment. These instruments are being implemented through various AU Agenda 2063 programmes (AU, 2019a).

Informal employment remains pervasive, which has an impact on the adequacy of earnings and working conditions, including occupational safety and health. More progress is needed to increase employment opportunities, particularly for young people, reduce informal employment and the gender pay gap as well as promote safe and secure working environments

to create decent work for all (UN DESA, 2019c). Although gender inequalities still persist in SSA, there has been some progress, including the reform of laws to improve gender equality and the implementation of gender-responsive budgeting.

According to a recent Africa Renewal report (Ighobor, 2019), conflicts and political instability still persist in several SSA countries including the Democratic Republic of Congo, Nigeria, Central Africa Republic, South Sudan, Mali and Somalia. Such conflicts have caused untold human suffering, with tens of thousands killed and millions displaced.

The greatest challenge to social development in 2020 and the following years will be the impacts of the COVID-19 pandemic, which is causing unprecedented death, human suffering, and disruption to normal life. According to the UN, the COVID-19 outbreak affects all segments of the population and is particularly detrimental to the most vulnerable, including people living in poverty, the elderly, persons with disabilities, youth and indigenous peoples. Early evidence indicates that the health and economic impacts of the virus are being borne disproportionately by poor people. The UN further points out that if not properly addressed through policy, the social crisis created by the COVID-19 pandemic may also increase inequality, exclusion, discrimination and global unemployment in the medium and long term. Comprehensive, universal social protection systems, when in place, play a major role in protecting workers and reducing poverty (UN DESA, 2020). The impact of COVID-19 on aquaculture development in SSA is considered further in Chapter 7 of this report.

1.2 SALIENT ISSUES

The demographic and socio-economic issues highlighted in this chapter, such as population increase, prevalence of hunger, malnutrition, unemployment and gender gaps all point to a need to sustainably develop an aquaculture sector that will contribute meaningfully to improved fish supplies, economic growth and ultimately the achievement of the SDGs.

The recent development by the AU of various youth policies and instruments has been an indicator that youth issues are high on the continental agenda. There are also notable efforts by the AU and other parties to contain conflicts within SSA, as this will ultimately improve socio-economic status.

COVID-19 has significantly affected economic growth prospects for the region. However, the World Bank has predicted a rebound in 2021, subject to governments effectively managing the pandemic and the dynamics of reopening their economies.

1.3 THE WAY FORWARD

There needs to be continued monitoring of how general demographic and economic factors in SSA are impacting aquaculture development to facilitate evidence-based policy-making and sector management while promoting the sector. Focused women and youth programmes on aquaculture should be strategically integrated into the AU Youth Decade Plan of Action, and the Malabo Decision on Youth Empowerment.

There should be assistance by the national governments, regional economic communities (REC), FAO and other development partners, for strategic monitoring of impacts of COVID-19 on economies and specifically on the aquaculture sector. This will facilitate the sharing of information as new insights become apparent. This could be aided by the development of policy briefs on what governments and aquaculture actors can do to mitigate these impacts.

2. General characteristics of the sector

2.1 STATUS AND TRENDS

2.1.1 Aquaculture as a component of total fishery production

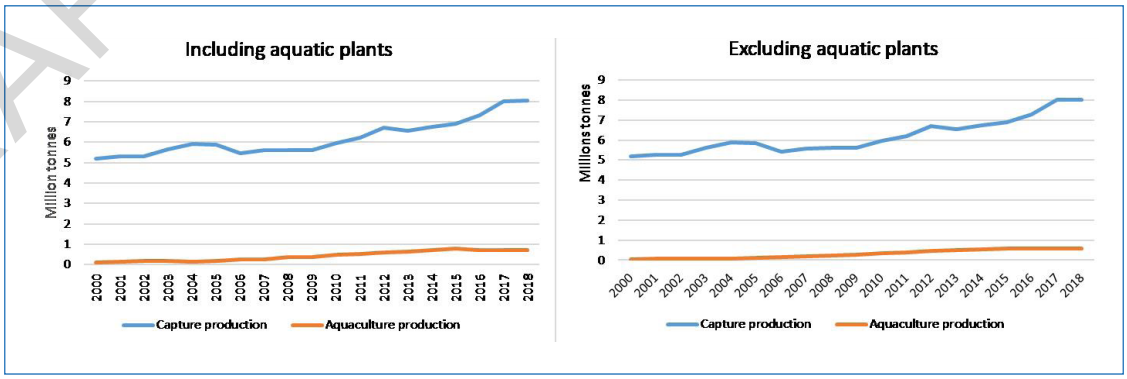
The catches from capture fisheries still dominate SSA fishery production statistics, comprising 92 percent of total fishery production in sub-Saharan Africa in 2018. This resulted from a 43 percent increase in catches over the period 2008 to 2017, but slower growth of only 0.4 percent between 2017 and 2018.

However, the past ten years have seen more variable trends in SSA aquaculture, particularly if aquatic plants are included in the statistics. The share of aquaculture in total fisheries and aquaculture production has increased slowly, from two percent in 2000 to eight percent (719 000 tonnes) in 2018. However, the average annual production growth rate, which enjoyed record highs of over 12 percent before 2014, has for the first time in the past two decades shown negative growth. This was the result of a number of factors, most importantly a reduction in seaweed (mainly *Eucheuma* spp.) production in key producer countries, especially United Republic of Tanzania, Zanzibar and Madagascar (Largo, Msuya and Menezes, 2020). Seaweed farming has experienced serious challenges from disease and epiphytes, attributed to climate change, with significant reductions in the seaweed trade, household incomes and livelihoods in general (Kyewalyanga and Msuya, 2016). Compounding the problems of seaweed disease and epiphytic infestations, there has been a reduction in African catfish (*Clarias gariepinus*) production in Nigeria, as well as overall decreases in aquaculture production from two other key producers, Uganda and Kenya, largely due to increased aquaculture costs.

2.1.2 Farming environments

An analysis of FAO statistics shows that all three aquatic environments, freshwater (inland aquaculture), brackish water and marine (coastal aquaculture) are used for aquaculture production in SSA. However, most activities are inland, where the most common aquaculture species including tilapia (mainly Nile tilapia, *Oreochromis niloticus*) and African catfish are grown in almost all countries. The farming operations range from subsistence to small-scale commercial and large-scale commercial. The total volumes produced in each of the farming environments are shown in Table 6.

FIGURE 2. Share of aquaculture in total fishery production in sub-Saharan Africa from 2000 to 2018 (million tonnes)



Source: FAO, 2020a.

Marine aquaculture began less than 30 years ago and is limited to a few countries in Eastern and Southern Africa. The top five marine aquaculture producers by volume in 2018 were United Republic of Tanzania, Zanzibar (seaweeds), Madagascar (shrimp and seaweed), South Africa (shellfish), Mauritius (marine finfish) and Namibia (shellfish). Except for seaweed farming, these operations are predominantly medium to large industrial-scale operations often associated with foreign investment and exports to overseas markets.

2.1.3 Scales of aquaculture production

Large industrial-scale aquaculture, which is an intensive, highly controlled commercial activity, continues to develop in SSA where the growth of several vertically integrated fish farms is evident. Such large farms operate their own breeding facilities, hatcheries, grow-out and even post-harvest processing facilities, distribution and marketing chains. Aquatic animals are stocked at high densities, usually in monoculture, thus requiring a high level of environmental management and husbandry, a process that is increasingly being automated. Large-scale commercial aquaculture ventures have in recent years been established in major tilapia producing countries including Ghana, Kenya, Nigeria, Uganda, Zambia and Zimbabwe, while new ventures have started recently in several other countries including Mozambique, Senegal, the United Republic of Tanzania and Togo. Rainbow trout (*Oncorhynchus mykiss*) production in the Lesotho and South Africa are also industrial, vertically integrated operations.

In marine aquaculture, shrimp (giant tiger prawn, *Penaeus monodon*) farms in Madagascar, marine finfish farms in Mauritius as well as several shellfish farms in South Africa are large and vertically integrated.

Small and medium-scale enterprise (SME) aquaculture ventures are common in many parts of rural SSA, with different levels of entrepreneurship and integration into other small-holding activities on the family or communal farm. Freshwater aquaculture SME operations are often run by individual farmers, but also by groups or associations and can be spread over wide areas contributing significantly to local fish production and consumption. The bulk of catfish production in Nigeria is by small aquaculture businesses. Similarly, tilapia production in Kenya, Rwanda, the United Republic of Tanzania, Uganda and Zambia is predominantly by SME operators. Other examples of SME aquaculture ventures include shellfish farming in Namibia (Pacific oysters, *Crassostrea gigas* and African abalone, *Haliotis midae*) and Senegal, and family or co-operatively-owned seaweed farms in United Republic of Tanzania, Zanzibar.

Subsistence aquaculture is also prevalent in almost all SSA countries, particularly within the freshwater aquaculture sector, improving household food and nutrition security and growing mostly tilapia or to a lesser extent, African catfish and carps (mainly common carp, *Cyprinus carpio*). Fish production is usually integrated into other small-holder activities on the family or communal farm, primarily for family consumption, at a smaller scale and using simple techniques compared to commercial operations. Subsistence aquaculture is characterized by having low levels of investment, both in terms of infrastructure and ongoing husbandry. Typically, it involves stocking juvenile fish at low-densities in backyard ponds or in community-owned water bodies. Fingerlings may come from a local hatchery or may also be harvested from the wild. The fish use natural food with limited or no additional feeding. As a result, yields are very low and growth is slow. Harvesting is often ad hoc and consumption is by the household or by the local community.

2.1.4 Main production systems

Aquaculture systems in SSA range from extensive aquaculture in ponds, lagoons and coastal areas, semi-intensive aquaculture predominantly in ponds, intensive aquaculture in tanks

and cages through to highly intensive systems such as recirculating aquaculture systems (RAS) and aquaponic systems.

By far the most common production system in SSA is lined or unlined earthen ponds, mostly for semi-intensive production of tilapias and African catfish. Many of these pond systems are integrated with other farm activities including vegetable gardens, poultry and pig farming, sharing use of aquatic infrastructure such as irrigation canals and water storage ponds. The intensity of pond culture ranges from extensive, to semi-intensive and intensive with different levels of management and material inputs. Marine shrimp aquaculture in Madagascar and Mozambique is also carried out largely in earthen pond systems.

The production of fish in small, medium or large floating cages in large public water bodies has increased significantly in SSA. Most of these are producing tilapias as well as, to a lesser extent, trout and marine finfish. There are medium-to-large scale tilapia cage farms in Ghana, Malawi, Nigeria, Uganda, Zambia and Zimbabwe, while cage farming is increasing in Kenya along the shore of Lake Victoria and in Rwanda. Rainbow trout is produced in cages in highland reservoirs in Lesotho while Madagascar, Mauritius and South Africa also have some marine finfish cage farms. These are mostly large, circular, floating high density polyethylene (HDPE) cages but square cages with wooden or metal frames are also used in Lake Victoria and Lesotho. Most of these operations are large, commercial-scale ventures, vertically integrated with their own hatcheries and processing plants and their own feed mills or agreements with international feed companies.

There has been a notable increase in the adoption and promotion of Low Volume High Density (LVHD) cage systems by SME cage farms, mostly growing tilapia in large, medium and even small water bodies. These are compact cages with a volume from one to 30 cubic meters that can yield up to 100 kg of fish per cubic metre. LVHD fish cage farming was introduced in China in the 1990s, with remarkable success, and is now practiced in several SSA countries including Burundi, Kenya, Rwanda, Uganda and Zambia.

Recirculating aquaculture systems (RAS) are widely used for hatcheries and grow-out in intensive, commercial aquaculture. This system is currently used for grow-out in several countries including Kenya, Namibia, Nigeria and South Africa, mostly for tilapia and to a lesser extent, catfish. However, further development of RAS grow-out systems has largely been hindered by the high cost of operation and unreliable electricity supplies in many countries leading to farms being abandoned or downgraded to less intensive culture systems. Meanwhile, due to their need for intensive management, many hatchery units have used RAS technologies.

A successful commercial RAS grow-out fish farm was established in Kenya in 2017 by a public-private partnership in East Africa, FoodTechAfrica, who claimed their commercial RAS systems can produce much more than conventional pond systems with minimal water use. The system is designed to operate at stocking densities of up to 125 kg of fish per cubic metre with lower feed costs and higher survival rates than conventional systems due to total control of water quality (FoodTechAfrica , 2019a).

Various types of plastic, concrete or fiberglass tanks, either circular or rectangular are used for grow-out of several finfish, as well as for hatchery operations and the production of ornamental fish in SSA, in some instances with greenhouse covers. Tilapias are the most common type of fish grown in tank-based systems while trout aquaculture has been practiced in raceway tank systems in several countries including Zimbabwe, Kenya and South Africa.

Controlled stocking of small water bodies or man-made impoundments to either enhance new fish stocks or revive declining stocks continues as a form of extensive aquaculture

or fishery management in several SSA countries. This is carried out in both private dams and public water bodies. The most common species stocked are tilapias, African catfish and carps. Stock enhancement initiatives have led to an increase in the number of private hatcheries for large-scale production of fish seed. In West Africa, trap-ponds are used in many remote areas, as a type of extensive aquaculture operated by individual or communal owners. Sections of small streams are blocked at the start of the dry season to trap wild fish for subsequent grow-out with or without supplementary feeding and harvested before the arrival of the rains.

2.1.5 Other production systems

Rice-aquaculture integrated systems are common in West African countries including Burkina Faso, Guinea, Mali and Nigeria.

Seaweed farming is usually carried out using the "tie-tie" system where fronds of seaweeds are tied to ropes that are stretched between pegs and placed in shallow intertidal lagoons. The system is used for seaweed culture in Eastern Africa, including the United Republic of Tanzania, Zanzibar and Madagascar while tanks are used for seaweed culture in South Africa.

Abalone farming in Namibia and South Africa is land-based, with pumped seawater and highly technical hatchery technology, in concrete or plastic tanks. Mussel and oyster farms collect seed (spat) from the wild or it is produced in hatcheries and grow-out occurs on a

Box 2. Main aquaculture production systems in Nigeria

Nigeria is the largest aquaculture fish producer in sub-Saharan Africa, accounting for 42 percent of the total farmed fish production in the region and focused mainly on freshwater fish, with African catfish accounting for the largest share. The country has numerous opportunities for large-scale production, although currently 80 percent of production is from small-scale farmers who are involved in brackish and freshwater cultivation.

Nigerian aquaculture production systems include extensive systems (seaweed culture, coastal bivalve culture, coastal fish ponds, and pen and cage culture), semi-intensive systems (fresh and brackish water ponds, integrated agriculture-aquaculture, sewage-fish culture) and intensive systems. In addition to the use of ponds, fish are cultured in various water holding facilities, including pens, hapas, tanks, cages and raceways.

For generations, artisanal fishers and fishing communities in Nigeria practiced traditional methods of fish culture in tidal pools, floodplains, reservoirs and undrainable ponds. These are extensive systems that do not conform to the modern perspective of aquaculture and do not contribute significantly to the national economy. The fish, once stocked, depend on natural production of the pond water. This approach is characterized by low input, low-density stocking, no artificial feeding and no fertilization, and results in low yields per unit area.

Most aquaculture undertakings in Nigeria practice semi-intensive aquaculture in earthen ponds, with much better yields. Over 30 000 tonnes of various freshwater and brackish water fish species are being reared under intensive (commercial) and semi-intensive systems.

There is also the promotion of integrated aquaculture systems with either livestock or a plant crop. The most common of these is a rice/fish integration. In the traditional method, wild fish, mainly catfish, enter flooded rice paddies from streams or irrigation canals, are trapped and allowed to grow along with rice. When rice is harvested, fish are caught for sale or consumption.

Source: Kaleem and Bio Singou Sabi, 2020.

raft-based and long-line systems. Sea cucumber (sandfish, *Holothuria scabra*) farming has recently started in Madagascar and United Republic of Tanzania, Zanzibar, with shallow ponds and wild-sourced juveniles (Hacker, 2017).

Aquaponics is an emerging technology that integrates recirculating aquaculture with hydroponics (production of plants in nutrient solutions, without soil). Many SSA farmers have adopted this in recent years, particularly in Southern Africa, as a form of urban and peri-urban agriculture. Aquaponics has particularly been promoted for government-supported social development projects by Non-governmental Organizations (NGOs) and in schools. Together with conventional RAS systems, aquaponics is regarded as climate-smart as it can be carried out with minimal water use. Tilapia is the most common type of fish cultured in aquaponics because of fast growth relative to other farmed fish and robustness. The Aquaponics Association of Southern Africa was established in 2016 and has a membership of over 100 operators (AASA, 2016).

Biofloc Technology (BFT) is a relatively new and potentially revolutionary technology being tested for tilapia and shrimp aquaculture, with promising results. As an example, Chambo Fisheries in Malawi operates a vertically integrated BFT farm (Kourie, 2017).

Technologies for the spawning and rearing of some new species such as mud crab (*Scylla serrata*) and pearl oyster (*Pinctada* spp.) culture have emerged in Eastern Africa (Madagascar, United Republic of Tanzania).

2.1.6 Regional aquaculture production, species and values

Production volumes and values

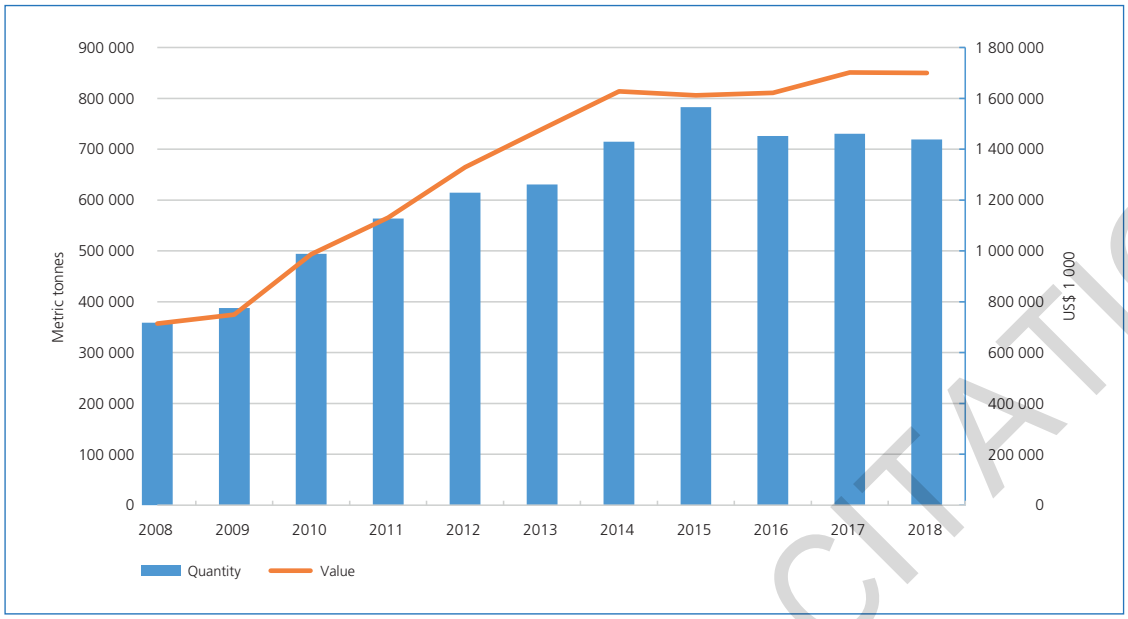
In general, the contribution of SSA to global aquaculture production remains minimal (0.62 percent in 2018). Nevertheless, total production (including aquatic plants) has doubled from 359 000 tonnes in 2008 to 719 000 tonnes in 2018 resulting from average annual growth rates of around 12 percent from 2008 to 2015, which is much faster than the world average growth rate for aquaculture production over this period (six percent). However, there has been little or no growth in production over the years 2015 to 2018 because of reduced seaweed production and slower than expected growth in key finfish producing countries, such as Kenya, Nigeria and Uganda. Nevertheless, the farmgate value of 2018 total production was USD 1.70 billion, up from USD 714 million in 2008 (Figure 3).

When excluding aquatic plants, Western Africa has led the region in production volume for many years, contributing 63 percent of total SSA production in 2018. The Eastern African region followed with 32 percent, whereas Southern Africa and Northern Africa (Sudan) accounted for two percent each, and Central Africa- one percent in 2018 (Table 4, Figure 4).

Nigeria has consistently been the largest aquaculture producing country in SSA, accounting for 48 percent of aquaculture production by quantity in 2018 compared to 60 percent in 2008, reflecting growth in other countries. Other major producers are Uganda, Ghana and Zambia in that order, while these four countries together contributed 82 percent of total SSA aquaculture production in 2018 (Table 4). Table 5 shows the top aquaculture producers in sub-Saharan Africa by volume (excluding aquatic plants).

Remarkable growth in production has been recorded in major producing countries such as Ghana, Malawi, Rwanda, United Republic of Tanzania and Zambia over the past five years (Table 5). This can be attributed to significant investments in capacity building, farm management and production infrastructure for tilapia cage culture. However, production growth seems to have decreased in Kenya and Uganda and has remained nearly stagnant in Nigeria, South Africa and Zimbabwe.

FIGURE 3. Aquaculture production volume and value in sub-Saharan Africa (2000–2018)



Source: FAO, 2020a.

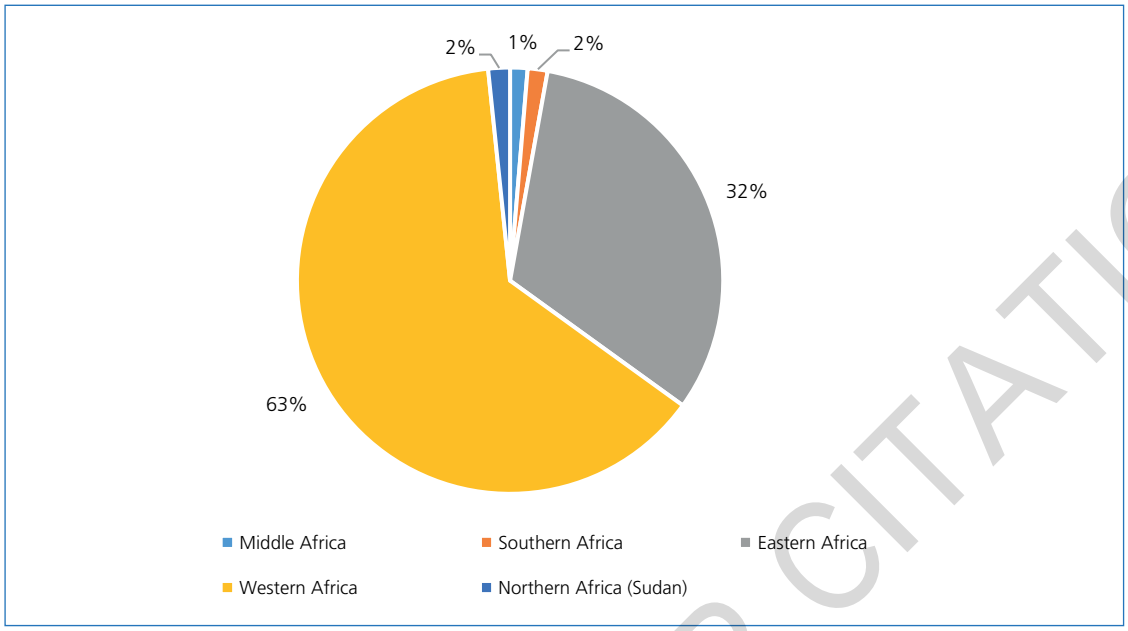
TABLE 4. Total African aquaculture production volume by region in 2008 and 2018 (including aquatic plants)

Country/area	Tonnes	
	2008	2018
World	70 203 425	114 508 041
Africa	1 061 593	2 308 673
Sub-Saharan Africa	358 948	719 013
Western Africa	152 106	384 876
Eastern Africa	196 657	305 094
Southern Africa	6 117	10 956
Northern Africa (Sudan)		10 000
Middle Africa	4 067	8 087
Top 10 aquaculture countries/territories (by quantity) in sub-Saharan Africa		
Nigeria	143 207	291 323
Uganda	52 250	103 737
United Rep. of Tanzania, Zanzibar	107 925	103 234
Ghana	5 594	76 630
Zambia	5 640	24 300
United Rep. of Tanzania	5 217	16 852
Kenya	4 452	15 524
Madagascar	14 486	12 758
Zimbabwe	2 652	10 586
Sudan	-	10 000
Malawi	1 700	9 014

Source: FAO, 2020a.

In terms of monetary value, Nigeria is in the leading position with aquaculture production worth USD 840 million in 2018, followed by Uganda (USD 241 million). However, in terms of unit price per kg of product, South Africa leads because of its high-value abalone sector, followed by the high-value shrimp sector in Madagascar. The price per kg for 90 percent of the key producers is around USD 2 to USD 4, which falls within the normal farm-gate price for tilapias and catfish, as indicated in Figure 5. Table 6 shows the major aquaculture producers by volume and value in SSA in 2018, excluding aquatic plants.

FIGURE 4. Sub-Saharan Africa aquaculture production volume (tonnes) by subregion, 2008 to 2018 (excluding aquatic plants)



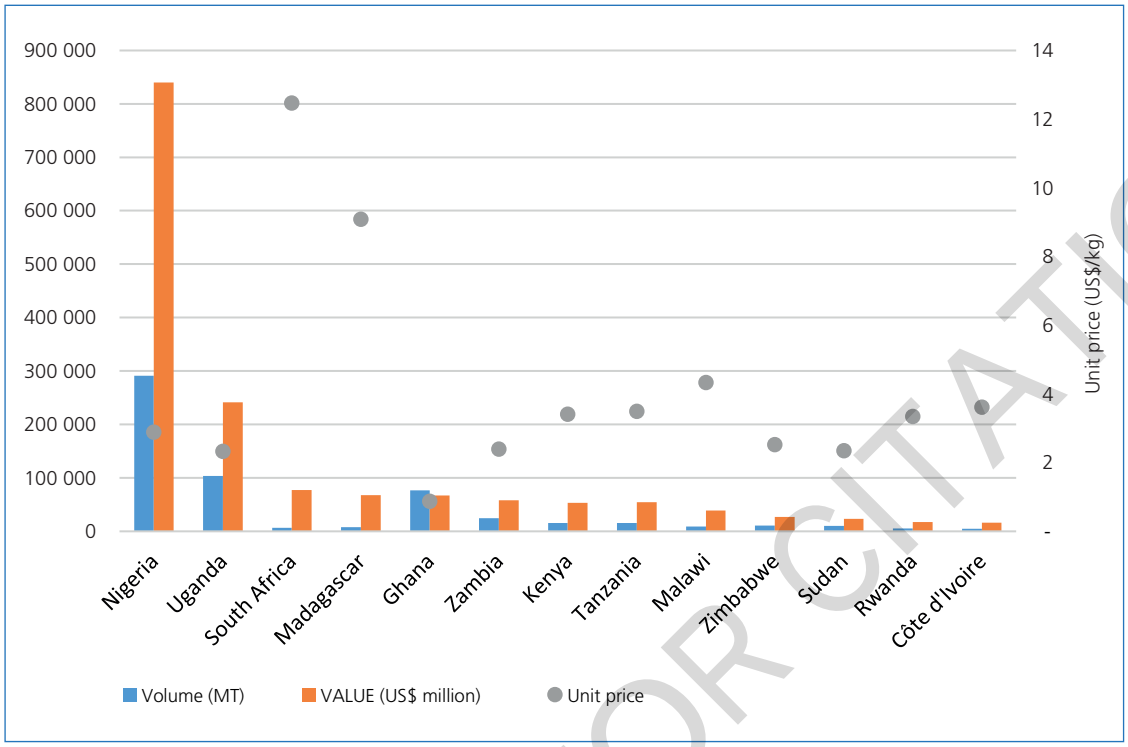
Source: FAO, 2020a.

TABLE 5. Top aquaculture producers in sub-Saharan Africa from 2008 to 2018 (MT) (excluding aquatic plants)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Nigeria	143 207	152 796	200 535	221 128	253 898	278 706	313 231	316 727	306 767	296 191	291 323
Uganda	52 250	76 654	95 000	85 713	95 906	98 063	111 023	117 590	118 051	112 344	103 737
Ghana	5 594	7 154	10 200	19 092	27 450	32 513	38 545	44 610	52 480	57 415	76 630
Zambia	5 640	8 505	10 290	10 530	12 988	20 271	19 281	22 754	21 600	21 567	24 300
Tanzania, United Rep. of	217	202	454	648	3 407	3 477	3 612	3 992	5 047	11 802	15 523
Kenya	4 452	4 895	12 154	22 135	21 488	23 501	24 098	18 658	14 957	12 360	15 124
Zimbabwe	2 652	2 702	2 782	7 682	8 090	10 090	10 600	10 600	10 085	10 300	10 585
Sudan					7 500	6 500	6 000	7 000	6 000	9 000	10 000
Malawi	1 700	1 620	2 631	2 833	3 232	3 705	4 742	4 974	7 646	12 217	9 014
Madagascar	10 836	6 116	6 886	8 845	8 588	8 974	8 470	7 317	8 575	10 928	7 421
South Africa	3 587	3 082	3 133	3 343	3 927	4 813	5 222	5 430	5 594	5 476	6 181
Rwanda	60	60	100	265	506	1 165	1 504	1 620	1 580	3 357	5 128
Benin	213	308	364	400	500	667	1 425	4 460	4 207	4 530	5 114
Côte d'Ivoire	1 290	1 340	1 700	3 394	3 720	3 720	3 750	4 000	4 392	4 500	4 500
Others	7 939	8 275	9 904	9 725	9 173	11 312	13 868	16 268	19 826	21 527	21 818
Total	239 637	273 709	356 132	395 734	460 373	507 477	565 371	586 000	586 807	593 514	606 398

There is a high expectation that aquaculture will flourish in other SSA countries because of a number of factors including increased public understanding of aquaculture, continued adoption of good governance in some countries, a greater focus on commercial aquaculture, an emphasis on capacity building, the promotion of public and private sector partnerships, an emphasis on research and outreach and the provision of credit. In addition, the promotion of private sector-led market-driven aquaculture is evident in investments in the development and use of new production systems, sound management, establishment of efficient, commercial hatcheries, construction of aquafeed mills and the use of quality aquafeeds. These investments

FIGURE 5. Production volumes and values (top ten producers in sub-Saharan Africa) in 2018 (excluding aquatic plants)



Source: FAO, 2020a.

TABLE 6. Major aquaculture producers by volume and value in sub-Saharan Africa

Rank by Volume (2018)				Rank by Value (2018)			
Rank	Country	Volume (MT)	% share	Rank	Country	Value (1 000 US$)	% share
1	Nigeria	291.323	48%	1	Nigeria	839.821,00	50%
2	Uganda	103.737	17%	2	Uganda	241.388,00	14%
3	Ghana	76.630	13%	3	South Africa	76.456,00	5%
4	Zambia	24.300	4%	4	Madagascar	67.449,00	4%
5	Tanzania, United Rep. of	15.523	3%	5	Ghana	66.852,00	4%
6	Kenya	15.124	2%	6	Zambia	58.089,00	3%
7	Zimbabwe	10.585	2%	7	Tanzania, United Rep. of	54.155,00	3%
8	Sudan	10.000	2%	8	Kenya	52.862,00	3%
9	Malawi	9.014	1%	9	Malawi	39.031,00	2%
10	Madagascar	7.421	1%	10	Zimbabwe	26.663,00	2%
11	South Africa	6.181	1%	11	Lesotho	26.434,00	2%
12	Rwanda	5.128	1%	12	Sudan	23.428,91	1%
13	Benin	5.114	1%	13	Rwanda	17.168,00	1%
14	Côte d'Ivoire	4.500	1%	14	Benin	16.325,00	1%
	Others	21.818	4%	15	Côte d'Ivoire	16.260,00	1%
	Total	606.398			Others	73.154,00	4%
					Total	1.695.535,91	

continue to demonstrate great confidence in the young industry, as reported in the previous review (FAO, 2017a) and in the recently published FAO assessment of the integration of aquaculture in African policies (Murekezi, Martone and Menezes, 2020).

2.1.7 Production by environment

Production by aquatic environment (Table 7) shows the continued prominence of inland aquaculture. In 2018, marine and coastal aquaculture production was 13 320 tonnes, accounting for only two percent of production quantity with a farm gate value of USD 148 million, or nine percent of the total regional aquaculture value.

Inland aquaculture has, in general, continued to increase. This may be attributed to a combination of the expansion of large-scale operations and to the rapid increase in the number of SME farms, most of which are now producing meaningful volumes of tilapia and African catfish.

Marine aquaculture has shown improved growth in volume since 2014 in countries such as Madagascar (which appears to have recovered from WSSV shrimp disease of the last decade), Mauritius and South Africa. However, marine aquaculture has declined in Namibia as it has not yet fully recovered from red tide-associated oyster mortalities in 2008 (Murta, G. and Kibria, G. 2017).

TABLE 7. Aquaculture production volumes & values by environment (2008–2018)

		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Inland waters	Tonnes - live weight	227 672	267 016	348 005	386 428	451 222	497 223	554 666	576 420	575 162	580 862	593 371
Inland waters	Value (USD 1 000)	622 914	688 512	900 001	1 032 108	1 231 580	1 367 769	1 527 645	1 527 394	1 501 802	1 573 987	1547 252
Marine areas	Tonnes - live weight	11 965	6 693	8 127	9 306	9 150	10 253	10 705	9 581	11646	12 651	13 028
Marine areas	Value (USD 1 000)	88 266	57 427	82 960	95 725	94 334	107 836	95 166	78 686	113257	122 133	148284
Total	Tonnes - live weight	239 637	273 709	356 132	395 734	452 872	500 977	559 371	579 001	580 809	584 513	606 399
Total	Value (USD 1 000)	711 180	745 939	982 961	1 127 832	1 280 432	1 451 113	160 0325	1 569 570	1 574 328	1 630 659	1 695 536

2.1.8 Production by species

FAO data (FAO, 2020a) show that 49 aquatic species are farmed in SSA. Catfish and tilapia are the main inland species groups and account for 88 percent of total aquaculture production in inland waters, while five marine and coastal species were the major contributors to coastal production, dominated by shrimp (41 percent) in 2018 (Table 8).

Nile tilapia (*Oreochromis niloticus*) production has continued to grow, increasing by 256 percent from 2010 to 2018, while production of other tilapia species and strains is also increasing, thus affirming the importance of tilapia to food security in SSA. The growth rate of African catfish (*Clarias gariepinus*) production has decelerated in recent years, due to reduced production from Nigeria. This has been attributed to a lack of modern technologies and the high cost of doing business, with many farmers struggling to make a profit (L. Badmus, *personal communication*). There has been a rapid increase in rainbow trout production from Lesotho, driven by export markets. In marine aquaculture, the production of red drum (*Sciaenops ocellatus*) in Mauritius has trebled, also driven by export markets.

TABLE 8. Aquaculture production volumes of freshwater and marine species in 2010 and 2018 (tonnes)

Freshwater species (tonnes)			
Year	2010	2018	% share (2018)
African catfish	183 402	211 330	35%
Nile tilapia	59 582	212 209	36%
Other tilapias	27 484	54 409	9%
Other catfishes	14 914	47 673	8%
Cyprinids	16 747	24 012	4%
Trout	1 538	4 887	1%
Other freshwater	28 762	40 932	7%
Total freshwater species	332 429	595 452	100%

Marine species (tonnes)			
Year	2010	2018	% share (2018)
Shrimp/ prawn	4 913	5 419	41%
Mussels	710	2 320	17%
Abalone	1 015	1 522	11%
Red drum, Seabass	625	1 985	15%
Oysters	817	1 189	9%
Other marine	37	885	7%
Total marine species	8117	13 320	100%

Source: FAO, 2020a.

2.1.9 Aquatic plants

A total of 112 615 tonnes of aquatic plants were produced in 2018, valued at USD 4.1 million, primarily in the Indian Ocean (Table 9). The most important producers in 2018 were United Republic of Tanzania, Zanzibar which produced 103 220 tonnes mostly of *Eucheuma* spp. while another 1 330 tonnes of *Eucheuma* spp. were produced in United Republic of Tanzania, and production of the same seaweed dropped in Madagascar from 17 400 tonnes in 2017 to only 5 337 tonnes. There appears to be a decreasing trend in seaweed production in the Indian Ocean region, as the sector is faced with challenges such as climate change-induced disease, fouling by epiphytes, and reduced growth (Box 3).

TABLE 9. Aquatic plant production volumes in sub-Saharan Africa, 2008–2018 (tonnes)

Country	Species	Region	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Madagascar	Eucheuma seaweeds nei	Indian Ocean, Western	3 650	3 600	4 000	1 699	1 400	3 575	6 970	15 377	17 423	17 407	5 337
South Africa	Sea lettuces nei	Atlantic, Southeast	1 534	1 500	1 565	2 000	2 000	1 800	2 000	1 300	2 500	862	1 687
United Republic of Tanzania	Eucheuma seaweeds nei	Indian Ocean, Western	5 000	5 520	6 885	6 601	6 510	6 689	6 705	6 750	7 500	7 800	1 330
United Rep. of Tanzania, Zanzibar	Spiny eucheuma	Indian Ocean, Western	107 760	102 476	125 029	129 779	149 972	108 430	127 690	166 650	111 130	109 550	102 960
United Rep. of Tanzania, Zanzibar	Elkhorn sea moss	Indian Ocean, Western	165	206	128	621	904	2 008	5 330	5 840	12	260	260
Others	Other	Other	1 202	830	722	420	672	692	673	653	731	742	1 041
Total	Total	Total	119 311	114 132	138 329	141 120	161 458	123 194	149 368	196 570	139 296	136 621	112 615

Source: FAO, 2020a.

2.1.10 Diversification: new species in sub-Saharan Africa

New species that began production in the last five to ten years include Tanganyika tilapia *(Oreochromis tanganicae)* in the Zambia, macroalgae species *Meristotheca senegalense* in the Senegal, milkfish *(Chanos chanos)* in Kenya and United Republic of Tanzania, Zanzibar, sea cucumber ("sandfish" - *Holothuria scabra)* in Madagascar and United Republic of Tanzania, Zanzibar, and Japanese meagre *(Argyrosomus japonicus)* in Mauritius. Shrimp (giant tiger prawn - *Penaeus monodon)* aquaculture has also begun in Nigeria. Although production volumes for all these species are still low (Table 10), producers have expressed confidence.

Box 3. Recent seaweed mariculture developments in Zanzibar

Fisheries and aquaculture play a significant role in livelihood and food security in the United Republic of Tanzania and in particular in United Republic of Tanzania, Zanzibar where the seaweed industry is one the major economic activities employing around 24 000 farmers, 80 percent of whom are women. Although seaweed production and trade has declined in the last six years, it continues to be important for empowerment of women in United Republic of Tanzania, Zanzibar.

Seaweed farming in Zanzibar started in 1989 using Eucheuma denticulatum commercially known as '*spinosum*' and *Kappaphycus alvarezii* commercially known as '*cottonii*'. Both *cottonii and spinosum* belong to the red seaweed family Rhodophyceae, order Girgatinales. Despite higher production of spinosum, cottonii fetches a higher price but its production has been declining substantially over the last six years, due to increasing temperatures and longer hot seasons.

Since 2011, farmers have experienced serious problems of die-off and diseases resulting in decreased production. It was mainly caused by a severe cases of epiphyte infestation coupled with high incidence of ice-ice disease that occurs during extremely high water temperatures and high light intensities in the hot-dry season. Both maladies have long been observed by farmers and verified by a recent study conducted as part of FAO funded project "Support to seaweed diseases and die-off understanding and eradication in Zanzibar". The study revealed that intensification of the disease occurs during the hot season and diminishes during the wet season, which revives the farms until the next hot-dry season returns.

This, in effect, makes seaweed production in Zanzibar highly seasonal, compared with what used to be a continuous year-round of plant-harvest-plant cycle every 30 to 45 days, providing steady income for mainly women seaweed farmers. Implementing the recommendations from the FAO project and advice from the Institute of Marine Sciences helped project participants to recover production in 2015 to 16 600 tonnes.

Source: FAO, 2018a.

TABLE 10. New species production volumes in sub-Saharan Africa in 2018

New species	Key producing country (s)	Total production in 2018 (MT)
Tanganyika tilapia (*Oreochromis tanganicae*)	Zambia	1 690
SenMacro-algae (*Meristotheca senegalense*)	Senegal	300
Shrimp (*Penaeus monodon*)	Nigeria	90
Milkfish (*Chanos chanos*)	Zanzibar, Kenya	7
Sandfish (*Holothuria scabra*)	Zanzibar, Madagascar	63
Japanese meagre (*Argyrosomus japonicus*)	Mauritius	63

Source: FAO, 2020a.

Upcoming high-value species

In Madagascar, French entrepreneurs have recently established Africa's first sturgeon caviar farm, "Acipenser". The farm produced caviar under the brand-name 'Rova Caviar' with 300 tonnes of sturgeon (*Acipenser* spp.) in 2019. The farm is equipped with a hatchery and a pre-growing and out-growing unit, both on land and in offshore cages in Lake Mantasoa, a hydropower reservoir in the highlands of Madagascar. The farm now has between 250 and 300 local employees and produces five tonnes of caviar for export each year, with plans to double production in the next five years. Caviar sells for up to USD 780 per kg in French restaurants (Gulf Today, 2019; Acipenser-Madagascar, 2020).

In Lesotho, there is early stage planning for Africa's first USD 250 million land-based, 20 000 tonne capacity, salmon (*Salmo salar*) farm. This is being developed by the private

sector with support from the Lesotho National Development Corporation (LNDC). If successful, the venture could produce annual revenues accounting for eight per cent of total GDP for Lesotho. Located in the highland region, the farm is due to be completed by 2023 and is expected to generate more than 250 full-time jobs (Fish Farmer Magazine, 2019).

2.1.11 Main drivers for regional expansion and growth

The general regional aquaculture growth trajectory factors of the past five years may shape growth for the next five years and has been largely due to the establishment of medium and large-scale investments, mostly by external or national investors capable of accessing loans from foreign commercial banks in key producer countries. These investments have resulted in substantial production, responding to domestic and regional demand for fish products in countries such as Uganda, Zambia and Zimbabwe, and emerging industrial-scale ventures in Kenya and Rwanda.

There is also much better public understanding of aquaculture in many countries, which has led to many farmers establishing private fish farms to supplement traditional agriculture, using their own funding. Meanwhile several countries have actively created an enabling environment for the development of commercial aquaculture through government and international development institution support. This has led to the development of aquaculture governance frameworks (policies, strategies, action plans, regulatory measures) and direct funding support mechanisms.

The supply of inputs has improved through the use of improved technologies for production and distribution of better quality fish seed (mostly tilapias and catfish) as well as the establishment of large scale aquafeed producers in key aquaculture countries including Zambia (AllerAqua), Ghana (Ranaan), Nigeria (Skretting), Kenya (Skretting) and Mauritius (LFL).

There is also increased awareness of the nutritional value of fish and fish products and increased demand for white meat such as tilapia and catfish in national, regional and international markets while attractive global commodity prices for export products such as shrimp, trout, abalone, ornamental fish and sea cucumber have also stimulated investment.

Finally, assistance from development organizations such as FAO, European Union (EU), African Union InterAfrican Bureau for Animal Resources (AU-IBAR), World Bank, African Development Bank (AfDB), WorldFish and Regional Economic Communities have been important through providing direct funding, guidance or other capacity development initiatives.

2.2 SALIENT ISSUES

2.2.1 Background

In order for SSA to realize its full aquaculture development potential, important challenges still need to be strategically addressed in several countries. Many of these have been highlighted in previous reviews and some improvements have been witnessed while aquaculture resource opportunities and limitations are considered further in Chapter 3 of this report.

2.2.2 Ineffective development approaches

Historical attempts to develop aquaculture were top-down, based on hand-outs from governments and development partners. They also promoted technologies without due consideration of stakeholder needs and expectations such as income levels, seasonal need for cash, risk aversion, alternative uses for productive inputs or transportation costs for

marketing. Networking, information and knowledge sharing at all levels from producers to other value chain stakeholders and governments would facilitate a coordinated way forward for aquaculture development in the region but they are still inadequate. Extension and applied research in agriculture have become more accessible in recent decades, especially through peer-to-peer knowledge exchange between farmers and through private extension services, but mainstreaming has not yet been achieved everywhere.

2.2.3 Weak administrative and institutional frameworks

A lack of adequate sector-specific policies, strategies, plans, laws and regulations in several SSA countries is hindering the sector, in spite of the improvements witnessed in some countries, especially in the last five years (Murekezi, Martone and Menezes, 2020).

2.2.4 Underdeveloped value chains

Markets are among the major drivers of aquaculture development. However, aquaculture value chains are frequently underdeveloped and do not take advantage of value addition. The main reasons include poor investment in public infrastructure such as road networks, water and energy supplies and sanitation, as well as inadequate research and inappropriate technology. There is also a need for the improved collection, documentation and dissemination of market information. As a result, aquaculture value chains are often short and restricted to the immediate vicinity of farms.

2.2.5 Low availability and high costs of key production resources

Significant amounts of fish seed and aquafeeds for semi-intensive systems or land for extensive systems are required to ensure adequate production levels for farmers. However, their availability is low in many countries and their costs are very high compared to other regions of the world. Moreover, accessing inputs can be difficult or expensive for the vast majority of farmers, who do not have efficient and cost-effective means of transportation. The cost of credit is also very high, as access to loans is limited by high interest rates and short pay-back periods. High costs of production can make aquaculture unprofitable or uncompetitive compared to other sources of fish such as capture fisheries or foreign imports.

2.2.6 Lack of disaster risk reduction, mitigation, adaptation and preparedness

The aquaculture sector is increasingly facing threats posed by climate change. Strategies to build the resilience, adaptation and mitigation measures, especially for vulnerable small-scale farmers, are still widely lacking. Disease outbreaks experienced in the last decade have exposed sectoral biosecurity weaknesses. Moreover, the recent COVID-19 pandemic has demonstrated the sector's lack of preparedness for sudden shocks significantly impacting value chain activities.

2.2.7 Lack of reliable production statistics in support of sectoral management and policy-making

The sustainability of the aquaculture sector can only be achieved through more cautious and effective management. Reliable and timely data are fundamental for the management and policy formulation, allowing regular monitoring and control of production, evaluation of performance and justifying allocation of resources. Yet most SSA countries do not have effective data collection systems for aquaculture production, with many also lacking a framework aligned with internationally and regionally accepted standards. Furthermore, in several countries, the staff responsible for reporting production estimates lack knowledge,

adequate support or relevant mechanisms such as specifically designed databases for developing accurate production estimates. Reasons include the low priority given to the sector and the complexity of collecting data from dispersed rural farmers (Murekezi, Martone and Menezes, 2020). Even in countries where data collection systems are better established, governments tend to attach low importance to aquaculture statistics, perhaps because of the relatively small contribution of aquaculture to total national fish production.

Despite some improvements, not all the SSA countries have regularly reported their national aquaculture data to FAO, with the total number fluctuating around 21 countries. Furthermore, there may be issues of quality and coverage in some of the data. FAO makes estimates for non-reporting countries and to improve the quality of questionable statistics as well as disaggregating by species and by culture environment from lump-sum figures reported to FAO.

2.3 THE WAY FORWARD

Improved public understanding of aquaculture has been a major advance for the SSA region and has encouraged many players to invest in the sector at various levels, especially in SME businesses. External investments have become a springboard for growth, notably for the establishment of large integrated fish farms and feed mills. Having realized what aquaculture can generate, government support has generally increased and this has given the private sector the confidence to bring in emerging technologies, farm new species and apply best management practices (BMP).

The African Union's aquaculture action plan for Africa, 2016–2025 (AU-IBAR, 2016a), which has spelled out the vision for Africa's aquaculture sector, needs to be promoted and supported in order for the sector to meaningfully contribute to improved fish supplies, and generate economic growth, wealth and better nutrition. In turn, African member states need to continue improving or creating the necessary enabling policies and environments that would support private sector development and growth. This will strengthen aquaculture value chains and attract more investment. Much-needed technical assistance from the international community through their development organizations will help to address some of the pressing issues SSA is facing today, such as sustained and appropriate application of genetic improvement approaches, improved genetics, biosecurity management and aquaculture investment. There is also a need to move towards digitalizing aquaculture.

Specific actions include:

- *Supporting aquaculture input supply chains.* The availability of cost-effective feed and seed of appropriate quality is a critical step in the upscaling of aquaculture in Africa. Dedicated commercial hatcheries now seem to be functional in several countries but are often not applying appropriate management to ensure sustainable seed supply and quality. The situation is even more complicated with feeds which often have to be imported to meet the demands of hatcheries, nurseries and grow-out farms. Feeds are the main production cost in many production systems and tax exemptions could be helpful to keep prices down. Public and private investments and capacity development should target the promotion and development of improved small-scale hatcheries and local feed mills. Any policy or strategy to this effect should account for parallel, emergent small-scale feed producers as low-cost extruders are becoming accessible to some small-scale investors, while there is a need to build special, dedicated, industrial fish feed facilities in the region to address accessibility, quality and price.

- *Developing a dedicated network to support African aquaculture development.* Sustainable African aquaculture development requires monitoring of the sector, sharing knowledge and information, and supporting the various stakeholders in a coordinated way. A dedicated network such as the Network of Aquaculture Centres in Asia-Pacific (NACA) that played an important role in Asian aquaculture development is much needed. African countries have already expressed their firm intention to implement a special programme to promote aquaculture development through an Aquaculture Network for Africa (ANAF), but the necessary financial and human resources have not yet been allocated.
- *Supporting conducive governance, policies, strategies and legal frameworks.* The existing administrative and legal frameworks must be reviewed to ensure that regulatory mechanisms and institutional arrangements are effective (Murekezi, Martone and Menezes, 2020). Aquaculture development strategies should support the existing market-oriented, rural fish farming that is now well established in several areas of SSA. Strategies can also play a major role in increasing farm resilience through crop diversification, improved nutrition and livelihoods, increased income and better water resource management. Rural producers are generally well integrated into wider farming landscapes but often lack access to inputs to upscale their production and to take advantage of new market opportunities.

The strategies should also promote the emergence of new entrants and entrepreneurs, especially youth and women. Promoting decent work in aquaculture is also an important component of these strategies as it can lead to more effective and responsible management of the sector, improve the livelihoods, food security and nutrition of employees and surrounding communities, and enhance responses to market demands (Murekezi, Menezes and Ridler, 2018).

3. Resources, services and technologies

3.1 STATUS AND TRENDS

3.1.1 Access to land

The previous regional review on aquaculture development in sub-Saharan Africa (FAO, 2017a) identified competition for access to land and water resources by multiple users and degradation of these resources as key issues, and they remain so. In addition, the report pointed out that proximity to existing infrastructure, markets and environmental suitability are also important. For most subsistence and SME commercial farmers in SSA, land arrangements are through customary or family rights, where a farmer with existing land decides to invest in aquaculture as an additional agricultural activity such as aquaculture ponds. However, large-scale operations with high investment levels will usually seek government-backed access rights, most of which are long-term leases. An example is Lake Harvest Aquaculture in Zimbabwe, where both its land and cage-based operations are located in national parks under a lease agreement with the Zimbabwe Parks and Wildlife Management Authority (AfDB, 2011).

In recent years, some governments, in the quest to create enabling land access policies for large scale aquaculture development, have zoned land for aquaculture development in areas where basic infrastructure and services are already provided. In Madagascar, shrimp farming occurs in publically-owned, industrial free-trade zones (IFTZ) where foreign investors are offered long-term leases for land, rather than owning it (Ridler and Hishamunda, 2001). Similarly, in Apac, northern Uganda, a European Union funded project on commercial aquaculture development has recently allocated a total of 200 hectares for aquaculture investments. Since 2019, the government has been looking for potential investors to develop aquaculture-based businesses on this zoned land in an area that has been assessed as suitable for pond and tank-based intensive fish production based on a pumped water supply from the Nile River. (A. Napuru, *personal communication*, 2019). Lesotho has also allocated desirable land to the Lesotho National Development Corporation under a public-private partnership agreement to develop a land-based salmon farm (Evans, 2019).

3.1.2 Access to water

One of the reasons why SSA is potentially one of best areas of the world for aquaculture development is its extensive, untapped water resources including inland lake and dam systems, rivers and coastlines. However, water shortage is a factor in semi-arid regions, such as the Sahel. The great lakes region is a potential hotspot for sustainable aquaculture development where major lakes (Albert, George, Kivu, Nyasa/Malawi, Tanganyika, and Victoria) plus hundreds of smaller lakes and rivers offer ideal conditions for both cage and pond aquaculture. Other examples include important reservoirs where some of the major cage aquaculture ventures are located, such as Lake Volta in Ghana, Lake Kariba on the border between Zambia and Zimbabwe and Katse Dam in Lesotho.

Most of the SSA coastline has yet to be exploited for commercial mariculture. For instance, the East African Indian Ocean coastline stretching from Mozambique to Kenya has sheltered waters suitable for marine aquaculture, especially cage culture. However there are challenges including access to public infrastructure and services and in some cases security and tenure issues, such as conflicts with artisanal fisheries. Only seaweed farming in the shallow areas of United Republic of Tanzania, Zanzibar and some surrounding islands has flourished so far. In 2018, South Africa identified and zoned over 800 ha of ocean in Saldanha Bay for the expansion of marine aquaculture. According to the government, this zoning is expected to

attract significant investment, especially by small, medium-sized and microenterprises in the oyster and mussel subsector (Arnoldi, 2018).

As with land, the concept of aquaculture zones or "aquaparks" in both marine and freshwater has recently been adopted in several countries including Ghana, Mauritius, South Africa, Uganda and Zambia, in order to stimulate aquaculture investment (Box 4).

Box 4. Lake Volta zoned to boost aquaculture in Ghana

Zonation of Lake Volta has been carried out to help streamline fish farming activities on the lake and to ensure orderly and sustainable aquaculture development in the country. The zonation was also to identify the best possible areas for aquaculture production on the lake, as well as to determine the maximum fish production from aquaculture that could be sustained without adverse environmental degradation. The findings of the zonation, which was carried out by local researchers revealed that cage fish culture on Lake Volta has the potential to become a viable industry in Ghana, and that indications also suggested that fishing activity would spread over the lake. They recommended that zonation to regulate activities was critical. The lake runs from the north of the country through Yeji in the Brong Ahafo Region, to the Eastern and Volta Regions.

According to the Ghana Ministry of Fisheries and Aquaculture Development, despite the huge size of the lake, not all of it was conducive for aquaculture. Zonation of the lake would therefore, drastically reduce the time and cost for investors to determine the best places to site their fish farms. Copies of maps identifying the best areas for aquaculture as determined by the zonation will be sent to all Government agencies with responsibility for regulating aquaculture on the lake as well as regional and zonal offices of the Fisheries Commission to guide potential investors.

The zonation will help to reserve the high priority areas for aquaculture on the lake for investment thereby reducing conflict and tensions with other users of the lake. It would also provide the necessary information for the Government to develop necessary infrastructure such as electricity, road networks and potable water to support aquaculture businesses in those areas.

Source: Graphic Online, 2018.

3.1.3 Seed

As reported in previous reviews, despite scattered improvement, the availability of and access to quality seed still remains a limiting factor for commercial aquaculture development in several SSA countries.

In the Kenya, shortages of good quality seed have been a bottleneck for development of tilapia farming. Traditionally, many tilapia farmers and particularly small-scale farmers use self-grown fingerlings or purchase them from neighbours. Such fingerlings tend to be of low quality. Although farmers could purchase tilapia seed from commercial seed producers, they are often unsatisfied with the quality in terms of size, growth and mortality rates. This is especially the case as they have to rely on trust because in the very early stages it is difficult to know whether the fingerlings are of good quality or not. A similar situation has been noted in several other countries, especially among emerging aquaculture producers in countries like Cameroon , Democratic Republic of Congo and Eswatini.

However, there have been some positive developments on seed supply chains in the last five years including the development of dedicated hatcheries with modern technologies to produce all-male tilapia fingerlings as well as spawning technologies to produce large numbers of African catfish fry. For example, a catfish hatchery has been designed to produce about 2.4 million fingerlings a year in Ughelli, Delta State, Nigeria (Waycott, 2018).

Seed production and distribution has become a lucrative business in many countries. In addition to direct seed supplies, hatchery operators such as Aquafeeds Ltd in Zimbabwe are providing other services as start-up kits, such as advice, training and sales of aquafeeds (Profeeds Zimbabwe, 2016).

New, technologically-advanced marine hatcheries have been developed in several countries including Seychelles, United Republic of Tanzania, Zanzibar and Madgascar. In Seychelles, groupers, snappers, sea cucumbers and sea urchins are currently being kept at a facility to be bred for commercial farming (Ernesta, 2019) while in United Republic of Tanzania, Zanzibar, sea cucumber, mud crab and milkfish hatcheries have recently been established (FAO, 2017c) and sea cucumber hatcheries have been set up in Madagascar (Robinson, 2013). New freshwater hatcheries for tilapia and catfish have also been built in several countries (Box 5).

Improved technologies and efficiencies for domestic shellfish hatcheries has led to reduced importation of seed (spat) in recent years in Namibia, Senegal and South Africa while research and experimental breeding trials for new species is on the rise including dusky kob (*Argyrosomus japonicus*) and rock lobster (*Panulirus* spp.) in South Africa (DAFF, 2015).

Box 5. Improving fish seed production in hatcheries

An FAO project promoting agricultural diversification in Eastern Africa introduced a range of adaptive technologies, including recirculation aquaculture, induced breeding and improved feed formulation, to 26 hatcheries in Kenya and Uganda. Over a two and a half year period (2015–2018) fingerling survival improved by 70 percent across all the hatcheries.

In Uganda, improved production practices increased seed production and at the same time increased the profitability of the enterprises, shifting average monthly gross income of all six private hatcheries from USD 8 205 to USD 41 848.

Source: FAO, 2018b.

3.1.4 Genetic resources

In terms of management of genetic quality in the seed supply system, where there is no genetic improvement programme in place, the basic principles of genetic management are often not followed which can result in a deterioration of quality and performance in just a few generations. Although there are anecdotal reports of this occurring in the SSA region, the main challenge can be the lack of monitoring tools, making it difficult to know if poor seed quality and performance is due to poor management or genetic deterioration (FAO, 2017d).

Nonetheless, genetic improvement programmes have been established in recent years while advances in pedigree-based, breeding programmes for both tilapia and catfish are in various stages of development in both the public and private sectors (FAO, 2017a). Some of the breeding programmes include giant tiger prawn (*P. monodon*) in Madagascar, abalone in South Africa, tilapia from Lake Volta in Ghana, tilapia sourced from local lakes in Uganda and African catfish in Kenya and Nigeria.

The increased focus on Nile tilapia for commercial aquaculture development in many parts of SSA has sparked debate, particularly in Southern and Eastern Africa countries where it is not native, centred on the relative merits of farming Nile tilapia versus indigenous species such as the three spot tilapia (*Oreochromis andersonii*), Tanganyika tilapia (*O. tanganicae*) and Shire tilapia (*O. shiranus)* in their respective watersheds. This issue needs to be resolved based on sound risk assessment, so that decisions can be made to move forward with

appropriate development of farmed types. In West Africa, there is another debate on the relative merits of introduced Nile tilapia types including genetically improved farmed tilapia (GIFT) developed under the GIFT project versus indigenous types of Nile tilapia. As GIFT was derived from a mix of different tilapia populations, its introduction and widespread use poses a risk for genetic contamination of native populations. This issue needs to be resolved and is also discussed in Chapter 4.1.2.

The main fund source for genetic improvement programmes has been governments and international organizations, as well as individual universities and private companies such as Lake Harvest Aquaculture in Zimbabwe which manages its own genetic selection-based breeding programme.

FAO and its partners, including WorldFish, have recently begun a global capacity-building programme in the conservation, sustainable use and development of aquatic genetic resources, with the aim of developing a model for improving the fish types that can be used in particular SSA countries (FAO, 2020b; FAO, 2017e). In the Southern African Development Community (SADC) region, FAO and WorldFish supported a Platform for Genetics and Biodiversity Management in Aquaculture through a German-funded project focused on Malawi and Zambia. This project was established partly with the aim of developing protocols to guide sustainable genetic improvement research and development (R&D) in Africa (FAO, 2019a).

3.1.5 Feed resources

There has been an expansion of local feed mills in recent years, driven largely by three international aquafeed companies: Skretting, AllerAqua and Ranaan. Feed mills have been established in Ghana (Ranaan), Kenya (Skretting), Nigeria (Skretting) and Zambia (Skretting and AllerAqua), producing aquafeeds largely for tilapia and catfish. Several domestic aquafeed manufacturers have also expanded or have established new feed mills in recent years to produce aquafeeds (mostly for tilapias and catfish) including Olam, Grand Cereals and Triton in Nigeria, Novatek in Zambia, AquaFeeds in Zimbabwe, LFL in Mauritius and Hill Feeds in United Republic of Tanzania. Many of the other countries in SSA import their feed from these producing countries, which adds to the high cost of feed.

According to a recent United States Soybean Export Council (USSEC) report, current demand for fish feed in SSA is entirely driven by the production of tilapia and catfish. This trend is likely to continue in the short to medium term. According to the report it is predicted that regional aquaculture production could reach 830 000 tonnes by 2023, potentially creating a demand for around 1.4 million tonnes of aquafeed. Based on the substantial contribution of semi-intensive, small scale aquaculture, the demand for commercially manufactured complete aquafeeds will most likely be close to one million tonnes per annum in 2023. The main growth is expected to come from the expansion and intensification of small-scale aquaculture (mainly African catfish farming in Nigeria) and the development of large, commercial culture systems for tilapia in Ghana, Kenya, Uganda and Zambia (Wright, 2019).

For some SME operators, especially in the less productive aquaculture countries, there are a variety of local feed manufacturing options, ranging from farmer-formulated meal-type diets to simple pellets produced with a meat grinder that are subsequently dried to form water-soluble, hard, sinking pellets. This is normally done to supplement higher quality commercial feeds.

The price of aquafeeds varies between and within countries according to source, the cost of feed ingredients and season. However, feed costs always appear to increase and many countries lack appropriate aquafeed policies, regulatory frameworks, and feed standards (FAO, 2017a).

3.1.6 Aquatic animal health and biosecurity

In 1996, the FAO Committee on Fisheries and Aquaculture published a technical paper which compiled and consolidated existing information on diseases and infections in African fish caused by viruses, bacteria, fungi and parasites. The paper also provided information on diagnostics to assist in the recognition of disease agents, relevant data on their effects on fish, the way they are transmitted and some suggestions for therapy and control (Paperna, 1996).

The OIE has listed the diseases in Table 11, reported from some wild populations and aquaculture farms in SSA (OIE, 2020).

Other diseases not listed in Table 11, which have significantly impacted aquaculture in SSA include infectious spleen and kidney necrosis virus (ISKNV) recently reported from tilapia in Ghana and seaweed disease in Eastern Africa.

Most of these diseases are regarded as transboundary aquatic animal diseases (TAADs) which are highly contagious and transmissible agents with potential for very rapid spread and may cause serious socio-economic and possibly health consequences.

In the last decade, the outbreak of white spot syndrome virus (WSSV) in Mozambique and Madagascar almost decimated the once-flourishing shrimp aquaculture sector in SSA. This prompted national governments to seek assistance from international agencies such as the World Bank and FAO. In response, FAO provided technical assistance to develop a sub-regional aquatic biosecurity strategy for shrimp for the three neighbouring countries at risk in the Mozambican Channel, Madagascar, Mozambique and United Republic of Tanzania (FAO, 2015a). In addition, the major shrimp producing companies invested significantly in on-farm biosecurity measures which included stopping using wild broodstock, since the WSSV is widely found in wild shrimp along the coast, and the utilization of specific pathogen-free broodstock genetically selected for resistance to WSSV.

As a result of these interventions, WSSV now appears to be under control in these countries and no new outbreaks have been reported. Consequently, there appears to be a rebound in shrimp production, with a significant increase in Madagascar. One of the major shrimp producers, Aquapesca, now estimates it will produce 1 000 tonnes in 2020, having discontinued production in 2011 due to the disease (Marcos, 2018). There is also growing interest to expand shrimp aquaculture in United Republic of Tanzania, although at present there is only one commercial shrimp farm.

Epizootic ulcerative syndrome (EUS) was first detected in the African continent in 2006 when it was confirmed in the Chobe-Zambezi River system, specifically in Botswana,

TABLE 11. World Organisation for Animal Health listed aquatic diseases in Africa

OIE listed aquatic disease in SSA	Reported cases
Epizootic ulcerative syndrome disease (EUS)	Wild, farmed freshwater and estuarine finfish mostly in Eastern, Southern and Central Africa
Koi herpesvirus disease (KHV)	Wild and farmed populations of carps and ornamental fish in Southern Africa
Spring viraemia of carp (SVC)	Carp populations in Southern Africa.
White spot syndrome virus (WSSV)	Wild and farmed shrimp populations in Eastern Africa
Acute hepatopancreatic necrosis disease (AHPND)	Shrimp populations in Eastern Africa
Abalone herpesvirus (AbHV)	Farmed abalone populations in Southern Africa
Bonamia exitiosa and Bonamia ostreae diseases	Farmed oyster populations in Southern Africa
Tilapia Lake Virus (TiLV)*	One case reported but not yet confirmed from Uganda.

Source: OIE, 2020.
* Still in the process of being listed by OIE.

Namibia and Zambia in both wild populations and on some fish farms. The disease largely affected finfish including African catfish and tilapias. The disease continued to spread with cases reported in South Africa in 2010. In 2014, EUS was reported in the Congo River catchment in Zambia and spread further to Central Africa where in early 2015 an outbreak was reported in the Congo Basin, Equateur Province, Democratic Republic of Congo. Surveillance data from Zimbabwe also indicated widespread incursion of EUS into multiple catchments of that country (Huchzermeyer, 2018).

The most recent outbreak was reported in eastern Malawi, bordering Zambia, during the winter of 2020 where the disease was reported from both wild and farmed fish populations including tilapia and African catfish (SADC, 2020). In all reported cases, FAO with local and regional partners and experts has offered technical emergency response assistance at national and regional level, including building capacity through training courses on active surveillance using the FAO 12-point surveillance checklist. Several knowledge-based materials are being used by the countries and other stakeholders for awareness and disease control (FAO, 2009). The University of Zambia and Rhodes University in South Africa are EUS diagnostic centres utilized by SADC countries.

The first confirmed case of ISKNV in Africa was reported towards the end of 2018 in Lake Volta, Ghana where tilapia cage farmers were reporting losses of up to 80 percent (Okai and Fletcher, 2019). The government reported that tilapia production reduced from 76 000 tonnes in 2018 to 52 000 tonnes in 2019. In an effort to control the disease, the government has approved the use of vaccines (AU-IBAR, 2020b).

Tilapia lake virus (TiLV) is an emerging disease under surveillance in several SSA countries, having been reported in Israel, Colombia, Ecuador and many other countries where tilapia is grown. Mugimba et al. (2018) reported the first detection of TiLV infection in farmed and wild Nile tilapia from Lake Victoria, Eastern Africa.

TiLV poses a serious risk to wild tilapia populations in African water bodies and has the potential to impede expansion of tilapia aquaculture in SSA, causing significant socio-economic harm including to small scale fish farmers. Within the framework of the project, Enhancing capacity/risk reduction of emerging tilapia lake virus (TiLV) to African tilapia aquaculture, funded by the Africa Solidarity Trust Fund, FAO is assisting Uganda, Kenya, Nigeria, Ghana and Angola to develop their TiLV National Action Plans. This includes building capacity on diagnostics, surveillance, information dissemination, national consultation and emergency preparedness while Zambia is receiving similar technical assistance under another project.

Since 2011, seaweed farmers in United Republic of Tanzania, Zanzibar have been experiencing decreased production partly due to seaweed die-off, specifically of *spinosum* and *cottonii* species. Die-offs are mainly caused by severe epiphyte infestation coupled with a high incidence of ice-ice disease (whitening of the thalli), which has long been observed by farmers to intensify during the hot-dry season and diminish during the wet season. High temperature in the farming sites is one of the main triggers of the ice-ice occurrence, as well as the bloom of epiphyte infestation. Another factor is high light intensity or irradiance. As seaweed farming in United Republic of Tanzania, Zanzibar is mainly done in shallow intertidal lagoons, seaweeds are almost in direct contact with the bottom substrate during low tides and hence exposed to higher temperatures and light intensity. This combination makes seaweed vulnerable to opportunistic pathogens, manifesting ice-ice disease. Bacterial infection leads to softening of the thalli and to their eventual fragmentation. These infestations and diseases are a continuing threat to the commercially farmed *eucheumoids* and makes seaweed production in United Republic of Tanzania, Zanzibar highly seasonal,

compared to the previous year-round production with harvest cycles every 30 to 45 days. This affects the income of seaweed farmers, many of whom are women (Largo, Msuya and Menezes, 2020).

In response, the FAO has worked with local institutions in United Republic of Tanzania, Zanzibar which has led to the formulation of emergency response projects to assist government and seaweed stakeholders (Largo, Msuya and Menezes, 2020). Some of the short term, on-farm management measures recommended in their report include implementing strict quarantine procedures, transferring the farming of seaweed to deeper waters (where practical) and improving the genetic stock with alternative local strains.

At the international level, FAO continues to provide guidance, including through knowledge-based material. For instance, within the FAO Code of Conduct for Responsible Fisheries (CCRF), voluntary technical guidelines on aquaculture development have been produced and published. Although these are voluntary instruments, CCRF has become a globally-recognized, international framework covering the world's marine, coastal and inland fisheries (including aquaculture) and is based on major international agreements. Examples of technical guidelines produced for aquatic animal health (AAH) include technical guidelines on the prudent and responsible use of veterinary medicines in aquaculture and technical guidelines on health management for responsible movement of live aquatic animals (FAO, 2019b).

The Codex Alimentarius, or "Food Code", has over the years, been useful in providing a collection of international standards, guidelines and codes of practice to protect the health of consumers and ensure fair practices in the food trade.

At the continental level, since 2017, AU-IBAR under the auspices of the Fisheries Governance Project, has been building capacity on AAH, through the implementation of focused programmes and activities to strengthen veterinary capacity for aquatic animal disease diagnosis, control and surveillance on the continent. These include the establishment of regional aquatic animal health networks, the development of knowledge-based products on current status of aquatic animal diseases within the continent (AU-IBAR, 2016b) and workshops and training programmes. AU-IBAR has been participating in consultative processes for the development of some national and regional AAH strategies, for example the Regional Aquatic Biosecurity Strategy (RABS) for SADC.

The OIE, within its mandate and through the Aquatic Code and Standards also continues to provide future direction and guidance to member states in efforts to prevent the spread of transboundary aquatic animal diseases. Focal points on AAH from national veterinary authorities have been established in several SSA countries in SSA with responsibility to establish a network of aquatic animal health experts within a country, support the collection and submission of aquatic animal disease information to the OIE, receive reports of the Aquatic Animal Health Standards Commission and conduct in-country consultation processes. The focal points are regularly trained by OIE and OIE was involved in the development of the SADC RABS. An Africa-based commissioner on AAH was recently appointed to represent the continent in the OIE Aquatic Animal Health Standards Commission which meets twice a year in France to set, update and review the Aquatic Animal Code and Aquatic Animal Health Diagnostic Manual, as well as to recommend and monitor reference laboratories.

The SADC regional aquaculture biosecurity strategy was developed through a systematic five-step process, which could be replicated in other SSA subregions:

- An aquatic animal health capacity and performance survey was completed in 14 out of 15 SADC countries to understand the current status of aquatic animal health and to identify areas of strengths and weaknesses.
- An international consultative workshop was held in Durban, South Africa (with partners including government of South Africa, AU-IBAR, SADC, OIE) to review the results and analysis of the FAO self-assessment survey and to discuss and approve the framework and contents for the RABS.
- A strategy was drafted based on the consensus reached during the Durban Workshop, with support from FAO and the government of South Africa.
- The strategy was adopted at the SADC Technical Committee on Fisheries in 2016.
- The strategy was integrating into the SADC aquaculture strategy and Action Plan (2016-2026). The SADC aquaculture strategy was approved by the SADC Ministers Responsible for Agriculture and Food Security, and Fisheries and Aquaculture in 2017.

Meanwhile, SSA countries are at various stages of developing their aquaculture biosecurity strategy (AB) or National Strategy on Aquatic Animal Health (NSAAH) including developing and updating their national pathogen lists. United Republic of Tanzania, Botswana, and Zambia have developed their NSAAH with support from FAO projects while FAO is providing support to several countries on active surveillance of TiLV and EUS (see Box 6). At the farm level, more companies are investing in on-farm biosecurity measures and adopting BMP to secure their stocks, in the context of what can be done at national level.

Although there is currently no official guidance on the use of antibiotics in aquaculture in SSA, they may already be in use and this is likely to increase as the sector grows and intensifies and new aquatic diseases emerge. FAO notes that antimicrobials are often misused, fostering the development of antimicrobial resistant micro-organisms. Antimicrobial resistance (AMR) has become a major global threat of increasing concern to human and animal health. It also has implications for food safety and food security and the economic wellbeing of millions of farming households. For this reason, FAO has recently begun working closely with its member countries (including SSA) to provide assistance, expertise and guidance as they develop National Action Plans that aim at curbing AMR in aquaculture. This includes increasing the awareness on AMR in aquaculture settings, enhanced collaboration among professionals and increased awareness of risk analysis as a tool to manage AMR (FAO, 2018c). The OIE began a programme on capacity building on AMR in the aquaculture sector and the application of risk analysis to manage it with training of OIE focal points in Southern Africa in 2019 (Obonyo, 2019).

3.1.7 Financial products and services

Lack of capital remains one of the greatest barriers to aquaculture development in SSA. Most SME operators still use their own savings or to a lesser extent borrow from local finance institutions to start fish farming. Many banks still perceive commercial aquaculture as risky, partly due to negative experiences and insist on collateral which influences decisions on whether to lend and how much to lend. In addition to very high interest rates, there is also the issue of inappropriate loan conditions. Some commercial banks in SSA are providing short-term loans and not medium or long-terms loans which are required to finance investment and cycles of production. Meanwhile, commercial aquaculture operators often lack knowledge on how to prepare and present loan applications and the type of information the bank requires.

Access to credit has improved in some countries and especially in major aquaculture-producing countries, as operators have demonstrated that with a shift to business-oriented models, aquaculture can be a viable proposition. The underlying problem is that most SME operators (and potential entrants) do not keep records and lack the

Box 6. Outbreak of Epizootic Ulcerative Syndrome (EUS) Disease in the SADC Region

The Government of Malawi on 29 July 2020 announced a suspected incursion of *Epizootic Ulcerative Syndrome* (EUS) in Mchinji District, bordering the Zambian town of Chipata. This was following reports received from Mchinji District Fisheries Office, fish farmers and fishers during mid-July 2020, where fish kills of species like African catfish, tilapia (*Oreochromis shiranus*) and *Barbus paludinosus* (straight fin barb) were observed and dead fish had ulcerative lesions on their skin.

EUS is a seasonal epizootic condition of great importance in wild and farmed freshwater and estuarine fish. The fungus involved in EUS is also known variously as *Aphanomyces invadans*, *A. piscicida, A. invaderis* and ERA (*EUS-related Aphanomyces*). It occurs mostly during periods of low temperatures and after periods of heavy rainfall. EUS is transmitted from one fish to another through the water supply. When EUS spreads into a fish culture pond, high morbidity (>50%) and high mortality (>50%) might be observed. Some infected fish may recover when the cold period is over.

Samples were taken during inspection of affected areas and were sent to the University of Zambia's School of Veterinary Medicine Laboratory, which is a Regional Diagnostic Centre for fish diseases. Unfortunately, histopathology and Polymerase Chain Reaction (PCR) tests were positive. Since EUS is a notifiable disease, the World Animal Health Organization (OIE) was notified and so far, the Government of Malawi has put in place measures to prevent further spread of the disease. This includes working with the SADC Secretariat through a Regional Emergency Task Force on EUS to develop a roadmap and coordinate efforts to address the situation. The Task Force consists of affected Member States (Malawi and Zambia) and regional partners (FAO, OIE and WorldFish).

Source: SADC, 2020.

business acumen to fully articulate their projects. In turn, private sector financiers lack the expertise to appraise aquaculture projects. Complex bureaucracy and rules make access to credit through public sector schemes difficult (Mapfumo, unpublished). Most large-scale investors in SSA have depended on external funding to kick-start a commercial aquaculture business and for initial working capital.

3.1.8 Infrastructure

Several countries, including some of the major aquaculture producing countries, lack basic infrastructure such as roads, transport, electricity, farming machinery and equipment to support growth of the sector.

Major infrastructure programmes such as hydro-electric schemes and transport 'corridors' are under development, driven by the rapid expansion of industries such as oil and gas as well as mining. These tend to be funded by China and other public-private partnership investments. Demand for infrastructure services currently exceeds supply, so in the short-term infrastructure and logistics constraints will remain a major factor determining the location, transaction costs and risks of carrying out aquaculture developments (Tralac, 2018).

In several countries, most of the public aquaculture infrastructure such as hatcheries and research centres needs to be upgraded. The majority were set up many decades ago with donor assistance but their long-term sustainability failed due to lack of exit strategies and adequate capacity of the stakeholders while they tend to have high maintenance costs and are difficult to manage.

Bilateral arrangements between African governments and development assistance programmes from developed countries have led to grant support for the establishment of national

aquaculture centres that include hatcheries. The Chinese government has supported the establishment of large hatcheries in several countries including Angola, Namibia and South Africa (Africa News Wire, 2013).

3.1.9 Research, knowledge and technological capacity

Aquaculture is a technology-driven industry in which modern tools are used to improve seed production, aquafeeds, genetic resources and other aspects of the industry. One good example is South African research on abalone culture technology, which is "homegrown" and internationally competitive providing South African abalone farmers with a global production advantage.

Sub-Saharan Africa is home to several academic institutions with aquaculture research capacity, but these tend to be geographically isolated with minimal networking and sharing of resources. Through concerted efforts and networking, these institutions could help alleviate some of the problems facing the sector. To this end AU-IBAR began a process to establish centres of excellence for fisheries and aquaculture across the continent, to enhance capacity building in the sector (AU-IBAR, 2016a).

The Aquaculture and Fisheries Science Centre of Excellence (AquaFish), based at Lilongwe University of Agriculture and Natural Resources (LUANAR), Malawi has trained a pool of skilled and innovative graduate students and aquaculture industry professionals in aquaculture business and entrepreneurship in recent years. Although the skills developed by this initiative can be applied in aquaculture, there is also scope to apply them in other business settings. FAO and SADC played an important role in providing a platform for training and linking private aquaculture actors from SADC to government officials and policy makers. This has allowed public and private stakeholders to gain a better understanding of their respective needs and challenges (FAO, 2020c).

Aquaculture research is mostly carried out by public institutions in departments of fisheries, in universities or research institutes, often with a main focus on natural resources or agricultural scientific research. Most aquaculture research stations are in poor condition with limited infrastructure, equipment and support. Research financing is generally limited and most research activities rely heavily on foreign financial assistance. Collaboration between aquaculture research and private aquaculture businesses is still limited although some large-scale farms are increasingly becoming active in on-farm research initiatives, linked to local universities.

In major farmed products such as seaweed, the importance of exploring new streams of biological and economic research on seaweed farming is a relevant pillar for mariculture (Murekezi, Martone and Menezes, 2020) . Social and economic research are other fields still to be explored, including improving governance of aquaculture employment (Hishamunda *et al*. 2014), improving the integration of aquaculture in national and regional policies (Murekezi, Martone and Menezes, 2020), and exploring new aquaculture models to boost and retain youth in the sector (Murekezi, Menezes and Ridler, 2018).

Partnership programmes offered by FAO continue to enhance knowledge and technological development on aquaculture. The recently launched EU-funded TRUE-FISH programme is an example, where the FAO is collaborating with Lake Victoria Fisheries Organization (LVFO), WorldFish and other local institutions. The programme aims to contribute to competitive, gender equitable and sustainable commercial aquaculture in the Lake Victoria basin, which includes the development of a cadre of local, skilled workers for aquaculture-related businesses (EAC, 2018).

In addition, the recently launched FAO FISH4ACP (FAO, 2020d) will work on fisheries and aquaculture value chains in ten ACP (African, Caribbean and Pacific) countries, to maximize economic returns and social benefits, while minimizing detrimental impacts on natural habitats and aquatic resources. The programme will pay special attention to small and medium-sized businesses because of their potential to deliver economic and social benefits, particularly for women and youth and includes the following SSA countries: Cameroon (shrimp), Côte d'Ivoire (farmed tilapia), Nigeria (farmed catfish), São Tomé and Príncipe (pelagics), Senegal (oysters), United Republic of Tanzania (Lake Tanganyika sprat, sardine and Nile perch) and Zimbabwe (farmed tilapia) (FAO, 2020d).

University and institutional-level collaboration has been instrumental in research, knowledge and technological development in Africa and needs to be further promoted. Over the years, such arrangements have fostered student and university staff exchange programmes where African students spend time at an international university to learn about aquaculture in a new environment. Scientific research partnerships have produced some good outcomes. For example, collaboration between the Institute of Aquaculture, University of Stirling, United Kingdom of Great Britain and Northern Ireland and the Water Research Institute in Ghana has led to a plan for improved and sustainable cage aquaculture on Lake Volta (Asmah *et al*., 2016).

Similarly, institutions in China have become regular training grounds on aquaculture technologies for several countries in SSA. The China Freshwater Fisheries Academy in Wuxi has conducted group training on aquaculture for students from Democratic Republic of Congo, Ghana, Malawi and South Africa facilitated under the Forum on China-Africa Cooperation (Godfrey, 2015).

WorldFish continues to be actively engaged in aquaculture technology research and development in SSA. According to a recent report, WorldFish cites the lack of adequately trained staff to undertake production programmes as one of the main constraints for development of aquaculture in Africa. The report also points to the major technical and on-farm challenges facing the sector such as stunted fish seed, high mortalities, poor aquatic health management, expensive fish feed, high levels of postharvest losses and low value addition. In response, WorldFish is the aquaculture lead partner in the knowledge and innovation-based programme, Technologies for African Agricultural Transformation (TAAT), supported by the AfDB and implemented by a wide range of development organisations. The aquaculture component of TAAT aims to increase fish production and self-sufficiency through intensification of existing aquaculture enterprises in ten African countries: Democratic Republic of Congo, Ghana, Kenya, Nigeria and Zambia as focal countries, and Benin, Burundi, Cameroon, Cote d'Ivoire and United Republic of Tanzania as satellite countries.

In late 2018, the TAAT aquaculture compact organized training on proven aquaculture technologies and BMP for representatives of national agricultural research and extension systems and aquaculture value chain actors from all ten countries. The two-week training took place at the WorldFish Africa Aquaculture Research and Training Center in Abbassa, Egypt (El Azzazy, 2019).

3.2 SALIENT ISSUES

There is a need for state actors to create enabling land access policies for large-scale aquaculture development, including the zoning of desirable land for aquaculture development, where some basic infrastructure and services are in place. This applies not just to inland aquaculture systems but also to the bulk of the SSA coastline which has yet to be exploited for commercial mariculture. The challenge is access to public infrastructure and services, and in some cases

security and tenure. As with zoning on land, the concept of aquaparks, which is increasingly being adopted in several SSA countries, is a good way to stimulate investment in aquaculture, although the private sector still tends to find the risks unacceptably high. The FAO Blue Growth Strategy for the Development of Fisheries and Aquaculture in Eastern Africa (FAO, 2018d) recommends the formulation of national plans for the expansion of aquaculture by allocating zones for certain culture systems and species, and to facilitate decision-making by investors when selecting locations for their farms. Long-term sustainability of aquaculture requires good spatial planning and management, starting with appropriate zoning and selection of sites, followed by the adoption of good area management practices. The strategy further recommends the creation of integrated coastal zone development plans, with land and water user rights for large and small-scale users, including youth.

The lack of quality seed remains a serious problem in many SSA countries and increased efforts to develop dedicated hatcheries with appropriate modern technologies are needed. In terms of management of genetic quality in the seed supply system (where there is no genetic improvement), basic principles of genetic management are often not followed which can result in deterioration of quality and performance of seed in just a few generations. The main challenge is the absence of any monitoring tools, which can make it difficult to know if poor seed quality is due to management or genetic deterioration. In addition, the ongoing debate on introduction of genetically improved Nile tilapia in some parts of Eastern and Southern Africa need to be addressed.

Difficult access to aquaculture investment and operating loans remains one of the stumbling blocks in development of the SSA aquaculture sector. Innovative ways of helping small and large-scale farmers to access capital are much needed.

The needs to be special emphasis, led by OIE, on strengthening national veterinary capacity for aquatic animal disease management, especially at a time when SSA is facing significant threats from emerging aquatic diseases.

Aquafeed availability and quality is a major constraint to the growth of aquaculture production in SSA. Producers express doubts about the quality of both imported and locally produced aquafeeds. Improvements to the quality and preparation of such feeds should boost productivity and reduce costs. Feed formulation issues, in particular the provision of species-specific feeds that meet the nutritional requirements of different life stages, remain important for both commercial and farm-made feed. In addition, appropriate aquafeed policies, regulatory frameworks and feed standards are lacking in many SSA countries.

There is a need for adaptive and innovative aquaculture practices in all SSA countries. They could be further explored by each country or enterprise and should be based on real needs and expectations. These include development of appropriate technologies to produce all-male tilapia, large-scle production of African catfish seed, genetic improvement including pedigree-based breeding systems, promotion of RAS aquaculture and mini hatchery technology for water conservation and high quality seed production, expansion of local feed mill capacity, improved pond construction and rehabilitation, improved cage culture technologies, integration of aquaculture with other agricultural sectors (rice-fish, animal-fish etc.) and the promotion of integrated coastal aquaculture.

3.3 THE WAY FORWARD

Aquaculture has strong potential to effectively contribute towards the 2030 Agenda for Sustainable Development, but it can also generate negative impacts. The responsible use, management and conservation of aquatic species and genetic improvement through selective breeding programmes has significant potential to reduce negative impacts. The drivers and pathways for emergence of aquatic animal disease need to be better understood to find innovative ways to deal with them in a cost-effective and sustainable way. Innovative intergrated agriculture-aquaculture systems efficiently use scarce resources and deserve more attention, including integrated multi-trophic aquaculture, where fish are grown along with other agricultural crops, livestock, or trees.

Securing long-term tenure is essential, with full support from government bodies allocating production rights. Development of pond farming or other forms of extensive or semi-extensive aquaculture are highly dependent upon reliable access to suitable water resources. Agreements to access and share water need to be established in advance.

Public sector agencies should continue increasing their investment in aquaculture research and education, support research in feed and seed, enforce research-extension linkages and promote digital aquaculture. Through their various national or regional programme frameworks, development organizations such as the European Union, FAO, WorldFish, and others should continue providing technical assistance to SSA aquaculture, including through the AU framework.

Innovations to upscale aquaculture and cope with challenges such as climate change and environmental degradation are required. Farmers and producers must be involved in the process through participatory and non-formal education approaches such as Farmer Field Schools and farmer-to farmer exchanges. The support and capacity development provided to rural entrepreneurs should be pursued and remain inclusive to all kinds of producers (rural, urban, farmers, youth, women, etc.) as well as technical staff, rural advisers and other value chain stakeholders. Networking has also become a critical component for innovation. At the national level, support for communication platforms already used by African farmers and aquaculture stakeholders is recommended, as well as the development of partnerships with key institutions and networks including AU-IBAR, ANAF and Sustainable Aquaculture Research Networks in sub-Saharan Africa (SARNISSA) to develop regional research and teaching capacity. South-south cooperation is another way of supporting knowledge spread.

FAO has developed a framework for effective management of genetic resources in aquaculture and is also developing a registry of farmed types of genetic resources which will enable countries to collate and monitor information on their resources below the level of species. These knowledge and guidance products could be useful to SSA.

As the SSA aquaculture sector can be regarded as emerging, with fewer diseases compared to other world regions, the approach to aquatic biosecurity should be more preventative, rather than solution-based, proactive and systematic rather than ad hoc and piecemeal while plans should also be long-term and sustainable. Many countries do not have national strategies and action plans on aquatic animal health. Regional strategies are also important, particularly for the management of TAADS. Such strategies may require regular review to take into account emerging issues and also need to place special emphasis on building capacity on risk assessment and understanding national and regional aquatic disease profiles. Understanding the economics of disease burdens and social impacts requiring behavioural change are also important. The process of developing, adopting and implementing the SADC RABS can be replicated in other RECs of SSA.

FAO has initiated the development of a new initiative, the Progressive Management Pathway (PMP) tool to assist national and international improvement of biosecurity in aquaculture production. The PMP for Aquaculture Biosecurity (PMP-AB) is an extension of the "Progressive Control Pathways" (PCP) approach which has been internationally adopted to assist countries as a systematic framework for planning and monitoring risk reduction strategies for control of major livestock and zoonotic diseases. Most PCPs relate to control of single diseases or disease complexes. In contrast, the PMP focuses on building management capacity through a bottom-up approach with strong stakeholder involvement to promote the application of risk management at producer level as part of the national approach. The progressive management pathway for aquaculture biosecurity (PMP/AB) was endorsed at the 2019 COFI subcommittee on Aquaculture (FAO, 2019b) and FAO intends to begin capacity building initiatives (including training and improved awareness and communication of the PMP/AB approach) prior to its launch, pilot testing and systematic implementation under focused projects.

4. Aquaculture and environmental integrity

4.1 STATUS AND TRENDS

4.1.1 Scarcity of land and water resources

In general terms, African land and water resources have been barely tapped for aquaculture production compared to other regions of the world. A WorldFish report projected that if fish farming was adopted on only one percent of the 250 million hectares in Africa identified by the FAO as suitable for aquaculture, the continent could produce an additional 3.5 million tonnes of fish each year (WorldFish, 2011).

Meanwhile a recent assessment by FAO (Table 12) compared the 1.98 percent share of world aquaculture tonnage in 2017 produced by Africa (including North Africa) with its 22 percent share of total world land area (including inland water surface), its 10 percent share of total world renewable water resources and its 16.5 percent share of the world population.

Africa's contribution of four percent towards world inland aquaculture production in 2017 was also less than half of its 8.8 percent share of world total inland water surface area (FAO, 2020e).

However, the situation varies by country and across regions. For example, freshwater aquaculture has not grown significantly in most countries of Southern Africa, largely due to scarcity of water. For example, the South African environment is too cold to reliably grow tilapia and catfish in conventional systems and it does not have enough cold mountain streams to support higher production of trout (Herbst, 2013).

TABLE 12. Africa: Aquaculture growth potential from a supply-side perspective

Africa (2017)	Share of world total
Total land area (excl. coastal waters)	22.41%
Surface area of inland water bodies	8.84%
Total renewable water resources	10.29%
Population	16.48%
Aquaculture production (all areas)	1.98%
Aquaculture production (inland waters)	4.12%
Aquaculture production (marine areas)	0.27%

Source: FAO, 2020e.

4.1.2 Spatial planning for aquaculture

To improve the economic efficiency of operations, technologies such as Geographical Information Systems (GIS) and remote sensing are being used to identify suitable aquaculture sites. In recent FAO aquaculture projects in Angola, Kenya and Eswatini, unmanned aerial vehicles (drones) have been used in reconnaissance fieldwork for aquaculture site selection or mapping of suitable zones for aquaculture. Atlases were produced under these projects to guide governments and other aquaculture actors in their strategic planning for aquaculture ventures (see Box 7, Saunders *et al.*, 2017).

4.1.3 Biodiversity and introduced species

Although there are several cases of species being introduced for aquaculture in SSA, there is still limited research and monitoring being carried out to determine the impacts of these introductions and limited guidance for future developments (Gupta *et al.*, 2004).

Box 7. Drawing an atlas to guide aquaculture spatial planning in Kenya

There is considerable potential for development of mariculture in Kenya. However, the expansion and long-term sustainability of this will require good spatial planning and management, starting with the appropriate zoning and selection of sites, followed by the adoption of good area management practices. Spatial planning will help determine where and how to best develop aquaculture enterprises that are socially inclusive, equitable and environmentally responsible, and that provide opportunities for sustainable and profitable businesses and decent work on farms as well as from supporting economic activities.

Geographical Information Systems (GIS) and remote sensing tools were used to develop an aquaculture atlas, which is an important spatial planning tool to support the development of environmentally sustainable and socio-economically responsible mariculture. The atlas provides invaluable information to help guide the Government of Kenya and others in formulating a systematic plan for the expansion of aquaculture by allocating zones for certain culture systems and species, and to facilitate decision-making for investors when selecting locations for their farms. It can also help in the creation of integrated coastal zone development plans and help anticipate and address the impacts of sea level rise on the intertidal and supratidal locations required for marine aquaculture.

Source: Saunders *et al.*, 2017.

Reported cases of introductions in the past ten years include *Pangasius* spp. in Nigeria and Kenya. Similarly, Australian red claw crayfish (*Chelax quadricarinatus*) was introduced in Zambia through aquaculture and this species has spread to many water bodies in the country. The impacts of red claw crayfish on the Zambian environment and other introductions have yet to be determined (Kefi and Mwango, 2018; Agenuma, 2013)

Nile tilapia has been introduced for commercial aquaculture in several SSA countries where it is not indigenous, notably in Mozambique, Zambia and Zimbabwe. It is now not only widely present in recipient river systems but also being farmed on a large scale. Although there are still ongoing debates regarding impacts on the environment and ecosystems of these countries, the socio-economic benefits have often prompted decision makers to allow the introduction and movement of Nile tilapia. However, there are countries such as Malawi, and regions of South Africa and Zambia, where Nile tilapia has not yet become established and prospective fish farmers need to carry out risk assessments for the introduction of Nile tilapia to inform national authorities for decisions on whether to allow its introduction.

Despite the widespread introduction of Nile tilapia, national environmental laws in SSA countries often specifically prohibit or stipulate strict control over species introductions, which will only be approved under exceptional circumstances. The Nairobi Declaration on Conservation of Aquatic Biodiversity and Use of Genetically Improved and Alien Species for Aquaculture in Africa provides regional guidance on introductions. The African Union in 2003 added political weight to this position by requesting that member states strictly control the intentional and as far as possible, accidental introduction, in any area, of species not native to that area. The Code of Conduct for Responsible Fisheries (CCRF) is the reference guide for the management of aquaculture in SSA and over 40 SSA countries have ratified the Convention on Biological Diversity (CBD). Both the CCRF and CBD seek to establish a precautionary approach to the use of alien species (FAO, 2017a). In SSA, it is not known if the low number of reported introductions reflects adherence to these instruments or just that such introductions are simply not reported.

4.1.4 Antibiotics, chemicals and fish escapees

There is regular use of chemicals in SSA aquaculture, which as reported in the previous review, in most cases are considered safe except through negligent management (FAO, 2017a). Some of the chemicals commonly used in aquaculture include lime, fertilizer, therapeutants and feed additives. Most fish farms will solicit expert advice as well as involve national aquatic competent authorities for guidance on their use.

Although there are presently no known official statements on the use of antibiotics in aquaculture in SSA, this needs to be considered as the sector intensifies and new aquatic diseases emerge. However, the transmission of pathogens and parasites between farmed and wild fish and vice versa is difficult to determine and yet to be adequately reported in SSA.

FAO has developed voluntary technical guidelines which are intended to provide general advice in support of the implementation of the CCRF and thus have no formal legal status (FAO, 1995). Section 9, "Aquaculture Development" directly addresses some of the broader issues related to the prudent and responsible use of veterinary medicines in aquaculture, including the need for appropriate environmental assessment and monitoring of drug and chemical use and impacts (Sections 9.1.5 and 9.2.5); the safe and appropriate use of feed additives, including veterinary medicines added to feeds (Section 9.4.3); the need to promote effective farm and fish health management practices, including favouring of hygienic measures and vaccines and the safe, effective and minimal use of therapeutants, hormones and drugs, antibiotics and other disease-control chemicals (Section 9.4.4); the need for states to regulate the use of chemical inputs in aquaculture that are hazardous to human health and the environment (Section 9.4.5); and, the need for states to ensure the safe disposal of veterinary medicines used in aquaculture (Section 9.4.6).

The information presented in the technical guidelines document is meant to assist with consideration of issues related to the implementation of the provisions of the CCRF. Furthermore, any differences in the terminology employed should not be considered as a reinterpretation of the Code. These guidelines, which also support The FAO Action Plan on Antimicrobial Resistance 2016–2020, are intended to be flexible and capable of evolving as circumstances change or as new information becomes available.

4.2 SALIENT ISSUES

As African aquaculture is generally regarded as under-developed compared to other regions of the world this justifies the need for states and other actors to promote aquaculture investments. Proactive spatial planning has proven to be essential for successful aquaculture development in many parts of the world because it takes into account the many interactions between aquaculture farms and surrounding ecosystems.

For existing cases of introduced aquaculture species in SSA, there is a need for research and monitoring studies to determine the impacts of such introductions. Countries must be encouraged to conduct risk assessments prior to the introduction of non-native species, in line with their overarching national environmental regulations and relevant international declarations, instruments and best practices which include continuous research and monitoring.

Environmental management responsibilities largely lie with the fish farmers, and through continued education, awareness and the application of BMPs most of these farmers are increasingly conscious of "doing the right thing".

4.3 THE WAY FORWARD

The AU-IBAR has recently developed the Framework on Environmental Management for Sustainable Aquaculture Development in Africa (see Box 8). This support tool will facilitate a range of international and regional environmental strategies and guidelines, in a manner specific to the nature and character of African aquaculture.

With support from development partners, including FAO, SSA countries and their RECs are encouraged to develop guidelines to be used as the baseline from which to develop environmentally sound and sustainable aquaculture sectors. The SADC region has been progressive on this front where it developed its Best Practice Aquaculture Management Guidelines (BPAMG) which were approved by SADC Ministers in June 2019 (SADC, 2019). Capacity building support for their implementation and monitoring is required. The process of guideline development, adoption and implementation can be replicated in other regions of SSA.

As part of the FAO Blue Growth Initiative (BGI), FAO Member Countries of the eastern Africa sub-region agreed on a strategy for the development of fisheries and aquaculture within the Blue Growth Initiative which considers the broader coastal ecosystem, including fisheries and aquaculture, rather than individual sub-sectors (FAO, 2018d).

FAO, in its efforts to assist member countries to develop aquaculture in a sustainable manner, has developed spatial planning tools and key publications which can be used by SSA states while capacity building support is needed for risk assessments on introductions of exotic species.

Box 8. Regional Framework on Environmental Management for Sustainable Aquaculture Development in Africa

The Regional Framework on Environmental Management for Sustainable Aquaculture Development in Eastern Africa and the Great Lakes Region is based on principles of FAO's Ecosystem Approach to Aquaculture (EAA) and Code of Conduct for Responsible Fisheries. It adapts these concepts to the Comprehensive Africa Agriculture Development Programme (CAADP) and the AU Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa (PFRS).

This regional framework has consequently been developed to ensure aquaculture development in the region conforms to the principles that promote responsible use of natural resources to ensure sustainability and equitable benefits for stakeholders and citizens of Eastern Africa and the Great Lakes Region. In conformity to this, this framework is built upon six core principles, notably:

- profitable – improve the productivity, incomes and potential to generate wealth from sustainable aquaculture practice;
- inclusive – accommodate and meaningful engagement of communities, disadvantaged groups as well as other sectoral actors.;
- healthy – supports nutritional well-being of society as well as ecosystem health;
- smart – expands opportunities for the region's people to succeed nurturing them through to life-long learning, ensuring higher and more widely shared achievements by ensuring the best use of technology and training for aquaculture; and,
- green – safeguarding environmental goods and services for the future generations by developing the sector within parameters of the regions environmental carrying capacity and thus building capacity for responsible use of natural resources for aquaculture development.

Source: AU-IBAR, 2016c.

5. Markets and trade

5.1 STATUS AND TRENDS

5.1.1 Demand for aquaculture products

Sub-Saharan Africa has a high overall demand for fish, yet availability from capture fisheries combined with population growth are deficient per capita fish consumption rate has dropped. The 2017 annual food fish supply in the region was estimated at 8.8 kg per capita, while the global average rose to 20.3 kg per capita (FAO, 2020f). In 2018, SSA imported over 3.1 million tonnes of fish valued at nearly USD 4.1 billion (excluding aquatic plants). Growth of aquaculture therefore provides the most sustainable option for the region to reduce its food fish deficit.

Five factors will increase the demand for aquaculture products in years to come: (i) increasing populations; (ii) decreasing or stagnating supply from wild fisheries; (iii) rising awareness of the health benefits from consuming fish; (iv) the fact that fish remains the preferred source of protein in many countries; and (v) an increase in the numbers of affluent middle-class consumers who are able to pay more for farmed fish.

5.1.2 Domestic markets

Domestic demand for farmed fish products continues to increase and markets are expanding as the regional population increases. Urban markets are growing significantly and expected to do so in years to come. The UN estimates that the proportion of Africa's population living in urban areas will rise from the current 43.45 percent to 48.37 percent by 2030 (FAO, 2020e). An analysis of FAO statistics shows that most of the tilapia and African catfish produced in SSA is consumed in domestic markets and intra-regionally, with minimal exports out of Africa. There is also growing domestic demand for high-value products in some upper middle-income countries such as South Africa, where such products are increasingly featuring in restaurants and large retail chains. Table 13 presents a synopsis of the main farmed fish products commonly sold in the domestic markets.

Tilapia supply chains from local fish farms are now well established in SSA, with large industrial-scale producers selling significant volumes of fresh fish, year-round. Most of these have their own cold storage facilities, including refrigerated trucks, for distribution to major urban centres, where they have established distribution depots and retail outlets. A common feature of the supply chain at most of the farm-gates and distribution centres are informal fish vendors, many of them women, who come in large numbers to buy small quantities of fish in plastic containers for distribution to their localities in urban areas. Such business practices have supported women's livelihoods and affirmed their importance in the aquaculture supply chain. This is mainly evident in Ghana, Zambia and Zimbabwe.

Markets for fish seed, especially tilapia and catfish fingerlings, are also growing substantially and are expected to increase. As discussed elsewhere, this is partly in response to the promotion of aquaculture, including the proliferation of independent SME farmers and an interest in stocking private and public water bodies, both in leading aquaculture countries as well as those where aquaculture has not yet developed. This has led to an increase in dedicated private hatcheries, some of which are contracted by governments or development agencies to provide regular fingerling supplies to promote and stimulate aquaculture in new areas.

TABLE 13. Farmed fish products commonly sold in domestic markets

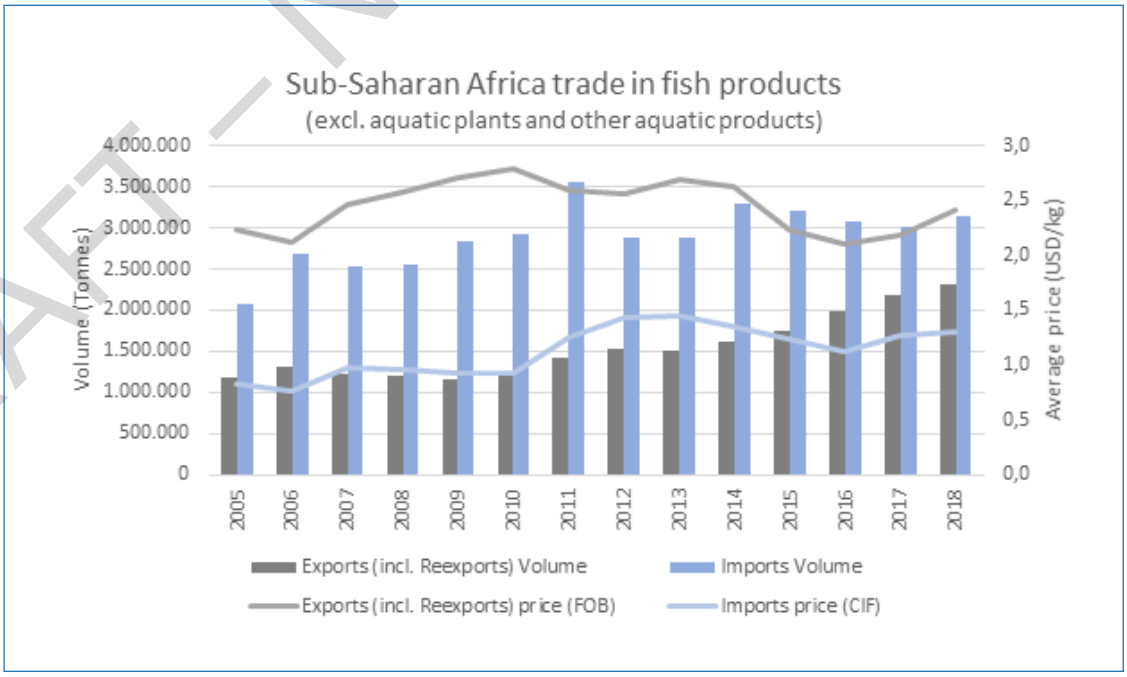
Product	Key producer countries	Main product forms	Domestic distribution	Main producing companies (examples)
Tilapias	Nigeria, Uganda, Ghana, Zambia, Kenya, Zimbabwe	Whole round (fresh on ice) Whole gutted (fresh) Whole gutted (frozen) Some processed fillets Fingerlings	Farm gate sales Own distribution trucks to several towns Own fish shops Direct links to some middlemen Regular supplies to local hotels and restaurants	Tropo Farms, Ghana Yalelo, Zambia Lake Harvest Aquaculture, Zimbabwe, Victory Farms, Kenya Triton, Nigeria SON, Uganda
African Catfish	Nigeria, Uganda	Live (table size) Smoked Some processed fillets Uganda fingerlings for Nile perch bait	Farm gate sales Own distribution trucks to several towns Direct links to middlemen & retailers	Several SME producers
Trout	South Africa, Lesotho, Kenya	Value added products (smoked, filleted) Fresh on ice	Mainly fresh sold to high income earners, some high-end retailers and local restaurants	Three Streams Trout, South Africa Highlands Trout, Lesotho
Molluscs/shellfish (oysters and mussels)	South Africa, Namibia, Senegal	Mainly fresh but also frozen (mussels) and canned	Large retail shops, local restaurants	Various SME farms
Seaweeds (kelp)	South Africa	Kelp	Feed for abalone farms	

Sources: Author's analyses of FAO trade statistics (FAO, 2020a), national aquaculture reports and personal communications with producers.

5.1.3 Exports and imports

Overall, the general trend remains that SSA countries import more fish than they export, at least in terms of quantity, and that they import low-value fish for domestic consumption and export high-value fish as shown in Figure 6 and Table 14. Unless otherwise stated, trends and the contribution of fish to international commodity trade as well as consumption data are usually reported as aggregated, including both wild and farmed fish.

FIGURE 6. Exports and imports of aquatic products in sub-Saharan Africa 2005–2018 (tonnes)



Source: FAO, 2020a.

TABLE 14. Comparative analysis of fish imports volumes (tonnes) and values (USD 000) by sub-Saharan Africa subregion in 2000 and 2018 (excluding aquatic plants)

Country/area	Imports of fish and fish products (excl. aquatic plants and other aq. animals) Quantity (tonnes net-product weight)		Annual growth rate (%)
	2000	2018	
World	25 058 406	37 844 593	3.8
Africa	1 576 631	3 919 472	8.6
Sub Saharan Africa	1 275 579	3 139 274	8.5
Eastern Africa	113 464	500 642	14.4
Middle Africa	176 849	487 745	9.7
Southern Africa	187 487	312 001	4.7
Western Africa	797 779	1 838 886	7.9
Top largest importers in SSA (tonnes)			
Côte d'Ivoire	235 597	552 008	8.0
Nigeria	314 836	524 023	4.7
Ghana	171 361	357 806	6.9
South Africa	43 834	270 393	18.0
Cameroon	82 300	193 332	8.1
Mauritius	44 449	161 425	12.4
Congo, Dem. Rep. of the	61 584	125 487	6.7
Burkina Faso	12 401	117 725	22.7
Benin	21 219	107 520	15.9

Country/area	Imports of fish and fish products (excl. aquatic plants and other aq. animals) Value (USD 1 000)		Annual growth rate (%)
	2000	2018	
World	60 091 281	159 693 191	9.3
Africa	947 556	5 673 966	17.7
Sub Saharan Africa	733 565	4 101 958	16.9
Eastern Africa	88 780	831 503	22.6
Middle Africa	103 764	750 915	19.7
Southern Africa	112 159	589 827	16.3
Western Africa	428 862	1 929 713	14.7
Top largest importers in SSA (thousand USD)			
Nigeria	181 565	831 665	14.8
Côte d'Ivoire	132 069	534 675	13.6
South Africa	59 125	505 066	21.5
Mauritius	41 688	312 896	20.1
Ghana	83 645	285 952	11.8
Cameroon	27 736	241 088	21.7
Angola	16 328	197 720	25.4
Seychelles	11 497	163 767	27.3
Congo, Dem. Rep. of the	26 217	153 666	17.4

Source: FAO, 2020a.

In 2018, SSA imported 3.2 million tonnes of fish and fish products, valued at USD 4.1 billion (including aquatic plants and aquatic products) (Table 14), an increase of 6.2 percent in value and 3.6 percent in volume compared to 2017. However, imports declined by 5.0 percent in volume and 8.8 percent in value compared to 2014. This was mainly due to the decline in imports by Nigeria, one of the major importing countries in SSA for fish and fish products. In 2014, Nigeria began the implementation of a new import quota regime for fish to stimulate the self-sufficiency in fish production. Over four years, an annual 25 percent cut in imports was planned, with an annual baseline fish import figure of 700 000 tonnes for 2014. This reduced the allowable quantity of imported fish to 500 000 tonnes per year (Towers, 2014).

Many countries in SSA are importing farmed fish and other aquaculture products from outside Africa, particularly frozen tilapia from China, India and Thailand, to meet domestic demand. The last decade has also seen an increase in imports of other processed fish products including pangasius from Vietnam, shrimp from India and Thailand, mussels from New Zealand and salmon from Europe. Most of these regularly feature in upmarket restaurants of middle-income countries. The importation of live, genetically-improved broodstock or spat for trials and for improved commercial production is common in some SSA countries. Examples of these imports are listed in Table 15.

Several countries import frozen fish products, mostly from China, to satisfy increasing domestic demand as reported in the previous SSA review (FAO, 2017a). Concerns have been raised by domestic producers and producer associations who see substantial and in some cases, unregulated imports negatively impacting efforts to develop domestic aquaculture (see Box 9). Frozen tilapia lands in Africa at less than USD 1.50 per kg, which is lower than the cost of production for most large-scale African producers, largely due to the high cost of fish feed. In an effort to counter such competition, Ghana, Nigeria, Uganda and Zambia have imposed regulatory measures that include tariffs or import bans on frozen tilapia from China (Okai, 2018a).

The major driver for export of farmed fish products to countries outside Africa is that most of these are high-value or value-added commodities which are less affordable for the majority of consumers in SSA, but have good demand in export markets. Although the bulk of home-grown tilapia and catfish is destined for domestic markets, small volumes

Box 9. African farmers struggle to compete with cheap Chinese tilapia

Importing vast quantities of frozen tilapia from China, sometimes illegally, is having a negative impact on African fish farmers. Africa is the main destination for China's tilapia export industry. According to FAO, African countries imported 83 000 tonnes of whole, frozen and breaded tilapia in 2016, comprising 64 percent of China's total frozen tilapia exports. In value terms, in 2013 China officially exported USD 38.7 million worth of tilapia to Côte d'Ivoire, USD 14.7 million to Burkina Faso, USD 4.8 million to Ghana and USD 4 million to Togo. Current trends indicate that exports to West Africa are rising.

This is not good news for West Africa's fragile aquaculture industry, which is seeking to establish a firm foundation for closing the substantial gap in the continent's fish production, while illegal tilapia imports are also becoming a matter of concern to both tilapia farmers and regulators of the industry. Imported tilapia may be banned in Nigeria, but aquaculture producers have still been complaining about the volumes of foreign tilapia brought in from Benin. Although customs often seize fish and poultry products that are smuggled into Nigeria, the widespread availability of imported products shows that their efforts are not working. The fish farmers would like the government to close down those outlets that sell black market fish and argue that foreign tilapia is only so cheap because the smugglers do not pay taxes on them.

A similar problem exists in Ghana. Substantial amounts of foreign tilapia are available on the market, in spite of the 2014 ban on imports, which was intended to protect the local industry. Tilapia farmers and distributors are yet to raise their voices about competition from foreign products, but they are concerned by their quality.

Live tilapia import bans from from Columbia, Ecuador, Egypt, Israel and Thailand, were also imposed in 2019 by Benin and the Côte d'Ivoire in order to prevent the spread of tilapia lake virus.

Source: Okai, 2018b.

TABLE 15. Imports of aquaculture products from outside Africa

Product	Origin (outside Africa)	Remark
Frozen tilapia	Mainly China	Several SSA countries are importing frozen tilapia from China in large volumes to satisfy domestic demand
Mussels	New Zealand	A common product in restaurants and retail chains in Southern Africa
Pangasius	Vietnam	Sold in some South African restaurants and as frozen product in some West and Central African countries
Frozen shrimp	India and Thailand	Sold in many supermarket chains and up-market restaurants
Salmon	Norway, EU	Sold in restaurants and affluent retail chains in Southern and Eastern Africa
Live (fingerlings, spat, broodstock)	Various (mainly from Asia, EU, USA)	Commercial fish farms import genetically improved broodstock or spat for example, GIFT tilapia from Malaysia for trials in Ghana, genetically improved African catfish from Europe to Kenya, oyster spat from South America to Namibia, Nile tilapia broodstock from USA to Zimbabwe

of processed, value-added products are exported to overseas markets while trout products from Lesotho are exported to Japan, abalone and oysters from Southern Africa have well-established markets in Asia and shrimp from Madagascar has a market foothold in Europe. Table 16 shows a list of some of the SSA aquaculture products exported to overseas markets.

TABLE 16. Exports of farmed fish products to markets outside Africa (Source: various country reports and other projects)

Product	Product form	Origin country	Export destination
Tilapia	filleted	Zimbabwe	UK, UAE
African Catfish	smoked/dried	Nigeria Uganda	USA, EU
Trout	fresh, frozen, filleted	Lesotho	Japan
Shrimp	fresh, frozen	Madagascar	Mainly EU (France)
Abalone	canned, frozen	South Africa, Namibia	Mainly China
Oysters	live	South Africa, Namibia	Far east, Asia, China
Seaweed	raw (unprocessed)	United Republic of Tanzania, Madagascar	EU, USA
Red drum and seabass	fresh, filleted	Mauritius	Mainly EU (France)
Caviar	caviar	Madagascar	Mainly EU (France)
Pearls	pearls	United Republic of Tanzania	EU, USA
Sandfish	dried	Madagascar	Mainly China
Ornamental fish	live	South Africa, Kenya, Malawi, Cameroon, Burundi	Asia (China, Japan, etc)

5.1.4 Intra-African trade in aquaculture products

Aquaculture products are increasingly entering African regional trade routes for fish and fishery products as processed or fresh products. In most cases, regional bilateral trade arrangements facilitate and promote this trade.

A significant quantity of aquaculture production from Uganda (tilapia and African catfish) is transported to neighbouring countries including Democratic Republic of the Congo, Kenya, Rwanda and South Sudan. Tilapia, in various product forms, produced in Zimbabwe has found its way to a number of Eastern and Southern African countries including Democratic Republic of Congo, South Africa and Zambia. Catfish produced in Nigeria (largely in smoked form) is exported to several neighbouring countries including Cameroon, Democratic Republic of Congo, Ghana and Niger. Oysters produced in Namibia and trout produced in Lesotho are exported to South Africa.

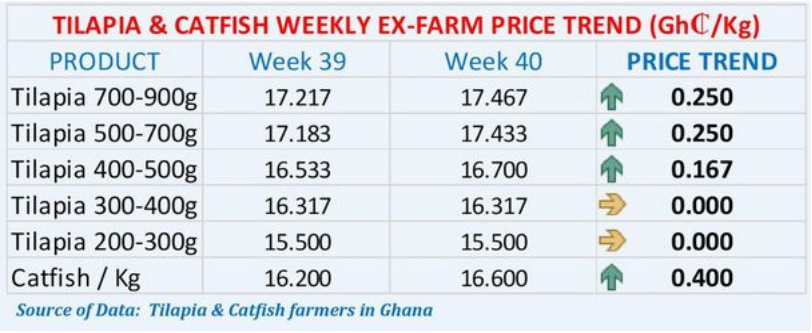
Fish feed products are also marketed between regions. For example, fishmeal produced in Mauritius and South Africa is exported to several countries in Africa, partly for fish feed production. Fish feed produced by large-scale, commercial feed companies in Ghana, Kenya, Mauritius, Nigeria, South Africa and Zambia is also exported regionally.

5.1.5 Domestic market services and information

A significant development in the region is the enthusiasm for farming fish especially by small producers, due in part to improved marketing information that enables producers to access domestic markets. There is increasing use of information and communication technology (ICT), including mobile smartphones that has revolutionized marketing systems. The use of social media tools such as WhatsApp groups and Facebook has not only enhanced the exchange of information but has also brought fish producers and traders closer to consumers and this trend is expected to continue.

There is good evidence of organized, clustered, small-scale producers experiencing improved market access, amongst other benefits. Consequently, some are now able to export their products in meaningful volumes through economies of scale and their ability to meet export standards. Examples are catfish farmers in Uganda under the Walimi Fish Farmers Cooperative Society (WAFICOS) and seaweed producers in United Republic of Tanzania, Zanzibar. Countries such as Nigeria, Uganda and Zambia have recently started

FIGURE 7. Ghana Chamber of Aquaculture weekly price report for 28 September 2020



TILAPIA & CATFISH WEEKLY EX-FARM PRICE TREND (GhC/Kg)

PRODUCT	Week 39	Week 40	PRICE TREND
Tilapia 700-900g	17.217	17.467	0.250
Tilapia 500-700g	17.183	17.433	0.250
Tilapia 400-500g	16.533	16.700	0.167
Tilapia 300-400g	16.317	16.317	0.000
Tilapia 200-300g	15.500	15.500	0.000
Catfish / Kg	16.200	16.600	0.400

Source of Data: Tilapia & Catfish farmers in Ghana

Source: Chamber of Aquaculture Ghana, 2020.
Ghana Cedi 1 = USD 0.17.

conducting annual fish trade shows or symposia where producers, processers and traders can showcase some of their farmed fish products. These events have attracted significant local and international participation of fish farmers and other value chain actors, including local producer organizations, input suppliers, marketers and researchers, attracting support from governments, NGOs and international development organizations.

Aquaculture associations in key producer countries have begun tracking and widely disseminating prices for farmed fish products in domestic markets as a service to their members. For example, the Ghana Chamber of Aquaculture, provides a weekly price report for farmed tilapia and catfish (Figure 7) while examples of other associations publishing market and price information include the Catfish Farmers Association of Nigeria, the Zimbabwe Fish Producers Association and WAFICOS in Uganda (Chamber of Aquaculture Ghana, 2020).

5.1.6 Standards for farmed fish products

There has been a focus on the development and harmonization of national and regional standards for fish, including farmed fish, in SSA region over the past decade due largely to the need to protect consumer health and ensure fair practices in the food fish trade. With technical assistance from the FAO and other parties, several SSA countries have in recent years developed and adopted national standards for the farming, handling, processing, storage and distribution of fish and fishery products. These have been aligned with international instruments such as Code of Practice for Fish and Fishery Products and the FAO Code of Conduct for Responsible Fisheries (Mukasa, 2014; see also Box 10).

The adoption of regional standards has largely been necessitated by the need to harmonize requirements governing the quality of products and services in regional economic communities. It is envisaged that through harmonized standardization, trade barriers within Regional Economic Communities will be removed. Member states, through their National Bureaus of Standards, have in recent years established standards development processes which include representatives of the national standards bodies, the private sector and consumer organizations.

An example is the SADC region where, since 2017, SADC Cooperation in Standardization (SADCSTAN) has developed 11 harmonized fish standards in line with the SADC Protocols on Fisheries and Trade. These standards and specifications, which can be accessed through national standards bodies in SADC member states, include those pertinent to aquaculture products such as farmed tilapia, fresh and frozen whole finfish, fresh and chilled fish, quick frozen fish fillets, smoked finfish, smoke-flavoured finfish and smoke-dried finfish, salted fish,

Box 10. New inspection and certification facility aims to boost fish trade in Africa

WorldFish and the Common Market for Eastern and Southern Africa (COMESA) launched the COMESA Fish Inspection and Certification Facility in Luangwa, Zambia on the border between Zambia, Zimbabwe and Mozambique. The facility, which was built by WorldFish through the European Union-funded FishTrade project (Improving Food Security and Reducing Poverty through Intra-Regional Fish Trade in sub-Saharan Africa), was the result of WorldFish research that identified challenges impeding cross-border trade. These included lengthy customs and bureaucratic formalities at border posts and a lack of harmonized regional fish standards and conformity assessments.

As part of the project, which was implemented under the CGIAR Research Program on Fish Agri-Food Systems and in partnership with the African Union Inter-African Bureau for Animal Resources and NEPAD Planning and Coordinating Agency, WorldFish trained and registered two cross-border fish trader associations, who will co-manage the facility with the Government of Zambia. COMESA, an economic bloc of 21 countries, will install equipment for testing the quality and safety of fish products crossing the border. Certification will take place according to the regional harmonized fish standards facilitated by WorldFish and approved by the Southern Africa Development Community (SADC) in March 2017. The standards cover 11 products and areas, including fresh, frozen, farmed, salted and smoked fish, fish snacks, fish sausages, canned sardines and Good Aquaculture Practices for tilapia. At least three SADC countries have already adopted the standards in their national policies.

Source: Worldfish, 2018.

dried salted fish and fish sausages. There are also SADC good aquaculture practices for tilapia aquaculture. According to SADC, these standards are helping to increase trade amongst private sector associations, in particular fish processors and traders (largely women) and aquaculture producers, to make better use of expanding trade opportunities through competitive small and medium-scale enterprises (SADC, 2017). Similarly, the EAC region has standards for the handling, processing, storage and display of fish and fishery products (EAC, 2000).

As a national example, South Africa has an advanced regulatory system for the monitoring of fish standards. The National Regulator for Compulsory Specifications (NRCS), an entity of the Department of Trade and Industry, was established to administer compulsory specifications and other technical regulations to protect human health, safety and the environment, and to ensure fair trade in accordance with government policies and guidelines. NRCS has compulsory specifications for frozen fish, frozen marine molluscs, canned fish and other seafood products. These specifications cover the requirements for handling, preparation, processing, packaging, freezing, storage and quality of frozen fish, frozen marine molluscs, frozen fish products and frozen marine mollusc products intended for human consumption. Smoked, dried and salted fish are also included. It also covers requirements for factories and employees involved in the production. The manufacture and importation of fish and fish products is also strictly controlled by NRCS (NRCS, 2020).

5.1.7 Eco-labelling and certification for farmed fish products

Although the region is an insignificant player in the international trade of aquaculture products, a number of export-oriented aquaculture countries such as Madagascar, Mauritius and South Africa are capitalizing on export markets and adopting appropriate certification and labelling mechanisms.

In 2011, Lake Harvest Aquaculture in Zimbabwe, having complied with strict European production standards, became the only fish farming operation in Africa certified by GLOBALG.A.P., a review body that sets voluntary standards for environmentally and socially

sustainable aquaculture. However, Lake Harvest discontinued GLOBALG.A.P. certification in 2016 citing the high cost of the process. In 2015, following an audit by an independent certification body, the South African abalone company, Abagold, was found fully compliant with all the Friend of the Sea (FoS) criteria for sustainable aquaculture and became the first abalone company in the world to be awarded FoS certification (Friend of the Sea, 2015).

The largest shrimp exporter Madagascar, UNIMA Group Ltd has recently obtained "Label Rouge" certification (UNIMA, 2020), the first ever granted to a black tiger shrimp producer. Label Rouge is an official sign of quality granted by the French Ministry of Agriculture and Fisheries certifying the superior taste and flavour of the shrimp, validated by a panel of experts and consumers. It identifies shrimp that have been produced, processed and distributed to stringent quality standards. The company has also recently been awarded Aquaculture Stewardship Certification (ASC) for its aquaculture farm, Aqualma, located in Mahajamba, on the northwest coast of Madagascar (WWF, 2016).

Ferme Marine de Mahebourg, Mauritius (FMM), a marine aquaculture farm producing red drum and seabass, was recently certified by Friend of the Sea. FMM is the only large-scale mariculture farm in Mauritius and it also operates an EU approved, state-of-the-art processing plant to the highest international standards. According to the company, FoS certification has enabled it to strengthen its market position with EU customers (Friend of the Sea, 2009).

Individual fish farms, including tilapia and trout farms in Southern Africa, are exploring the possibility of accessing globally recognized third party certification schemes such as Aquaculture Stewardship Council and GLOBALG.A.P. (E. Hinrichsen, personal communication, 2019).

Following requests from member states, FAO developed technical guidelines on aquaculture certification, ecolabelling and other instruments, partnering with other institutions such the Global Sustainable Seafood Initiative (GSSI, 2020). Such global, non-binding guidelines are helping SSA countries promote and develop the aquaculture sector in a more sustainable, responsible and market-oriented way.

The African Union Development Agency (AUDA-NEPAD), in partnership with the African Organization for Standardization (ARSO), national standard bodies and the private sector, has launched a capacity-building programme on ecolabelling standards for farmed tilapia and catfish through EcoMark certification (FoodTechAfrica, 2019b). The goal is to increase the number of EcoMark Africa (EMA) certified aquaculture products in Africa to support responsible and equitable fish trade and marketing that will increase the benefits of aquaculture in Africa through trade and accelerated commercialization. So far, an SME fish farm in Kenya, Kamuthanga fish farm, has become the first African fish farm to receive the EcoMark Africa label through ARSO. It was awarded a platinum level EMA certificate, the highest of four certification levels, indicating that the tilapia produced at the farm for the Kenyan market is sustainable, incorporating key social and environmental aspects in the production processes (Larive International, 2019). Some other fish farms in Nigeria, Uganda and Zambia are currently under self-assessment for possible certification.

5.2 SALIENT ISSUES

Demand for aquaculture products is expected to increase in years to come, largely due to increasing populations, decreasing or stagnating supplies from wild fisheries, rising awareness of the health benefits of consuming fish and an increase in the numbers of affluent middle class consumers able to pay higher prices associated with some types of farmed fish.

Tilapia has become the favoured fish dish in SSA and the recent rapid expansion of domestic and intra-regional markets has created confidence in expansion of commercial tilapia aquaculture in the region.

Global demand for other species is growing, especially for marine species that can be successfully grown in SSA. The major driver for exports of farmed fish products to countries outside Africa is that most of these are high-valued or value-added commodities, which are less affordable for most consumers in SSA.

The demand for fish seed (eggs, fry and fingerlings) to serve the grow-out sector is expected to stimulate the establishment and viability of commercial hatchery businesses.

Marketing information services have generally improved in key producer countries with the utilization of ICT services. Producer associations in several countries, in their product promotion drives, have begun tracking and widely disseminating prices for farmed fish products on domestic markets.

The development and harmonization of national and regional standards for fish, including farmed fish, has been in the spotlight in SSA region over the past decade largely due to the need to protect consumer health and ensure fair practices in the food fish trade.

5.3 THE WAY FORWARD

SSA needs to focus on increasing investment in sustainable and competitive aquaculture to help reduce reliance on fish imports. This will improve and expand domestic supplies of locally-produced fish and ensure intra-regional markets are well sustained. The availability of better and up-to-date information on markets, consumer requirements and demand at domestic, regional and international level is important. The reduction of trade barriers to improve access to key aquaculture inputs such as fish feed, seed and aquaculture equipment should not be overlooked. Efforts to improve standards, to embrace certification and to develop more value from the farmed fish will open new markets for SSA farmed products.

Continued guidance efforts by FAO and other parties, such as WorldFish, is essential to strengthen aquaculture value chains and modernize domestic market chains.

States need to continue efforts to reduce trade barriers to improve access to key aquaculture inputs such as fish feed, seed and aquaculture implements. The same applies for the smooth movement of market-sized fish beyond borders.

At the intra-regional level, where possible, there should be a reduction in regional and international trade barriers and the harmonization of import and export regulations through strengthening the capacity of competent authorities and facilities to fully implement food sanitary and phytosanitary (SPS) regulations and risk analysis.

Commercial tilapia and catfish producers now have the opportunity to adopt a home-grown and affordable certification scheme, the EcoMark Africa label for responsible and equitable fish trade.

The continent is now looking forward to the implementation of the recently adopted African Continental Free Trade Area agreement (AfCFTA), which will constitute the world's largest free trade area, consolidating an integrated market of 1.3 billion consumers with a combined GDP of approximately USD 3.4 trillion. The objective is to realize a continent-wide single market for goods and services with free movement of business, persons and investments.

This will also entail the elimination of tariffs on 90 percent of product categories. Removal of such trade barriers will help to improve efficiency, enhance competition, and incentivize development of strategic solutions to local challenges through regional economies of scale, but also advance the efficacy of resource allocation.

6. Contribution of aquaculture to food security, social and economic development

6.1 STATUS AND TRENDS

6.1.1 Fish supplies, food and nutrition security

The African Union has recognized that total fish production in Africa does not meet its food fish requirements. With an estimated population of 1.3 billion people and a current annual per capita fish consumption rate of 9.9 kg, many important wild fish stocks are reportedly either fully or overexploited and fish is increasingly being imported (AU-IBAR, 2016a). The AU now looks to aquaculture as a sustainable option for increasing the continent's fish production. This recognition stems from the Africa's natural resource potential for aquaculture and rapidly increasing demand for fish meaning that in most SSA countries, aquaculture is being promoted as a sector with potential for economic growth, wealth creation and increased food and nutrition security.

There are generally limited data available on the consumption of farmed fish in SSA. While there is some literature on fish consumption in general, with the acknowledgment that farmed fish plays a role in filling the gap between national fish supply and demand, disaggregated data on the consumption of farmed fish are not widely available. A recent WorldFish report points out that less than two percent of Africa's total fish supply comes from aquaculture while projections show that if fish farming was adopted on only one percent of the 250 million hectares in Africa identified by the FAO as suitable for aquaculture, the continent could potentially produce 3.5 million more tonnes of fish each year (WorldFish, 2011).

Fish protein consumption in SSA has risen from 2.2 g per capita per day in 2000 to 2.6 g in 2017, when fish contributed 22.6 percent towards average animal protein consumption (FAO, 2020a). However, there are still wide variations between countries and subregions as shown in Table 17. Average consumption rates were over 30 percent of per capita protein intake in Western and Middle Africa as fish has become a relatively affordable protein source compared to other animal proteins. In contrast, the relative contribution of fish to per capita protein intake was less than 20 percent in Eastern and Southern Africa as both subregions have countries that prefer other protein sources such as chicken and beef. Northern Africa (Sudan) has the least with just over one percent.

In the ten key aquaculture producing countries the highest rates of fish contribution to animal protein were in Ghana (54 percent), Nigeria (37 percent) and Uganda (31 percent), whereas Sudan (1.1 percent), Kenya (6 percent) and Zimbabwe (9 percent) have the least.

In terms of annual per capita fish consumption, the SSA rate appears to have gone down by seven percent from 2014 to 2017, from 9.5 kg to 8.8 kg. This trend applied to all subregions except Eastern Africa where it increased slightly from 5.3 kg to 5.5 kg (Tables 18 and 19). The driving force behind this overall decrease could be a combination of population increases and reduced fish supplies from both capture fisheries and aquaculture. This is further exemplified by Nigeria, where a 27 percent drop in consumption corresponds with a five percent drop in aquaculture production and a 53 percent decline in imports of fish for human consumption.

On the other hand, the establishment of aquaculture farms has created much needed employment which is essential for achieving food security and reducing poverty in SSA. In a general sense, in order to be able to access food, poor people rely on the income from their labour, because it is often the only asset they have. Moreover, the amount of income

TABLE 17. Contribution of fish to animal protein intake in sub-Saharan Africa

	Per capita protein intake in 2017 (g/capita/day)		
	Fish products	Animal products	Fish share (%)
World	5.6	32.3	17.3%
Africa	2.9	14.0	21.0%
Sub-Saharan Africa	2.6	11.6	22.6%
Eastern Africa	1.7	9.5	17.7%
Middle Africa	3.3	10.2	32.5%
Southern Africa	1.7	33.0	5.3%
Western Africa	3.5	10.8	32.7%
Northern Africa (Sudan only)	0.3	28.1	1.1%
Top 10 fish farming countries in SSA (ranked by 2018 tonnage)			
Nigeria	2.7	7.1	37.3%
Uganda	3.4	10.9	31.0%
Ghana	8.2	15.2	53.9%
Zambia	3.6	11.7	30.4%
Tanzania	2.3	9.4	24.4%
Kenya	0.9	15.1	5.8%
Zimbabwe	1.0	11.6	9.1%
Sudan	0.3	28.1	1.1%
Malawi	3.6	12.2	29.4%
Madagascar	1.7	9.4	18.1%

Source: FAO Food Balance Sheets of fish and fishery products (FAO, 2020f).

TABLE 18. Regional fish consumption patterns in sub-Saharan Africa (kg per capita per year)

	2014	2017	% change
World	19.6	20.3	4%
Africa	10.5	9.9	-6%
Sub-Saharan Africa	9.5	8.8	-7%
Eastern Africa	5.3	5.5	4%
Middle Africa	12.9	11.2	-13%
Southern Africa	7.0	6.4	-9%
Western Africa	13.0	11.9	-8%
Northern Africa (Sudan)	1.0	1.1	10%

Source: FAO Food Balance Sheets of fish and fishery products (FAO, 2020f).

TABLE 19. Fish consumption in the most populous countries of sub-Saharan Africa (2014 and 2017)

Most populous nations in SSA				
	Population (2017)	**Consumption (kg/capita)**		
		2014	2017	% change
Nigeria	190 873 000	12.4	9.1	-27%
Ethiopia	106 400 000	0.5	0.5	0
Congo, Dem. Rep. of the	81 399 000	5.2	5.0	-4%
South Africa	57 010 000	7.1	6.4	-10%
Tanzania, United Rep. of	54 660 000	6.3	7.0	11%
Kenya	50 221 000	4.1	3.1	-24%
Uganda	41 167 000	14.4	11.3	-22%
Sudan	42 813 000	1.0	1.1	10%
Angola	29 817 000	26.4	20.2	-23%
Ghana	29 121 000	22.0	25.3	15%
Mozambique	28 649 000	10.9	12.5	15%

Source: FAO Food Balance Sheets of fish and fishery products, (FAO, 2020f).

generated from work determines the amount and quality of food that workers and their families can purchase, and also access to fish from the fish farms they work for.

6.1.2 Source of employment, income and wealth creation

Recent FAO statistics on the number of fish farmers in SSA (primary sector) show an estimate of 300 863 fish farmers in 2018 (Table 20) with Madagascar (43 800), Kenya (43 016) and Ghana (32 268) as the top three countries (Table 20).

There were about 8 000 people employed in aquaculture in Zambia in 2014, most of whom were working in the large-scale commercial sector, including the feed and seed sectors as well as processing. A more recent WorldFish report (Genschick *et al.*, 2017) predicts that with ongoing developments in the sector, there may be as many as 22 000 jobs in Zambian aquaculture by 2022. The seaweed sector in United Republic of Tanzania, Zanzibar employs nearly 24 000 farmers, of which 90 percent are women (Largo, Msuya and Menezes, 2020).

In Nigeria, about 13 627 people were reported to be employed in the aquaculture sector in 2012, of which two percent were women (FAO, 2017e). For every 100 tonnes of fish produced, 150 jobs are created in the country, according to the FAO (FAO, 2014a).

The emphasis on commercial aquaculture development in several countries has created direct and indirect jobs across the value chain and support activities. Aquaculture has become a new source of year-round, well-paying jobs in a number of countries. On most large-scale tilapia and catfish farms, over 70 percent of the jobs are full-time. Meanwhile, shellfish farming is characterized by some level of seasonality and, as a result, many of the jobs tend to be part-time.

In Eastern Africa, the largest employer in the aquaculture field, Lake Harvest Aquaculture Group, with a production volume of over 10 000 tonnes in 2019, provides nearly 800 direct and indirect jobs at its parent operations in Zimbabwe and subsidiary operations in Uganda and Zambia. The company has become the third largest employer in the town of Kariba, Zimbabwe (AfDB, 2011). Yalelo Fish Farm (12 000 tonnes in 2019), in neighbouring Zambia, employs about 800 workers at its farm and other operations, including distribution depots around the country (FoodBusinessAfrica, 2020). The company has a joint venture arrangement with Danish aquafeed producer AllerAqua, which employs 270 employees. Yalelo has recently initiated plans to set up another large-scale operation in Uganda, where it plans to grow over 10 000 tonnes of tilapia per year, representing a five-fold production increase (subject to regulatory approval).

The UNIMA shrimp aquaculture group in Madagascar employs over 1 500 people at its farms, producing over 5 500 tonnes of shrimp per year. UNIMA is the main and sometimes the only, source of formal employment in areas of Madagascar with very high unemployment. It has been estimated that one hectare of commercial shrimp farming in Madagascar can generate labour equivalent to USD 827 income per year and 0.64 jobs (FAO, 2014a). In Ghana, Tropo Farms, the second largest tilapia farm in Africa, has around 800 direct and 700 indirect employees.

In addition to producing food fish for local markets, these large-scale ventures are also actively engaged in corporate social responsibility (CSR) initiatives. For example, Tropo works closely with local communities to maintain community roads, provide boreholes for water, and support housing, skills and training.

TABLE 20. Number of fish farmers in Sub-Saharan Africa in 2018
(Employment patterns – country level examples)

Geographical region	Country	Gender	2018	FAO estimation
Eastern Africa	Burundi	M	6 000	X
	Ethiopia	F	51	
		M	483	
	Kenya	M	43 016	X
	Madagascar	M	43 800	
	Malawi	F	9 300	
		M	5 700	
	Mauritius	F	47	
		M	136	
	Mayotte	F	0	X
		M	3	x
	Mozambique	F	125	x
		M	69	x
	Rwanda	F	5 465	x
		M	5 415	x
	Tanzania, United Rep. of	F	10 098	
		M	12 500	
	Uganda	F	1 091	x
		M	4 221	x
		U	16 005	x
	Zambia	F	2	x
		M	27	x
		U	12 836	x
	Zimbabwe	U	4 933	x
Eastern Africa Total			**181 323**	**x**
Middle Africa	Angola	F	2 238	x
		M	2 396	x
	Cameroon	F	815	x
		M	873	x
		U	20 041	x
	Central African Republic	U	3 248	x
	Chad	F	1	x
		M	86	x
	Congo	F	51	x
		M	294	x
	Congo, Dem. Rep. of the	F	713	x
		M	1 666	x
		U	10 628	x
	Equatorial Guinea	F	14	x
		M	16	x
	Gabon	F	144	x
		M	155	x
Middle Africa Total			**43 379**	
Southern Africa	Botswana	M	3	x
	Eswatini	F	212	x
		M	228	x
	Lesotho	F	159	
		M	544	
	Namibia	F	80	
		M	236	
	South Africa	U	3 257	
Southern Africa Total			**4 719**	**x**

Geographical region	Country	Gender	2018	FAO estimation
Western Africa	Benin	F	1 052	
		M	2 495	
	Burkina Faso	M	1 370	x
	Cabo Verde	F	33	
		M	12	
	Côte d'Ivoire	U	1 078	x
	Gambia	F	863	x
		M	399	x
	Ghana	F	581	x
		M	32 268	x
	Guinea	F	1 168	
		M	2 726	
	Liberia	F	556	x
		M	932	x
	Mali	F	94	
		M	2 540	
	Niger	M	27	x
	Nigeria	F	275	
		M	15 360	x
	Senegal	M	2 173	x
	Sierra Leone	F	49	x
		M	53	x
	Togo	F	303	
		M	5 035	
Western Africa Total			**71 442**	**x**
Total SSA			**300 863**	**x**

Gender: M= Male; F= Female; U= Unspecified
Source: FAO FishStatJ (FAO, 2020a

Notably, some of these large fish farms have recently become important training grounds for university and college graduate trainees or interns, who get exposure to farm operations and systems through company internship programmes, enhancing their knowledge and skills. This helps to fulfil regional aspirations for youth employment in aquaculture.

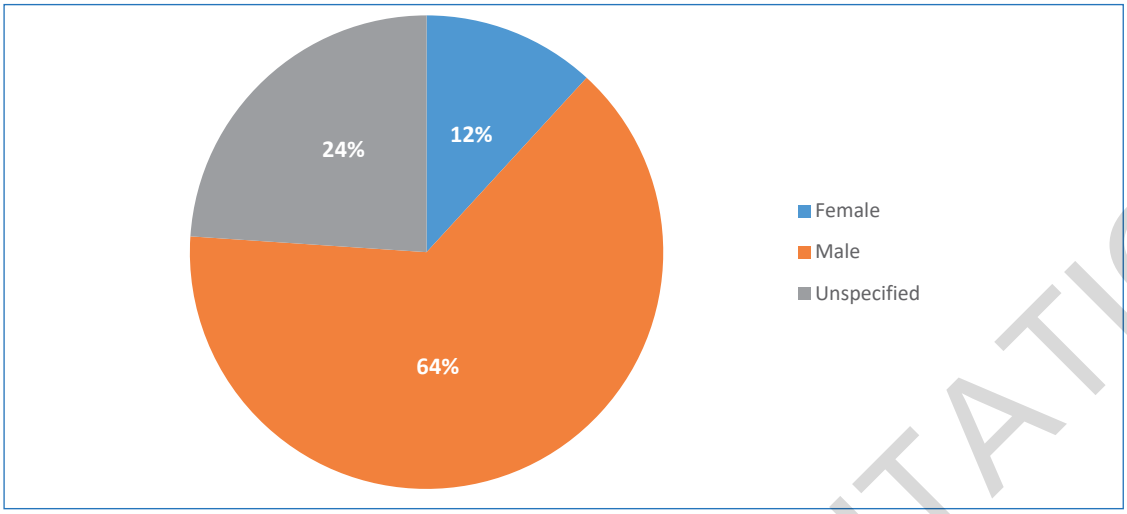
6.1.3 Women and youth in aquaculture

Although the role of women and youth has not been fully documented, there is evidence of direct involvement in the sector, particularly in small-scale production and as owners of fish farms.

According to FAO statistics (Table 20), out of the 300 863 fish farmers in SSA in 2018 (primary production), only about 12 percent were women. However, it should be noted that during data collection and disaggregation, a large proportion was regarded as "unspecified" (Figure 8).

Women tend to be more actively involved in post-harvest operations (fish processing and marketing) than in fish farming. For example, approximately 30 percent of the directly employed labour force on shrimp farms in Madagascar are women, whose jobs are in post-harvest operations or administration (FAO, 2006). Similarly, a number of women are employed in fish processing plants at large scale farming operations such as those in Zambia and Zimbabwe. Informal fish traders or vendors are mostly women and have become an important part of the distribution chain, as seen at fish distribution centres in Zambia (Lake Harvest Aquaculture) and Ghana (Tropo Farms). Many of these women come to buy fish

FIGURE 8. Estimated total women fish farmers in 2018



Source: FAO FishStatJ.

in small quantities for onward distribution within their urban localities. Seaweed farms in United Republic of Tanzania, Zanzibar, Madagascar and Mozambique are family-owned businesses and more than 80 percent are owned or managed by women.

Some of the common challenges faced by women include access to land resources and other tenure issues, access to credit, lack of start-up or investment capital and skills. There tend to be few focused projects to attract women into aquaculture.

Youth unemployment and underemployment are serious concerns in sub-Saharan Africa, especially given the region's young population. The barriers young people face stem both from skills deficiencies and from weak fundamentals that constrain job creation more generally in the region (Betcherman and Khan, 2018).

The growth of aquaculture has not yet meaningfully affected youth unemployment in the region, although there are efforts underway in countries such as Kenya, Nigeria, Seychelles and Zambia. As with women, the engagement of youth as owner-operators of fish farms is challenging due to barriers to entry into the sector, primarily access to finance. In addition, access to land, markets and skills need to be addressed, as discussed in Box 11.

6.1.4 Producer and service provider organizations

There has been a notable increase in the participation of fish farmers' associations in several SSA countries. These organizations perform a range of important functions including ensuring that farmers' voices are heard when defining research agendas, national and continent-wide policy making, improving dialogue and exchange among producers and enabling producers to better share their successes and failures. Many of these associations are involved in consultative efforts to develop aquaculture policies, strategies, and programmes and are holding annual events or symposia that bring together fish farmers and other actors in the aquaculture value chain.

6.1.5 Regional aquaculture support networks

Since 2018, the AU and its partners (including FAO) have been working on a process to revitalize and transform the Aquaculture Network for Africa, which was established in 2006 with support from FAO to foster sustainable aquaculture in Africa. The establishment of ANAF has been inspired by the NACA, a successful intergovernmental organization that has pioneered cooperation and collaboration on aquaculture development. Efforts are underway to restructure ANAF, including placing its Secretariat at AU-IBAR.

Box 11. New inspection and certification facility aims to boost fish trade in Africa

Youths in Cameroon are progressively making a living from fish farming. The young entrepreneurs engaged in aquaculture as a means to diversify sources of fishery products are due to benefit from financial support for their projects. Some 300 aquaculture enterprises have already been identified in the Centre, Littoral and South regions of Cameroon.

In a bid to empower local producers, boost the local economy and create jobs for young Cameroonians the Ministry of Livestock, Fisheries and Animal Industries through its partner, the International Fund for Agricultural Development (IFAD) is supporting the youths. The multifaceted support from IFAD comprises the development of production skills and techniques to boost enterprises. It is expected that about 1 500 jobs will be generated in the three regions following the support. The agreement for the financing of aquaculture projects in Cameroon worth USD one million donated by IFAD was signed on 29th January, 2016 in Rome, Italy. The Project for the Promotion of Aquaculture Entrepreneurship (PPEA) in the Ministry of Livestock, Fisheries and Animal Industries that facilitates the implementation of the projects in the field eases access to appropriate technologies for production, processing and conservation. It also provides inputs and aquaculture products.

Source: Teke, 2018.

TABLE 21. Examples of aquaculture associations in sub-Saharan Africa

Subregion	Organization
Eastern Africa	Walimi Fish Cooperative Society (WAFICOS), Uganda Aquaculture Association of Kenya (AAK) Aquaculture Association of Tanzania (AAT) Aquaculture Development Association of Zambia (ADAZ)
Western Africa	Tilapia and Aquaculture Developers Association of Nigeria (TADAN), Fisheries Society of Nigeria (FISON) Ghana Chamber of Aquaculture (GCA) Senegal National Aquaculture Association (SNAA)
Southern Africa	Aquaculture Association of South Africa (AASA) Tilapia Aquaculture Association of South Africa (TAASA) Mariculture Association of Namibia
Middle Africa	Aquaculteurs du Cameroun (AQUACAM)

At the sub-regional level, the AU has recently established non-state actors (NSA) platforms in fisheries and aquaculture in all the five regional economic communities of Africa. These platforms are for implementation of continental fisheries and aquaculture sectoral reforms and plans are underway to establish an apex continental NSA platform (AU-IBAR, 2019a).

The AU Policy Research Network for Fisheries and Aquaculture in Africa (PRNFA) was established in 2019, with support from AU-IBAR with roles to build research partnerships that focus on generating information for producers and consumers and crafting policy briefs for key issues and challenges affecting aquaculture development in the continent (AU-IBAR, 2017)

At the continental level, other platforms include the Research Network for Sustainable Marine Aquaculture in Africa (AfriMAQUA) which was established in 2019 to bring together researchers in the field of marine aquaculture from Southern Africa (Namibia, South Africa); Eastern Africa (Kenya, Mauritius, United Republic of Tanzania) and Western Africa (Côte d'Ivoire, Senegal) to facilitate scientific cooperation for the development of sustainable marine aquaculture in the continent (AfriMAQUA, 2020).

The SARNISSA network has continued to be an important, extensive and open platform for the exchange of information and knowledge on aquaculture, with thousands of subscribers (SARNISSA, 2020).

In 2018, the World Aquaculture Society established a chapter in Africa which is hosted at the African Union Development Agency (AUDA) in South Africa. The role of WAS Africa Chapter (WAS AC) is largely to facilitate science, technology, education, and information exchange, thus contributing to the development of aquaculture in Africa. From 2021, WAS AC will host annual aquaculture conferences and expositions, with the first planned for Egypt in December 2021, then Zambia in 2022 and Ghana in 2023. Such large events, which have been widely endorsed by governments and development agencies, will aim to bring together a variety of actors in the aquaculture community in Africa and worldwide to foster improved development (WAS, 2018).

6.2 SALIENT ISSUES

While there is some literature on fish consumption patterns in SSA in general, the data are not usually disaggregated into wild or farmed fish. This needs to be addressed in order to better understand the contribution of aquaculture to food and nutrition security. Nevertheless, both capture fisheries and aquaculture are currently not adequately filling SSA demand for fish. On the other hand, increased aquaculture activity in SSA has created much needed employment, which is essential to achieving food security and reducing poverty in SSA, thus fulfilling some of the contributions towards regional SDGs.

The involvement and engagement of women and youth as owner-operators of fish farms is currently limited, due to entry barriers to the sector such as access to affordable feed, seed, market, credit, and knowledge. However, women are increasingly active in post-harvest and marketing. Both women's and youth development issues have been placed high on the agenda by states as well as by the AU. Consequently, women and youth are increasingly included in aquaculture policies, strategies and programmes. For example, the AU and its partners, through the Aquaculture Network for Africa (ANAF), is considering programmes for enhancement of the role of women and youth in aquaculture enterprise development in Africa (AU-IBAR, 2019b).

Although fish farmers' associations exist in several countries to ensure that farmers' voices are heard in policy debates, many of these appear to become dysfunctional or dormant after several years of operation often due to lack of funding or internal conflicts. Mechanisms and tools to strengthen, empower and sustain small-scale aquaculture farmers' associations are needed.

6.3 THE WAY FORWARD

As the AU now looks to aquaculture as a sustainable option for increasing African fish production and associated benefits and having realized the natural resource potential for aquaculture and the rapidly increasing demand for fish, increased efforts are needed to create an enabling environment, especially for commercial aquaculture development. This will ultimately create much-needed direct and indirect jobs across the value chain while also creating opportunities to benefit women and youth.

The aspirations of women and youth need to be soundly integrated into aquaculture policies, strategies, and programmes. States, developmental agencies and NGOs need to initiate and support projects focused on youth and women for their empowerment in the sector.

As the aquaculture sector grows and expands, there is a corresponding increase in demand for more information, skills and innovative technologies. Focused, strategic, regional and continental networks and platforms for capacity development, knowledge building and information exchange need to be sustained and strengthened over the longer term.

7. External pressures on the sector

7.1 STATUS AND TRENDS

7.1.1 Climate change

There is a wide body of research pointing to recent changes in weather patterns, such as rainfall amounts, relative humidity, wind strengths and fluctuating temperatures having affected agricultural production in SSA, as well as fisheries and aquaculture (Table 22). Climate change has both direct and indirect influences on fisheries and aquaculture. The direct implications of climate change are on the physiology and behaviour of fish that affect growth, reproduction, mortality and distribution. The indirect impact is on the productivity, structure and composition of the ecosystem on which the fish depend for food, shelter and reproduction. Changes in biophysical characteristics of the aquatic environment and more frequent occurrence of extreme weather events will also have significant effects on the ecosystems that support fish (Asiedu, Adetola and Kissi, 2017). The full impacts of long-term climate change trends, in particular related to global warming, are less well understood in fisheries although they are beginning to receive attention.

According to a recent report by FAO on impacts of climate change on fisheries and aquaculture (Barange *et al.*, 2018), short-term climate change impacts on aquaculture can include losses of production and infrastructure arising from extreme events such as floods, increased risk of disease, parasites and harmful algal blooms.

Increasing temperature will have both positive and negative impacts for aquaculture. The type and scale of aquaculture systems affects temperature impacts and shallow ponds with limited water exchange are probably most at risk as they are prone to exceeding critical temperatures throughout their water column during the hottest part of the day or during periods of unusually warm weather. Climate warming may stimulate the growth of harmful algae blooms that kill fish and shellfish resulting in economic losses for cage-based finfish and shellfish aquaculture in open water (FAO, 2017a).

Shellfish farmers in the Walvis Bay Lagoon on the Namibian coast have been severely affected by algae blooms caused by warming ocean currents over the past decade. Persistent algae blooms reduce oxygen in the water as they die and decompose, in some cases also leaving behind natural toxins. Such "red tides" killed about 70 percent of the farmed oysters in Walvis Bay Lagoon in 2008 (Murta and Kibria, 2017).

There has been a recent drop in seaweed production from United Republic of Tanzania, Zanzibar, largely attributable to disease and infestations which are to a certain extent triggered by rising water temperatures and changes in oceanographic movements in the lagoons and bays where seaweed farming has been developed. FAO undertook field research in affected villages and farms including identifying the underlying cause of the seaweed diseases and seaweed die-off (Largo, Msuya and Menezes, 2020). To respond to the negative impacts on seaweed production and productivity, the surface lagoon cultivation system needs to be adapted to a new seasonal mode of production, and there is a need to invest in different income-generating activities within and outside farming (Largo, Msuya and Menezes, 2020).

Sea level rise will cause erosion and loss of land, that in turn increases the risk of inundation for aquaculture in low-lying areas. Coastal systems such as mangroves and salt marshes may be lost while salinization of ground water may also occur, reducing the availability of freshwater for aquaculture and other uses. The potential effects of these changes include increased costs

for flood defences and the loss of ecosystem services provided by coastal systems including defence against extreme weather as well as the provision of spawning and nursery grounds for species that may be important in terms of fisheries recruitment or supplying aquaculture seed.

The effects of sea level rise are evident in the coastal Ghanaian town of Keta, a major aquaculture production area where, according to long-term residents of this historically vibrant trading town, about two-thirds of the original coastal town has now been lost to the sea. In neighbouring Côte d'Ivoire, the eastern "tourist" coastline, which also had vibrant coastal aquaculture enterprises, has been eroded. Meanwhile, an integrated coastal area management plan is being applied to save Kribi in Cameroon (FAO, 2017a).

Reduced annual rainfall, in combination with higher temperatures and evaporation rates, poses potential threats to aquaculture, especially when considered in the context of competing water uses. In areas with marginal water availability, culture in small ponds by poorer farmers is perhaps at greatest risk as there is potential for reduced harvests, shorter growing seasons and more limited choice of species and harvest size. In Malawi, most of the wetlands, rivers, and streams that were perennial and could be diverted for the purpose of fish farming are now becoming seasonal. This scenario has made fish farming a challenge in areas that were once suitable for aquaculture as fish ponds dry up each year due to lack of adequate water (Mulumpwa, 2020).

Madagascar and Mozambique have significant aquaculture sectors with the majority of production taking place in coastal systems. The two countries are also prone to tropical storms and cyclones. Heavy rainfall during intense storms can present a significant risk through localized flash flooding and lowering of salinity. In March 2019, Cyclone Idai, one of the worst to hit Africa and the Southern Hemisphere in recent years, severely affected several SME fish farms in Malawi, Mozambique and Zimbabwe. In Mozambique, aquaculture ponds and cages are usually built next to water bodies, especially riverbeds and in low sea areas, where the impact of the cyclone and flooding was severe, affecting 895 small-scale fish farmers, while 562 ponds occupying an area of 17 hectares were destroyed and 375 tonnes of fish were lost. In the city of Beira, hatcheries and a fish feed production unit also suffered severe damage (ILO, 2019). The cyclone left thousands of people dead, nearly half a million people displaced and entire cities and infrastructure severely damaged, including in Madagascar.

To address adaptation, it is necessary to understand vulnerability and be able to identify major drivers and general exposure to climate change. It is almost always difficult to foresee what will happen as a result of climate change, but likely negative impacts can be mitigated by reducing the sensitivity of the sector and by increasing measures to minimize exposure. (Barange *et al.*, 2018).

According to FAO, in general, aquaculture spatial planning and management following an ecosystem approach to aquaculture (EAA) could strengthen adaptation capacity, especially at the local level (FAO, 2017a). This requires understanding the risks at relevant spatial and temporal scales, prioritizing them and then addressing such risks through participatory approaches and using the best available information. Most importantly, all measures and investments to reduce vulnerability are good for aquaculture sustainability in any future scenario. Reduction of vulnerability is unlikely to take place for aquaculture in isolation, and the EAA can facilitate better integration of preparedness and response with other users of resources.

In 2016, a country self-assessment survey was carried out by FAO for the Workshop on Climate Proofing Aquaculture in sub-Saharan Africa: review of policies and production systems for climate change resilience (FAO, 2017c). Almost all the 21 SSA countries sampled showed that the degree of inclusion or mention of aquaculture in climate change adaptation plans was minimal. Reasons included lack of capacity among national fisheries authorities,

lack of scientific information which authorities can use as evidence for policy formulation and institutional barriers that arise because climate change issues at both national and international levels tend to be championed by the ministries responsible for environment. Policies with specific relevance to fisheries and aquaculture will be required in African countries.

FAO and the Global Environment Facility (GEF) have initiated a joint programme on Enhancing Climate Change Resilience in the Benguela Current Fisheries System (Angola, Namibia, and South Africa), which includes marine aquaculture, through strengthened adaptive capacity and adaptive strategies to ensure food and livelihood security. Among key actions, the project aims to integrate climate change considerations into fisheries and aquaculture policies and planning as well as into broader inter-sectoral development and build capacity to adopt improved climate-resilient practices (FAO, 2015b).

In recent years, with increased knowledge and availability of information and some experience on the ground, some of these countries when reviewing their aquaculture policies and strategies. They are taking into account EAA and climate change issues, for the long-term sustainability of the sector and aiming to develop climate-smart aquaculture systems.

7.1.2 Impacts of drought on aquaculture

According to OECD and FAO (2016) the occurrence of drought is already higher in SSA compared to most other regions in the world and it has significantly affected agriculture production and implicitly aquaculture development. The incidence of drought has been serious over the past three years in some parts of Eastern and Southern Africa, significantly impacting food security.

In general, the adverse impact of drought on fish farming could be avoided or minimized by careful site selection, especially in drought-prone areas. In Niger, better-off fish farmers in the suburb of the national capital have tried to equip themselves with solar panels for energy to pump water from deep wells and overcome shortages during drought. Nevertheless, cage farms in reservoirs may find it more difficult to adapt (see Box 12), both with respect to their growing environments and challenges to hydroelectric power generation.

7.1.3 Impacts of COVID-19 on aquaculture development

The COVID-19 pandemic has been the greatest threat to national SSA economies in 2020. The World Bank predicts that the outbreak has set off the first recession in sub-Saharan Africa in 25 years, with growth forecast to drop between 2.1 percent and 5.1 percent in 2020, from a modest 2.4 percent growth in 2019 (World Bank, 2020c).

The aquaculture sector has not been spared (Box 13). Although aquaculture has been declared as an essential food producing sector, with most fish farms continuing to operate, either partially or fully, the pandemic has caused numerous disruptions to day-to-day farming activities as a result of lockdowns, travel restrictions, social distancing policies and worker safety. Reduced domestic and export market activity is evident and has threatened the viability of most producers and traders in the short to medium term.

In Nigeria, there were reports of low market activity and as a result fish farm stocking plans and harvesting projections have been badly affected. There were reports of fish farmers incurring debts as they had to continue feeding fish that they were not able to harvest. Procurement and transportation businesses for farm inputs (seed, feed and other implements) were frustrated by national public health movement restrictions (L. Badmus, personal communication, 2020).

Box 12. Fish farmers hit hard by drought on Lake Kariba

Tilapia farmers on Lake Kariba are suffering as the lake's levels continue to drop in the face of the worst drought to hit southern Africa in 40 years. Lake Kariba's tilapia farmers are concerned, as dwindling water levels mean access to electricity is becoming more sporadic and suitable sites for their operations are becoming scarcer. The reducing lake levels are a cause for concern on many fronts. Lake Harvest Aquaculture, recognized as the biggest integrated freshwater fish farming business in Africa, operates land and on-lake operations in cages, both of which have been affected. As the water recedes, the company's water pump station must be moved at great cost. It also means that the oxygen, pH and water temperature levels start to deteriorate from the ideal conditions for fish breeding, growing and handling. To mitigate this, booster pumps have to be installed, the ponds have to be aerated and water quality checks have to increase. As for the grow-out cages on the lake, as the water level falls, predation and disease pressure tend to increase while oxygen levels drop. Furthermore, as the lake becomes shallower, stocking densities have to be reduced.

Lake Kariba, which marks the border between Zambia and Zimbabwe, was made by a dam constructed across the Zambezi River in 1958 and remains the globe's largest man-made water body. It is fed from rainfall in a catchment area that covers large areas of Angola, Botswana, Namibia, Zambia and Zimbabwe. Although it was primarily constructed for electricity generation, the dam has spawned a sizeable tourism industry for Zimbabwe and Zambia while supporting wild kapenta fishing and tilapia farming ventures. On the Zambian side, Yalelo, which is operated by the Dutch-headquartered FirstWave Group, is suffering as a result of the depressed hydroelectricity output caused by the drought. With reported regular power blackouts nationwide in Zambia, Yalelo had to install on-site electricity generation and backup at their fish shops, warehouses and offices. Furthermore, end consumers struggle to store fish as most households are unable to install backup electricity generation in their home to operate fridges.

Source: Nkala, 2020.

In the Ghana, there were reports of a drop in demand for fresh tilapia and catfish products due to social distancing policies and general lockdowns in major urban market centres, including hotels, restaurants and tourist centres. Imported fish feed and other required inputs were severely constrained. Social distancing meant that no meaningful work could be done at fish farm processing units. (S. Amisah, personal communication, 2020). In Zimbabwe, the situation was more or less the same as in Ghana. The pandemic has significantly impacted fish sales (including exports), logistical movement for people and inputs (G. Munatsirei, personal communication, 2020).

In South Africa, due to local and international market constraints, many farms struggled with cash flow and there was a high risk of closure for around 70 percent of farms. It was anticipated that annual sector revenue would drop by 40 percent from approximately USD 60 million to USD 40 million. There were also reports of job retrenchments and that 18 percent direct jobs could be lost, which could equate to at least 1 200 jobs throughout the sector. The government was working with aquaculture stakeholders to support interventions (DEFF, 2020; Box 13).

During the year, several planned knowledge sharing platforms and forums that aim to bring together fish farmers and other aquaculture value chain actors had to be cancelled or postponed.

As the pandemic continues, it will be important for states and their aquaculture actors to continue regular and coordinated monitoring and surveillance, particularly as more impacts continue to unfold. This will ensure calibrated responses from governments, RECs, industry,

Box 13. Government conducts survey to understand the impacts of COVID-19 on aquaculture operations

In response to the impact of COVID-19 and to assist with informing support measures and interventions, the Department of Environment, Forestry, Fisheries (DEFF) in South Africa undertook a quick survey of aquaculture farms to understand the impact that COVID-19 has had to date, the potential impact over the next six months and beyond as well as the type of support the farms require. The questionnaire followed a meeting with all industry representatives on the 7 April 2020 to unpack the general impacts and interventions in order to quantify the amounts, numbers and actual percentages. The department also held various virtual meetings in April 2020 with industry associations and other key stakeholders.

Due to local and international market constraints, many farms were struggling with cash flow and there was a high risk of closure of around 70 percent of farms. It was anticipated that the sector revenue generated for the year would drop by 40 percent from ZAR 1 billion to ZAR 627 million. Retrenchments have been limited to date (62 reported), staff salaries have been impacted by reductions in working hours and an additional 18 percent of direct jobs could be lost going forward which could to equate to 1 200 jobs throughout the sector, if not more.

As a result of the cash flow constraints, the primary support intervention requested was in the form of soft loans to cover shortfalls in cash flow as well as employee welfare support. Deferring payments/levies to local municipalities and other government departments could alleviate almost 20 percent of the monthly operational expenditure of the farms which have experienced average drops in sales of around 54 percent year-on-year. The market has been impacted but should improve as the restrictions are lifted and sales of fresh fish become less impacted. In addition, fish feed is a significant cost to small farms. If the government provided feed to small scale farms it could provide quick and immediate relief to the projects.

Source: DEFF, 2020.

development partners and stakeholders. The design of policy responses (including relief packages to industry), along with how they are implemented, will be critical. With lessons learnt from other countries, efforts to build resilience, adaptation and mitigation, especially for vulnerable small-scale farmers, will be of paramount importance now and for future pandemics.

7.2 SALIENT ISSUES

Negative climate change dynamics are increasingly becoming evident, impacting aquaculture production in SSA. The reduction of seaweed production in key producer countries due to the effects of climate change is a clear example and needs to be urgently addressed as it affects the livelihoods of tens of thousands of seaweed farmers. The SSA region is generally weak in terms of adaptation and mitigation, in part due to lack of policies and strategies as well as programmes on climate change. Climate change is regarded as an emerging challenge to aquaculture development and more research is required.

As elsewhere in the world, COVID-19 has disrupted several economic activities including aquaculture value chains. The design of policy responses, including relief packages for aquaculture actors is critical, particularly for vulnerable small-scale farmers.

7.3 THE WAY FORWARD

To address adaptation it is necessary to understand vulnerability and be able to identify major drivers and general exposure to climate change and pandemics such as COVID-19. It is almost always difficult to foresee what will happen but likely negative impacts can be mitigated by reducing the sensitivity of the sector and by increasing measures to minimize exposure (Barange *et al*., 2018).

The concept of spatial planning for aquaculture (within the framework of EAA), needs to be adopted in SSA states as it provides an opportunity for the aquaculture sector to plan future growth in areas that will minimize exposure to externalities with the potential to affect production, and to adopt resilience measures. At the farm level, innovation systems such as climate-smart aquaculture systems that will help the sector adapt to climate change are important. These include improved production systems, water re-use systems (including aquaponics), better on-farm aquaculture practices and the promotion and scaling out of the concept of agro-ecology in aquaculture.

FAO has developed tools on climate change and spatial planning for aquaculture and is also involved in monitoring and surveillance of COVID-19 and its impacts on the sector. Such tools could be useful in designing national and/or regional response strategies.

8. Governance and management of the sector

8.1 STATUS AND TRENDS

8.1.1 Policy and legal frameworks

In terms of policy frameworks, political will has been demonstrated in many SSA countries, through standalone aquaculture policies to support development of the aquaculture sector. Namibia, South Africa, Uganda and Zambia are examples where dedicated aquaculture policy frameworks are at various stages of development and adoption while several other SSA countries have aquaculture policies embedded either in fisheries policy or agricultural policy. As reported in the previous regional review (FAO, 2017a) there are long time-lapses between policy formulation, policy adoption and the formulation of concerted action plans, so that strategies may no longer apply to rapidly changing circumstances.

In terms of legal frameworks, some countries continue to rewrite and improve their legal frameworks to take into account of the needs of aquaculture. There are also examples of countries such as Madagascar that have several legal instruments and regulations to support aquaculture through Acts of Parliament, Ordinances and Decrees (FAO, 2005–2021). The most common types of regulations that have been amended to take into account of the needs of aquaculture include the fisheries regulations, land regulations and environmental management regulations.

As an example of good practice, the South African government developed a Legal Guide for the Aquaculture Sector in South Africa, mainly intended for primary stakeholders in the sector including existing aquaculture enterprises, potential investors, government officials, extension officers, NGOs and new aquaculture businesses. (DAFF, 2013).

Sub-Saharan African countries also have various policy and legal instruments governed by their RECs. For example, in the SADC Region, the Protocol on Fisheries was adopted by SADC Member States in 2003. The objectives of the protocol are to "promote responsible and sustainable use of the living aquatic resources and aquatic ecosystems of interest to State Parties in order to: a) promote and enhance food security and human health; b) safeguard the livelihood of fishing communities; c) generate economic opportunities for nationals in the region; d) ensure that future generations benefit from these renewable resources; and, e) alleviate poverty with the ultimate objective of its eradication." (SADC, 2006).

Similarly, as a key member, Ghana is aligned to the rules of the Economic Community of West African States (ECOWAS), is a key party to the Ministerial Conference on Fisheries Cooperation among African States Bordering the Atlantic Ocean (ATLAFCO), as well as being the host and member of the Fisheries Committee for West Central Gulf of Guinea (FCWCGG).

At continental level, the AU continues to implement its Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa (PFRS) with the purpose of facilitating policy development for the sustainable management of fisheries and aquaculture in AU member States. In 2018, the Policy Research Network for Fisheries and Aquaculture in Africa (PRNFAA) was launched in an effort to guide fisheries and aquaculture policy reforms and to enable the sector to transform and contribute to continental goals.

Several SSA countries are also signatories to various international instruments and conventions, most of which are relevant to the governance of aquaculture. Examples are

the United Nations Convention on the Law of the Sea, the World Trade Organization (governing international fish trade), Convention on Biological Diversity and the UN Framework Convention on Climate Change.

In addition, FAO has produced voluntary technical guidelines to assist the international community to take the necessary steps to implement the CCRF (FAO, 2019c). Examples include; Technical Guidelines on Aquaculture Certification, Technical Guidelines for Responsible Fish Trade, Technical Guidelines on the Prudent and Responsible Use of Veterinary Medicines in Aquaculture and Technical Guidelines on Health Management for Responsible Movement of Live Aquatic Animals.

8.1.2 Governance of aquaculture within transboundary or shared aquatic ecosystems

Improvements are being made to regional governance of transboundary resources by applying the principles of the EAA. Freshwater aquaculture examples include the Lake Victoria Fisheries Organization (LVFO) of the East African Community (EAC), which has been an active specialized institution coordinating the management and development of fisheries and aquaculture in the region. LVFO has developed and adopted the EAC Regional Strategy and Implementation Plan (2015–2020) for sustainable aquaculture and is working with various partners (including FAO) to implement regional projects supporting aquaculture development (EAC, 2018). Similarly, the Lake Kariba and Zambezi catchment areas, where aquaculture is flourishing, are managed under shared watercourse protocols.

In marine aquaculture ecosystems, examples where protocols and strategies for the management of shared water bodies have been developed and aquaculture has been included are the Benguela Current Large Marine Ecosystem (BCLME) which extends from South Africa through to Angola, the Indian Ocean Commission (IOC) and the Fisheries Committee for the West Central Gulf of Guinea (FCWC).

8.1.3 Aquaculture strategies and action plans

Several countries in SSA now have dedicated aquaculture strategies or development plans intended to contribute to socio-economic development. These include some of the non-key or lowest aquaculture-producing countries in the region such as Botswana, Eritrea and Eswatini, the latter being in the process of validating its commercially driven strategy.

Key producer countries such as Malawi, Nigeria, Uganda and Zambia are also at various stages of reviewing their aquaculture strategies to take emerging issues into account. Reported factors that contributed to poor implementation of aquaculture strategies and development plans include inadequate funding and human resources at government level, and fragmentation and lack of collaboration between governments and other key actors.

Regional economic communities in SSA are at different stages of developing their aquaculture strategies. For example, SADC has recently developed and adopted its SADC 2016-2026 regional aquaculture strategy and action plan (SADC, 2018). The EAC, with support from the FAO and EU, has also developed its EAC regional strategy and implementation plan for the development of sustainable aquaculture (de San, 2013) while the Intergovernmental Authority on Development (IGAD) region approved its regional fisheries and aquaculture strategy in 2016.

The African Union has put in place a number of instruments to support fisheries and aquaculture management, as enshrined in the African Union aquaculture action plan for

Africa 2016-2025 (AU-IBAR, 2016a). These include aquatic animal health, environmental management and policy formulation (see Box 14). Aquaculture is also now featuring in national development plans as an emerging agricultural practice that can contribute to the aspirations of the CAADP.

Box 14. Improving aquatic biosecurity governance in Africa

An aquatic biosecurity governance workshop bringing together more than 120 participants from Africa was held in South Africa in 2014. The workshop, whose objective was to support sustainable aquatic food security for dietary animal protein and livelihoods through responsible aquaculture, started with discussions on trends in global, African and SADC regional aquaculture as well as global and commodity-specific trends in aquatic animal health management.

Country specific and industry presentations on disease incidences and on-farm biosecurity management systems from Egypt, Madagascar, Nigeria, South Africa and Zambia were made setting the stage for focused group discussions. The outcomes of these discussions were a draft Framework for the SADC regional aquatic biosecurity and aquatic animal health management strategy which will serve as a package to be used for development of country-specific national plans and an implementation tool for cross-cutting and regional projects. The other outcome was the Trade and Improved Livelihoods in Aquatic Production in Africa (TILAPIA) project plan to be used by AU-IBAR, to promote development of other regional strategies in the four other Regional Economic Communities (RECs) in Africa and their Member States.

Robust biosecurity systems and measures have now become an essential pillar to healthy aquaculture production that protects producers and the emerging sector from the risks and threats of aquatic pathogens and diseases. National governments are thus expected to use long-term preventive and pro-active strategies rather than reactive measures as seen in many developed aquaculture regions. The workshop was conceptualized to come up with plans and programmes for effective, coordinated and proactive biosecurity systems premised on science-based knowledge and practices used within effective regulatory frameworks backed by sufficient resources for enforcement as fish health infrastructure in SSA is typically not established to support rapidly growing aquaculture industries and meet biosecurity needs in fisheries.

The incursion of two significant aquatic diseases, in the Chobe-Zambezi River and in Mozambique and Madagascar serve as a wakeup call to Africa. Fortunately, these were known pathogens but it could be devastating if an unknown disease suddenly appears. Another danger is when a trans-boundary aquatic animal disease moves from one country or region to another.

Participants were drawn from all SADC Member States, other African countries which are major players in aquaculture. International organizations and development partners present were AU-IBAR, African Eco-labelling Mechanism (AEM), FAO, SADC Secretariat, WorldFish, World Organisation for Animal Health (OiE), and private sector representatives. This workshop was supported by AU-IBAR through STDF TILAPIA project and European Union, the South African government through the Department of Agriculture, Forestry and Fisheries (DAFF) and FAO in South Africa.

Source: FAO, 2014b.

8.2 SALIENT ISSUES

Although not evenly spread, political will is evident, as demonstrated by many SSA countries and RECs being at various stages of developing and implementing their aquaculture strategies, investment plans, policies and legal instruments to govern and support the sector. The challenge in the development of aquaculture policies and strategies has always been the time lapses between policy formulation, policy adoption and the formulation of concerted action plans, so that strategies may no longer apply to rapidly changing circumstances.

Following adoption of the AU Aquaculture Action Plan, the AU has continued in its commitment to assist its member states, recently through creation of platforms such as the PRNFAA, which has begun the process of assisting countries and their REC on aquaculture policy reforms. FAO has also been instrumental in providing guidance on the development of aquaculture policies and strategies.

8.3 THE WAY FORWARD

SSA countries (and their RECs) should continue updating their aquaculture policies, legal frameworks, strategies, investment plans and other essential instruments in line with overarching changes and emerging issues in the sector. The involvement of non-state actors in the formulation of national policies and management of the resources is also important.

States should continue exploring avenues to pool funding and human resources for the effective implementation of such aquaculture policies and strategies. This could include the establishment of national aquaculture development or support funds from external donors.

FAO is encouraged to continue developing and informing on the implementation of the various technical guidelines on aquaculture and facilitating their adoption and effective implementation by SSA member states.

9. Contribution of aquaculture to the FAO strategic objectives, the Sustainable Development Goals, and the Blue Growth Initiative

9.1 STATUS AND TRENDS

9.1.1 Aquaculture and the Sustainable Development Goals

According to FAO, Agenda 2030 and the SDGs are highly relevant for policy-making, planning and management for sustainable development of aquaculture. In particular, SDGs 1 (end poverty), 2 (end hunger), 5 (gender), 8 (growth, employment), 12 (production and consumption), 13 (climate change), 14 (marine resources and ecosystems) and 15 (biodiversity) will have significant relevance for aquaculture, while other SDGs will influence the work of FAO members and partners. Aquaculture, when developed appropriately, will also contribute to the achievement of many other SDGs.

The contribution of aquaculture to SDGs in SSA is currently not fully documented, however there is shas been notable progress and evidence of sustainable aquaculture being a pathway to continental goals. This is enshrined in the African Union Agenda 2063 (adopted by the African Union Summit in 2015) as a framework formulated for the purpose of guiding Africa's development over the next fifty years (AU, 2019b). A number of the agenda goals relevant to aquaculture are relevant to the SDGs, particularly the following:

- **Goal 1:** A high standard of living, quality of life and well-being for all citizens (SDG1, 2 and 8).
- **Goal 5:** Modern agriculture for increased productivity and production (SDG 2).
- **Goal 6:** Blue economy for accelerated economic growth (SDG 14).
- **Goal 7:** Environmentally sustainable and climate resilient economies and communities (SDG 13).
- **Goal 17:** Full gender equality in all spheres of life (SDG 5).
- **Goal 18:** Engaged and empowered youth and children (SDG 4, 5).
- **Goal 19:** Africa as a major partner in global affairs and peaceful co-existence (SDG 17).

Details of how SSA aquaculture contributes to these SDGs is presented more fully in Table 22.

9.1.2 Ongoing FAO programmes and activities

Technical assistance to fisheries and aquaculture development in SSA by FAO has continued through various projects, mostly within the framework of the Blue Growth Initiative (BGI). Specific BGI activities are underway in Cabo Verde, Côte d'Ivoire, São Tomé e Principe and Seychelles, and FAO is also formulating BGI programmes in Kenya, Madagascar, Senegal and Zambia (FAO, 2017f).

FAO has also developed a substantial body of guidance material, most of which has helped national governments plan for sustainable and responsible aquaculture development, taking into account social, economic and environmental dimensions, thus facilitating delivery of the SDG goals and targets. Guidance material for addressing various pressing sustainability issues (environmental, technology adaptation, investment, biosecurity, species diversification, genetics, trade, R&D and other challenges) is available. To this end, FAO encourages states and all those involved in fisheries and aquaculture to implement the CCRF in an effort to achieve Blue Growth. (FAO, 2019d).

TABLE 22. Aquaculture and Sustainable Development Goals in sub-Saharan Africa (Source: Author's analysis)

SDG		Examples of progress in SSA
SDG 1	No poverty	• Aquaculture has created livelihoods, thus contributed to poverty alleviation: • Over 300 000 fish farmers in SSA in 2018 • Seaweed farming livelihoods for nearly 25 000 farmers in Zanzibar • Large number of progressive SME aquaculture farms in several countries (e.g. Nigeria, Kenya, Ghana, Rwanda, Zambia, etc) • Significant number of jobs created at several large commercial fish farms (e.g. Zimbabwe, Madagascar, Zambia, Ghana, Uganda and elsewhere)
SDG 2	Zero hunger	• Aquaculture has contributed to food and nutrition security: • Tilapia and catfish farms are producing affordable protein for the bulk of SSA's populations • The ongoing establishment of fish farms has created much-needed employment and livelihoods which is essential to achieving food security
SDG 5	Gender Equality	• Aquaculture has been identified as an agricultural practice in which women can participate: • Out of the 300 000 fish farmers accounted for in 2018, 12 percent are women • Women are directly involved in aquaculture activities (e.g. over 80 percent of seaweed farming in United Republic of Tanzania, Zanzibar is conducted by women, women oyster farmers in Senegal) • Women are actively involved in post-harvest and marketing as noted at some large fish farms in Ghana, Zambia, Zimbabwe, Madagascar, Nigeria. • Women active in provision of aquaculture services (government, research, etc.).
SDG 8	Decent Work and Economic Growth	• The promotion of aquaculture especially large-scale ventures has meaningfully contributed to decent employment: • Significant direct employment created by the large farms in Nigeria, Zambia, Zimbabwe, Kenya, Madagascar, Ghana and elsewhere. • Spin-off sectors (e.g. fish feed industries, fish marketing and distribution, government/civil service), have developed and created employment. • Local economic growth evident where fish farms are established.
SDG 13	Climate Action	• The ongoing promotion and increased adoption of "climate smart" farming practices and innovations: • Adoption of the EAA in aquaculture planning. • Climate-smart aquaculture practices such as water reuse systems (aquaponics, RAS, etc.) evident in SADC region. • Continued research and development.
SDG 14	Life Below Water	• Sustainable aquaculture is meant to reduce fishing pressure, thus conserving our inland waters/ocean resources: • The adoption of EAA for aquaculture planning by SSA countries (sustainable practices that reduce negative impacts to environment). • Aquaculture as an alternative livelihood option, especially for coastal communities.
SDG 17	Partnerships to achieve the Goal	• There are several existing partnerships for the implementation of aquaculture programmes in SSA: • FAO-initiated Technical Cooperation Programmes (TCPs) and other Trust Funds in SSA. • AU agencies working collaboratively with regional organizations in Africa such as FAO, AU-IBAR, RECs, WorldFish. • Other global partnerships (bilateral/multilateral engagements e.g. China-Africa partnership development has benefitted Africa in establishment of hatcheries and training in China).

FAO continues to implement its programmes in SSA through technical co-operation programmes, Trust Funds and other assistance. Examples are assistance rendered to governments in developing aquaculture policies, strategies and guidelines, capacity development including on fish and food systems value chains, provision of start-up packs on aquaculture and information tools and datasets. FAO has also been instrumental in developing partnerships with the AfDB, AU, European Union, World Bank, WorldFish and others.

9.1.3 Aquaculture and the Blue Economy in Africa

The concept of Blue Growth is similar in many respects to that of the Blue Economy, and came out of Rio+20, built on the three pillars of sustainable development; environmental, economic and social growth.

The Blue Economy concept, which is now widely promoted, seeks to fully harness the potential of oceans and inland waters for sustainable economic development. From 2019 the African Union has begun developing Africa's Blue Economy Strategy (AU-IBAR, 2019a; Box 15) to include fisheries, aquaculture, conservation and sustainable aquatic ecosystems. This concept also seeks to promote inclusive economic growth and the preservation or improvement of livelihoods while at the same time ensuring environmental sustainability of inland waters, oceans and coastal areas. The AU designated 2015-2025 as 'The Decade of African Seas and Oceans' placing Africa's Blue Economy in the spotlight and helping to raise local and global awareness that Africa has a vision and a plan to stimulate wealth creation for the continent.

Several countries, mostly Eastern and Southern African island or coastal states, such as Kenya, Madagascar, Mozambique, Namibia, Seychelles, South Africa and the United Republic of Tanzania have clearly articulated their desire to base their future economic development on the Blue Economy and aquaculture has become an integral part of that development. As a result, these countries have developed a number of development pathways and models that take into account investment and capacity development, as guided by the FAO Ecosystem Approach to Aquaculture.

Seychelles is among the top countries championing the Blue Economy. The country now has a Blue Economy roadmap, which defines how the country will make maximum use of its ocean space in the most sustainable manner possible. This comprehensive roadmap covers the whole spectrum of potential resources including aquaculture and sustainable fishing. Investment capital and funding opportunities for business activities within the blue economy are also available through the Blue Investment Fund Scheme from the Development Bank of Seychelles and Blue Grants Fund from the Seychelles' Conservation and Climate Adaptation Trust (SIB, 2019).

9.2 SALIENT ISSUES

The contribution of aquaculture to SDGs as well as to Blue Growth goals is not fully documented, but there is good evidence of the sector being a pathway to fulfil the continent's goals, within the framework of the AU Agenda 2063.

FAO's strategic intervention has been very important in guiding the sector's development, to achieve the SDGs.

There is a focus on the promotion of the Blue Economy by SSA member states where aquaculture has been identified as a priority for investment. Consequently, SSA states have begun developing their national, regional and continental blue economy strategies that take into account the EAA.

9.3 THE WAY FORWARD

Continued technical support for capacity development by the FAO under the aquaculture component of the BGI is important, especially as SSA aims to address various pressing sustainability issues including environmental sustainability, technology adaptation, investment, biosecurity, species diversification, genetics, trade and R&D.

The BGI needs to be integrated into continental Blue Economy strategies at national, regional and continental levels, especially ensuring Blue Economy investment plans are in line with the EAA.

SSA countries must recognize that development of the sector cannot rely only on development project funding or their own capital. Adapted financing mechanisms, in particular from the formal banking system, are crucial for stable and continuing development of the sector.

Strategic tools and guidance are needed to monitor aquaculture's contribution to the AU Agenda 2063 and the SDGs.

Box 15. Launch of the Africa Blue Economy Strategy

Africa's Blue Economy can be a major contributor to the continental transformation, sustainable economic progress, and social development. The Africa Blue Economy Strategy was launched in February, 2020 during the 33rd African Union Summit in Addis Ababa, Ethiopia under the theme "Developing a sustainable blue economy; increasing momentum for Africa's Blue Growth". The vision of the Africa Blue Economy Strategy is an inclusive and sustainable blue economy that significantly contributes to Africa's transformation and growth.

The objective of the Africa Blue Economy Strategy is to guide the development of an inclusive and sustainable blue economy that becomes a significant contributor to continental transformation and growth, through advancing knowledge on marine and aquatic biotechnology, environmental sustainability, the growth of an Africa-wide shipping industry, the development of sea, river and lake transport, the management of fishing activities on these aquatic spaces and the exploitation of deep sea minerals and other resources.

The Africa Blue Economy Strategy is consolidated into the following five detailed thematic technical reports that are annexed to the Strategy:

- Fisheries, aquaculture, conservation and sustainable aquatic ecosystems
- Shipping/transportation, trade, ports, maritime security, safety and enforcement
- Coastal and maritime tourism, climate change, resilience, environment, infrastructure
- Sustainable energy and mineral resources and innovative industries
- Policies, institutional and governance, employment, job creation and poverty eradication, innovative financing

The strategy reinforces the commitments of African countries to work towards the SDGs, particularly SDG 14 "life below water", the vision of Agenda 2063 and to accelerate implementation of AU policies and instruments.

Source: AU-IBAR, 2020a.

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Annex 1. FAO statistical data

Data used in this regional aquaculture review, derive mainly from the different FAO fisheries and aquaculture statistics (FishStat), accessible through different tools, including the FAO Yearbook Fishery and Aquaculture Statistics, online query panels and FishStatJ (FAO, 2020a; FAO, 2020b; FAO, 2020c). These tools provide free access to fisheries and aquaculture data, including production, trade, consumption and employment for over 245 countries and territories from 1950 to the most recent year available. FAO represents the only global source of fisheries and aquaculture statistics, which are mainly compiled from data submitted by member countries. Statistics received are validated by FAO through adequate quality controls and, in the absence of official reporting, FAO estimates the missing data based on information obtained from alternative sources or standard estimation methods. Estimates also involve disaggregating some of the data received by FAO in aggregated form by species and, in the case of production, also by culture environment.

FAO highlights that data received from countries show different levels of quality in terms of coverage of species, environment and overall national reporting. Inconsistencies may occur in data reported or data are not reported at all. For example, in the case of aquaculture production, FAO has noted that not all the countries have adequate and effective data collection systems set in place. Many countries still do not have a systematically established framework aligned with internationally and regionally accepted standards for data collection from fish farms. In addition, in several countries, the staff responsible for reporting aquaculture production lack the relevant knowledge, support or relevant mechanisms such as specifically designed databases to develop accurate production estimates and improve monitoring and control of the industry. Production data are often estimated through extrapolation by multiplying the area under fish culture by an estimate of average productivity, with adjustments according to advice from key contacts in the industry. Improvements to this problem could, for example, be found by resolving issues related to the fish farm licensing process and devising a system for direct reporting of production, coupled with validation through sample survey by trained enumerators.

Problems occur as well for other typologies of aquaculture statistics. Only a very limited number of countries have a breakdown for farmed vs wild species in their trade statistics and, in addition, many farmed species are often reported in an aggregated form under miscellaneous entries as other fish. The lack of accurate trade data on farmed fish and fish products implies the impossibility to calculate separate consumption statistics on farmed species, with no clear assessment of the nutritional role of farmed species in the countries. In addition, not all the countries have a good collection of employment data in the primary and secondary aquaculture sectors, including insufficient detail on the role of women in the sector, which is captured mainly by ensuring employment data is sex-disaggregated and that all types (part time, full time, occasional time use) are all collected and reported . These data are essential to better assess dependency on the sector and other relevant indicators.

Due to the key role that accurate and timely data play in the management and policy formulation for sustainable aquaculture development, FAO remarks the urgent need for national capacity development in aquaculture statistics systems at several levels, including:

- the legal status, institutionalization and resource allocation;
- development of national statistical standards in line with international standards;
- adequate and stable staffing plus an effective mechanism for data collection, compilation, storage, dissemination and reporting; (FAO, 2020d);
- improvement in the coverage of farmed species in trade statistics, with the clear separation of farmed vs wild species; and,
- improvement in the coverage and accuracy of employment data, disaggregated by sex, occupational status and age.

In continuing the global efforts to achieve aquaculture sustainability through dissemination of up-to-date information on the status and trends of the sector, FAO publishes Aquaculture Regional Reviews and a Global Synthesis about every 5 years, starting in 1997. This review paper summarizes the status and trends of aquaculture development in sub-Saharan Africa.

Relevant aspects of the social and economic background of each region are followed by a description of current and evolving aquaculture practices and the needs of the industry in terms of resources, services and technologies. Impacts of aquaculture practices on the environment are discussed, followed by a consideration of the response by the industry to market demands and opportunities, and its contribution to social and economic development at regional, national and international levels. External pressures on the sector are described, including climate change and economic events, along with associated changes in governance.

The review concludes with an analysis of the contributions of aquaculture to the Sustainable Development Goals, the FAO Strategic Objectives, and the FAO Blue Growth Initiative. Throughout the review, outstanding issues and success stories are identified, and a way forward is suggested for each main topic.