



COMMITTEE FOR INLAND FISHERIES AND AQUACULTURE OF AFRICA
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SUSTAINABILITY OF AQUACULTURE PRODUCTION: PROFITABILITY vs. SOCIO-ECONOMIC BENEFITS

SUMMARY

This paper shows that African aquaculture has been growing faster than the World's average in the last two decades, providing more socio-economic benefits to the Region, in terms of enhanced contribution to food and nutrition security, national economic growth, poverty reduction and countries' balance of trade. The lack or shortage of adequate farm records, commercial farmers' reluctance to share data, sub-sector segregated data and information on fish consumption and trade, and rigorous secondary time series data renders the quantification of these benefits difficult. Farmers' limited ability to produce or otherwise access good quality seeds and feeds in desired quantities, and the quasi-inaccessibility of loans by farmers, mainly due to prohibitively high interest rates, poor good governance of the sector threaten the latter's sustainability. Reviewing reporting methods to have clear, complete and coherent aquaculture-specific data, training small-scale and non-commercial farmers in record keeping, requiring all farmers, including large-scale commercial farmers to keep and provide complete and timely farm records, and conducting regular comprehensive farm, consumption and export surveys could allow for the quantification of the socio-economic benefits of the sector. Having and implementing aquaculture-specific policies, laws, strategies and programmes including on Aquatic Biosecurity, supporting hatcheries and feed mills, having and enforcing practical measures to tackle the problem of high bank interest rates and other constraints to accessing bank loans, and promoting digital aquaculture are some of the ways of ensuring the sustainability of the sector.

The Committee is invited to:

- (i) review this paper and comment on the possible future actions suggested therein by the Secretariat in terms of their suitability to Member countries' needs;
- (ii) share national experiences in terms of policies, strategies and programmes, and other actions put in place to develop aquaculture in such a way as to maximize its socio-economic benefits to their populations while preserving private entrepreneurship and ensuring the sector sustainability;
- (iii) identify and agree on the way forward in order to ensure that aquaculture significantly contribute to the well-being of CIFAA Members' populations in terms of food and nutrition security, national economic growth, poverty reduction and countries' balance of trade without jeopardizing its ability to meet future generations' needs.

I. BACKGROUND: TRENDS IN AQUACULTURE PRODUCTION AND SOCIO-ECONOMIC BENEFITS

1. Aquaculture continues to be one of the World's fastest growing food-producing sectors. In the last two decades, from 1997 to 2017, the volume of the world aquaculture production increased from 27,321,751 to 80,133,588 tonnes, or an average growth rate of **5.3** percent. With this growth, the sector's contribution to total fish production increased from 22.7 to 46.4 percent in the same period.
2. In Africa, the trend was similar. However, Africa displayed a higher than the World's average growth rate, and a much lower rate of contribution to total fish production compared to the World's average. In 1997, aquaculture produced 137,767 tonnes compared to 2,077,562 tonnes in 2017, which represents an average growth rate of **13.8** percent during this interval. In the same period, its contribution to the continent's fish production increased from 0.4 to 17.6 percent.
3. As aquaculture grew in Africa, it generated more socio-economic benefits for the continent as well as profits for many farmers and businesses in the region. There is, however, the lack of a common understanding of what constitutes **socio-economic benefits** of aquaculture.
4. Some experts suggest that, from the farmer's perspective, socio-economic impacts of aquaculture consist of its contribution to the livelihoods of communities and should be understood in terms of direct and indirect benefits, where direct benefits include the provision of high-quality food, self-employment in case of small-scale farmers, and incomes from sales of produce. Indirect benefits cover the supply of aquatic products to local markets and employment opportunities for local communities including on larger farms, in seed supply networks, market chains and manufacture, repairs and other functions.
5. Others contend that the socio-economic benefits of aquaculture are usually regarded in terms of employment, generation of foreign exchange and food supply¹. Others again insist that aquaculture is an important domestic provider of much needed high-quality animal protein and other essential nutrients, generally at affordable prices, to the poorer segments of the community².
6. All these claims seem to suggest that socio-economic benefits of aquaculture could be understood as the sector's contribution to **food and nutrition security, national economic growth, poverty reduction** (especially through employment and income generation) and countries' **balance of trade**³.
7. Thus, it can be argued that the last two decades have seen growth in the aquaculture contribution to the three main dimensions of **food security** in Africa⁴.
8. With respect to the **food availability** (which includes quantity and quality aspects) dimension, aquaculture contributed to *food quantity* through the supply of more aquatic products (*direct food*

¹ Aguero, Max and Exequiel Gonzalez. 1997. Aquaculture economics in Latin America and the Caribbean: a regional assessment. In Charles et al. ed.; Aquaculture Economics in Developing Countries: Regional Assessments and an Annotated Bibliography, FAO Fisheries Circular No.932. Rome, Italy.

²Tacon G.J. Albert. 2001. Increasing the contribution of aquaculture for food security and poverty alleviation. In Subasinghe, R. et al., ed. Aquaculture in the Third Millennium. Technical Proceedings of the Conference on Aquaculture in the Third Millennium, pp 63-72. Bangkok, Thailand.

³ Hishamunda, N ;Cai, J.; Leung, P..Commercial aquaculture and economic growth, poverty alleviation and food security:assessment framework. FAO Fisheries Technical Paper. No. 512. Rome, FAO. 2009. 58p.

⁴ "Food security exists when all people, at all times, have **access** to **sufficient, safe** and **nutritious** food to meet their dietary needs and food preferences for an active and healthy life"⁴. It can be inferred from this definition that food security includes three main dimensions, namely **availability** of sufficient *quantities* of food of appropriate *quality*, their **access** by households and individuals and their **utilization** for nutritious diets and adequate health⁴.

supplies) to producing households and individuals for home consumption, as well as to domestic markets for local buyers⁵. Its contribution to food quantity may have also been in terms of supply (to domestic markets) of aquatic and non-aquatic food products purchased from abroad (imports) through foreign exchange earnings from aquaculture exports (*indirect food supplies*)⁶.

9. Regarding the **food access** dimension, aquaculture contributed to food affordability, which is the major aspect of food access. Affordability implies adequate financial resources to acquire appropriate food items for dietary and preference needs. It also implies relatively low food prices.
10. By providing producing households and individuals with revenues obtained through sales of their produce and by creating direct and indirect jobs in communities and paying salaries and wages, aquaculture enhanced households' disposable incomes and their ability to purchase food items which would otherwise be inaccessible. By increasing the availability (supply) of aquatic products to domestic markets, everything else remaining the same, aquaculture may have contributed to lowering the price of these products, thereby making them affordable and, thus, accessible to local consumers.
11. In terms of **utilization (nutrition)**, aquaculture contributed to food quality by providing nutritious aquatic food products. The contribution to food quality is also through health benefits which are associated with consumption of aquatic products. It is widely accepted that seafood is an exceptional source of high quality protein and other nutrients⁷.
12. The absolute and relative growth of aquaculture contribution to food and nutrition security in Africa varied regionally; the growth in production volume varied across regions.
13. By producing 91,270 tonnes in 1997 and 1,485,325 tonnes in 2017, or an average growth rate of **14.2** percent, **Northern Africa**'s aquaculture grew fastest. With 25,393 tonnes produced in 1997 and 369,221 tonnes in 2017, or an average growth rate of 13.6 percent, **Western Africa** came in the second position. It was followed closely by **Eastern Africa** whose volume of production increased from 15,490 tonnes in 1997 to 208,255 tonnes in 2017, or an average growth rate of 13.2 percent. During the same period, **Middle Africa**'s aquaculture production rose from 1,303 to 7,691 tonnes, which represents an average growth rate of 8.8 percent. Aquaculture grew smallest and slowest in **Southern Africa** whose production increased from 4,311 tonnes in 1997 to 7,070 tonnes in 2017, or an average growth rate of 2.4 percent.
14. Regarding the **national economic growth** benefit, little information exists as to the magnitude of aquaculture contribution to African countries' economic growth. In 1997, aquaculture added USD 322,975,000 to Africa's economies, a value that increased to USD 3,192,257,000 in 2017, or an average growth rate of 11.5 percent. However, for example, investments and profits made in aquaculture, as well as other indicators of the sector's contribution to these economies remain unknown.

⁵ It is reasonable to assert that the growth of aquaculture in terms of tonnage resulted in a higher contribution of aquaculture to fish consumption; small volumes of the continent's aquaculture production, including high value species such as shrimp, move into inter-continental trade. Little information exists as to whether or not the fish consumed is an aquaculture product, or is from the wild. To be able to quantify this contribution, we need to segregate data by sub-sector: fish from the capture and aquaculture in terms of domestic fish consumption and fish trade.

⁶ The lack of segregated data on fish trade and consumption makes it difficult to quantify the contribution of aquaculture to food consumption in Africa.

⁷ SFIC (Sports and Fitness Insurance Corporation) Seafood for Health. 2006. <http://www.sealord.biz>

15. A growing aquaculture also means more taxes paid to public treasury. With more taxes collected, aquaculture has contributed, to some extent, to road and school construction and other amenities, to GDP, and others, and hence, to countries' economic growth. But, again, the lack of data excludes the possibility of knowing the extent of this contribution.
16. Nevertheless, as was the case for the production volume, the contribution of aquaculture to the continent's economy varied across regions. From 1997 to 2017, in **Western Africa**, the value of aquaculture production increased from USD 60,383,000 to USD 950,470,000, or an average growth rate of 14.0 percent. In the same period, the value of aquaculture production grew from USD 45,941,000 to USD 604,009,000 in **Eastern Africa**, or an average growth rate of 13.1 percent. In **Middle Africa** this value was USD 2,638,000 in 1997 and USD 32,568,000 in 2017, representing an average growth rate of 12.7 percent. **Northern Africa** saw the value of its production rising from USD 204,789,000 in 1997 to USD 1,547,444,000 in 2017, or an average growth rate of 10.1 percent. In **Southern Africa**, aquaculture production was valued at USD 9,223,000 in 1997 and USD 57,767,000 in 2017, which represents an average growth rate of 9.1 percent.
17. Data and information that would allow for an adequate assessment of the **poverty reduction** benefit of aquaculture in Africa are very limited. A rough estimate indicates that aquaculture employment in Africa, including fish farmers, increased from an estimated 65,000 people in 1995 to 304,000 in 2016. Salary rates and volume, and other indicators of poverty reduction are yet to be determined.
18. The lack of aggregated data in fish trade (by aquaculture and capture) makes estimation of aquaculture contribution to the **balance of trade** in Africa difficult. However, it is reasonable to assume that, by consuming more of the fish produced domestically, less fish was imported on the continent, which, in turn, contributed to improving the continent's intra-industry balance of trade, at least. Indeed, in 2017, Africa's fish imports were valued at USD 5 038 490 000 while exports totaled USD 7 191 333 000, or a positive intra-industry balance of trade of USD 2 152 843 000. Compared to 1997, where fish imports represented USD 1 095 796 000 and exports were valued at USD 2 518 980 000, or a positive intra-industry balance of trade of USD 1 423 184 000, this change represents an average growth rate of 2 percent.
19. Recognizing the importance of improving and expanding socio-economic benefits of aquaculture, the Seventeenth Session of the Committee on Inland Fisheries and Aquaculture of Africa (CIFAA), which was held in Banjul, The Gambia, from 09 to 11 May 2017, identified a discussion on this topic as one of the major priorities for the 18th Session. The aim would be to balance their improvement and profit in the context of aquaculture production sustainability.
20. The purpose of this paper is to entice this discussion. Such a debate could pave the way to identifying the means by which to improve these benefits while ensuring the sustainability of the sector.

II. AQUACULTURE SUSTAINABILITY

2.1 MEANING AND CONDITIONS

21. Sustainability of aquaculture implies that the later develops in such a way that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

22. For aquaculture to develop in a sustainable manner, it has to meet a set of conditions. It has to be technically, economically, socially, environmentally and legally feasible. These conditions are referred to as technical, economic, social, environmental and legal sustainability of the sector.
23. **Technical sustainability** refers to the condition for aqua farmers to, at all times, identify and master the appropriate technologies, either imported or locally produced, and to utilize them properly within the production cycle. In other words, technical sustainability requires that, at all times, aqua-farmers have the necessary knowledge and technical skills to grow a given aquaculture organism including producing the inputs needed in the process, and that growing conditions of cultured species are adapted to local conditions⁸.
24. **Economic sustainability** entails aquaculture farms to generate competitive profits over time. Otherwise, unless subsidized, aqua- farmers may decide to leave the sector to focus their efforts on better rewarding opportunities.
25. **Social sustainability** entails that aquaculture be socially acceptable. Social acceptability, also known as social license, refers to the degree to which aquaculture is accepted by local and neighboring communities, the various interest groups and society as a whole. These attitudes to aquaculture are largely determined by its perceived benefits⁹. Thus, to be socially acceptable, aquaculture operations should benefit a broader spectrum of society, including women, the youth and the elderly, rather than a small elite.
26. **Environmental sustainability** of aquaculture demands that the latter be respectful of the environment. This implies that, for example, aquaculture should not create significant disruption to the ecosystem, or cause the loss of biodiversity or substantial pollution impact. Negative impacts of aquaculture should be mitigated and limited to the very minimum so as to allow farmers to pursue their activities on the same location for a long time period.
27. **Legal sustainability** implies that, for aquaculture enterprises to grow and prosper overtime, related laws and regulation must be clear, stable and predictable. The clarity, stability and predictability of laws and regulations give investors the time to adapt and adopt them. Frequent changes create a climate of mistrust among investors, dissuade them and limit investment in the sector¹⁰. Without adequate investment, chances for the sector to thrive overtime are limited. In addition, aqua-farmers must be legally compliant.

2.2 BALANCING PROFITS AND SOCIO-ECONOMIC BENEFITS FOR THE SECTOR SUSTAINABILITY: THE IMPORTANCE OF GOVERNANCE

28. Businesses, individual or corporate, invest in aquaculture for profits. They seek maximum and competitive profits. Profitability of aqua-businesses requires, among other things, an enabling business-friendly approach by governments; also the rule of law to ensure security of property rights, and a minimum of rent seeking. These are integral parts of **governance**.

⁸ Hishamunda, N., Ridler, N., & Martone, E. 2014. Policy and governance in aquaculture: lessons learned and way forward. FAO Fisheries and Technical Paper No. 577. Rome, FAO. 68pp.

⁹ Hishamunda, N., Ridler, N., & Martone, E. 2014. Policy and governance in aquaculture: lessons learned and way forward. FAO Fisheries and Technical Paper No. 577. Rome, FAO. 68pp.

¹⁰ Percy, R.D.; Hishamunda, N. 2001. Promotion of sustainable commercial aquaculture in sub-Saharan Africa. Volume 3. Legal, regulatory and institutional framework. FAO Fisheries Technical Paper. No. 408/3. Rome, FAO. 2001. 29p

29. As discussed previously, investments in aquaculture profit to society as a whole by producing several socio-economic benefits, in addition to positive effects on the environment by reducing the pressure on over-exploited wild fish stocks. However, there are also potential costs associated with aquaculture. Benthic enrichment, eutrophication of the water column, escapees and aesthetic loss are examples of potential hazards associated with cage culture. Aquaculture can also induce mangrove destruction.
30. While some of these detrimental effects are reduced through the learning curve and technological advances, and through self-interest of farmers themselves, many are intrinsic to the industry itself. For this reason, the industry is subject to regulations or voluntary codes of conduct such as the FAO Code of Conduct for Responsible Fisheries. These too, are elements of **governance**.
31. In aquaculture, **governance** is defined as the set of processes by which a nation manages its productive resources with respect to the sector, its stakeholders participate in making and implementing decisions affecting aquaculture's development, government personnel are accountable to the aquaculture community and other stakeholders, and the respect for the rule of law is applied and enforced in aquaculture¹¹.
32. The aim of all **governance** instruments is to internalize externalities from myopic behavior that may come with profit seeking, while ensuring maximum benefits to society¹². The challenge of **aquaculture governance** is, therefore, to ensure that the right measures are implemented to safeguard environmental sustainability without destroying entrepreneurial initiatives, the very source of socio-economic benefits to society. Risks to society must be reduced, but also risks and transaction costs to farmers.
33. Although in practice **governance regimes** are fluid and mixed, with no clear-cut demarcation between them, three main types of governance can be used to achieve this goal¹³.
34. At one extreme is "**hierarchical governance**". This is a top-down, command and control type of governance where elites (government) assume that they are the sole repository of knowledge and can enforce unpopular measures. There, there is little or no consultation with stakeholders. Basically, in aquaculture, hierarchical governance exists where governments develop policy independently, leaving producers to manage their farms¹⁴.
35. In some countries, this type of governance has disappeared for practical reasons. Command and control measures failed to produce sustainable aquaculture; laws became outdated, enforcement was inadequate and producers non-compliant¹⁵.

¹¹ Guidance can be obtained from: FAO Aquaculture Governance and sector development. FAO Technical Guidelines for Responsible Fisheries. No. 5, Suppl. 7. Rome, FAO. 2017. XX p..

¹² Hishamunda, N., Ridler, N., & Martone, E. 2014. Policy and governance in aquaculture: lessons learned and way forward. FAO Fisheries and Technical Paper No. 577. Rome, FAO. 68pp

¹³ Hishamunda, N., Ridler, N., & Martone, E. 2014. Policy and governance in aquaculture: lessons learned and way forward. FAO Fisheries and Technical Paper No. 577. Rome, FAO. 68pp

¹⁴ Hishamunda, N. and Subasinghe, R.. 2003. Aquaculture development in China. The role of the public sector policies. FAO Fisheries and Technical Paper No. 427. Rome, FAO.

¹⁵ Kaiser, M. and Stead m., (2002), Uncertainties and values in European aquaculture; communication management and policy issues in times of "changing public perceptions" Aquaculture International. 10; 469-490

36. At the other extreme, there is **market governance**. This largely “Laissez-faire” governance regime leaves market forces (supply and demand) to lead aquaculture development. The danger is that market excesses result in unintended effects. There are numerous examples of where these negative effects occurred, as farmers pursued myopic profit-maximization and governments failed to regulate external costs because they were attracted by the potential of aquaculture to contribute to their people’s livelihoods and foreign exchange earnings. In some places, the result was destruction of mangroves, leaving land unusable for other activities. The result was also social unrest. Broader economic benefits of aquaculture were lost and may even have become negative¹⁶.
37. Since then, countries where such bitter experiences occurred have learnt from their mistakes and intervened to mitigate market failures. They enacted regulations, and imposed moratoria on some aquaculture development. Codes of conduct were also developed and applied.
38. The third type of governance is **participatory governance**. Participatory governance extends from industry self-regulation, co-management of the sector by industry representatives and government regulators, and community partnerships, to “environmental stewardship”¹⁷.
39. **Industry self-regulation** is the principal form of participatory governance. There, aquaculture producers implement a detailed code of conduct. This may be at a local, national or international level.
40. At the **local level**, neighboring (and competing) farmers work together to co-ordinate production and environmental measures. The motivation may be altruistic, but also self-interest in maintaining a healthy husbandry environment. Compliance is enforced by peer pressure¹⁸.
41. At the **national level**, many countries have codes of conduct. The incentive for farmers to meet these codes is certification of quality. However, industry organizations must also have the ability to exclude those who do not comply.
42. At the **international level**, a best example is the 1995 FAO *Code of Conduct* which “sets international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity”.
43. A second form of participatory governance of aquaculture is **co-management**. In co-management, the industry representatives and regulators (governments) work together to manage the sector. To do so, they enter into “benefit-and-cost” (right-and-responsibility)-sharing partnerships. In some countries, however, the industry undertakes most tasks with governments only checking periodically; an indication that the industry is increasingly moving towards self-regulation.
44. Experience from fisheries has identified the following resource functions of co-management: (i) data gathering; (ii) logistical decision-making (such as who can harvest and when); (iii) allocation decision-making; (iv) protection of the resource from environmental damage; (v) enforcement of regulations; (vi) enhancement of long-term planning; and (vii) more inclusive decision-making¹⁹. These functions can as well be expected from co-management in aquaculture.

¹⁶ Hishamunda, N., Ridler, N., & Martone, E. 2014. Policy and governance in aquaculture: lessons learned and way forward. FAO Fisheries and Technical Paper No. 577. Rome, FAO. 68pp

¹⁷ Environmental stewardship refers to responsible use and protection of the natural environment through conservation and sustainable practices. https://en.wikipedia.org/wiki/Environmental_stewardship. Accessed on 09 November 2019 at 18:03.

¹⁸ Hishamunda, N., Ridler, N., & Martone, E. 2014. Policy and governance in aquaculture: lessons learned and way forward. FAO Fisheries and Technical Paper No. 577. Rome, FAO. 68pp

¹⁹ Environmental Law Institute . 2010. Challenges and Opportunities for Aquaculture Co-Management: Lessons Learned from Case Studies. Washington, D.C.

45. The caveat of self-regulation and co-management in aquaculture is the narrow range of stakeholders. Most modern aquaculture rarely occurs in isolation; it often involves locations where natural resources are claimed by other sectors such as the capture fisheries, agriculture, shipping and tourism. This is the case of coastal, marine and inland cage aquaculture, for example. The non-exclusive use of resources by aquaculture has prompted countries to adopt more- inclusive forms of participatory governance to account for other stakeholders. An extensive array of stakeholder participation in managing the sector has the potential to reconcile conflicts over aquaculture sites and activities, make it equitable, and, thus, increases its legitimacy and social acceptability; therefore, sustainable over a long time period.

III. TOWARDS AQUACULTURE SUSTAINABILITY IN AFRICA: PROGRESS MADE AND OUTSTANDING ISSUES

46. An important determinant of aquaculture viability is the ability of farmers to produce, or otherwise access good quality productive inputs such as seed and feed in desired quantities. While good quality seed and feed are produced or available in some countries in Africa, they are not accessible to most farmers. Additionally, the shortage of and access to good quality seed and feed remains one of the main bottlenecks to aquaculture development in many other countries. Very few up-to-date hatcheries and fish feed mills exist that produce seeds and feeds at affordable and competitive prices; many African countries still import fish feed, sometimes from as far as Europe and Asia. As a result, a number of farmers still understock their culture milieus and underfeed their fish. This is an indication of a lack of or weak **technical sustainability** of African aquaculture.

47. There is also the issue of inaccessible loans. Loans can be vital for aquaculture farmers. The latter need loans to meet farm fixed and operating financial obligations. Most need them to purchase or rent land, machinery and equipment including boats, vehicles and aerators, to build ponds and/or cages as well as storage facilities, hatcheries, feed mills and processing plants. They need them to buy feed and pay labour during the first or in-between production cycles. These costs, especially the fixed ones, can be important in the short run. Yet, accessing loans to cover those remains extremely problematic in Africa.

48. Of the many factors that limit aqua farmers' access to loans in Africa is the high interest rates. In many African countries, several banks demand interest rates as high as 30 to 40 percent.

49. Such high interest rates are a common disincentive to borrowing in sub-Saharan Africa. In aquaculture, not only prohibitive loans limit poor domestic investment in the sector, which limits its growth, but they also render domestically farmed aqua products less profitable to farmers and non-competitive internationally.

50. The lack of competitive profits at home and competitiveness of aquaculture products abroad are indicators of lack of or limited **economic sustainability** of the sector, and a threat to its long-run growth. Already, there are widespread complaints by a number of small-scale Tilapia farmers in many parts of Africa that they can no longer compete with imported Tilapia and could be forced out of business.

51. Good governance is a pre-requisite for an orderly and long-run viability of any sector, including aquaculture. Aquaculture governance requires setting up and implementing sector-specific policies, strategies and plans, laws and regulations in addition to administrative and institutional arrangements to lead the development and growth of the sector. Yet, although a good number of African countries have long-standing institutional arrangements for aquaculture development, the

latter remain generally weak, with dysfunctional extension services. Moreover, few countries have aquaculture-specific policies, strategies and development plans and, even fewer have functioning aquaculture legal and regulatory frameworks. The absence of such instruments is an indication of a dearth of or a weak **legal sustainability** of the sector.

52. Deficient (or absence of good) governance frameworks, including legal and regulatory structures, put the sector at risks, of which environmental and economic.
53. There are indications that non-indigenous fish species, including live fish, continue to enter some countries freely, without control of any kind. Such practices put the aquaculture sector in jeopardy. Not only could non-indigenous species displace endemic ones (implying lack of **environmental sustainability**), but also uncontrolled introductions could bring in diseases that might spread and wipe out the local industry. In either case, socio-economic costs to society could be extensive. An example is the White Spot Syndrome Virus (WSSV) that severely affected shrimp aquaculture in the Indian Ocean region a few years back.
54. In spite of these threats, and although a step in the right direction has been made with the recent development of a “Regional Aquatic Strategy for Southern African Development Community-SADC”²⁰, very few African countries have Aquatic Biosecurity Strategies and Programmes. Such strategies and programmes could be useful in shielding the industry from introduced and other diseases and contribute to ensuring the sustainability of its growth.

CONCLUSIONS

55. This paper revealed that, in the last two decades, African aquaculture grew faster than the World’s average. By volume, North Africa’s grew fastest while Southern Africa’s, slowest. By production value, West Africa recorded the highest growth and Southern Africa displayed the lowest.
56. This growth brought about important socio-economic benefits to the Region, in terms of enhanced contribution of the sector to **food and nutrition security, national economic growth, poverty reduction** (especially through employment and income generation) and countries’ **balance of trade**.
57. Mainly because of the lack or limited availability of adequate farm records (particularly in the case of small-scale and non-commercially oriented operations), farmers (particularly large commercial)’ reluctance to share data, and rigorous secondary time series data, the quantification of these benefits, especially aquaculture contribution to national economic growth and poverty reduction is difficult.
58. The lack or limited availability of segregated data and information as to whether or not fish consumed or traded is an aquaculture product, or is from the wild complicates the quantitative assessment of aquaculture contribution to food and nutrition security, and countries’ balance of trade.
59. Yet, systematic and quantitative information on these socio-economic benefits of aquaculture to society is essential for African governments and development agents to appreciate its merits. A proper understanding of these merits allows for the formulation of suitable policies enabling the

²⁰ FAO. 2018. Development of a Regional Aquatic Biosecurity Strategy for the Southern African Development Community (SADEC). FAO Fisheries and Aquaculture Circular No. C1149. Rome. 344pp.

development of the sector into a mature industry that contributes to local, national and regional economies and to society's wellbeing to the extent possible without compromising its capacity to do the same for future generations: the very essence of sustainability.

60. Technically, sustainability of African aquaculture is threatened by the still farmers' limited ability to produce or otherwise access good quality seeds and feeds in desired quantities; the shortage of and limited access to such fundamental productive inputs remains one of the main bottlenecks to aquaculture development in many countries. Inaccessibility of loans by farmers, mainly due to prohibitively high interest rates, further exacerbates the issue.
61. In addition, not only prohibitive loans limit poor domestic investment in the sector, which, in turn, limits its growth, but also they mean less and uncompetitive profits to farmers, and loss of international competitiveness of domestically farmed aqua products. In other words, they limit **economic sustainability** of the sector.
62. Poor good governance of the sector, as exemplified by weak administrative and institutional structures across the continent and a widespread lack of adequate sector-specific policies, strategies and plans, laws and regulations in several countries, is not conducive to **legal** and environmental **sustainability** of the sector. Poor governance of the sector could also result in high socio-economic costs to the continent as, for example, uncontrolled introductions of non-indigenous fish species observed in some countries could carry worrying diseases.
63. To resolve these outstanding issues, the following actions could be explored (the list is not exhaustive):
 - a. ***With respect to quantifying socio-economic benefits of the sector:***
 - i. Review the reporting methods so as to have clear and coherent aquaculture-specific data including on production, consumption and trade;
 - ii. Initiate and train small-scale and non-commercial farmers in record keeping;
 - iii. Make it mandatory for all farmers, including large-scale commercial farmers to keep and provide farm records to government. This requirement could be linked to, for example, the renewal of farming permits;
 - iv. Conduct regular comprehensive farm, consumption and export surveys.
 - b. ***With respect to maximizing socio-economic benefits from the sector while minimizing the negative effects accruing from irresponsible profit-seeking and ensure the sector sustainability:***
 - i. Countries to develop and/or implement sector-specific policies, strategies, programmes to resolve or ease the problem of seed and feed, as well as farmers' access to loans. This would mean, for governments, to, inter-alia:
 - (i) Support technically, environmentally and economically feasible hatcheries and feed mills;
 - (ii) Set up practical measures to ease the problem of high bank interest rates and other constraints to accessing bank loans (collateral, farmers' capacity to prepare business plans, and financing institutions' capacity to evaluate aquaculture proposals, etc.);
 - ii. Countries to establish, or review existing governance frameworks with the aim to establish, and implement good aquaculture governance practices²¹. This would

²¹ Guidance can be obtained from: FAO Aquaculture Governance and sector development. FAO Technical Guidelines for Responsible Fisheries. No. 5, Suppl. 7. Rome, FAO. 2017. XX p.

imply, for example, having and implementing aquaculture national policies and laws, national aquatic biosecurity strategies and programmes, etc.

c. *With respect to both “a” and “b”:*

64. One of the ways forward could be to move towards **making African aquaculture digital**.
65. Borrowing from agriculture, **digital aquaculture** would refer to” tools that numerically collect, store, analyze, and share electronic data and/or information along the sector value chain”²².
66. As for agriculture, digital aquaculture would use on-farm technologies, perhaps adapted, (like yield mapping, GPS guidance systems, and variable-rate application) and digital technologies (like e-commerce platforms, e-extension services, warehouse receipt systems, food traceability systems, machinery rental apps, etc.). Thus, digital aquaculture would affect the entire aquaculture food value chain; i.e. before, during, and after on-farm production²³.
67. By lowering the costs of replicating, transporting, tracking, verifying, and searching for data.^[36], digital technology will improve efficiency throughout the aquaculture value chain (on-farm and off-farm efficiency).
68. On-farm, precision aquaculture technologies such as automatic feeding, where applicable, could cut the quantity of feed required for a given yield and reduce labour cost, thereby enhancing the economic sustainability of the farm.
69. Not only does using fewer feed lower the cost of production, thereby increasing the farm profitability and its economic sustainability, but it could also reduce feed wastes and other pollutants such as fish feces, which would lessen negative impacts of aquaculture activities on the rearing environment, and, hence, enhance the environmental sustainability of the farm.
70. Evidence exists that “digital agriculture improves labor productivity through improved farmer knowledge. This is because “E-extension (electronic provision of traditional agricultural extension services) allows for farming knowledge and skills to diffuse at low cost”. For example, the company Digital Green works with local farmers to create and disseminate videos about agricultural best practices in more than 50 languages.^{[50][51]} .There is no reason not to believe that the same can be done in aquaculture.
71. Digital technologies could also be useful in aquaculture greenhouses with automated climate control. For example, by fixing, water temperature, dissolved oxygen levels, PH and other water quality parameters at optimal levels, and having technologies to monitor and maintain these parameters at the desired levels, farmers could cut length of growing cycles and quantities and costs of production inputs, thereby make aquaculture more efficient and sustainable economically and environmentally.
72. Off-farm, digital agriculture technologies have proven effective in making agriculture markets more efficient. Mobile phones, online ICTs, e-commerce platforms, digital payment systems, and other digital agriculture technologies can mitigate market failures and reduce transaction costs

²² *"Digital Agriculture: feeding the future". Project Breakthrough. Accessed on 13 November 2019.*

²³ *Shepherd, Turner, Small, and Wheeler (2018). "Priorities for science to overcome hurdles thwarting the full promise of the 'digital agriculture' revolution". Journal of the Science of Food and Agriculture.*

throughout the value chain. These same technologies could be used for the same purpose in aquaculture.

73. Because digital technologies reduce transaction costs and information asymmetries, they can improve smallholder farmers' market access, thereby creating a more equitable aquaculture-food value chain:

SUGGESTED ACTION BY THE COMMITTEE

74. The Committee is invited to:

- i. Review this paper and comment on the possible future actions suggested therein by the Secretariat in terms of their suitability to Member countries' needs.
- ii. Share national experiences in terms of policies, strategies and programmes, and other actions put in place to develop aquaculture in such a way as to maximize its socio-economic benefits to their populations while preserving private entrepreneurship and ensuring the sector sustainability.
- iii. Identify and agree on the way forward in order to ensure that aquaculture significantly contribute to the well-being of CIFAA Members' populations in terms of food and nutrition security, national economic growth, poverty reduction and countries' balance of trade without jeopardizing its ability to meet future generations' needs.