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Review **Derleme**

Aquaculture in Africa: Challenges and Future Prospects

Afrika'da Su Ürünleri Yetiştiriciliği: Zorluklar ve Gelecek Perspektifleri

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Abstract: Aquaculture in Africa has shown gradual growth, though progress remains slow due to differences in water availability, economic conditions, and access to fisheries across countries. Therefore, this study examines the challenges and prospects of the fish farming sector in Africa. Evaluating aquaculture performance should consider factors beyond production levels or GDP contribution, such as its role in food supply, population size, and natural resource availability. Egypt leads in aquaculture contribution to national fish supply, followed by Lesotho, which focuses on exports. Ethiopia, Guinea-Bissau, and Sudan have significant per capita fish supply gaps. Egypt also dominates in total production, with 2018 output surpassing all other African countries combined. Countries like Rwanda, Burundi, Lesotho, and Benin have shown strong production growth over the past decade, while Lesotho, South Africa, and Mauritius excel in high-value aquaculture production. The combination of reaching maximum yields in marine and inland fisheries, expanding markets, urbanization, and opportunities for private-sector growth presents immense potential for aquaculture development in Africa.

Keywords
- Africa
- Aquaculture
- Challenges
- Future Prospects

Özet: Afrika'da su ürünleri yetiştiriciliği kademeli bir büyüme göstermiştir, ancak ülkeler arasında su bulunabilirliği, ekonomik koşullar ve balıkçılığa erişimdeki farklılıklar nedeniyle ilerleme yavaş kalmaktadır. Bu nedenle, bu çalışma Afrika'daki balık çiftçiliği sektörünün zorluklarını ve beklentilerini incelemektedir. Su ürünleri yetiştiriciliği performansını değerlendirirken, gıda tedariğindeki rolü, nüfus büyüklüğü ve doğal kaynak bulunabilirliği gibi üretim seviyeleri veya GSYİH katkısının ötesindeki faktörler dikkate alınmalıdır. Mısır, ulusal balık tedarikine su ürünleri yetiştiriciliği katkısında başı çekerken, onu ihracata odaklanan Lesotho takip etmektedir. Etiyopya, Gine-Bissau ve Sudan'da kişi başına düşen balık tedariğinde önemli açıklar bulunmaktadır. Mısır, 2018 yılı üretiminin diğer tüm Afrika ülkelerinin toplamından fazla olmasıyla toplam üretimde de lider konumdadır. Ruanda, Burundi, Lesotho ve Benin gibi ülkeler son on yılda güçlü bir üretim büyümesi gösterirken, Lesotho, Güney Afrika ve Mauritius yüksek değerli su ürünleri yetiştiriciliği üretiminde öne çıkmaktadır. Deniz ve iç su balıkçılığında maksimum verime ulaşma, genişleyen pazarlar, kentleşme ve özel sektör büyüme fırsatlarının birleşimi, Afrika'da su ürünleri yetiştiriciliğinin geliştirilmesi için muazzam bir potansiyel sunmaktadır.

Anahtar kelimeler
- Afrika
- Su Ürünleri Yetiştiriciliği
- Zorluklar
- Gelecek Perspektifleri

1. INTRODUCTION

Aquaculture was initially brought to various African nations in the early 20th century to support colonial recreational fishing (Heck et al., 2007). Kenya's success in cultivating tilapia led colonial governments to promote African aquaculture, enhancing nutrition, income, and employment through government-supported fish farming stations and production ponds (Adeleke et al., 2020). Since the 1960s, the FAO, in collaboration with governments, donor nations, research institutions, and nongovernmental organizations, has led efforts to promote

aquaculture development in the region. These initiatives initially focused on basic research and practical techniques for cultivating various primarily indigenous species. The sector's growth accelerated thanks to financial and technical support from bilateral and multilateral donors, amounting to approximately US$500 million between the early 1970s and early 1990s. However, by the mid-1990s, funding for aquaculture in Africa declined significantly as donors shifted their priorities to address pressing issues like education, healthcare, and governance (Heck et al., 2007). Fish is a vital component of Africa's agri-food system with significant potential to address food and nutrition insecurity. It provides 19% of the animal protein consumed across the continent and offers essential micronutrients and long-chain polyunsaturated fatty acids, which are difficult to replace with other food sources. Small indigenous fish, such as Dagaa from Lake Victoria and Kapenta in southern Africa, are integral to traditional diets and serve as rich sources of micronutrients. Additionally, fish is highly efficient at converting feed into high-quality food (Bene et al., 2015).

Despite its immense potential in fisheries and aquaculture, Africa lags behind other regions in global fish production, consumption, and trade (FAO, 2018). The sector faces numerous challenges that hinder its growth and sustainability, including a lack of improved fish breeds, feeds, technical training, weak research capacity, inadequate human and financial resources, poor market infrastructure, and weak governance and regulation (Brummett et al., 2008). Additionally, fish post-harvest losses and waste are significant problems, with more than a quarter of the fish harvest being lost in Sub-Saharan Africa (Affognon et al., 2015). In Sub-Saharan Africa, deterioration from long-distance transportation, high temperatures, inadequate packaging, insufficient preservation techniques, erratic logistics, species preferences, and fishing gear constraints are the main causes of fish post-harvest losses (Abelti & Teka, 2024). The lack of developed cold chains is a key area for intervention to improve resource efficiency and increase profits in the value chain. Compared to Asia, where aquaculture is highly developed, Africa's aquaculture sector, mainly commercial aquaculture, remains in its early stages, with Egypt and Nigeria being notable exceptions. Overfishing and overcapacity have further stressed fishery resources, especially in Western Africa. Africa's declining per capita fish consumption severely impacts food and nutrition security, as fish provides essential micronutrients and protein to millions of malnourished people (FAO, 2018).

2. THE STATUS OF AQUACULTURE IN AFRICA

Africa’s contribution to global aquaculture production remains modest at approximately 1.9 % (FAO, 2024).However, it has grown significantly due to large-scale investments in Egypt, Nigeria, Uganda, and Ghana (Cai et al., 2017). Between 1995 and 2018, production increased twenty-fold, from 110,200 tons to 2,196,000 tons, with a Compound Annual Growth Rate (CAGR) of 15.55%. This growth has been driven by the rise of private sector-led small and medium enterprises (SMEs) and the establishment of large commercial ventures. These developments were supported by public backing, foreign direct investment, increased interest in aquaculture, and global awareness initiatives (Satia, 2011).

Most African aquaculture production (99%) comes from inland freshwater systems, primarily cultivating native and abundant species like tilapia and African catfish. In contrast, mariculture accounts for only 1% of total production, though it is a growing and promising subsector (FAO, 2018). Innovations in aquaculture include introducing new production systems, such as tanks and cages, alongside improvements to existing methods (Satia, 2017). The sector employs approximately 6.2 million people, with women playing a significant role, particularly in large-scale commercial farms. Women are predominantly involved in downstream activities such as postharvest processing and marketing within the aquaculture value chain (Satia, 2016). Given its scale and potential, aquaculture is well-positioned to enhance food security, reduce unemployment, and support Africa's economic development (Adeleke et al., 2020).

Many African governments recognize the importance of fostering a supportive business environment and implementing policy reforms to promote economic growth, positively impacting the aquaculture sector (Satia, 2011). Some nations have introduced aquaculture-focused policies and strategic frameworks to guide the

sector's development. While a few governments have facilitated soft loans and incentives, significant barriers remain. Challenges such as limited access to affordable credit, inadequate availability of high-quality inputs, and land ownership issues continue to hinder aquaculture development and expansion (Moehl & Machena, 2000). Africa's aquaculture sector is diverse, with regions excelling in different production and value aspects. In North Africa, Egypt leads in production volumes and national fish supply. East Africa is dominated by Uganda, which ranks third in Africa and excels in critical indicators like national fish supply, GDP contribution, and renewable water use. In Southern Africa, Zambia leads in production and per capita production, while South Africa stands out for high-value marine species farming. Lesotho and Zimbabwe excel in relative contributions to national fish supply, GDP, and inland aquaculture. West Africa sees Nigeria dominate in output and value, with Ghana excelling in aquaculture's contribution to GDP, production per capita, and value per capita. Central Africa remains underdeveloped, with the Democratic Republic of the Congo leading in production but ranking low in Africa overall. At the same time, high fish consumption is driven by abundant capture fisheries in countries like São Tomé and Príncipe, Gabon, and Congo. This regional breakdown illustrates Africa's growing aquaculture industry, with distinct strengths and challenges across the continent (table 1) (Hinrichsen et al., 2022).

Research efforts in the region have primarily concentrated on species characterization, selective breeding, and developing low-cost diets in select centers. On-farm participatory research using model farms and private enterprises has facilitated the rapid transfer of aquaculture technologies through farmer-to-farmer networks, particularly in countries targeted by SPADA. However, extension services remain weak, highlighting the need to strengthen connections between research and development initiatives (Cocker, 2014). In some countries, the private sector has increasingly taken the lead in producing and delivering essential aquaculture inputs, such as seed and feed (Wadah et al., 2022). In contrast, others host manufacturers and suppliers of aquaculture equipment (Koge et al., 2018). Aquaculture producer associations are active across many African nations, playing vital roles in information dissemination, knowledge exchange, and supporting aquaculture-related activities. Additionally, fish farmer clusters have emerged as effective mechanisms for improving service delivery, achieving economies of scale, lowering transaction costs, and enhancing competitiveness (Satia, 2017).

Despite the obstacles, such as inadequate infrastructure and a lack of facilities, emerging aquaculture marketing activities in some countries are gradually improving the value chain (Elsheikh et al., 2022). To meet consumer demand for ready-to-prepare products, artisanal fish processing subsectors are developing near farms and markets, utilizing simple techniques. Value-addition practices, including freezing, smoking, drying, and cold-smoking catfish fillets, have also enabled the export of processed products to European markets. The leading aquaculture producers in Africa include Egypt, Nigeria, Uganda, Ghana, Tunisia, Kenya, Zambia, Madagascar, Malawi, and South Africa (Satia, 2017). These countries have achieved significant growth over the past decade, driven by capacity building, good governance, research and development, access to credit, and a strong emphasis on private sector-led aquaculture. Private sector involvement has spurred investments in effective management practices, advanced production systems, aqua-feed formulation, and the establishment of vibrant producer associations and service providers (Satia, 2011). As the aquaculture industry grows and activities intensify, several challenges are emerging in leading countries, including increasing demand for capital, insufficient quantities and quality of seed and feed, competition for resources (land, water, and feed), and the need to strengthen aquaculture management and overall governance of the sector (Satia, 2016). Despite these obstacles, the combination of peak marine and inland capture fisheries yields, expanding markets and services, urbanization, and private-sector development opportunities presents significant potential for aquaculture growth (Satia, 2017).

Around 2.5 million tonnes of aquaculture were produced in Africa in 2022, making up 1.9% of the world's total (FAO,2024), while in 2018, Africa's contribution to global aquaculture production was estimated at 2.196 million tons, accounting for a modest 2.67% of the total, with freshwater finfish production being the dominant sector (Halwart, 2020). The top producers—

Egypt, Nigeria, and Uganda—accounted for approximately 90% of the region's total aquaculture output. Egypt's aquaculture industry overgrew in 1998, driven by ongoing government interventions and increased private sector investment. As a result, Egypt's production rose from 139,389 tons in 1998 to 1,561,457 tons in 2018, representing 71% of Africa's total aquaculture production (Feidi, 2018). Nigeria, with a population exceeding 200 million (Pison et al., 2022), has the highest fish demand in Africa, leading to the swift development of peri-urban commercial aquaculture. Driven by market demand, aquaculture production in Nigeria grew from 20,458 tons in 1998 to 291,233 tons in 2018. The Nigerian government plays a crucial role in creating a supportive business environment, while the private sector leads the aquaculture value chain development. In Uganda, aquaculture development gained momentum in 2000 due to growing awareness of its potential to combat malnutrition, food insecurity, and unemployment. This sector received significant support through government initiatives and aid from development partners, increasing production from 2,360 tons in 2001 to 103,737 tons in 2018 (Adeleke et al., 2020).

Table 1: Top 10 aquaculture producers in Africa in 2018.

Country	Production (metric tons)
Egypt	1,561,457
Nigeria	291,233
Uganda	103,737
Ghana	76,630
Zambia	24,300
Tunisia	21,756
Kenya	15,124
Malawi	9014
Madagascar	7421
South Africa	6181

2.1 Aquaculture production systems in Africa

Aquaculture production in Africa is highly diverse, varying in terms of technologies, natural resources, and value chain structures. Most production (82%) occurs in inland waters (FAO, 2021), with ocean-based aquaculture mainly practiced in the Mediterranean and the Black Sea (70% of marine production) and the Indian Ocean (29%). The production systems can be categorized as extensive, semi-intensive, or intensive, with different approaches in various regions (Hinrichsen et al., 2022).

In Sub-Saharan Africa, common production systems include earthen ponds, cages, and basins. In North Africa, extensive systems are common, where juvenile fish are stocked in reservoirs, a method practiced in countries like Egypt, Morocco, Algeria, and Libya (El-Sayed, 2017). Semi-intensive aquaculture, typically practiced in earthen ponds with supplementary feeding, is most prevalent in Egypt, contributing up to 80% of the country's fish production (Soliman, 2017). Intensive systems in tanks and cages are also proliferating (Satia, 2017).

In Southern Africa, production systems are more varied, with raceways used for trout farming, ponds for extensive and semi-intensive production, and cages for grow-out. Additionally, longlines are used for mussel and oyster production, and recirculating aquaculture systems (RAS) are more common in South Africa. South Africa also employs land-based pumping systems for abalone farming using advanced hatchery technology. Cage fish farming is essential, with large companies operating on lakes such as Lake Kariba in Zambia, where two cage farms control 85% of the cages (Adeleke et al., 2020).

In East Africa, aquaculture is mainly extensively pond-based due to lower infrastructure costs and more straightforward techniques. However, some farmers have adopted more intensive methods like cage farming, which is profitable and requires less capital per unit of fish produced. Uganda has the highest number of inland cage farms in East Africa (18%), followed by Kenya, Tanzania, Rwanda, Zimbabwe, Zambia, and Malawi (Musinguzi et al., 2019). Lake Victoria has the highest number of caged aquaculture facilities among African inland waters (Musinguzi et al., 2019).

In West Africa, countries like Guinea, Côte d'Ivoire, and Cameroon use dam ponds created by closing valleys to form large ponds. Integrated agri-aquaculture systems are standard in Benin and Nigeria (Satia, 2017). Cage farming is prevalent among privately owned industrial farms, producing between 1,000 and 10,000 tons of fish annually (Hinrichsen et al., 2022).

2.2. Fish feed in Africa

The growth of aquaculture production in Africa has been accompanied by increased fish feed production. Before 2010, feed mills primarily produced feed for terrestrial animals and only supplied fish feed when requested explicitly by farmers. This was due to low

demand, which made it challenging for manufacturers to invest in dedicated production lines for aquaculture feed (Agboola et al., 2019). However, the rise in aquaculture production, particularly in Egypt, can be attributed to a shift from extensive to semi-intensive and intensive production systems (Waite et al., 2014), which are feed-dependent (El-Sayed et al., 2015). This transition has spurred demand for more feed, prompting the development of local feed production capacity, including the establishment of new feed mills and increased feed imports.

In Egypt, feed mills grew from five in 1999, producing 20,000 tons annually, to 73 mills, producing approximately 1 million tons per year by 2017 (Shaalan et al., 2018). Nigeria, which has the highest number of feed mills in Sub-Saharan Africa, produces 60% of the local aqua feeds used (Adeleke et al., 2020). Despite this, the production capacity of these mills is relatively low, with output ranging from 0.5 to 3 tons of feed per hour. Large-scale aquaculture investors in countries like Nigeria, Uganda, Kenya, and Zambia still rely heavily on imported aquaculture feed and ingredients due to their higher quality, better value for money, and the competition for ingredients from other sectors of animal production (Adedeji & Okocha, 2011). Feed manufacturers in these countries have established regional feed mills or outlets to meet the growing demand. Despite these advancements, the fish feed industry and farmers face the challenge of rapidly increasing feed prices.

2.3 Fish hatchery in Africa

The availability and quality of juvenile fish for stocking have consistently been highlighted as significant obstacles to African aquaculture development (Shaalan et al., 2018). Most fish seeds are sourced from the wild (wild catch), production ponds, or both licensed and unlicensed hatcheries. However, collecting fish seeds from the wild is strongly discouraged due to biosecurity risks, unpredictability, and sustainability concerns (Hasimuna et al., 2019). While the number of hatcheries on the continent has grown significantly over the past two decades, primarily due to private sector investment, most hatcheries are small-scale. These hatcheries mainly produce fingerlings of Nile tilapia (*Oreochromis niloticus*) and African catfish (*Clarias gariepinus*). Standard hatchery systems include small open ponds, hapas (net enclosures), indoor tanks, and concrete tanks, with some hatcheries also using indoor flow-through tanks and recirculating raceways. In Egypt, for example, between 400 and 500 private hatcheries are producing sex-reversed tilapia, though only about 150 are licensed. . Farmers prioritize cost over quality, through selective breeding programs (Hebisha & Fathi, 2014).

There is a significant gap in the demand for high-quality juvenile fish in Africa (Adewumi, 2015), which stems from various factors, including poor genetic management and deteriorating genetic quality in parental populations. Furthermore, many hatcheries lack standardized practices and adequate quality control, and regulatory frameworks to ensure seed quality are often absent or poorly implemented. Biosecurity measures to prevent contamination are minimal or non-existent in many hatcheries. There is an urgent need to explore advanced breeding technologies to address these challenges and develop new and improved fish seed strains (Kajungiro et al., 2019).

3. CHALLENGES OF AQUACULTURE IN AFRICA

Aquaculture production in Africa faces several significant challenges that must be addressed for sustainable growth. Inadequate infrastructure is a crucial obstacle, limiting many producers' access to larger markets and hindering the sector's potential for growth. Additionally, government regulations are often poorly adapted or poorly enforced, which stifles local initiatives and slows the development of the industry. Small-scale farmers, who make up a significant portion of the sector, lack training and technical support, which hampers the adoption of modern, efficient aquaculture practices. To overcome these barriers, international cooperation and capacity-building programs can be pivotal in providing farmers with the necessary resources and training, particularly in rural areas (Adeleke et al., 2020). Another major challenge is the impact of climate change (Adeleke et al., 2020). Fluctuating temperatures, extreme weather events, and changes in water quality significantly affect fish farm productivity (Elsheikh, 2021). To mitigate these effects, an integrated approach that combines innovative technologies with sustainable resource management is essential for the sector's resilience (Elsheikh et al., 2024). Targeted initiatives to enhance their involvement

in the sector will improve livelihoods and contribute to long-term, sustainable development in African aquaculture.

3.1 Climate change

Increasing aquaculture production can lead to resource constraints as competition for land and freshwater intensifies (Elsheikh et al., 2022, Bagdatli et al., 2023). According to Ahmed et al. (2019), the expansion of land-based aquaculture systems, such as ponds and tanks, may be limited by the need for agricultural land. Additionally, freshwater resources, vital for aquaculture in Africa, are also used for crop production and other purposes, making water limitations a concern (Elsheikh & Nasreldin, 2022). As freshwater aquaculture continues to grow, competition for water may increase, particularly for maintaining pond levels and replacing water lost through seepage and evaporation. To address these pressures, it is recommended that aquaculture production systems be intensified to increase efficiency and reduce the feed conversion ratio (Mungkung et al., 2014). However, switching to marine water systems may not fully resolve these challenges, as a large portion of the water used in aquaculture is indirectly related to aquafeed production (Mungkung et al., 2013). Other significant environmental issues are water pollution and eutrophication caused by expanded aquaculture. Using fertilizers, antibiotics, and wastewater discharges containing nutrients from feed and waste can lead to eutrophication, negatively affecting water quality. Over 90% of aquaculture production in Africa relies on fed systems, which contribute to high levels of phosphorus and nitrogen in wastewater, resulting in organic matter buildup (FAO, 2020). This buildup can deplete oxygen levels, cause algal blooms, and lead to disease outbreaks. Improvements in technology and management practices are needed to reduce aquaculture's impact on water pollution. These include using settling ponds before wastewater discharge, incorporating filtration systems, and adopting modern production systems like recirculating aquaculture systems and biofloc technology (Waite et al., 2014).

Aquaculture is more vulnerable to climate change than capture fisheries, as changing environmental conditions directly affect cultured organisms and infrastructure (Augustyn et al., 2017). Climate change poses significant threats to aquaculture production through global warming, ocean acidification, sea-level rise, and increasingly frequent extreme weather events like floods, droughts, and irregular rainfall patterns (Ahmed et al., 2019). While much research has focused on global impacts, fewer studies address the specific effects on African aquaculture. The impacts can be categorized into ecological changes (e.g., altered productivity, new diseases, algal blooms), physiological changes in organisms, operational shifts, resource limitations (freshwater and feed shortages), and socio-economic consequences, including increased poverty and food insecurity for farmers (Asiedu et al., 2017). Mitigation strategies like sustainable wastewater management and environmentally friendly technologies are essential to building resilience, alongside adaptation measures focused on enhancing the strength of aquaculture systems, such as diversifying species and optimizing water and feed use. The African aquaculture sector requires tailored climate strategies to ensure its sustainability and reduce the socio-economic impacts of climate change (Hinrichsen et al., 2022).

4. OPPORTUNITIES FOR GROWTH AND FUTURE DIRECTIONS:

Despite modest growth, aquaculture productivity in Africa has increased steadily over time. The macroeconomic environment, access to fisheries resources, water availability, and other variables vary widely across African countries (Hinrichsen et al., 2022). Aquaculture in Africa presents challenges and opportunities, with key nations such as Egypt, Nigeria, and Uganda emerging as leaders in various aspects compared to South Africa. Regarding market demand, these countries exhibit higher per capita fish consumption and more efficient value chains, spurring aquaculture growth. Egypt, for example, benefits from a well-established market system. At the same time, Nigeria has developed a robust catfish value chain, with Fish Farming Estates enhancing access to large markets and reducing post-harvest losses. Uganda’s Tilapia and niche catfish markets also show promising growth (Adeleke et al., 2020). In contrast, South Africa has lower fish consumption, with its aquaculture sector facing relatively low production levels and numerous challenges. Regarding infrastructure, Egypt, Nigeria, and Uganda boast more developed support systems, including active government involvement in hatcheries, research,

training, and establishing fish farm estates. While South Africa has an infrastructure capable of supporting feed and fish seed production, governmental involvement is limited beyond policy-making, and firms are often far from fish farms. Environmental factors play a significant role. Egypt faces constraints from limited land and water availability due to its desert climate, while Nigeria and Uganda benefit from abundant arable land, water, and a warm tropical climate suitable for aquaculture. On the other hand, South Africa is limited by water scarcity in its inland areas and an unfavorable climate for traditional aquaculture (Hinrichsen et al., 2022). Regarding technology, Egypt has been a leader in adopting advanced production systems, including desert aquaculture and integrated systems. Nigeria and Uganda have also integrated efficient technologies into feed production, hatchery operations, and fish processing. South Africa, however, lags in technological adoption, which hampers the expansion of its aquaculture sector. On the commercialization front, Egypt, Nigeria, and Uganda have attracted private and government investments, particularly in feed and seed production. Nigeria's Fish Farming Estates model has significantly enhanced the aquaculture value chain, while Uganda's private sector-driven growth has been notable. South Africa's aquaculture sector relies primarily on private investment, with recent policy shifts aiming to adopt a value chain-driven approach. Lastly, regarding institutional support and skill development, Egypt, Nigeria, and Uganda benefit from well-established aquaculture research institutions and universities that support capacity building. South Africa has aligned its policies with regional development goals but lacks the level of institutional support and training facilities seen in other key aquaculture nations (Adeleke et al., 2020). The bottom line is that, while Egypt, Nigeria, and Uganda excel in various aspects of aquaculture development, South Africa's sector faces challenges in market demand, infrastructure, technology adoption, and institutional support, hindering its growth compared to these African leaders.

5. CONCLUSION

Aquaculture in Africa holds immense potential to drive economic growth, enhance food security, and foster rural development, but its progress remains uneven across the continent. While countries like Egypt, Lesotho, and Uganda have made significant strides in high-value aquaculture production, the sector faces challenges such as resource constraints, technological gaps, and fish supply per capita disparities. Addressing these issues requires a tailored approach prioritizing sustainable practices, effective resource management, and strategic capacity-building. Collaboration among governments, regional organizations, and international partners is essential to foster knowledge exchange, finance innovative technologies, and improve market access. Strengthening local aquaculture industries could reduce food insecurity, create new income opportunities, and support livelihoods. By leveraging its natural resources, enhancing policy frameworks, and promoting inclusive growth, Africa can unlock the full potential of aquaculture and build a resilient, sustainable, and equitable future for the sector.

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The author declares that there is no conflict of interest.

AUTHOR CONTRIBUTIONS

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REFERENCES

Abelti, A. L., & Teka, T. A. (2024). Intervening fish post-harvest losses to narrow the gap between demand and supply: A review on magnitude of fish post-harvest losses in some Sub-Saharan African countries. *Aquaculture, Fish and Fisheries*, *4*(2), e168.

Adedeji, O. B., & Okocha, R. C. (2011). Constraint to aquaculture development in Nigeria and way forward. *Journal of Applied Sciences Research*, *7*(7), 1133-1140.

Adeleke, B., Robertson-Andersson, D., Moodley, G., & Taylor, S. (2020). Aquaculture in

Africa: A comparative review of Egypt, Nigeria, and Uganda vis-a-vis South Africa. *Reviews in Fisheries Science & Aquaculture*, *29*(2), 167-197. https://doi.org/10.1080/23308249.2020.1795615

Adewumi, A. A. (2015). Aquaculture in Nigeria: Sustainability issues and challenges. *Direct Resource Journal of Agriculture and Food Science*, *3*(12), 223-231.

Affognon, H., Mutungi, C., Sanginga, P., & Borgemeister, C. (2015). Unpacking postharvest losses in sub-Saharan Africa: a meta-analysis. *World development*, *66*, 49-68. https://doi.org/10.1016/j.worlddev.2014.08.002

Agboola, J. O., Yossa, R., & Verreth, J. (2019). Assessment of existing and potential feed resources for improving aquaculture production in selected Asian and African countries. *Monographs*.

Ahmed, N., Thompson, S., & Glaser, M. (2019). Global aquaculture productivity, environmental sustainability, and climate change adaptability. *Environmental management*, *63*, 159-172. https://doi.org/10.1007/s00267-018-1117-3

Asiedu, B., Adetola, J. O., & Odame Kissi, I. (2017). Aquaculture in troubled climate: Farmers' perception of climate change and their adaptation. *Cogent Food & Agriculture*, *3*(1), 1296400. https://doi.org/10.1080/23311932.2017.1296400

Augustyn, J., Cockcroft, A., Kerwath, S., Lamberth, S., Githaiga-Mwicigi, J., Pitcher, G., Roberts, M., van der Lingen C. & Auerswald, L. (2017) South Africa. In B.F. Phillips & M. Pérez-Ramírez (eds.) *Climate Change Impacts on Fisheries and Aquaculture* (Vol. 14, pp. 479–522). Chichester, UK: John Wiley & Sons, Ltd. https://doi.org/10.1002/9781119154051.ch1

Bagdatli, M.C., Ucak, I. and Elsheikh, W., 2023. Impact of global warming on aquaculture in Norway. *International Journal of Engineering Technologies and Management Research*, 10(3), pp.13-25

Bene, C., Barange, M., Subasinghe, R., Pinstrup-Andersen, P., Merino, G., Hemre, G. I., & Williams, M. (2015). Feeding 9 billion by 2050–Putting fish back on the menu. *Food Security*, *7*, 261-274. https://doi.org/10.1007/s12571-015-0427-z

Brummett, R. E., Lazard, J., & Moehl, J. (2008). African aquaculture: Realizing the potential. *Food policy*, *33*(5), 371-385. https://doi.org/10.1016/j.foodpol.2008.01.005

Cai, J., Quagrainie, K., & Hishamunda, N. (2017). Social and economic performance of tilapia farming in Africa. *FAO Fisheries and Aquaculture Circular*, (C1130).

Cocker, L. M. (2014). Strategic review on African aquaculture markets and export potential. *Partnership for African Fisheries (PAF) Aquaculture Working Group. University of Stirling/NEPAD Report*.

El-Sayed, A. F. M. (2017). Regional review on status and trends in aquaculture development in the Near East and North Africa-2015. *FAO Fisheries and Aquaculture Circular*, (C1135/6), I.

El-Sayed, A. F. M., Dickson, M. W., & El-Naggar, G. O. (2015). Value chain analysis of the aquaculture feed sector in Egypt. *Aquaculture*, *437*, 92-101.

Elsheikh, W. (2021). Effects of climate change on aquaculture production. *Eurasian Journal of Food Science and Technology*, *5*(2), 167-173.

Elsheikh, W., & Nasreldin, M. (2022). Impacts of Climate Change on Water Resources in Sudan. *Eurasian Journal of Agricultural Research*, *6*(2), 83-90.

Elsheikh, W., Ucak, İ., & Bağdatlı, M. C. (2022). The Assessment of Global Warming on Fish Production in Red Sea Region of Sudan. *Eurasian Journal of Agricultural Research*, *6*(2), 110-119.

Elsheikh, W., Ucak, İ., & Bağdatlı, M. C. (2024, October). The Importance of Aquaculture Production in Africa. In *International Anatolian Agriculture, Food, Environment and Biology Congress* (pp. 291-295).

FAO (2020). Aquaculture growth potential in Africa. World Aquaculture Performance Indicators (WAPI) (March), 113. Rome: Food and Agriculture Organization of the United Nations.

FAO (2021) FAO Fishery Statistical Collections, UN Food and Agriculture Organization, https://www.fao.org/fishery/activities/home, accessed 21 November 2024.

FAO, (2018). FAO. Fishery and aquaculture statistics. Global production by production source 1950-2016 (FishstatJ), FAO Fisheries

and Aquaculture Department, Rome. http://www.fao.org/fishery/statistics/software/fishstatj/en

FAO. (2024). *FAO Report: Global fisheries and aquaculture production reaches a new record high, untapped potential remains in Africa.* FAO Regional Office for Africa. Retrieved from, https://www.fao.org/africa/news-stories/news-detail/fao-report--global-fisheries-and-aquaculture-production-reaches-a-new-record-high--untapped-potential-remains-in-africa/en

Feidi, I. (2018). Will the new large-scale aquaculture projects make Egypt self sufficient in fish supplies?. *Mediterranean Fisheries and Aquaculture Research*, *1*(1), 31-41.

Halwart, M. (2020). Fish farming high on the global food system agenda in 2020. *FAO Aquaculture Newsletter*, (61), II-III.

Hasimuna, O. J., Maulu, S., Monde, C., & Mweemba, M. (2019). Cage aquaculture production in Zambia: Assessment of opportunities and challenges on Lake Kariba, Siavonga district. *The Egyptian Journal of Aquatic Research*, *45*(3), 281-285.

Hebisha, H., & Fathi, M. (2014). Small and medium scale aquaculture value chain development in Egypt: Situation analysis and trends.

Heck, S., Béné, C., & Reyes-Gaskin, R. (2007). Investing in African fisheries: building links to the Millennium Development Goals. *Fish and Fisheries*, *8*(3), 211-226. https://doi.org/10.1111/j.1467-2679.2007.00251.x

Hinrichsen, E., Walakira, J. K., Langi, S., Ibrahim, N. A., Tarus, V., Badmus, O., & Baumüller, H. (2022). Prospects for Aquaculture Development in Africa: A review of past performance to assess future potential. ZEF Working Paper Series, No. 211, University of Bonn, Center for Development Research (ZEF), Bonn, https://nbn-resolving.de/urn:nbn:de:101:1-202202100155593583879O

Kajungiro, R., Mapenzi, L., Nyinondi, C., Haldén, A. N., Mmochi, A., Chacha, M., ... & de Koning, D. J. (2019). The need of a structured tilapia breeding program in Tanzania to enhance aquaculture production: A review. *Tanzania Journal of Science*, *45*(3), 355-371.

Koge, J., Opola, F., Obwanga, B., Kilelu, C., & Rurangwa, E. (2018). *A comparative study on aquaculture sector development in Egypt, Ghana and Nigeria: Sharing insights and drawing lessons for Kenya: An Expert Group Round-Table Meeting, 16th March 2018, Azure Hotel, Nairobi* (No. 002). Wageningen Marine Research.

Moehl, J., & Machena, C. (2000). African Aquaculture: A Regional Summary with Emphasis on Sub-Saharan Africa. FAO.

Mungkung, R., Aubin, J., Prihadi, T. H., Slembrouck, J., van der Werf, H. M., & Legendre, M. (2013). Life cycle assessment for environmentally sustainable aquaculture management: a case study of combined aquaculture systems for carp and tilapia. *Journal of Cleaner Production*, *57*, 249-256. https://doi.org/10.1016/j.jclepro.2013.05.029

Mungkung, R., Phillips, M., Castine, S., Beveridge, M., Chaiyawannakarn, N., Nawapakpilai, S., & Waite, R. (2014). *Exploratory analysis of resource demand and the environmental footprint of future aquaculture development using Life Cycle Assessment*. WorldFish.

Musinguzi, L., Lugya, J., Rwezawula, P., Kamya, A., Nuwahereza, C., Halafo, J., ... & Ogutu-Ohwayo, R. (2019). The extent of cage aquaculture, adherence to best practices and reflections for sustainable aquaculture on African inland waters. *Journal of Great Lakes Research*, *45*(6), 1340-1347.

Pison, G., Couppié, E., & Caporali, A. (2022). The population of the world, 2022. *Population Societies*, *603*(8), 1-8.

Satia, B. P. (2011). Regional Review on Status and Trends in Aquaculture Development in Sub-saharan Africa-2010/Revue régionale sur la situation et les tendances dans l'aquaculture en Afrique subsaharienne-2010. *FAO Fisheries and aquaculture circular*, (C1061/4), I.

Satia, B. P. (2016). An overview of the large marine ecosystem programs at work in Africa today. *Environmental development*, *17*, 11-19.

Satia, B. P. (2017). Regional review on status and trends in aquaculture development in sub-Saharan Africa–2015, FAO Fisheries and Aquaculture Circular No. 1135/4. *Rome, Italy*.

Shaalan, M., El-Mahdy, M., Saleh, M., & El-Matbouli, M. (2018). Aquaculture in Egypt: insights on the current trends and future

perspectives for sustainable development. *Reviews in Fisheries Science & Aquaculture*, *26*(1), 99-110.

Soliman, N. F. (2017). Aquaculture in Egypt under changing climate. *Alexandria Research Center for Adaptation to Climate Change (ARCA): Alexandria, Egypt*.

Wadah E., Ucak, I., Bagdatli, M. C., & Mofid, A. (2022). Effect of Climate Change on Agricultural Production: A Case Study Khartoum State, Sudan. *J Agri Res*, *7*(3), 000299.

Waite, R., Beveridge, M., Brummett, R., Castine, S., Chaiyawannakarn, N., Kaushik, S., ... & Phillips, M. (2014). *Improving productivity and environmental performance of aquaculture*. WorldFish.