Chapter 23
The Governance of Aquaculture in Namibia as a Vehicle for Food Security and Economic Growth

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Abstract The Namibian aquaculture sector is still very small, but it has the potential to act as a vehicle for both food security and economic growth for the country. The governance structure in place regulates matters such as public health, environmental protection, animal health and disease. The aquaculture license includes the classical bundles of property rights such as transferability, renewability, specified duration and cancellation based only on failure to perform. However, aquaculture land ownership/leasing is not sufficiently regulated to encourage long-term investment into aquaculture. Freshwater aquaculture has the potential to contribute to food security, but the absence of differentiation between community-based and commercial farming creates regulatory burdens which cannot be easily be met by prospective small-scale fish farmers. The strict regulatory requirements for importing new species limit the opportunity for growth that can be achieved with fast-growing non-native species. Mariculture can significantly contribute to economic growth, but a significant part of the value chain needs to be localized. Aquaculture investors, just like those of its sister sector (agriculture), require a regulatory framework that gives sufficient tenure security and ascertainable property rights, an important requirement that appears to only partially be met by the Namibia aquaculture governance structure.

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23.1 Introduction

Fish and aquatic products are considered the most valuable traded food commodities internationally (Davies et al. 2019). Internationally, aquaculture is also regarded as the fastest-growing fishery sector and has now surpassed that of capture fisheries (FAO 2020). Aquaculture in Namibia started in the 1980s by introducing carp and several other exotic species for stocking of cattle dams and state water dams (Iitembu 2005). An increase in aquaculture began in the 2000s onwards because the private sector became more involved in commercial farming, especially marine species (Iitembu 2005) (Fig. 23.1). After Namibia's independence in 1990, the government identified aquaculture as a priority development through development plans such as Namibia's VISION 2030 and National Development Plan (NDP). In May 2004, the Ministry of Fishery and Marine Resources produced the first Aquaculture Strategic Plan, built on the existing Aquaculture policy, the Aquaculture Act and its regulations.

Although progress has been made in marine and freshwater aquaculture in Namibia, its production levels are still not comparable to capture fisheries, which averages 450,000 metric tons per year (FAO 2019). While the aquaculture sector is still relatively small in Namibia, it has a huge potential given the changing fish-eating habits of the population (Erasmus et al. 2021; York and Gossard 2004), whose demand need to be met. It is well known that much of the cost of aquaculture is

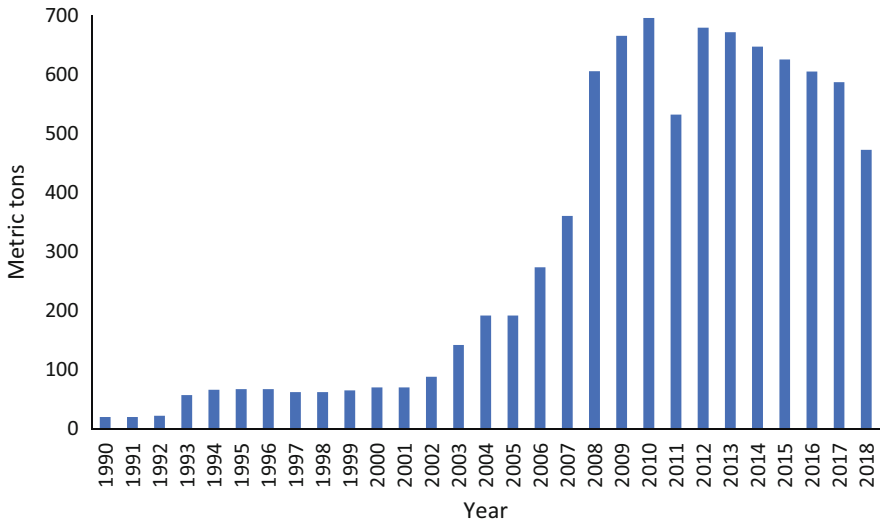

Fig. 23.1 Aquaculture production from Namibia (1990–2018) (Data source: World Bank)

incurred to meet the feed requirements. Namibia here also potentially enjoys a competitive advantage because of its established capture fishery and the nutrient-rich Benguela ecosystem (Hutchings et al. 2009), which can act as a source of cost-effective fish feeds.

However, for aquaculture to grow, its governance frameworks must be pro-growth and must ensure aquaculture's continued contribution to food security in Namibia is promoted. The absence of effective governance has, for example, led to the boom and bust experienced in shrimp aquaculture in the 1990s (Arquitt et al. 2005). Significant environmental degradation experienced from aquaculture in countries like India has also been attributed to a lack of adequate regulatory frameworks (Belton et al. 2017). The regulatory frameworks for aquaculture must be explicit to support the sustainability and legal certainty of the aquaculture growth path. In this chapter, the status of marine and freshwater aquaculture in Namibia is presented. Their regulatory frameworks are also presented in consideration of aquaculture as a vehicle for food security and economic growth in Namibia. Recommendations for future directions in aquaculture in Namibia are also made.

23.2 Aquaculture in Namibia

23.2.1 Marine Aquaculture

The Namibia marine aquaculture industry is found within the waters of the Benguela marine ecosystem. One of the Benguela Current's main characteristics is the wind-driven coastal upwelling which brings nutrient-rich deep water to the surface (Carr and Kearns 2003). While upwelling is a dominant oceanographic process in the Benguela Current area, other features include the leakage of warm Angola Current water from the north (Gammelsrod et al. 1998), hydrogen sulphide eruption and red tides (Weeks et al. 2004). The Benguela Current ecosystem is one of the most biologically productive regions of the world's oceans, supporting large commercial fisheries due to its high primary productivity (Hutchings et al. 2009. The marine waters off Namibia, though productive, are subject to several human activities, including offshore mining, oil and gas extraction, and fishing (Finke et al. 2020). There are few aquaculture sites for aquacultures along the Namibian coastline, which include the only two sheltered embayments in the country (Lüderitz and Walvis Bay), and shore-based aquaculture restricted to Lüderitz, Oranjemund, Walvis Bay and Swakopmund (Britz et al. 2019) (Table 23.1).

The Namibian commercial marine aquaculture is relatively small, with a total production that has been constant at around 600 tons/y since 2008 (Britz et al. 2019). The main farmed species are oyster (*Crassostrea gigas*), mussel (*Mytilus galloprovincialis* and *Perna perna*) and abalone (*Haliotis midae*).

Marine farming experienced a boom in the 2000s because of government incentives to invest in aquaculture and establishing the Aquaculture Park as per Aquaculture Act 2002 (Act No.18 of 2002). However, sulphur eruptions in 2008 and 2010 in Walvis Bay (Ohde and Dadou 2018) led to mass mortalities resulting in many operations going out of business.

Table 23.1 The farmed species and locality of marine aquaculture operations (December 2017) (Information source: Britz et al. 2019)

Species	Locality
Abalone *Haliotis midae*	Lüderitz
Oysters *Crassostrea gigas*	Lüderitz, Radford Bay
Oysters *Crassostrea gigas*	Walvis Bay Aquaculture Park
Mussels *Mytilus galloprovincialis* and *Perna perna*	Walvis Bay Aquaculture Park
Oysters *Crassostrea gigas*	Swakopmund salt works
Oysters *Crassostrea gigas*	Oranjemund

23.2.2 Freshwater Aquaculture

Freshwater aquaculture can trace its roots to the late 1800s by introducing carps, bass, and tilapia in private and state dams (Iitembu 2005). The freshwater aquaculture sector took off in mid-1990 when the government established community-based intensive freshwater aquaculture facilities in Omusati, Okavango and Caprivi region, producing tilapia and catfish for local distribution. Although still at an infant stage, this sector has been envisaged as the most significant production source by the year 2030 (Failler and Tall 2012). The freshwater aquaculture sector is primarily community-based, emphasizing promoting food security, creating employment, and generating income for the community members (MFMR 2004). Namibia has no small-scale or subsistence freshwater aquaculture tradition, so all activities in this sub-sector have been government- or donor-driven. Under the Directorate of Aquaculture, the Ministry of Fisheries and Marine Resources manages several fish farms, most of which are located near catchment areas as there are few privately owned fish farms.

Namibia's natural water bodies have several species that might have great potential for aquaculture. Species selection for aquaculture is based on certain criteria, including the growth rate, length at maturity, feeding, stocking density, and market price. Species being cultured include the three-spotted bream/tilapia (*Oreochromis andersonii*), red-breasted bream/tilapia (*Coptodon rendalli*), the African catfish (*Clarias gariepinus* and *C. ngamensis*), all of which are endemic. The exotic species cultured in Namibia are the Nile tilapia (*O. niloticus*) and Mozambican tilapia (*O. mossambicus*), and common carp (*Cyprinus carpio*). These exotic species have excellent traits that make them attractive for aquaculture, such as exceptional growth potential, hardy and ability to thrive in high stocking densities. They also have a high market demand.

Data on Namibian freshwater aquaculture is scarce, and the annual production reports are few and far between. Hamukwaya (2021) report indicated production of 36.9 tonnes for the year 2011, mainly from government-managed fish farms, with the combined production output (government and private fish farms) at more than 50 tonnes per annum. Most of the production yield comes from the Tilapia species.

In Namibia, freshwater aquaculture uses various production systems such as ponds, cages, and recirculation aquaculture systems (RAS) using tanks. The pond systems, being the oldest production method (Brune et al. 2003), are widely used and provide natural productivity. The RAS is mainly deployed at hatcheries managed by the MFMR. RAS is becoming the key technology (Ebeling and Timmons 2012) and one of the fastest-growing fish rearing systems (Martins et al. 2010), especially to produce larvae and juveniles of diverse species. The sites that are suitable for a cage culture system include the national dams and disused mine pits (e.g. Uis tin mine pit), which are filled with water sipping from underground aquifers.

23.3 Governance of Aquaculture in Namibia

23.3.1 Governance Institutions

Regulatory frameworks are essential for the aquaculture industry to operate under the circumstances, giving predictable and stable working conditions (Davies et al. 2019). In Namibia, aquaculture is regulated under the Aquaculture Act (No.18 of 2002) ("Aquaculture Act" hereinafter), which designates the Namibian Ministry of Fisheries and Marine resources as the competent authority. Other institutions involved in aquaculture governance include the Ministry of Environment, Forestry and Tourism (MEFT), as aquaculture is listed as one of the activities that may not be undertaken without an environmental clearance certificate in terms of the Environmental Management Act (No 7 of 2007) and its Environmental Impact Assessment Regulations(Government Notice 30 of 2011). The above is vital as it can avoid environmental degradation experienced by aquaculture in countries like India (Belton et al. 2017). The Ministry of Agriculture, Water and Land Reform (MAWR) is responsible for veterinary services, and is also involved when a case of fish diseases or harmful aquatic organisms is reported in the specific aquaculture facility or area to advise on the steps that need to be taken to isolate, quarantine or treat the infected aquatic organism (Section 25 (2) of the Aquaculture Act). The Ministry of Health and Social Services, responsible for public health, also advises where harmful or detrimental effects to the aquatic environment or aquaculture from pollution or natural phenomena are reported (Section 26(2) of the Aquaculture Act). The Ministry of Health and Social Services may also advise whether the aquaculture products farmed are fit for human consumption; if they are not, the Ministry of Trade gets involved in preventing the sale or marketing of such aquaculture products. The Minister of Fishery must also consult the local authority (under Local Authorities Act, 1992 (Act No. 23 of 1992)), the regional council (under Regional Councils Act, 1992 (Act No. 22 of 1992)), or The Traditional Authority (under Traditional Authorities Act 2000 (Act No. 25 of 2000)), when determining or implementing aquaculture policies and regulations.

23.3.2 Licensing Requirements

The Minister of Fishery and Marine Resources, in consultation with the aquaculture advisory council, may declare any area of Namibia or Namibian water as an aquaculture development zone (ADZ) (Section 32 of the Aquaculture Act). A farming license is required for any location or area in Namibia, created for the primary purpose of aquaculture or to encourage aquaculture development. In terms of geographical scope, the license can be granted for any area within inland waters, the internal waters, and Namibia's territorial Sea (Territorial Sea and Exclusive Economic Zone of Namibia Act, 1990 (Act No. 3 of 1990)). The above also include areas from the seabed up to the high-water mark and private water as defined under section 1 of the Water Act, 1956 (Act No. 54 of 1956).

Aquaculture can only be conducted with a license (Section 11 of the Aquaculture Act), which must specify the organism to be farmed, including whether freshwater or marine. The prescribed application form further requires the applicant to specify the location, size, and description site, sources of the stock of the species, maximum annual production in quantity and weight per year, and the annual quantity effluent from the farm (Aquaculture (Licensing) Regulations, Government Notice 246 of 2003).

In deciding to grant the license, consideration is given to the technical and financial ability of the applicant; the proposed species to be farmed; the farming method and any other relevant matters applicable to the license applied (Section 12 (3) of the Aquaculture Act). The granting of the license can only be granted if the approval required land or water and environmental clearance and if the license will not create a significant risk of pollution or otherwise adversely affect the environment (Section 13 of the Aquaculture Act).

23.3.3 Property Rights in Aquaculture

One of the important aspects of aquaculture governance is the security of the farmers' interest (property rights) (Bankes et al. 2016). For the aquaculture right to function as a real property right, it must be transferable, duration and renewability must be specified, and its cancellation must only be based on failure to perform or meet the specified conditions (Saunders and Finn 2006).

The license issued in terms of the Aquaculture Act is only transferable with prior approval by the Minister (Section 23(1) of the Aquaculture Act), and the licensee is given the exclusive right to farm and harvest aquaculture products, the exclusive right to own the aquaculture products within the approved site; and the exclusive right to release and harvest aquaculture products within the specified site (Section 14 of the Aquaculture Act). The farmed organisms in farming sites and those that have escaped into the natural environment are the exclusive property of the licensee if they can positively be identified (Section 31 of the Aquaculture Act). The duration of

the issue license is specified, and the Minister of Fisheries may make regulations concerning the duration of any licence and the renewal conditions (Section 43(2)(c) of the Aquaculture Act). An aquaculture licence is currently issued for 5, 10, 15, 20 or 25 years at the Minister's discretion.

In terms of the renewability of the licences, it can be refused if the licensee has not complied with the conditions of the license or has not remedied non-compliance within a reasonable period (Section 18(3) of the aquaculture Act). The renewal can also be refused, for the purposes of aquaculture management, to ensure the protection and conservation of the environment (Section 18(3) of the Aquaculture Act). In terms of revocability, for a license, this can be done on a similar basis as the renewal refusal. However, the basis for cancellation also includes failure to report the presence of any disease or harmful organism, failure to treat or destroy any aquatic organism or parasite-infested organisms (Section 19 of the Aquaculture Act).

Overall, the Namibian aquaculture property right regime has the general attributes of real properties rights, although issues related to leases of land for aquaculture are not clearly regulated, especially in communal areas where land is governed under a different property right regime (see Communal Land Reform Act 5 of 2002).

23.3.4 Aquaculture Management and Control Measures

Although aquaculture is one of the fastest-growing sectors globally, it has biosecurity risks and hazards it poses to the aquatic environment and society (FAO 2008). As aquaculture development increases, the possibility of a major disease also increases (Bondad-Reantaso et al. 2005). Aquaculture's possible environmental impacts may include direct pollution problems, waste from feed and faeces, medications, and pesticides (Read and Fernandes 2003). Some aquaculture species introduced because they offer more economic gain may threaten or damage the local ecosystems (Yan et al. 2001), including changes to the desired genetic diversity (Vanina et al. 2019). Therefore, the governance frameworks for aquaculture management and control measures mitigate or eliminate these risks.

In terms of the presence of any disease or harmful organism, a licensee or other person is required to report (Section 25 of Aquaculture Act) immediately; the failure to report such can be used as a basis to cancel the license (Section 19 (1)(e) of the Aquaculture Act). The farmers are also required to establish and maintain a water monitoring system that ensures timely detection of any event that may have a harmful or detrimental effect on the aquatic environment or any aquaculture product (Section 26 of the Aquaculture Act). The introduction of any species or any genetically modified aquatic organism and its transfer within Namibia requires written permission from the Ministry (Section 27 of the Aquaculture Act). The written permission is also required to import and export, remove, or transport live aquatic organisms (Section 29 of the Aquaculture Act). The contravention of any of the specified regulatory measures is an offence that attracts a fine ranging from 4000

to 8000 Namibian dollars or imprisonment ranging from 12 months to 2 years (or both) (Section 40 of the Aquaculture Act).

The management measures in place are wide-ranging and cover various areas of aquaculture that need to appropriately be controlled and monitored. Additionally, the Minister may make any regulations for any matters (section 43 of the Aquaculture Act), including emerging concerns.

23.4 Aquaculture as a Driver for Food Security in Namibia

Food insecurity is one of the most visible dimensions of poverty in most of the sub-Sahara African (SSA) countries, including Namibia (FAO et al. 2020). In Namibia, a meta-analysis of demographic and health survey (2006–2016) reported that about 23.8% of children were stunted (chronic malnutrition), 6.2% were wasted (acute malnutrition), and 13.4% were underweight (Akombi et al. 2017). Therefore, best strategies are required to transform or introduce food production systems that have the potential to ensure a sustainable food supply as part of the efforts to put an end to hunger and malnutrition in Namibia.

Today, fish are considered assets to fight food insecurity and livelihood upliftment worldwide (FAO 2016; USAID 2016). Fish provides 19% of animal protein and play a pivotal role in supplying essential micronutrients such as vitamins, minerals (i.e. iron, zinc, iodine), and essential fatty acid (i.e. polyunsaturated fatty acids and highly unsaturated fatty acids), which are required for maternal health and early childhood development (Kawarazuka and Béné 2011). The fish being enjoyed today are coming both from capture fisheries and aquaculture; however, the production growth rate of capture fisheries has been compromised over the years (FAO 2020). At the moment, aquaculture presents the opportunity to bridge the supply and demand gap of aquatic food in most parts of the world. In Africa, this sector is generally new; thus, it only contributes about 2% of the global aquaculture production (McClanahan et al. 2015).

In Namibia, this sector has considerable potential to contribute to food security and the alleviation of poverty, especially in rural areas. It can empower women to also play a role in rural socio-economic development and provide answers for resource governance since women fit well in the value chain of fish distribution. However, the aquaculture sector is faced with several challenges. For instance, the first investments were short-lived; thus, they could not deliver the expected outputs geared toward food security and poverty alleviation (Villasante et al. 2015). Furthermore, the lack of technical personnel, production and logistical facilities, limited access to funds, and the market hinder rural aquaculture development in Namibia. Therefore, aquaculture has not yet reached its full potential to significantly contribute to Namibia's food security and poverty alleviation.

23.5 Aquaculture as a Driver for Economic Growth of Namibia

In 2018, the global world aquaculture production had a value of USD 263.6 billion (FAO 2020). The human population and demand for fish protein are increasing globally (Godfray et al. 2010), and most of it is expected to be met by aquaculture production (Kobayashi et al. 2015). Therefore, aquaculture, like any economic sector, can be a driver of the economic growth of any country. The ability of the aquaculture sectors to contribute to economic growth depends on whether it is done for subsistence or commercial purposes. Subsistence aquaculture largely contributes to the social benefit, while small-scale farming enterprises, cooperative and state farms can be run for economic gains (Pillay 1997). As an economic sector, aquaculture also plays an important role in job creation, which stands globally at more than 23 million direct and indirect jobs (Ottinger et al. 2016). In Egypt, one of Africa's largest aquaculture products producers, it is estimated that the entire value chain of aquaculture generates about 19.56 full-time jobs per 100 tonnes of fish produced (Nasr-Allah et al. 2020). Aquaculture is also known to significantly contribute to the economic development of rural areas (Ottinger et al. 2016; Filipski and Belton 2018; Nasr-Allah et al. 2020).

In Namibia, aquaculture production is still very low (see Sects. 2.1 and 2.2 and Fig. 23.1), but it has an excellent potential to contribute to its economic growth. In 2020, the total employment in aquaculture was about 398 individuals (Hamukwaya 2021), which is significantly smaller than, for example, the 16,000 recorded in capture fishery (MFMR 2017). The production from marine aquaculture, which produces mostly shellfish, needs to be increased for its economic contribution to be visible. At the moment, the production is mainly of primary products from oysters, but if the entire value chain is localized to include, for example, the canning of oysters or mussels, it can have a significant impact on the Namibian economic growth. However, this will require massive investment from the private sector to set up large-scale farms that can benefit from the economies of scale. The potential for mariculture can benefit from the nutrient-rich Benguela Current, including the established seafood and distribution network. Other considerations can include the introduction of Integrated Multitrophic Aquaculture (IMTA) for wild-caught rock lobster seed and oysters, which has been suggested as a climate change adaptation option for Lüderitz lobster fishers (Iitembu et al. 2021, *in press*).

In terms of freshwater aquaculture, it can have a significant contribution economic growth of rural areas. The small- and large-scale enterprises need to be supported to produce more fish and establish a local fish market whose demand will continuously need to be met. The governance of freshwater aquaculture also needs to be improved, especially in tenure and land ownership security, which can encourage investment. Aquaculture investors, just like those of its sister sector (agriculture), require a regulatory framework that gives sufficient tenure security and secure property right in both land and infrastructure for long-term investment to be made.

23.6 Conclusion

The Namibian aquaculture sector is still very small, but it can grow to act as a vehicle for both food security and economic growth. Its governance structure is multipurpose and regulates matters such as water, public health, sanitation, animal health, and disease. Application processes for a licence resemble a one-stop-shop strategy, although additional permits like the environmental clearance are acquired separately. The aquaculture license includes the classical bundles of property rights, such as transferability, renewability, specified duration and cancellation, only based on failure to perform or meet the specified conditions. However, land ownership and tenure security need to be appropriately regulated to encourage long-term investment, especially for freshwater aquaculture.

In terms of food security, it is freshwater aquaculture that has the potential to have a significant impact on it. This is because freshwater aquaculture is mostly community-based or small scale (smallholder farms), which is driven to meet the local fish demand. However, the current regulatory framework does not differentiate small-scale/community-based aquaculture from large scale/commercial aquaculture. The results of the non-distinction are that the regulatory burdens (i.e. environment clearance requirements) cannot be easily be met by prospective small-scale fish farmers, which constrains its growth as a food security driver at a community level. The growth of freshwater aquaculture is also constrained because the species currently being farmed are mostly slow growing species. Although there are strict regulatory requirements for importing new species, which may help prevent the biosecurity risk to the environment from invasive species; flexibility should be given for well-studied freshwater fast-growing strains of species like Nile tilapia (*Oreochromis niloticus*). Importing some of the fast-growing species can contribute to the growth of aquaculture as both an economic and food security driver.

In terms of direct contribution to economic growth, marine or large-scale aquaculture can have a significant contribution. However, it will require that the whole value chain is localized or significant value additions (e.g. canning of oysters) to have a considerable contribution to, for example, job creation. Consideration of integrated multi-trophic aquaculture (IMTA) for wild-caught seeds of rock lobster and oysters must be seriously considered as it has the potential to contribute to economic growth if done at a large-scale level.

Therefore, the governance structure will need to be adaptive and appropriately regulate or deregulate areas that can promote aquaculture growth in Namibia. Practical-oriented policy guidance is also necessary for the development of this sector, especially that most Namibians do not have a fish farming tradition.

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