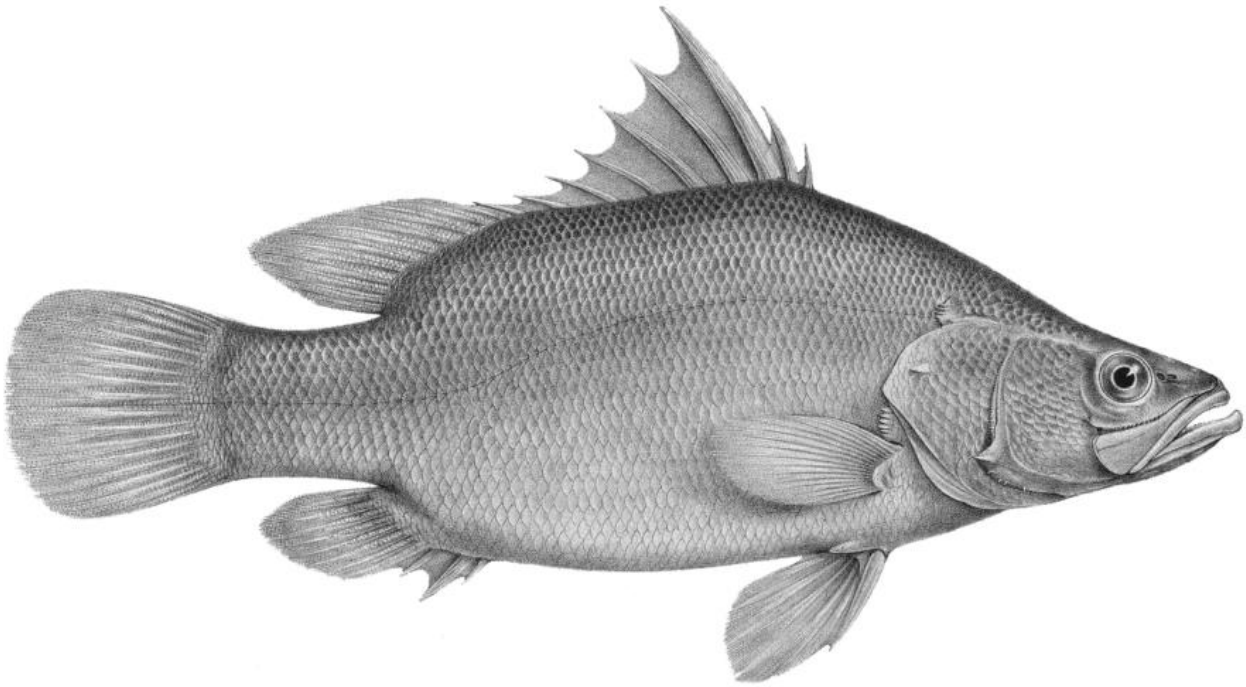
The United Republic of Tanzania

Tanzania Investment Centre

Investment Opportunities in the Fisheries and Aquaculture Sub-sector, Tanzania



Contents

Table of Figures

List of Tables

1 Tanzania's Fishery Resources

Fisheries in Tanzania are dominated by inland fisheries with a contribution of a minimum 85% to the national fish production, mainly from Lake Victoria and to a lesser extent Lake Tanganyika. Marine fisheries contribute 10 – 15% to the national fish production and aquaculture (excluding seaweeds) is negligible. According to Ministry of Livestock and Fisheries Development official data, current fish production is approximately 340,000 MT per year, excluding catches of tuna and tuna-like species by Distant Water Fleet Nations (DWFN) in the Exclusive Economic Zone (EEZ)[1]. Figure 1 shows Tanzania's expansive inland (freshwater) and marine water bodies.

Figure 1 Tanzania's Marine and Freshwater Bodies

1.1 Inland Fishery Resources

As illustrated on Fig. 1, Tanzania's inland (freshwater) resources cover a surface area greater than 50,000 km² when the three major internationally shared lakes are considered: Lake Victoria (approx. 33,300 km²), Lake Tanganyika (approx. 13,400 km²) and Lake Nyasa/Malawi (approx. 300 km of shoreline). Lake Rukwa covers some 5,760 km^2.

Other inland fisheries of commercial importance are dams such as Mtera and Nyumba ya Mungu and riverine systems, with the major rivers being Pangani, Wami, Ruvu, Rufiji and Ruvuma all emptying into the Indian Ocean.

1.2 Marine Fishery Resources

The marine fishery waters comprise coastal waters that extend over a 1,240 km shoreline including major islands such as Unguja, Pemba and Mafia, and offshore waters. The coast generally has a steep, narrow, continental shelf covering a total surface area of about 17,900

[1] Ministry of Livestock and Fisheries Development (MLFD), Dodoma, Tanzania: March 2019

km². The coastal zone is generally composed of rocky islets, sandy beaches, lagoons, mangroves and coral reefs. The coastline is affected by the monsoon regime, with two typical seasons: the southeast monsoon from May to early September, and the northeast monsoon from November to March. Coastal waters are also influenced by the north flowing East African Coastal (EAC) current. The surface area of Tanzania's EEZ is 242,000 km ².

While it is estimated that the total catch of tuna and tuna-like species by foreign industrial fleets in the Tanzania EEZ is about 20,000 MT per year; domestic marine fish production has been more or less stable in Tanzania over the last 10 years, with production averaging 50,000 MT per year when cumulating data from both the mainland and Zanzibar. Landings are dominated by demersal reef and reef associated species, and pelagic fishery species caught mainly in the inshore waters.

1.3 Marine and Inland Fisheries Data Collection

This study was conducted in partnership between the Tanzania Investment Centre (TIC) and East Africa Trade & Investment Hub (EATIH) during July 2019. Officials from Kigoma, Rukwa, Mwanza, Ruvuma, Dar es Salaam and Dodoma Regional Government Authorities took the lead to guide our teams throughout the exercise.

The team visited and spoke to Regional Government Officials, Tanzania Fisheries Research Institute (TAFIRI) experts, fishermen, farmers and paid physical site visits to Lake Tanganyika, Lake Rukwa, and Marine Fisheries Department (Deep Sea Fishing) in Dar es Salaam. Data for Lake Victoria, Nyasa and Marine Fisheries were provided by the Ministry of Livestock and Fisheries Development – and qualified through extensive literature review search. Table 1 shows our travel schedule – with respective dates.

Table 1 Freshwater and Marine (Deep Sea) Fisheries Sub-sector Study Schedule

	Location	Names of institutions	Date
1	Dar es Salaam	Marine Division	July 2, 2019
2	Dodoma	Ministry of Livestock and Fisheries Development	July 4, 2019
3	Rukwa (Sumbawanga)	Rukwa Regional Authorities and Lake Rukwa	July 16 - 18, 2019
4	Kigoma	Kigoma Regional Authorities and TAFIRI	July 19 - 23

The following methods were used to generate required data or information: -

i. Desk work/Literature review
ii. Physical site visits - observation
iii. One-to-one or group interviews
iv. Questionnaires
v. Focus Group Discussions

2 Tanzania's Fisheries Sub-sector

Tanzania is bordered with Kenya and Uganda to the north, Rwanda, Burundi, and the Democratic Republic of Congo to the West, Zambia to the south west, and Malawi and Mozambique to the south. It has a coastline of 1,424 km, and the Exclusive Economic Zone (EEZ) has an area of 223,000 km^2. The country has maritime borders with Kenya, Comoros, Seychelles and Mozambique. Tanzania is well endowed with inland waters and lakes, with a total area of 64,500 km^2. It shares the waters of important rift valley lakes with its neighbors, of which Lakes Victoria, Tanganyika and Nyasa are some of the world's largest inland water bodies.

2.1 Overview of the Fishery Sub-sector in Tanzania

Tanzania is endowed with rich marine and inland waters that yield a wide range of living aquatic resources, providing livelihoods, food security, export revenues, and potential for further economic development.

According to the Ministry of Livestock and Fisheries[2], Tanzania's fisheries sub-sector can be divided as follows: -

a) Marine and inland capture fisheries
b) Aquaculture, and
c) Fish processing.

The scale of operations ranges from small-scale subsistence fishing to industrial fish processing. There is a vibrant export market, exploited by small-scale fish processors and traders serving the regional market, and by large fish processors selling into international markets.

Figure 3 summarizes fish production trend in Tanzania between 1960 – 2018. Stats indicate that, Tanzania has been growing its fishery sub-sector.

[2] The Tanzanian Fisheries Sector: CHALLENGES AND OPPORTUNITIES. September 2016

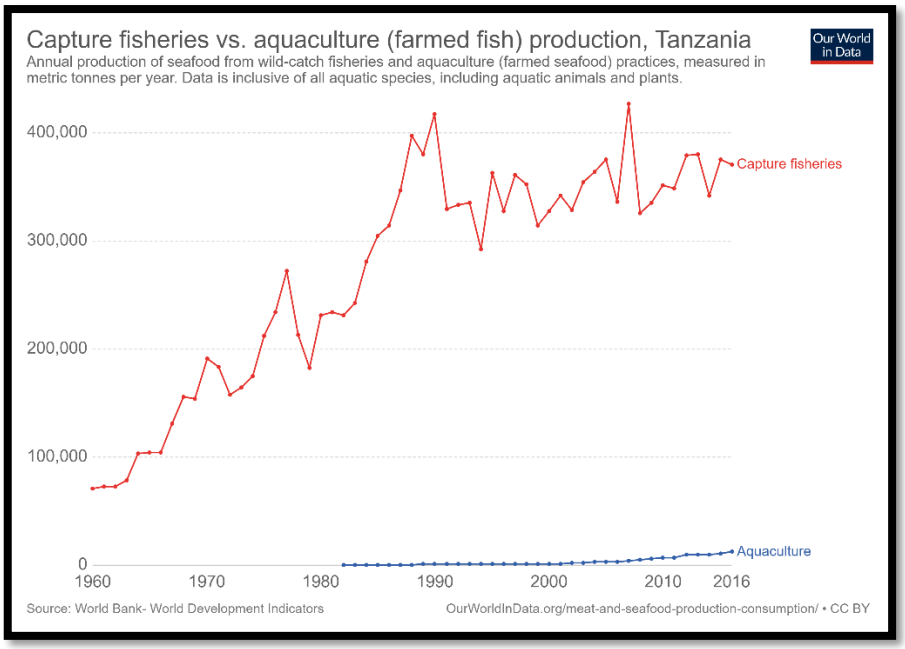


Figure 2 Fish Production in Tanzania: 1960 – 2016 (Source: Our World in Data)[3]

Over the last decade, Tanzania's fisheries production has been in the range of 325,000 to 380,000 Tons per annum, as shown in Figure 4. About 85% is from inland fisheries, 14% from marine fisheries and just 1% from aquaculture. Fish consumption is estimated to be about 7-8 kg/year and contributes to about 30% of the total animal protein intake. This level of per capita consumption is low, compared to the global per capita consumption of about 20 kg in 2018. With a population growing at 2.7% annually, increased supplies are required just to maintain this limited contribution to the diet.

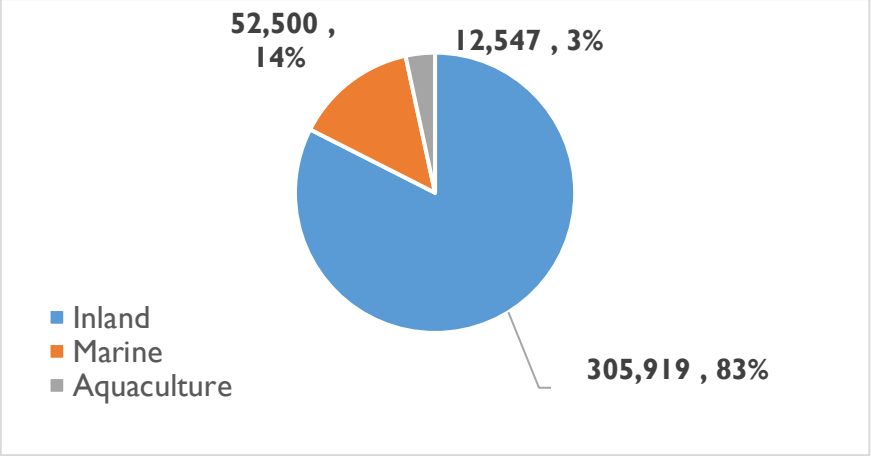


Figure 3 Fish Production in 2016 (in Metric Tons)

In 2018, there were some 183,800 persons engaged in fishing, accounting for about 0.7% of the work force, with a large, but unknown number, also engaged in fish trading and processing.

[3] Our World in Data & FAOStat (2019): https://ourworldindata.org/grapher/capture-fisheries-vs-aquaculture-farmed-fish-production?time=1960..2016&country=TZA

3 Inland Fisheries

About 37% of Tanzania's area of 945,000 km^2 is made up of inland waters. Tanzania owns 51% of Lake Victoria (68,800 km^2, shared with Uganda and Kenya), 41% of Lake Tanganyika (32,900 km^2, shared with the Democratic Republic of the Congo (DRC), Burundi, and Zambia) and 20% of Lake Nyasa (30,800 km^2, shared with Mozambique and Malawi). There are scores of minor natural lakes, man-made lakes or dams, and a number of major rivers such as the Rufiji, Kilombero, Ruvu and Pangani.

In 2010, Lake Victoria fisheries contributed an estimated 243,000 MT, valued at approximately US$ 400 million, to Tanzania's national fisheries production[4]. This figure may however be an underestimate given that total fish production in Lake Victoria was estimated at 808,000 MT according to Lake Victoria Fisheries Organization (LVFO) statistics in recent years[5].

Total fish production on Lake Tanganyika ranges between 160,000 and 200,000 MT per year. Considering that Tanzania has 46% jurisdiction of the lake, Tanzania's fish production in Lake Tanganyika may be close to 70,000 MT per year[4].

Tanzania's fish production from Lake Nyasa was estimated at 4,350 MT in 2008. No reliable data was obtained from Lake Rukwa authorities, in Sumbawanga during our visit of July 15th – 19th 2019.

Based on the above, the overall freshwater fish production may be greater than 320,000 MT per year, whereas official data (FAO FishStat) indicates a total freshwater fish production of approximately 290,000 MT per year.

Inland fisheries accounted for about 85% of the national fish production in 2018. Lake Victoria and Lake Tanganyika are the most important lakes from a fishery point of view, accounting for about 94% of the total inland fish production. Lake Victoria, according to the LVFO[5], is the most productive freshwater fishery in Africa.

The inland fisheries are currently exploited by an estimated 132,982 fishers, operating 42,288 (mostly very small) vessels, and over the last 15 years have produced an average overall catch of 296,370 tons[4]. Of the three lakes, Lake Victoria accounted for about 63% of all fish production from freshwater capture fisheries during 2018, Lake Tanganyika contributed about 18% and Lake Nyasa about 3%. No reliable data was obtained from Lake Rukwa.

The main species of commercial interest from Lake Victoria are the Nile perch or Sangara (*Lates niloticus*), Nile tilapia or Sato (*Oreochromis niloticus*), and the freshwater sardine or Dagaa wa Mwanza (*Rastrineobola argentea*)[6].

Consider all other small and major freshwater bodies in Tanzania, the main catches in the inland fishery sub-sector are composed of several species of perches of the genus Lates (*L. niloticus*, *L. stappersii*, *L. angustifrons*, *L. mariae*, and *L. microlepis*), small pelagics (*Rastrineobola argentea*, *Limnothrissa miodon*, *Stolothrissa tanganicae*, *Engraulicypris sardella* and *Copadichromis*

[4] Ministry of Livestock and Fisheries Development (March 2019), Dodoma, Tanzania.

[5] Lake Victoria Fisheries Organization (LVFO), August 2019, Mwanza, Tanzania

[6] Tanzania Fisheries Research Institute (TAFIRI), Mwanza, Tanzania: August 2019

spp) and tilapine species including *Oreochromis niloticus*. Other important stocks include haplochromines and catfish[6].

3.1 Lake Tanganyika

3.1.1 Geography and Geological History

Figure 5 shows the location of Lake Tanganyika – which is one of Africa's Great Lakes. It is the second-oldest freshwater lake in the world, the second - largest by volume, and the second - deepest, in all cases after Lake Baikal in Siberia[7]. It is the world's longest freshwater lake[8]. The lake is divided among four countries – Tanzania, the Democratic Republic of the Congo (DRC), Burundi, and Zambia, with Tanzania (46%) and DRC (40%) possessing most of the lake. The water flows into the Congo River system and ultimately into the Atlantic Ocean.

Figure 4 The Lake Tanganyika Basin

Lake Tanganyika is situated within the Albertine Rift, the western branch of the East African Rift, and is confined by the mountainous walls of the valley. It is the largest rift lake in Africa and the second-largest lake by volume in the world. It is the deepest lake in Africa and holds the greatest volume of fresh water, accounting for 16% of the world's available fresh water. It extends for 676 km in a general north-south direction and averages 50 km in width. The lake

[7] Tanganyika. Ramsar Sites Information Service. Retrieved 25 April 2018.

[8] Lewis, R. (16 May 2010). Brown Geologists Show Unprecedented Warming in Lake Tanganyika. Brown University. Retrieved 25 March 2017.

covers 32,900 km^2, with a shoreline of 1,828 km, a mean depth of 570 m and a maximum depth of 1,470 m (in the northern basin). It holds an estimated 18,900 cubic kilometres[9].

The catchment area of the lake is 231,000 km^2. Two main rivers flow into the lake, as well as numerous smaller rivers and streams (whose lengths are limited by the steep mountains around the lake). The one major outflow is the Lukuga River, which empties into the Congo River drainage.

The major river flowing into the lake is the Ruzizi River, formed about 10,000 years ago, which enters the north of the lake from Lake Kivu[10]. The Malagarasi River, which is Tanzania's second largest river, enters the east side of Lake Tanganyika. The Malagarasi is older than Lake Tanganyika, and before the lake was formed, directly drained into the Congo River.

The lake has a complex history of changing flow patterns, due to its high altitude, great depth, slow rate of refill, and mountainous location in a turbulently volcanic area that has undergone climate changes. Apparently, it has rarely in the past had an outflow to the sea. It has been described as 'practically endorheic' for this reason. The lake's connection to the sea is dependent on a high-water level allowing water to overflow out of the lake through the Lukunga into the Congo.

Due to the lake's tropical location, it has a high rate of evaporation. Thus, it depends on a high inflow through the Ruzizi out of Lake Kivu to keep the lake high enough to overflow. This outflow is apparently not more than 12,000 years old and resulted from lava flows blocking and diverting the Kivu basin's previous outflow into Lake Edward and then the Nile system, and diverting it to Lake Tanganyika. Signs of ancient shorelines indicate that at times, Tanganyika may have been up to 300 m lower than its present surface level, with no outlet to the sea. Even its current outlet is intermittent, thus may not have been operating when first visited by Western explorers in 1858[12].

The lake may also have at times had different inflows and outflows; inward flows from a higher Lake Rukwa, access to Lake Nyasa and an exit route to the Nile have all been proposed to have existed at some point in the lake's history[11].

Lake Tanganyika is an ancient lake. Its three basins, which in periods with much lower water levels were separate lakes, are of different ages. The central began to form 9 - 12 million years ago (Mya), the northern 7 - 8 Mya and the southern 2 - 4 Mya[12].

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[9] Database Summary: Lake Tanganyika. www.ilec.or.jp. Archived from the original on 1999-11-10. Retrieved 2008-03-14.

[10] Scheffel, Richard L.; Wernet, Susan J., eds. (1980). Natural Wonders of the World. United States of America: Reader's Digest Association, Inc. pp. 366–367. ISBN 978-0-89577-087-5.

[11] Lévêqu, Christian (1997). Biodiversity Dynamics and Conservation: The Freshwater Fish of Tropical Africa. Cambridge University Press. p. 110.

[12] Cohen; Soreghan; Scholz (1993). "Estimating the age of formation of lakes: An example from Lake Tanganyika, East African Rift system". Geosciences. 21 (6): 511–514. doi:10.1130/0091-7613(1993)021<0511:ETAOFO>2.3.CO;2.

3.1.2 Lake Tanganyika's Biology

3.1.2.1 Reptiles

Lake Tanganyika and associated wetlands are home to Nile crocodiles (including famous giant Gustave), Zambian hinged terrapins, serrated hinged terrapins, and pan hinged terrapins (last species not in the lake itself, but in adjacent lagoons)[13]. Storm's water cobra, a threatened subspecies of banded water cobra that feeds mainly on fish, is only found in Lake Tanganyika, where it prefers rocky shores.

3.1.2.2 Fish Species

3.1.2.2.1 Off-shore Species

Therefore, Lake Tanganyika is known internationally for its endemic cichlid fish fauna that comprises a genetically diverse demersal community assemblage. The pelagic fish community primarily comprises six endemic species including small pelagics (*Limnothrissa miodon and Stolothrissa tanganicae*) and their major predators, four members of the genus Lates (*L. stappersii*, *L. angustifrons*, *L. mariae*, and *L. microlepis*). *L. Stappersii* and *S. tanganicae* live exclusively in the offshore zone and comprise 90% of the catches from the lake fishery. According to FATIRI[14], the major off-shore commercial species (i.e. open water – after 1000 meters away from the lake shores) in Lake Tanganyika include: -

Sardines or Dagaa

a) Dagaa wa Kigoma *(Stolothrissa tanganyicae)*
b) Dagaa wakubwa or Malumbu (*Limnothrissa miodon*)

Perch or Sangara

a) Nonzi *(Lates microlepis)*
b) Makeke *(Lates mariae)*
c) Sangara wa Tanganyika *(Lates anguistifrous)* -these are different from Victoria's Nile Perch

Migebuka

Migebuka *(Lates strappersi*) – this fish is believed by natives to make the second most preferred dish after 'Kuhe'. According to them, 'Kuhe' is the most palatable fish.

3.1.2.2.2 In-shore Fish

According to FATIRI (2019), the major in-shore commercial species (i.e. within 1000 meters from the shores) in Lake Tanganyika include: -

a) Kuhe *(Boulengerochromis microlepis)* – believed to make the most appetizing and preferred fish recipe/dish around the Lake Tanganyika areas of Kigoma, Mpanda, Sumbawanga and Tabora

[13] Spawls, Howell, Drewes, and Ashe (2002). A Field Guide to the Reptiles of East Africa. Academic Press, London. ISBN 0-12-656470-1.
[14] Tanzania Fisheries Research Institute (TAFIRI), Kigoma (July 2019)

b) Sato/Ngege – *(Oreochromis tanganyicae)*
c) Ornamental Fish (many species)

3.1.2.2.3 Cichlid Fish

According to the Merriam – Webster dictionary[15], cichlids can be defined as any of a family (*Cichlidae*) of mostly tropical spiny-finned usually freshwater fishes including several kept in tropical aquariums.

According to TAFIRI (2019) Lake Tanganyika holds at least 250 species of cichlid fish and undescribed species remain. Almost all (98%) of the Tanganyika cichlids are endemic to the lake and it is thus an important biological resource for the study of speciation in evolution. The cichlids of the African Great Lakes, including Tanganyika, represent the most diverse extent of adaptive radiation in vertebrates[16].

Although Tanganyika has far fewer cichlid species than Lake Malawi and Victoria which both have experienced relatively recent explosive species radiations (resulting in many closely related species)[17], its cichlids are the most morphologically and genetically diverse. This is linked to the high age of Tanganyika, as it is far older than the other lakes[18]. Tanganyika has the largest number of endemic cichlid genera of all African lakes. All Tanganyika cichlids are in the subfamily *Pseudocrenilabrinae*. Of the 10 tribes in this subfamily, half are largely or entirely restricted to the lake (*Cyprichromini*, *Ectodini*, *Lamprologini*, *Limnochromini* and *Tropheini*) and another three have species in the lake (*Haplochromini*, *Tilapiini* and *Tylochromini*)[19].

Figure 6 shows the some of the fish species in the Lake Tanganyika.

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[15] Merriam-Webster Dictionary: https://www.merriam-webster.com/dictionary/cichlid: Retrieved on August 9, 2019

[16] Tanzania Fisheries Research Institute (TAFIRI), 2012

[17] Turner, Seehausen; Knight, Allender; Robinson (2001). "How many species of cichlid fishes are there in African lakes?". Molecular Ecology. 10 (3): 793–806. doi:10.1046/j.1365-294x.2001.01200.

[18] Nishida, M (1991). "Lake Tanganyika as an evolutionary reservoir of old lineages of East African cichlid fishes: Inferences from allozyme data". Experientia. 47 (9): 974–979. doi:10.1007/bf01929896.

[19] Sparks; Smith (2004). "Phylogeny and biogeography of cichlid fishes (Teleostei: Perciformes: Cichlidae)". Cladistics. 20 (6): 501–517. CiteSeerX 10.1.1.595.2118. doi:10.1111/j.1096-0031.2004.00038.x

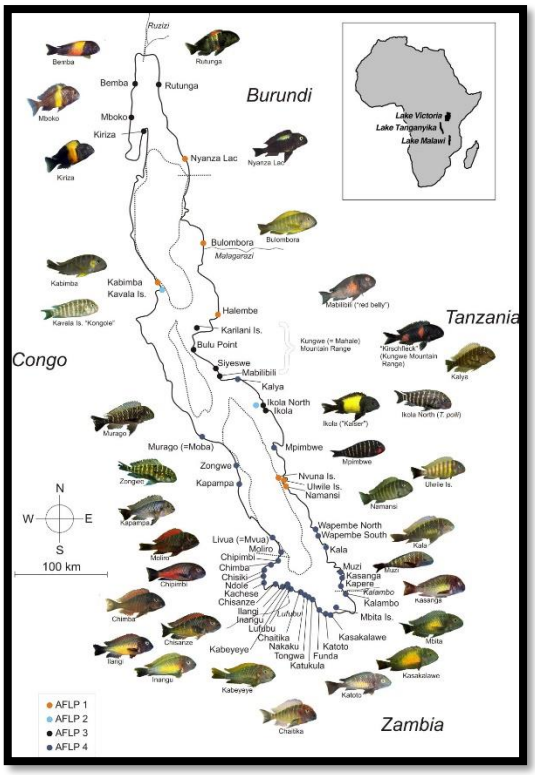

Figure 5 Lake Tanganyika Fish Species

Most Tanganyika cichlids live along the shoreline down to a depth of 100 m, but some deep-water species regularly descend to 200 m[20]. *Trematocara* species have exceptionally been found at more than 300 m, which is deeper than any other cichlid in the world[21]. Some of the deep-water cichlids (e.g., *Bathybates*, *Gnathochromis*, *Hemibates* and *Xenochromis*) have been caught in places virtually devoid of oxygen, but how they are able to survive there is unclear[22]. Tanganyika cichlids are generally benthic (found at or near the bottom) and/or coastal. No Tanganyika cichlids are truly pelagic and offshore, except for some of the piscivorous *Bathybates*. Two of these, *B. fasciatus* and *B. leo*, mainly feed on Tanganyika sardines. Tanganyika cichlids differ extensively in ecology and include species that are herbivores, detritivores, planktivores, insectivores, molluscivores, scavengers, scale-eaters and piscivores. Their breeding behavior fall into two main groups, the substrate spawners (often in caves or rock crevices) and the mouthbrooders. Among the endemic species are two of the world's smallest cichlids, *Neolamprologus multifasciatus* and *N. similis* (both shell dwellers) at up to 4 - 5 cm, and one of the largest, the giant cichlid (*Boulengerochromis microlepis*) at up to 90 cm[23].

Many cichlids from Lake Tanganyika, such as species from the genera *Altolamprologus*, *Cyprichromis*, *Eretmodus*, *Julidochromis*, *Lamprologus*, *Neolamprologus*, *Tropheus* and *Xenotilapia*, are popular aquarium fish due to their bright colors and patterns, and interesting behaviors[24].

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[20] Kirchberger; Sefc; Sturmbauer; and Koblmuller (2012). Evolutionary History of Lake Tanganyika's Predatory Deepwater Cichlids" International Journal of Evolutionary Biology, Volume 2012, Article ID 716209.

[21] Loiselle, Paul (1994). The Cichlid Aquarium, p. 304. Tetra Press, Germany. ISBN 978-1564651464.

[22] Lowe-McConnell, R.H. (1987). Ecological Studies in Tropical Fish Communities. ISBN 0-521-28064-8.

[23] Froese, Rainer and Pauly, Daniel, eds. (2017). "Neolamprologus multifasciatus" in FishBase. March 2017 version.

[24] Schliewen, U. (1992). Aquarium Fish. Barron's Educational Series. ISBN 978-0812013504.

Recreating a Lake Tanganyika biotope to host those cichlids in a habitat similar to their natural environment is also popular in the aquarium hobby[25].

3.1.2.2.4 Other Fish

Lake Tanganyika is home to more than 80 species of non-cichlid fish and about 60% of these are endemic[26].

The open waters of the pelagic zone are dominated by four non-cichlid species: Two species of 'Tanganyika sardine': - Dagaa Wakubwa (*Limnothrissa miodon*) and Dagaa wa Kigoma (*Stolothrissa tanganicae*) form the largest biomass of fish in this zone, and they are important prey for the forktail lates: - Nonzi (*Lates microlepis*) and sleek lates or Mgebuka (*L. stappersii*)[27]. Two additional lates are found in the lake, the Tanganyika lates or Sangara wa Tanganyika (*L. angustifrons*) and bigeye lates or Makeke (*L. mariae*), but both these are primarily benthic hunters, although they also may move into open waters[28]. The four lates, all endemic to Tanganyika, have been overfished and larger individuals are rare today.

3.1.2.3 Molluscs and Crustaceans

A total of 83 freshwater snail species (65 endemic) and 11 bivalve species (8 endemic) are known from the lake[29]. Among the endemic bivalves are three monotypic genera: *Grandidieria burtoni*, *Pseudospatha tanganyicensis* and *Brazzaea anceyi*.

3.1.3 Investment Opportunities in the Lake Tanganyika Basin

Total fish production on Lake Tanganyika ranges between 160,000 and 200,000 MT per year.

Considering that Tanzania has 41% jurisdiction of the lake, Tanzania's fish production in Lake Tanganyika may be close to 70,000 MT per year. Therefore, investment opportunities available at Lake Tanganyika, include: -

a) Embarking on fish production by the 'cage-culture' methods in suitable sites along Lake Tanganyika. The species recommended are Ngege and Sato. Migebuka and Kuhe are not easy to farm as they require a lot of oxygen – which may not be economically affordable by most farmers. Currently, there is an Australian investor who has been researching on the potential for cage-culture fish farming in Lake Tanganyika - preliminary results from the research are encouraging
b) Aquaculture or off-land fish farming. Experts confirm that the entire Lake Tanganyika Basin's environment (soils, climate, water quality) are suitable for aquaculture activities

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25 "tanganyika biotope aquarium". Aquariums Life. 2010-02-10. Archived from the original on 2012-03-02. Retrieved 2014-02-03.

26 Mortiff, C: Lake Tanganyika and its Diverse Cichlids. Cichlid-Forum. Retrieved 1 March 2017.

27 Tanzania Fisheries Research Institute, Kigoma (July 2019)

28 Lindqvist, O.V.; H. Mölsä; K. Solonen; J. Sarvala, editors (1999). From Limnology to Fisheries: Lake Tanganyika and Other Large Lakes. pp. 213–214. Springer. ISBN 978-0792360179

29 Seddon, M.; Appleton, C.; Van Damme, D.; Graf, D. (2011). Darwall, W.; Smith, K.; Allen, D.; Holland, R.; Harrison, I.; Brooks, E. (eds.). Freshwater molluscs of Africa: diversity, distribution, and conservation. The Diversity of Life in African Freshwaters: Under Water, Under Threat. An Analysis of the Status and Distribution of Freshwater Species Throughout Mainland Africa. IUCN. pp. 92–119. ISBN 978-2831713458.

c) Hatchery for fingerlings production to serve the growing aquaculture industry in the Lake Tanganyika basin
d) Fish food processing factory – using locally available materials
e) Ornamental fish farming (Fishing and 'cage-culture' of ornamental fish in Lake Tanganyika)
f) Ice production plants
g) Boat yards and the selling of good quality engines
h) Establishment of fisheries institutes for skills development

3.2 Lake Rukwa

3.2.1 Geography

Lake Rukwa is an endorheic lake in the Rukwa Valley of southwestern Tanzania. The alkaline Lake Rukwa (with area of 5,760 km^2) lies midway between Lake Tanganyika and Lake Nyasa at an elevation of about 800 meters, in a parallel branch of the rift system (Fig. 7). Almost half of the lake lies in Uwanda Game Reserve[30].

Wild animals and associated biodiversity at the Uwanda game reserve, Rukwa game reserve and Lukwati game reserve depend fully on water from this lake for their survival.

On the western side, Lake Rukwa is bordered with Lyamba lya Mfipa mountains – which one has to pass through when driving from Sumbawanga. On the eastern side, the lake is bordered with the Uwanda, Rukwa and Lukwati Game Reserves – which are extensive fertile, alluvial flood plains or plateau.

[30] Rukwa Uwanda Game Reserve. Utalii Travel and Safari. Retrieved 29 October 2010.

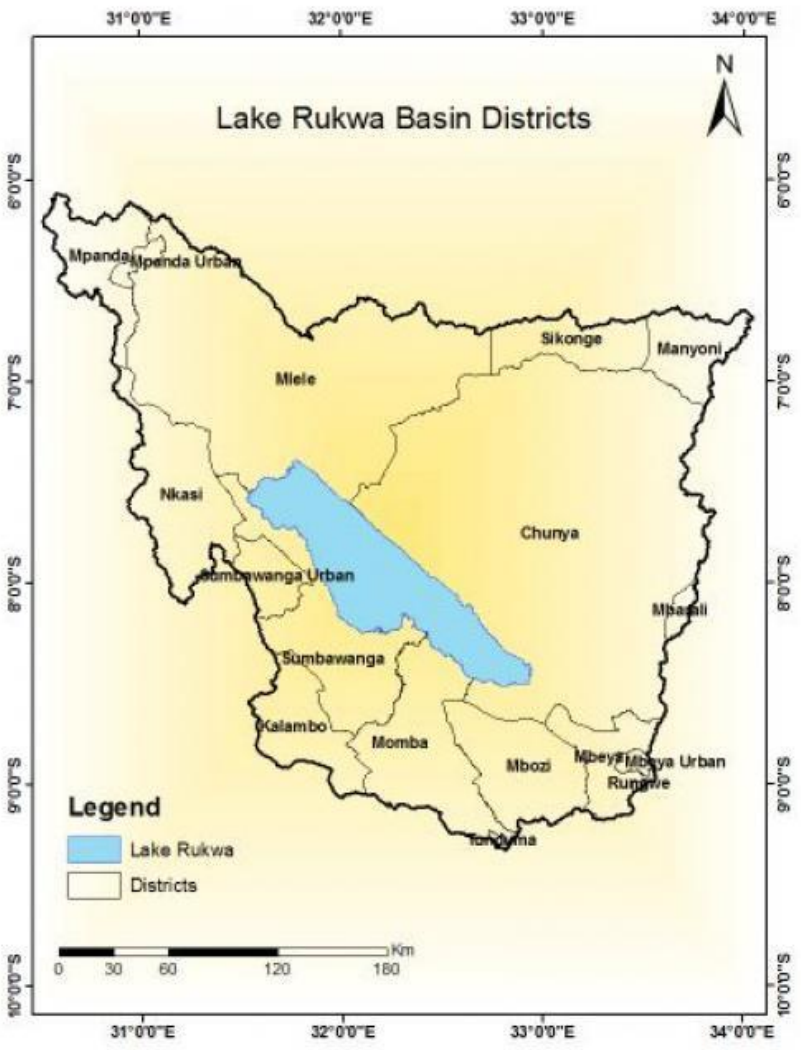

Figure 6 Lake Rukwa Basin

3.2.2 Population

The Rukwa-Katavi landscape has a population of over 1.5 million, mostly Fipa - sparsely populated, with an economy revolving around subsistence agriculture, cattle keeping and fishing.

An important rice - producing area, the main crops are maize and paddy. Garden crops include beans, pumpkins, and sweet potatoes; bananas, mangoes, lemons, pineapples, sesame, and sugar cane are grown as well. There is an influx of Sukuma cattle.

3.2.3 Lake Rukwa's Biology

3.2.3.1 Reptiles

Lake Rukwa, which has no outlet, contains a large crocodile population. The Uwanda Game Reserve, Rukwa Game Reserve and Lukwati Game Reserve are amongst the protected areas in the valley.

3.2.3.2 Fish Species

The main fish species in Lake Rukwa are: - (a) Tilapia or in Swahili 'Gege' (b) Clarius spp (Kambale) and (c) Kolokolo. With the exception of Gege, Kambale and Kolokolo are both mud fish – a typical characteristic of Lake Rukwa fish ecology.

It was learned during this study that, Lake Rukwa fish species have not been studied extensively; and, the Rukwa Regional Authorities couldn't provide reliable fisheries statistics from the Lake Rukwa.

3.2.3.3 Wildlife

There are three main flora zones in the Rukwa Valley: the treeless grass plains, a belt of open woodland, and the escarpment area. Valley grassland and wooded grassland are differentiated by the illuvial soil of the former and the colluvial soil of the latter. The woodland is partly covered by acacia. The northern end of Lake Rukwa encompasses a wetland of papyrus and reed.

The grasslands are inhabited by a rich biodiversity of thousands of species and a rich variety of birds. It has a significant population of topi and some groups of some 1500 have been reported in clusters in the valley. Estimates in the 1950s were that some 3000 - 4000 topi roamed the land around Lake Rukwa. Several mutations have been reported in the valley including an albino giraffe and a dark colored zebra 'marked with spots instead of stripes'[31].Other game animals include eland, reedbuck, and buffalo. The valley is home to some rare animals, including poku and Shoebill.

3.2.4 Fisheries' Challenges in the Lake Rukwa Basin

The main challenges in the lake are:

In the words of January Makamba, Minister of State in the Vice President's Office for Union Affairs and Environment, the ecologically sensitive region has experienced "colossal environmental degradation". This observation was made in October 2016.

The depth of the lake significantly dropped from 9.5 - 3.4 meters in the last 10 years. The 2014 Bathymetric Survey, which was jointly funded by the USAID and Global Water for Sustainability, had pointed out the waning water level.

Major rivers draining the Lake Rukwa include the Rungwa River (from the north), Lupa, Chambua, and Songwe rivers (from the south) and the Momba River (from the west). Despite the lake being fed by 17 rivers - both perennial and seasonal ones - it continues to get shallower every year. Intensive damming and development of irrigation systems in villages in the catchment area are reducing quantity and duration of water flow and hence, affecting the availability of water in the lake.

Illegal cultivation on buffer zones by the side of rivers has led to siltation of rivers. Overuse of pesticides for agriculture has also affected the health of the lake. Local communities are not aware of the damage they are causing by doing cultivation around riverbanks and in the

[31] Williams, John George (1967). A field guide to the national parks of East Africa. Collins. pp. 130–1. Retrieved 31 March 2012.

hills where streams start. Agricultural runoffs, including silt, are causing sedimentation of rivers that feed Lake Rukwa[32]. Even pesticides are also getting mixed with the water. One can tell that by the muddy color of the water. Slopes are deforested for agriculture, exposing the top layer of soil to the first rains. These soil particles are carried by the rivers and deposited when the speed of the flow is reduced in the floodplains of the Rukwa Valley. The quantity and quality of fish catch, essential source of protein and income for locals, is also affected.

With erratic rainfall and unpredictable climate limiting the scope of agriculture, locals are now becoming more dependent on livestock to ensure food security. But the population of cattle is very high compared to the carrying capacity of the area and Lake Rukwa comes under further stress to quench their thirst. More than 80% of the water from this lake is now used for domesticated livestock[32].

Mining is rampant in the region and so is mercury contamination. While artisanal and small-scale mining continues to be a hope for locals, processing of gold ore with mercury is a major concern as the same mercury reaches the river that feeds Lake Rukwa. The colour of the lake's water now resembles that of a cesspool.

Others are: -

a) Illegal fishing
b) No fish processing plants near the Lake Rukwa
c) No reliable power near the lake – to attract investment

3.2.5 Hydrology

The lake has seen large fluctuations in its size over the years, due to varying inflow of streams. Currently it is about 180 kilometers long and averages about 32 kilometers wide, making it about 5,760 square kilometers in size[33]. In 1929 it was only about 48 kilometers long, but in 1939 it was about 128 kilometers long and 40 kilometers wide[34]. The lake may at times have been even higher and linked Lake Tanganyika with Lake Nyasa; ancient shorelines suggest a final date of overflow into Tanganyika of 33,000BP[35].

3.2.6 Helium Discovery

In 2016, an estimated 1.53 billion cubic meters volume of helium gas was discovered in Lake Rukwa worth $3.5 billion[36].

3.2.7 Investment Opportunities in Lake Rukwa

It was not possible for us (TIC and EATIH team) to get reliable fisheries' data for Lake Rukwa. Fisheries officials seemed to be unsure – owing to illegal fishing and the fact that it has been

[32] Discussion with Shared Resources Joint Solutions (SRJS) initiative (July 2019). An NGO working around the Katavi-Rukwa Landscape.

[33] Source: Rukwa Regional Trade Officer (July 2019)

[34] Encyclopædia Britannica Online/Lake Rukwa

[35] Lévêque, Christian (1997). Biodiversity Dynamics and Conservation: The Freshwater Fish of Tropical Africa. Cambridge University Press. p. 110.

[36] Helium 'could earn Tanzania $3.5bn. www.thecitizen.co.tz. July 8, 2016.

difficult to track fishermen as they use hidden routes to escape taxes. However, investment opportunities available at Lake Rukwa, include:

a) Supply of fishing gears and accessories (fishing boats, engines, fishing nets)
b) Encouraging fish processing facilities/factories within the Lake Rukwa basin
c) Construction of storage facilities (blast freezers, cold rooms, and ice plants)
d) Investment on fish production by cage-culture in suitable sites along Lake Rukwa
e) Engaging into aquaculture – development of earthen and concrete fishponds
f) Manufacture and supply of fish packaging materials during the transportation (minimize postharvest losses)
g) Manufacture and supply of fish feeds (including live food production) to fish farmers
h) There are substantial commercial opportunities in the development of hatcheries/fingerlings and feed production systems (to serve the growing aquaculture industry in the Lake Tanganyika basin), as well as grow-out facilities to supply national and regional markets with fresh tilapia on ice
i) Fish feed manufacture and supply across the basin and beyong
j) Crocodile farming along lake Rukwa

3.3 Lake Nyasa

Lake Nyasa, also known as Lake Malawi and Lago Niassa in Mozambique, is one of Africa's Great Lakes and the southernmost lake in the East African Rift Valley system, located between Tanzania, Mozambique and Malawi - as illustrated on Figure 8.

It is the fourth largest freshwater lake in the world by volume, the ninth largest lake in the world by area - and the third largest and second deepest lake in Africa. Lake Nyasa is home to more species of fish than any other lake[37], including at least 700 species of cichlids[38]. The Mozambique portion of the lake was officially declared a reserve by the Government of Mozambique on June 10, 2011[39], while in Malawi a portion of the lake is included in Lake Malawi National Park.

Lake Nyasa is a meromictic lake, meaning that its water layers do not mix. The permanent stratification of Lake Nyasa's water and the oxic - anoxic boundary (relating to oxygen in the water) are maintained by moderately small chemical and thermal gradients[40].

In terms of fish captures, the lake can be classified as oligotrophic to mesotrophic (i.e. low to medium fish productivity). Dominant commercial species are made up of small pelagics, (notably *Engraulicypris sardella* (usipa) and *Copadichromis spp* (utaka), which represent about 70% of the lake's total catch.

3.3.1 Geography

Lake Nyasa is between 560 - 580 km; and about 75 km wide at its widest point[41]. The lake has a total surface area of about 29,600 km^2. The lake is 706 m at its deepest point, located in a major depression in the north-central part[42]. Another smaller depression in the far north reaches a depth of 528 m. The southern half of the lake is shallower; less than 400 m in the south-central part and less than 200 m in the far south. The lake has shorelines on western Mozambique, eastern Malawi, and southern Tanzania. The largest river flowing into it is the Ruhuhu River, and there is an outlet at its southern end, the Shire River, a tributary that flows into the very large Zambezi River in Mozambique. Evaporation accounts for more than 80% of the water loss from the lake, considerably more than the outflowing Shire River[43].

As appears on Figure 8, the lake is about 350 km southeast of Lake Tanganyika, and the Lake Malawi National Park is located at the southern end of the lake.

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37 Protected Areas Programme. United Nations Environment Programme, World Conservation Monitoring Centre, UNESCO. October 1995. Archived from the original on 2008-05-11. Retrieved 2008-06-26.

38 Turner, Seehausen, Knight, Allender, and Robinson (2001). How many species of cichlid fishes are there in African lakes? Molecular Ecology 10: 793–806.

39 WWF (10 June 2011). "Mozambique's Lake Niassa declared reserve and Ramsar site" Retrieved 17 July 2014.

40 Pilskaln, C. H. (2004). "Seasonal and Interannual Particle Export in an African Rift Valley Lake: A 5-Yr Record from Lake Malawi, Southern East Africa". Limnology and Oceanography, 49(4), 964–977. {{doi:10.2307/3597647}}.

41 Malawi Cichlids. AC Tropical Fish. Aquaticcommunity.com. Retrieved 2007-04-02.

42 Konings, Ad (1990). Ad Konings' Book of Cichlids and all the other Fishes of Lake Malawi. ISBN 978-0866225274.

43 Park, L.E.; and A.S. Cohen (2011). Paleoecological response of ostracods to early Late Pleistocene lake-level changes in Lake Malawi, East Africa. Palaeogeography, Palaeoclimatology, Palaeoecology 303: 71–80. doi:10.1016/j.palaeo.2010.02.038

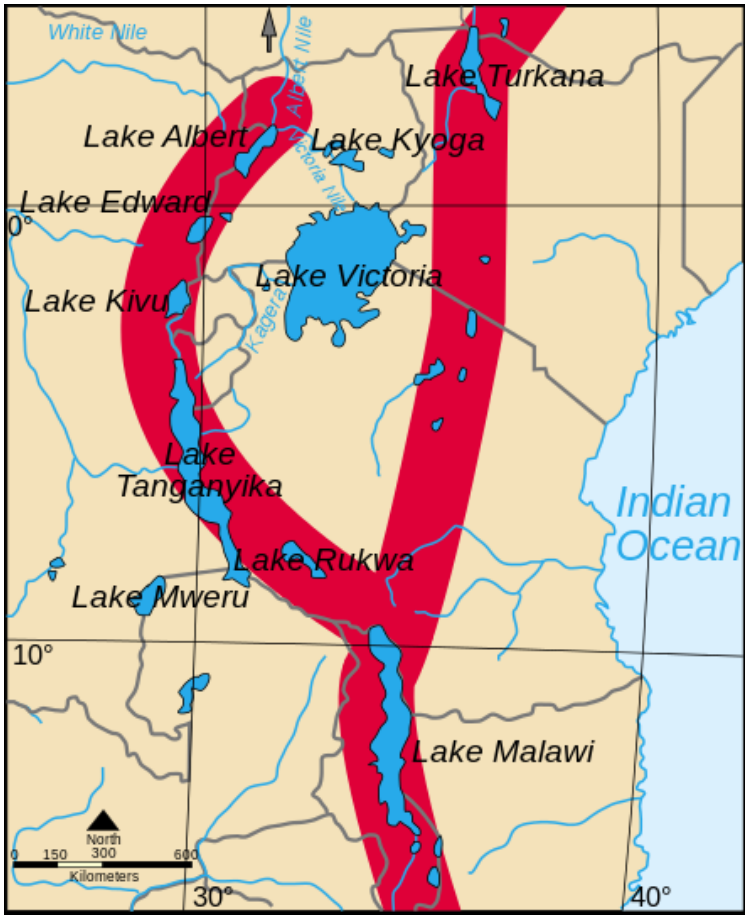

Figure 7 **The East African Rift (red) with the Rift Valley lakes, Lake Nyasa (or Malawi) being in the south**

3.3.2 The Tanzania – Malawi Border Dispute

The long dormant border dispute between Malawi and Tanzania was reignited during early 2012 - by the issuing of a licence by the Malawi government to UK company Surestream to explore for oil in the north-eastern part of Lake Nyasa. Malawi is hoping to find oil reserves of similar magnitude to those currently being exploited in Lake Albert (Uganda), estimated at 2.5 billion barrels[44].

Malawi has been claiming possession of the whole of the surface of the lake that is not in Mozambique, and their claim is supported by the Anglo - German Heligoland Agreement of 1st July 1890, which defines the border as running along the Tanzanian shore (Fig. 9). When the British colonial government captured Tanganyika from Germany, it placed all of the water under the jurisdiction of the territory of Nyasaland, without a separate administration for the Tanganyikan portion of the surface.

In the early 1960s, Malawi's first president, Hastings Kamuzu Banda, claimed that Lake Nyasa was part of Malawi and this was reaffirmed at the 1963 Organization of African Unity summit, where it was accepted reluctantly by Tanzania although the dispute re-ignited in 1967-8. The

[44] Tanzania Affairs (2012): https://www.tzaffairs.org/2012/09/malawi-tanzania-border-dispute/

Tanzanian case is based on international law which stipulates that when two countries are separated by a body of water, the border is at the middle of that body.

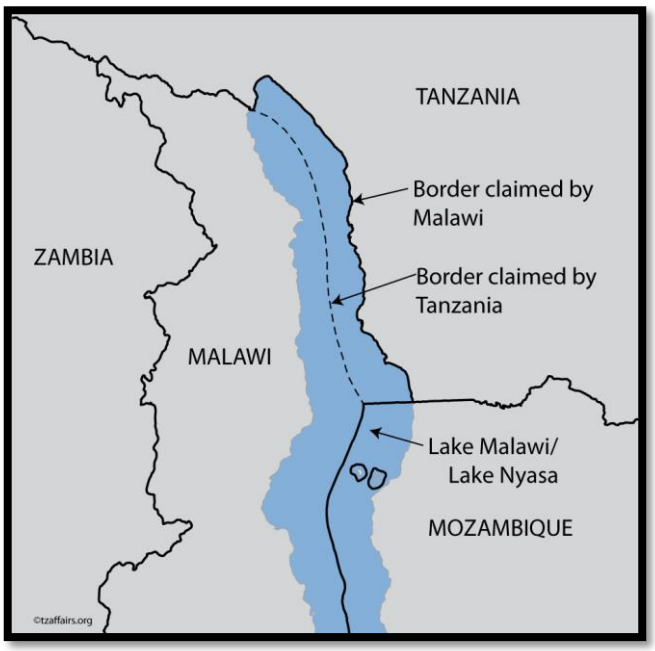

Figure 8 Diagram of the disputed Malawi - Tanzania border

After meeting in August 2012 with the then, Malawi President, Joyce Mbanda, President Kikwete downplayed any rumors of war over the conflict, saying that Tanzania had over the years enjoyed a good relationship with Malawi and it had no intention to strain it in any way. Technical experts from the two countries started meetings from August 2012 at the northern Malawian town of Mzuzu to discuss possible solutions to the dispute.

However, the then Tanzanian Foreign Affairs and International Co-operation Minister, Mr Bernard Membe, was quoted as saying that "After frank and spirited discussions between the two countries, we have concluded that our differences still remain," adding "Neighbors must endure, neighbors must always remain neighbors, and we are here because of differences in positions." Mr Membe confirmed that the parties had agreed to cease oil exploration in the disputed areas to allow space for negotiations to take place, and that if this does not lead to an agreement, the matter may be referred to the UN International Court of Justice.

3.3.3 Wildlife

Wildlife that is found in and around Lake Nyasa include Nile crocodiles, hippopotamus, monkeys, and a significant population of fish eagles that feed off fish from the lake.

3.3.3.1 Fish

3.3.3.1.1 Fishing

Lake Nyasa has, for millennia, provided a major food source to the residents of its shores since its waters are rich in fish. Among the most popular are the four species of chambo, consisting of any one of four species in the subgenus *Nyasalapia* (*Oreochromis karongae*, *O.*

lidole, *O. saka* and *O. squamipinnis*), as well as the closely related *O. shiranus*[45]. Other species that support important fisheries include the Lake Malawi sardine (*Engraulicypris sardella*) and the large kampango catfish (*Bagrus meridionalis*)[46]. Most fishing provides food for the increasing human population near the lake, but some are exported – mainly from Malawi.

3.3.3.1.1.1 Fishing Challenges

The main fishing challenges at Lake Nyasa include:

a) The wild population of fish is increasingly threatened by overfishing and water pollution[47].
b) A drop in the lake's water level represents another threat and is believed to be driven by water extraction by the increasing human population, climate change and deforestation[48].
c) The chambo and kampango have been particularly overfished (the kampango declined by about 90% from 2006 to 2016, *O. karongae* and *O. squamipinnis* by about 94%, and *O. lidole* might already be extinct[49]) and they are now seriously threatened. The IUCN recognizes 117 species of Nyasa cichlids as threatened; some of these have tiny ranges and may be restricted to rocky coastlines only a few hundred meters long[50].

3.3.3.1.2 Cichlids

Lake Nyasa is noted for being the site of evolutionary radiations among several groups of animals, most notably cichlid fish. There are at least 700 cichlid species in Lake Nyasa, with some estimating that the actual figure is as high as 1,000 species[51]. The actual number is labelled with some uncertainty because of the many undescribed species and the extreme variation among some species, making the task of delimiting them very complex. Except for four species (*Astatotilapia calliptera*, *Coptodon rendalli*, *Oreochromis shiranus* and *Serranochromis robustus*), all cichlids in the lake are endemic to the Nyasa system, which also includes nearby smaller Lake Malombe and the upper Shire River. Many of these have become popular among aquarium owners due to their bright colors. Recreating a Lake Nyasa biotope to host cichlids became quite popular in the aquarium hobby[52]. Most Nyasai cichlids are found in relatively shallow coastal waters, but *Diplotaxodon* has been recorded down to depths of 200 - 220 m

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45 Turner, G.F.; and N.C. Mwanyama (July 1992). Distribution and Biology of Chambo (Oreochromis spp.) in Lakes Malawi and Malombe. Food and Agriculture Organization, Fisheries and Aquaculture Department, FI:DP/MLW/86/013, Field Document 21. Retrieved 13 April 2017.

46 Konings, Ad (1990). Ad Konings' Book of Cichlids and all the other Fishes of Lake Malawi. ISBN 978-0866225274

47 Banda, M. (22 May 2013). "Rapid drop in Lake Malawi's water levels drives down fish stocks". The Guardian. Retrieved 11 April 2017.

48 Tanzania Fisheries Research Institute (TAFIRI), July 2012

49 Phiri, B.; Gobo, E.; Tweddle, D.; Kanyerere, Z. (2018). "Bagrus meridionalis". The IUCN Red List of Threatened Species. IUCN. 2018: e.T60856A47218749. doi:10.2305/IUCN.UK.2018-2.RLTS.T60856A47218749.en. Retrieved 3 January 2019.

50 Kanyerere, Z.; Phiri, B.; Shechonge, A. (2018). "Oreochromis karongae". The IUCN Red List of Threatened Species. IUCN. 2018: e.T61293A47244008. doi:10.2305/IUCN.UK.2018-2.RLTS.T61293A47244008.en. Retrieved 3 January 2019.

51 Turner, Seehausen, Knight, Allender, and Robinson (2001). "How many species of cichlid fishes are there in African lakes?" Molecular Ecology 10: 793–806.

52 Pardee, Keith. "African Cichlids, Lake Malawi". www.aquariumlife.net. Retrieved August 9, 2019.

and several (especially *Diplotaxodon*, *Rhamphochromis* and *Copadichromis quadrimaculatus*) are known from pelagic waters[53].

3.3.3.1.3 Non-cichlids

One example of a non-cichlid fish at Lake Nyasa is the famous kampango (*Bagrus meridionalis*), one of the largest catfish, reaching up to 1.5 m in length.

The vast majority of the fish species in the lake are cichlids. Among the non-cichlid native fish are several species of cyprinids (in genera *Barbus*, *Labeo* and *Opsaridium*, and the Lake Nyasa sardine *Engraulicypris sardella*), airbreathing catfish (*Bathyclarias* and *Clarias*, and the kampango *Bagrus meridionalis*), mochokid catfish (*Chiloglanis* and Malawi squeaker *Synodontis njassae*), *Mastacembelus* spiny eel, mormyrids (*Marcusenius*, *Mormyrops* and *Petrocephalus*), the African tetra *Brycinus imberi*, the *poeciliid Aplocheilichthys johnstoni*, the spotted killifish (*Nothobranchius orthonotus*), and the mottled eel (*Anguilla nebulosa*)[54].

3.3.3.2 Invertebrates

3.3.3.2.1 Molluscs

Lake Malawi is home to 28 species of freshwater snails (including 16 endemics) and 9 bivalves (2 endemics, *Aspatharia subreniformis* and the unionid *Nyassunio nyassaensis*)[55]. The endemic freshwater snails are all members of the genera *Bellamya*, *Bulinus*, *Gabbiella*, *Lanistes* and *Melanoides*[56].

Lake Malawi is home to a total of four snail species in the genus *Bulinus*, which is a known intermediate host of bilharzia. A survey[57] in Monkey Bay in 1964 found two endemic species of snails of the genus (*B. nyassanus* and *B. succinoides*) in the lake, and two non-endemic species (*B. globosus* and *B. forskalli*) in lagoons separated from it.

3.3.3.2.2 Crustaceans

Unlike Lake Tanganyika with its many endemic freshwater crabs and shrimp, there are few such species in Lake Nyasa. The Malawi blue crab, *Potamonautes lirrangensis* (syn. *P. orbitospinus*), is the only crab in the lake and it is not endemic[58]. The atyid shrimp *Caridina malawensis* is endemic to the lake, but it is poorly known and has historically been confused

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53 Lowe-McConnell, R.H. (2003). Recent research in the African Great Lakes: Fisheries, biodiversity and cichlid evolution. Freshwater Forum 20(1): 4–64.

54 (1990). Ad Konings' Book of Cichlids and all the other Fishes of Lake Malawi. ISBN 978-0866225274.

55 Kaunda, E., Magombo, Z., Kahwa, D. & Mailosi, A. (2010). Aspatharia subreniformis. The IUCN Red List of Threatened Species. IUCN. 2010: e.T44266A10884713. doi:10.2305/IUCN.UK.2010-3.RLTS.T44266A10884713.en. Retrieved 14 January 2018.

56 Brown, D. (1994). Freshwater Snails Of Africa And Their Medical Importance. p. 571. 2nd edition. ISBN 0-7484-0026-5

57 Wright, C. A.; Klein, J.; Eccles, D. H. (1967). Endemic species of Bulinus (Mollusca: Planorbidae) in Lake Malawi (= Lake Nyasa). Journal of Zoology. 151 (1): 199–209. doi:10.1111/j.1469-7998.1967.tb02873.x. Archived from the original on 2012-10-20. Retrieved 2010-05-22.

58 Cumberlidge, N., and Meyer, K. S. (2011). A revision of the freshwater crabs of Lake Kivu, East Africa. Journal Articles. Paper 30.

with *C. nilotica*, which is not found in the lake[59]. Pelagic zooplanktonic species include two cladocerans (*Diaphanosoma excisum* and *Bosmina longirostris*), three copepods (*Tropodiaptomus cunningtoni*, *Thermocyclops neglectus* and *Mesocyclops aequatorialis*), and several ostracods (including both described and undescribed species).

3.3.3.2.3 Lake flies

Lake Nyasa is famous for the huge swarms of tiny, harmless lake flies, *Chaoborus edulis*[14]. These swarms, typically appearing far out over water, can be mistaken for plumes of smoke.

The aquatic larvae feed on zooplankton, spending the day at the bottom and the night in the upper water levels[14]. When they pupate they float to the surface and transform into adult flies. The adults are very short-lived and the swarms, which can be several hundred meters tall and often have a spiraling shape, are part of their mating behavior. They lay their eggs at the water's surface and the adults die. The larvae are an important food source for fish, and the adult flies are important both to birds and local people, who collect them to make *kungu* cakes/burgers, a local delicacy with a very high protein content.

3.3.4 Investment Opportunities in Lake Nyasa

There is lack of fisheries data for Lake Nyasa; however, Tanzania's fish production from Lake Nyasa was estimated at 4,350 MT/year in 2008. Investment opportunities available at Lake Nyasa, include: -

a) Supply of fishing gears and accessories (fishing boats, engines, fishing nets)
b) Construction of advanced, modern fish processing facilities/factories within the Lake Nyasa basin
c) Build storage facilities (blast freezers, cold rooms, and ice plants)
d) Establishing fish production by 'cage-culture' in suitable sites along Lake Nyasa
e) Engaging into aquaculture – development of earthen and concrete fishponds
f) Manufacture and supply of fish packaging materials during the transportation (minimize postharvest losses)
g) Manufacture and supply of fish feeds (including live food production) to fish farmers
h) Investing into hatcheries for fingerlings production to serve the growing aquaculture industry in the Lake Nyasa basin
i) Promote and embark on crocodile farming
j) Promote and embark on ornamental fish farming for export

[59] Richard, J.; and Clark, P.F. (2009). African Caridina (Crustacea: Decapoda: Caridea: Atyidae): redescriptions of C. africana Kingsley, 1882, C. togoensis Hilgendorf, 1893, C. natalensis Bouvier, 1925 and C. roubaudi Bouvier, 1925 with descriptions of 14 new species. Zootaxa 1995: 1–75

3.4 Lake Victoria

Lake Victoria, with a surface area of approximately 59,947 km^2, is Africa's largest lake by area, the world's largest tropical lake, and the world's second largest freshwater lake by surface area after Lake Superior in North America[60]. In terms of volume, Lake Victoria is the world's ninth largest continental lake, containing about 2,424 cubic km of water.

Figure 9 Lake Victoria Basin

Lake Victoria occupies a shallow depression. The lake has a maximum depth of between 80 and 84 m and an average depth of 40 m[61]. Its catchment area covers 169,858 sq km. The lake has a shoreline of 7,142 km. The lake's area is divided among three countries: Kenya (6% or 4,100 sq km), Uganda (45% or 31,000 square), and Tanzania (49% or 33,700 sq km) as shown on Figure 10.

Lake Victoria has a multi-species fishery of tilapiines and haplochromines, cichlids and more than 20 genera of non-cichlid fish, including Mormyrus, catfish, cyprinids and lungfish. The fisheries are dominated by three fish stocks: Nile Perch (*Lates niloticus*), sardines (*Rastrineobola argentea*) locally known as Dagaa in the Tanzanian part of the lake, and Nile tilapia (mostly composed of *Oreochromis niloticus*). Other important stocks include Haplochromine cichlids and catfish (*Clarias gariepinus*)[62].

[60] Stuart, Hamilton (2016-10-05). Shoreline, Lake Victoria, vector polygon, ~2015 (Data Set). Harvard Dataverse. doi:10.7910/dvn/pwfw26.

[61] Stuart, Hamilton; Taabu, Anthony Munyaho; Noah, Krach; Sarah, Glaser (2018-05-17). Bathymetry TIFF, Lake Victoria Bathymetry, raster, 2017, V7 (Data Set). Harvard Dataverse. doi:10.7910/dvn/soeknr.

[62] Tanzania Fisheries Research Institute (TAFIRI), Mwanza, Tanzania (August 2019)

3.4.1 Hydrology and Limnology

Lake Victoria receives 80% of its water from direct rainfall. Average evaporation on the lake is between 2.0 and 2.2 m/year, almost double the precipitation of riparian areas[63].

Lake Victoria receives its water additionally from rivers, and thousands of small streams. The Kagera River is the largest river flowing into this lake, with its mouth on the lake's western shore. Lake Victoria is drained solely by the Nile River near Jinja, Uganda, on the lake's northern shore[64]. In the Kenya sector, the main influent rivers are the Sio, Nzoia, Yala, Nyando, Sondu Miriu, Mogusi, Migori and Mara – which entrers Victoria through Tanzania.

3.4.2 Lake Victoria's Bathymetry

The lake is considered a shallow lake considering its large geographic area with a maximum depth of approximately 80 m and an average depth of 40 m (Fig. 11). A 2016 project digitized ten-thousand points and created the first true bathymetric map of the lake[65]. The deepest part of the lake is offset to the east of the lake near Kenya and the lake is generally shallower in the west along the Ugandan shoreline and the south along the Tanzanian shoreline[65].

[63] Simeon H. Ominde (1971). "Rural economy in West Kenya". In S.H. Ominde (ed.). Studies in East African Geography and Development. London: Heinemann Educational Books Ltd. pp. 207–29. ISBN 978-0-520-02073-3.

[64] vanden Bossche, J.-P.; Bernacsek, G.M. (1990). Source Book for the Inland Fishery Resources of Africa, Issue 18, Volume 1. Food and Agriculture Organization, United Nations. p. 291. ISBN 978-92-5-102983-1. Retrieved 4 August 9, 2019.

[65] Hamilton, Stuart; Munyaho, Anthony Taabu; Krach, Noah; Glaser, Sarah (2018-05-17). Bathymetry TIFF, Lake Victoria Bathymetry, raster, 2016 – LakeVicFish Dataverse (Data Set). Harvard Dataverse. doi:10.7910/dvn/soeknr.

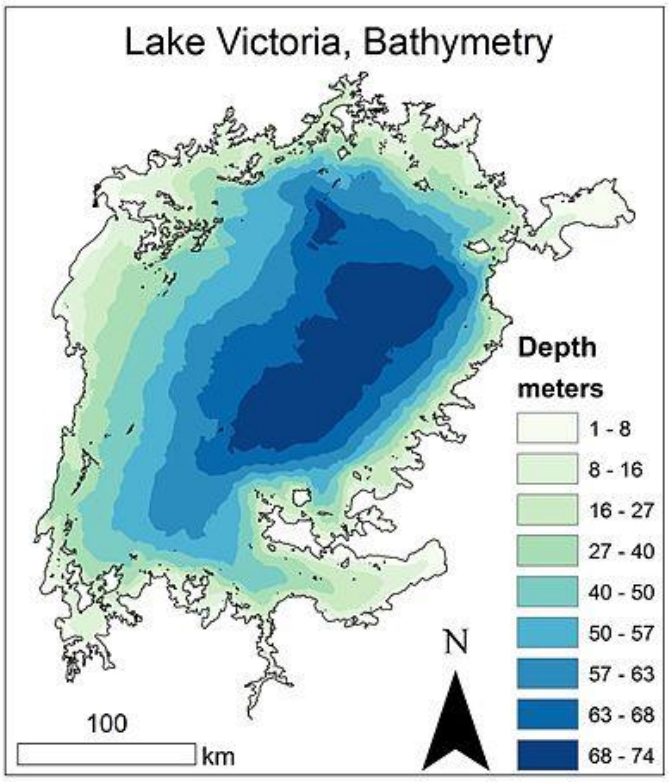

Figure 10 Lake Victoria Bathymetric Model[65]

3.4.3 Native Wildlife

3.4.3.1 Mammals

Many mammal species live in the region of Lake Victoria, and some of these are closely associated with the lake itself and the nearby wetlands. Among these are the hippopotamus, African clawless otter, spotted-necked otter, marsh mongoose, sitatunga, bohor reedbuck, defassa waterbuck, cane rats, and giant otter shrew.

3.4.3.2 Reptiles

Lake Victoria and its wetlands has a large population of Nile crocodiles, as well as African helmeted turtles, variable mud turtles, and Williams' mud turtle[66]. The Williams' mud turtle is restricted to Lake Victoria and other lakes, rivers, and swamps in the upper Nile basin[66].

3.4.3.3 Cichlid fish

Lake Victoria formerly was very rich in fish, including many endemics, but a high percentage of these became extinct during the last 50 years. The main group in Lake Victoria is the haplochromine cichlids (*Haplochromis sensu lato*) with more than 500 species, almost all endemic and some still undescribed. This is far more species of fish than any other lake in the world, except Lake Nyasa. These are the result of a rapid adaptive radiation in the last circa

[66] Spawls, Howell, Drewes, and Ashe (2002). A Field Guide to the Reptiles of East Africa. Academic Press, London. ISBN 0-12-656470-1.

15,000 years. Their extraordinary diversity and speed of evolution have been the subjects for many scientists studying the forces that drive the richness of life everywhere. The Victoria haplochromines are part of an older group of more than 700 closely related species, also including those of several smaller lakes in the region, notably Kyoga, Edward - George, Albert, and Kivu.

Before the mass extinction that has occurred among the lake's cichlids in the last 50 years, about 90% of the native fish species in the lake were haplochromines. Disregarding the haplochromines, the only native Victoria cichlids are two critically endangered tilapia, the Singida tilapia or ngege (*Oreochromis esculentus*) and Victoria tilapia (*O. variabilis*).

3.4.3.4 Other Fish

The non-cichlid native fish include African tetras (*Brycinus*), cyprinids (*Enteromius*, *Garra*, *Labeo*, *Labeobarbus*, *Rastrineobola* and *Xenobarbus*), airbreathing catfish (*Clariallabes*, *Clarias* and *Xenoclarias*), bagrid catfish (*Bagrus*), loach catfish (*Amphilius* and *Zaireichthys*), silver butter catfish (*Schilbe intermedius*), Synodontis squeaker catfish, Nothobranchius killifish, poeciliids (*Aplocheilichthys* and *Micropanchax*), the spiny eel Mastacembelus frenatus, elephantfish (*Gnathonemus*, *Hippopotamyrus*, *Marcusenius*, *Mormyrus*, *Petrocephalus*, and *Pollimyrus*), the climbing gourami *Ctenopoma* muriei and marbled lungfish (*Protopterus aethiopicus*)[67].

At a genus level, most of these are widespread in Africa, but the very rare *Xenobarbus* and *Xenoclarias* are endemic to the lake, and the common *Rastrineobola* is near-endemic[67].

3.4.3.5 Crustaceans and Molluscs

Two species of freshwater crabs are known from Lake Victoria, but neither is endemic: *Potamonautes niloticus* is widespread in the lake and *P. emini* has been recorded from the vicinity of Bukoba in Tanzania[68]. The only shrimp/prawn is *Caridina nilotica*, which is common and widespread in the lake[69].

Lake Victoria is home to 28 species of freshwater snails (e.g., *Bellamya*, *Biomphalaria*, *Bulinus*, *Cleopatra*, *Gabbiella*, and *Melanoides*), including 12 endemic species/subspecies[70]. There are 17 species of bivalves (*Corbicula*, *Coelatura*, *Sphaerium*, and *Byssanodonta*), including 6 endemic species/subspecies[70]. Two of the snail genera, *Biomphalaria* and *Bulinus*, are intermediate hosts of the parasite bilharzia (*schistosomiasis*). Human infections by this parasite are common at

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[67] FishBase: Fish Species in Victoria. Retrieved August 9, 2019.

[68] Cumberlidge, N. (2009). "Freshwater Crabs and Shrimps (Crustacea: Decapoda) of the Nile Basin". Chapter 27, pp. 547–61 in : Dumony, H.J. (editor). The Nile. Origin, Environments, Limnology and Human Use. Monographiae Biologicae, Vol. 89. Springer, New York. ISBN 978-1-4020-9726-3.

[69] Cumberlidge, N. (2016). "Potamonautes emini". The IUCN Red List of Threatened Species. 2016: e.T44523A84352263. doi:10.2305/IUCN.UK.2016-3.RLTS.T44523A84352263.en. Retrieved 14 January 2018.

[70] Seddon, M.; Appleton, C.; Van Damme, D.; Graf, D. (2011). Darwall, W.; Smith, K.; Allen, D.; Holland, R.; Harrison, I.; Brooks, E. (eds.). Freshwater molluscs of Africa: diversity, distribution, and conservation. The Diversity of Life in African Freshwaters: Under Water, Under Threat. An Analysis of the Status and Distribution of Freshwater Species Throughout Mainland Africa. pp. 92–119. ISBN 978-2-8317-1345-8.

Lake Victoria[71]. This may increase as a result of the spread of the invasive water hyacinth (an optimum snail habitat), and the loss of many snail-eating cichlids in the lake[72].

3.4.4 Fisheries

Lake Victoria supports Africa's largest inland fishery[73]. Initially the fishery involved native species, especially tilapia and haplochromine cichlids, but also catfish (*Bagrus*, *Clarias*, *Synodontis* and silver butter catfish), elephantfish, ningu (*Labeo victorianus*) and marbled lungfish (*Protopterus aethiopicus*)[74]. Some of these, including tilapia and ningu (*Labeo victorianus*), had already declined in the first half of the 20th century due to overfishing[75]. To boost fishing, several species of non - native tilapia and Nile perch were introduced to the lake in the 1950s. Nevertheless, the natives continued to dominate fisheries until the 1970s where their decline meant that there was a strong shift towards the non-native Nile tilapia (now 7% of catches), non - native Nile perch (60%) and the native Lake Victoria sardine (30%)[76]. Because of its small size, the abundant open - water Lake Victoria sardine only supported minor fisheries until the decline of other natives[76]. At the peak in the early 1990s, 500,000 tonnes (490,000 long tons; 550,000 short tons) of Nile perch were landed annually in Lake Victoria, but this has declined significantly in later years[77].

3.4.5 Environmental Issues

Several environmental issues are associated with Lake Victoria and the complete disappearance of many endemic cichlid species has been called the 'most dramatic example of human-caused extinctions within an ecosystem'[78].

3.4.5.1 Invasive Fish

Starting in the 1950s, several species have been introduced to Lake Victoria where they have become invasive and a prime reason for the extinction of many endemic haplochromine cichlids[79]. Among the introductions are several tilapias: redbreast (*Coptodon rendalli*), redbelly (*C. zillii*), and Nile tilapias (*Oreochromis niloticus*), and *O. leucostictus*. Although these have contributed to the extinction of native fish by causing significant changes to the ecosystem,

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71 Senthilingam, M. (9 February 2016). "The snails spreading fever across Africa". CNN. Retrieved August 9, 2019

72 Chege, N. (1995). "Lake Victoria: A Sick Giant" (PDF). People & the Planet. Retrieved August 9, 2019.

73 Kim Geheb (1997). The Regulators and the regulated: fisheries management, options and dynamics in Kenya's Lake Victoria Fishery (Ph.D. thesis). University of Sussex.

74 Lake Victoria Fisheries Organization (2016). Lake Victoria Fisheries: An introduction. Archived from the original on 15 September 2016. Retrieved 2017-03-27.

75 FishBase team RMCA & Geelhand, D. (2016). "Labeo victorianus". The IUCN Red List of Threatened Species. 2016: e.T60318A47182908. doi:10.2305/IUCN.UK.2016-3.RLTS.T60318A47182908.en. Retrieved 14 January 2018.

76 Njiru, Waithaka, Muchiri, van Knaap, and Cowx (2005). "Exotic introductions to the fishery of Lake Victoria: What are the management options?" Lakes & Reservoirs: Research and Management 10: 147–55.

77 Lowe-McConnell, R. (2009). "Fisheries and cichlid evolution in the African Great Lakes: progress and problems". Freshwater Reviews 2: 131–51.

78 Fiedler, P.L. and P M. Kareiva, editors (1998). Conservation Biology: For the Coming Decade. 2nd edition. pp. 209–10. ISBN 978-0-412-09661-7

79 Witte, Goldschmidt, Goudswaard, Ligtvoet, van Oijen & Wanink (1992). "Species extinction and concomitant ecological changes in Lake Victoria". Netherlands Journal of Zoology 42(2–3): 214–32. doi:10.1163/156854291X00298

outcompeted natives and (in the case of the Nile tilapia) possibly hybridized with the highly threatened native tilapias, the most infamous introduction was the large and highly predatory Nile perch (*Lates niloticus*)[79].

Due to the presence of the Nile perch, the natural balance of the lake's ecosystem has been disrupted. The food chain is being altered and, in some cases, broken by the indiscriminate eating habits of the Nile perch. The subsequent decrease in the number of algae-eating fish allows the algae to grow at an alarming rate, thereby choking the lake. The increasing amounts of algae, in turn, increase the amount of detritus (dead plant material) that falls to the deeper portions of the lake before decomposing. As a by-product of this the oxygen levels in the deeper layer of water are being depleted. Without oxygen, any aerobic life (such as fish) cannot exist in the deeper parts of the lake, forcing all life to exist within a narrow range of depth. In this way, the Nile perch has degraded the diverse and thriving ecosystem that was once Lake Victoria. The abundance of aquatic life is not the only dependent of the lake: more than thirty million people in Tanzania, Kenya and Uganda rely on the lake for its natural resources.

3.4.5.2 Water Hyacinth Invasion

The water hyacinth has become a major invasive plant species in Lake Victoria.

The release of large amounts of untreated wastewater (sewage) and agricultural and industrial runoff directly into Lake Victoria over the past 30 years has greatly increased the nutrient levels of nitrogen and phosphorus in the lake 'triggering massive growth of exotic water hyacinth, which colonized the lake in the late 1990s'[8081]. This invasive weed creates anoxic (total depletion of oxygen levels) conditions in the lake inhibiting decomposing plant material, raising toxicity and disease levels to both fish and people. At the same time, the plant's mat or 'web' creates a barrier for boats and ferries to maneuver, impedes access to the shoreline, interferes with hydroelectric power generation, and blocks the intake of water for industries. On the other hand, water hyacinth mats can potentially have a positive effect on fish life in that they create a barrier to overfishing and allow for fish growth, there has even been the reappearance of some fish species thought to have been extinct in recent years.

3.4.5.3 Pollution

Pollution of Lake Victoria is mainly due to discharge of raw sewage into the lake, dumping of domestic and industrial waste, and fertilizer and chemicals from farms.

The Lake Victoria basin while generally rural has many major centers of population. Its shores in particular are dotted with the key cities and towns, including Kisumu, Kisii, and Homa Bay in Kenya; Kampala, Jinja and Entebbe in Uganda; and Bukoba, Mwanza, and Musoma in Tanzania. These cities and towns also are home to many factories that discharge some chemicals directly into the lake or its influent rivers. Large parts of these urban areas also

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[80] Muli, J., Mavutu, K., and Ntiba, J. (2000). "Micro-invertebrate fauna of water hyacinth in Kenyan waters of Lake Victoria". International Journal of Ecology and Environmental Science 20: 281–302

[81] Luilo, G.B. (August 01, 2008). Lake Victoria water resources management challenges and prospects: a need for equitable and sustainable institutional and regulatory frameworks. African Journal of Aquatic Science, 33, 2, 105–13.

discharge untreated (raw) sewage into the river, increasing its eutrophication that in turn is helping to increase the invasive water hyacinth[82].

3.4.6 Investment Opportunities in the Lake Victoria

Lake Victoria is estimated to produce 500,000 tons annually, valued at US$ 600 million, with export value of US$217 in 2001[83]. Based on current stock estimates, the lake has the potential to yield fish valued at over US$ 800 million annually on a sustainable basis. Further processing and marketing of this fish in the local and export markets can generate an additional value of about US$ 57 million.

The following investment opportunities exist in Lake Victoria: -

a) Supply of fishing gears and accessories (fishing boats, engines, fishing nets)
b) Construct fish processing facilities/factories within the Lake Victoria basin
c) Build storage facilities (blast freezers, cold rooms, and ice plants)
d) Expand fish production by 'cage-culture' in suitable sites along Lake Victoria – train Tanzanians to adopt cage-culture fish farming methods
e) Engaging into aquaculture – development of earthen and concrete fishponds
f) Manufacture and supply of fish packaging materials during the transportation (minimize postharvest losses)
g) Manufacture and supply of fish feeds (including live food production) to fish farmers
h) Investing into hatcheries for fingerlings production to serve the growing aquaculture industry in the Lake Tanganyika basin
i) Crocodile farming along Lake Victoria
j) Embark on ornamental fish farming for export

[82] "Water Hyacinth Re-invades Lake Victoria". Image of the Dat. NASA. February 21, 2007.

[83] Lake Victoria Fisheries Organization (LVFO), July 2019

4 Marine Fisheries

The marine fisheries are conducted within territorial waters, which extend up to 12 miles, and in the EEZ, which extends up to 200 miles from the shoreline. Almost all of the activity takes place in water depths of less than 500 meters and within 40 miles from the coast. The territorial sea has an area of 64,000 km^2 and the EEZ area is around 223,000 km^2. The coastline has a length of 1,424 km, with almost all coastal communities engaged in fishing to some extent.

The Marine fisheries can be broadly divided into 3 main fisheries; the small-scale coastal fisheries, the prawn fishery and the offshore fishery (within the EEZ and beyond).

4.1 Prawn Trawl Fishery

Historically, Tanzania has had a coastal prawn fishery, which supplied export markets. However, the last trawl vessels operating in this segment ceased fishing in 2007 when, due to the over-exploitation of the resource, a shrimp management plan was introduced, requiring, a moratorium on the shrimp fishery. This is still in place, although one vessel continues to operate under an agreement with TAFIRI for research purposes, and small-scale fishers continue to operate and supply local markets with some exports.

4.2 Artisanal fisheries

The marine artisanal fleet operates mostly with small dug-out canoes between 3 and 5 meters in length, and wooden planked boats that range from 6 to 15 meters. Smaller vessels are powered by paddle and sail, larger vessels by inboard and outboard engines.

The latest data available (from 2016) indicates that there were 7,664 vessels fishing and landing their catches to 257 landing sites along the coast. This is a fleet motorization rate of one outboard engine for every 10 boats and one inboard engine for every 73 boats. In general, this level of motorization is very low, although typical for small-scale fisheries in Africa. Data from a 2018 marine fishery census data is being analyzed, but based on previous data it seems that the number of vessels has been increasing at a rate of about 280/year[1]. In 2009 the number of fishers was about 36,000, but this is now estimated to be much greater, at about 47,000. Gillnets and line fishing, including longlines, are the most common types of gear. Almost all of the fishing materials originate in China, Malaysia and India.

The narrow continental shelf of Tanzania drops off to waters with depths greater than 500 meters quite near to the coastline, and a large part of the fishing effort is therefore concentrated in the near-shore coastal waters. Approximately 90% to 95% of the marine fish production comes from fishing within the territorial sea.

Between 2000 and 2018, marine fisheries production appears to have remained relatively stable, oscillating between 43,000 and 55,000 tons annually, even though the number of vessels appears to have increased.

As well as supplying fresh fish into local markets, the artisanal fishery supplies a modest export trade in higher value species such as marine crabs, lobsters, octopus, shrimps and squid. There are about thirty-five small-scale seafood processors and exporters (based mainly in Dar es Salaam) receiving product from this sector. A list of these establishments can be found in

Annexes. They specialize in high value products mainly for export, but with some supplying the local restaurant and hotel trade.

4.3 Offshore Fisheries

Very few Tanzania vessels exploit the full extent of the EEZ, and there appears to be some potential for development in this area. The Indian Ocean has extensive stocks of skipjack, yellowfin and big eye tunas, and other large pelagic fish such as shark, swordfish and marlins. According to the Indian Ocean Tuna Commission (IOTC)[84], these are exploited by more than 6,400 industrial fishing vessels (in May 2007), plus 63 carrier vessels flying the flags of more than 30 nations; purse seine vessels target the tunas for processing into cans, while longline vessels target tunas, shark and swordfish.

These species are all characterized by their migratory pattern, and Tanzania is one of several countries in whose EEZ stocks may be found and exploited. The best fishing season for large pelagic fish in Tanzanian waters is during the North East Monsoon between November and March.

At present, there are three large (44 to 49 m) Tanzanian flagged tuna vessels, all freezer longliners, registered in Zanzibar. These operate throughout the Indian Ocean and consign their catches directly to international markets.

In addition, since 1998 the Government of Tanzania licensed foreign-flagged fishing vessels to operate in the EEZ. The number of licences has been varying from year to year (since the fishery is highly dynamic, and depends on the variable migratory patterns). Seventy-four vessels were licenced in 2014, of which 25 were for purse seiners which came from four countries Spain, (14 vessels), France, (2 vessels) Seychelles (7 vessels) and South Korea (2 vessels).

In 2011 and 2012, no foreign-flagged longliners applied for authorizations to fish in the Tanzanian EEZ, due to the threat of piracy from Somalia[1]. However, with the decline of piracy activities, 41 longliners drew licences to fish in the Tanzanian EEZ in 2014. It should be understood that, although vessels pay for the licences to fish in the Tanzanian EEZ they may not fish exclusively in the EEZ. They may sometimes use the license only for short periods, or not at all. The Government of Tanzania has held discussions with the EU regarding the possibility of a Fisheries Partnership Agreement, but these have not yet resulted in any formal proposals.

Although the income from foreign fishing makes a valuable contribution to the nation, the Government has indicated that it would like to see these fisheries exploited by national operators. This would require the provision of infrastructure and other incentives to international fleet operators to attract their operations which, in the case of tuna for canning, are increasingly center on Seychelles and Mauritius. Four canning and/or loining facilities operate within the region (in Kenya, Madagascar, Mauritius and Seychelles), with a combined capacity estimated at about 220,000 tons per year. Fish caught in the Indian Ocean is also processed in West Africa (Ghana and Cote d'Ivoire).

[84] Indian Ocean Tuna Commission (2019)

There are concerns about the status of some of the Indian Ocean stocks of migratory species. The scientific committee of the Indian Ocean Tuna Commission (IOTC), of which Tanzania is a member, provides management advice to members. Yellowfin tuna, one of the primary species used for canning, is subject to advice to reduce fishing effort, and the IOTC in 2016 required members to reduce purse seine catches by 15%, gillnetters and longlines by 10%, and to reduce the number of Fish Aggregating Devices. A precautionary reduction in effort is recommended for Black Marlin, Blue Marlin, Longtail tuna and Indo Pacific Sail Fish. Immediate management measures are not required for albacore, big eye and skipjack tunas, nor for swordfish and bonito.

Whilst there may be few opportunities to introduce new fishing effort for tuna for canning, there may be opportunities for increasing the exploitation of some other tuna-like species such as bonito, frigate tunas, and kingfish, which are presently caught on the Tanzanian coast using drift nets. More work needs to be done to determine the stock structure, migratory patterns and reproductive cycles, as well as the potential for other fishing vessels such as medium sized longliners[85]. TAFIRI is experimenting with Fish Aggregating Devices (FADs) to investigate the potential of a fishery for such species.

In the past, TAFIRI has also conducted experimental and exploratory fishing using drop lines, for deep water demersal species such as snappers and job fish on the edge of the continental shelf. This is likely to have some potential, but there is a lack of specific data to support a directed fishery.

At present, there are no dedicated port facilities for industrial fishing vessels in Dar es Salaam harbor. However, one area of the port (Berth 6) has been earmarked for fisheries by the Ministry of Agriculture, Livestock and Fisheries. The quay has the length and the depth to accommodate large ships and offers potential for landing of fish, and for transshipment to refrigerated transport vessels (reefers). There is also the possibility of constructing cold storage and fish processing facilities at the location, although more detailed feasibility studies will be necessary.

4.4 Marine (Deep Sea) Investment Opportunities

There are possible opportunities for fishing of some tunas in the EEZ by medium-sized long liners and purse seiners, and for exploitation of demersal resources at the edge of the continental shelf, but more study is required to assess their feasibility.

Whilst many countries in the region (Kenya, Madagascar, Seychelles and Mauritius) have developed shore-based infrastructure to serve the industrial tuna fisheries of the Indian ocean, these are now mostly fully exploited and, in the case of yellow fin tunas, subject to effort reduction measures. Under these circumstances, it would be difficult for Tanzania to break into this market. National benefits are presently derived from the presence of these migratory fish in Tanzanian waters, through foreign fishing access arrangements with fleets operating in the region. There appears to be some potential for these arrangements to be optimized beyond the current annual ad hoc licensing by entering into more formal and longer-term arrangements, for example via an EU Fisheries Partnership Agreement.

[85] Tanzania Fisheries Research Institute (TAFIRI), Dar es Salaam, Tanzania: August 2019

There are other few opportunities to introduce new fishing effort for tuna for canning, there may be opportunities for increasing the exploitation of some other tuna-like species such as bonito, frigate tunas, and kingfish, which are presently caught on the Tanzanian coast using drift nets. More work needs to be done to determine the stock structure, migratory patterns and reproductive cycles, as well as the potential for other fishing vessels such as medium sized longliners. TAFIRI is experimenting with fish aggregating devices (FADs) to investigate the potential of a fishery for such species.

5 Aquaculture

Aquaculture, in Tanzania started in the early 1950s with experiments with tilapia in pond culture[86]. These days the sector includes tilapia, trout, and catfish (in fresh water), and a small marine aquaculture (mariculture) sector producing milkfish and prawns. There is also small seaweed farming and harvesting sector exploiting red algae used for carrageenan production. Although seaweed production is modest, this activity occupies large numbers of harvesters (mostly women).

Aquaculture production is static at about 4,000 tons per year, three quarters of which is tilapia. The sector generates considerable employment, with an estimated 15,000 - 20,000 people engaged in the seaweed sector, 14,100 engaged in freshwater fish farming and 3,000 in the marine sector[87].

Apart from a few notable examples, aquaculture in Tanzania is primarily a small-scale activity, with small ponds, little formal management and low productivity, reflecting its largely subsistence nature. Many ponds are small and small-scale seaweed farms are run by the women assisted by the younger family members. They can be found along the entire coast from Tanga to Mtwara and in Mafia and Zanzibar.

However, there are some larger vertically integrated production units with cage farming in Lake Victoria, and some larger ponds for shrimp production in coastal areas. Production of Tilapia in cages has been introduced in Bunda district and some parts of the lake in Mwanza and Bukoba. There is one major joint venture between a Danish and a Tanzanian company, and several of the training institutions, such as FETA, also operate farms. These producers have developed their own feed supply and hatchery facilities.

There are nine hatcheries for tilapia in operation (three of them being government owned and operated) with production reaching slightly over 5,000,000 fingerlings, against a demand estimated by the Department of Fisheries Development to be over 30,000,000 fingerlings countrywide. There is an apparent lack of good quality fry, and the excess demand over supply results in lower quality and higher levels of mortality, undermining productivity.

Feed supply is another constraint. There is one main fish feed producer and supplier based in Dar es Salaam. Government supports the distribution of affordable fish feed by subsidizing 85% of the commercial selling price to fish farmers. The company also supplies juvenile tilapia for grow-out. There are a few commercial operators with vertically integrated facilities, which include small-scale fish feed mills, using locally available raw materials such as fish meal (from

[86] Ministry of Agriculture and Food Security, Dodoma, Tanzania: August 2019

[87] Ministry of Livestock and Fisheries Development, Dodoma, Tanzania. August 2019

Dagaa), soya beans, sun flower oil, cassava flour, wheat and maize bran. Some feeds are also imported directly by larger producers, to ensure better quality and productivity.

Government has strongly supported investment in aquaculture training, with degree programmes at Sokoine University of Agriculture and the University of Dar es Salaam, and skills training at Mbegani Fisheries Development Centre and FETA.

Unlike Uganda and Kenya, cage culture in Lake Victoria has not taken off at commercial levels, due to the reported complexity of multiple licensing requirements with several agencies, namely the National Environment Management Council, Ministry of Environment and the Ministry of Agriculture, Livestock and Fisheries.

Tanzania's aquaculture production equates to about 0.2% of fish supplies for human consumption in the country. In Kenya aquaculture contributes 1.4% and in Uganda it contributes 6.5%. Egypt, with considerably poorer production conditions than any of these countries, generates 80% of its fish supplies from aquaculture[1].

Clearly, Tanzania has considerable potential for increasing the contribution of aquaculture, given the extensive lake and river water resources, ideal temperatures and availability of raw materials for feed. Until now, despite the best efforts of the Department of Fisheries Development, and considerable investments, the Government has struggled to establish the right policy environment for private sector investment in aquaculture to take off.

6 Fish Processing and Marketing

Fish processing and exporting activities are segmented into small-scale operations for local and regional markets, and the Nile perch sector, aimed at the international market, where the EU is the major customer.

6.1 Small-scale Fish Processing

The sale of fresh fish is confined to the immediate hinterland of the fishing villages concerned. Other than Nile perch of a suitable size and quality, the remainder enters into small-scale processing using traditional drying/smoking/salting technologies. Dagaa continues to be largely sun dried on sand and grass. Drying on the ground results in high post-harvest losses. During the rainy season the processors can become overwhelmed, and are seriously challenged to dry the catches before the fish spoils. As a result, much sun dried dagaa is of low quality more suited to animal feed than human consumption.

A cleaner, better quality dagaa with higher yields, can be produced by using drying racks with covers. However, this entails increased costs, and buyers are often reluctant to pay a premium price for a better product. Smoking operations in artisanal processing facilities are fuel inefficient, with poor hygiene conditions, and subject to variations in quality. In Tanzania, as in many other African states, trading and processing of fish is mostly undertaken by women.

Dried dagaa is distributed in sacks via a network of traders, who transport it to almost every region in Tanzania. Major regional trading centers are located in Mwanza and Geita Regions where buyers purchase for export, often on commission from traders in the receiving country. The major importing countries include DRC, Burundi, Zambia, South Sudan, Kenya, Rwanda, and Malawi. Much of the trade is informal, and there are few reliable statistics available regarding the quantities, but they are evidently substantial.

In most Tanzanian communities, women buy fresh Dagaa which is salted, smoked and fried for home use and for street side sales. Many of these women were displaced from traditional processing of Nile perch after the establishment of the processing industries. Most processors are women, as are most small-scale traders. The role of women, and the socio-economic importance of their fish processing and trading activities, is often over-looked in the studies made of the fishery sector (which typically only count fishers).

6.2 Industrial Fish Processing

Nile perch provides a substantial white flesh which is readily filleted, and is in good demand on international markets. There are ten processing plants in Tanzania authorized for international exports of Nile perch (compared to fourteen in Uganda and four in Kenya). All are situated in the region of Lake Victoria. In addition, there are four establishments authorized for export of marine products (based in Dar es Salaam, Mafia and Tanga).

All of these establishments are operated to international standards, including Hazard Analysis and Critical Control Point (HACCP), and are compliant with EU hygiene rules. As well as complying with EU hygiene requirements, many of the establishments are certified to ISO 22000 BRC and other global standards certified on issues of food safety, hygiene standards.

Fresh fish on ice is delivered to the processing plant directly from the landing site, and sorted into export and non-export grades. Nile perch is gutted and scaled and processed by hand into a range of products according to market requirements. Premium quality fish is used for chilled fillets and steaks etc., which are air freighted in fresh form to global destinations[88]. The EU is the major market, but product is also sent to the Middle East, USA, Australia, Israel and South Africa. More recently, markets for skins and maws (swim bladders) have been developed.

As recently as 2008, new factories were still being established in Tanzania. Today, the Tanzanian factories have the capacity to process an average of 500 MT of raw fish/day. The decline in catches of fish of a suitable size has led to most plants operating at a much-reduced capacity; only 25% in some of the larger plants in 2018[89]. The international market for Nile perch has also been hit by the rise of the much cheaper Pangasius fillets from Asian aquaculture suppliers, such as Vietnam. However, most of the plants are over 20 years old, and are able to continue operations with relatively low overheads.

The Tanzanian Industrial Fishing and Processors Association was formed in 2006 as a result of the merging of the Lake Victoria Fish Processors Association of Tanzania (LVFPAT) with Industrial Fishing and Processors Association (IFPA). It represents the processing and export sectors. The Association has sixteen members, eleven operating at Lake Victoria in Tanzania and five on the Tanzania coast. The aim of the Association is to provide a forum on issues of common interest, and to promote the sector and coordinate representation to Government on matters of policy. The Association recruits independent quality control experts who perform regular audits of members.

[88] Lake Victoria Fisheries Organization (LVFO), Mwanza, Tanzania: August 2019

[89] Lake Victoria Fish Processors Association of Tanzania (LVFPAT), Mwanza, Tanzania: August 2019

7 International Trade in Fisheries Products

Tanzania is both an importer and an exporter of fishery products, although the latter are more significant. Exports were 43,354 tons in 2017, valued at US$188 million, and were mainly in the form of Nile perch fillets to international markets and dried Dagaa to regional markets. Other than Nile perch and dried dagaa, Tanzania also exports crabs, prawns, fish maws, octopus, seashells, live lobsters, squid, seaweed and ornamental fish.

Total exports of fishery products have plateaued since 2005, varying from year to year in the region of US$140 - 188 million. Exports of fishery products accounted for 10% of the value of all national exports, and between 2009 and 2013 the fisheries contribution to GDP rose from 1.3 to 2.2%. Tanzania also imports some fish, mainly low value species (6,793 tons in 2018, valued at about US$6 million, mostly small pelagic fish from China).

An export levy of US$0.12/kg is imposed on fish exports, and exporters complain that this affects their competitive position. However, this tax accounts for about 2% of the FOB price and has generated important revenues for the Government (estimated at US$4.5 million in 2018). Along with high import duties of about 25-30%, which raised a further US$1.7 million, this has helped to finance fisheries development and Monitoring Control and Surveillance (MCS) activities.

The exports were sent to 47 countries. The European Union as a trading block accounts for 45% of the volume and 52% of the total value of all exports. According to Eurostat data, the EU imported 26,100 Tons of Nile perch fillets in 2015, mainly from Tanzania, Kenya and Uganda. Tanzania was the main supplier of Nile perch fillets to the EU, exporting 12,400 tons (47.5% market share), followed by Uganda with 10,800 tons (41%) and Kenya with 2,900 tons (11%).

Within the African region, the DRC is a very important market, accounting for 17% of the value of exports. This may well be an underestimate due to the existence of a significant informal trade.

8 Hygiene Conditions

Tanzania was one of the first countries in Africa to achieve hygiene approval from the European Union, and be permitted to export fish and fishery products to the EU. At present there are 14 establishments and two freezer vessels approved for export to the EU. The Fisheries Development Division of the Ministry of Livestock and Fisheries Development, now headquartered in Dodoma, is the nominated Competent Authority for the official control of fishery products exported to the EU.

The system is periodically audited by the European Commission. The inspectorate is well equipped with a microbiological laboratory and a chemical analysis laboratory. Thirteen parameters are routinely verified. There are 34 Inspectors of whom 22 are based in Mwanza office and the rest in field offices on Lake Victoria[90]. Fish Inspectors take regular samples from all fish processing factories to assess the sanitary conditions of the fish before export. The national sanitary regulations require that establishments apply the Hazard Analysis and Critical Control Point (HACCP), and that they employ qualified Quality Control Staff.

[90] Ministry of Livestock and Fisheries Development (March 2019), Dodoma, Tanzania

Although the sanitary conditions for the export of fish are, for the most part, well regulated (at least for consignments to international markets), the domestic and regional trade in fishery products has hardly any effective food safety controls. Handling and quality management practices leave much to be desired and, as a result, post-harvest losses are high and contamination with harmful hazards cannot be ruled out.

Annex

Table 2 General Contacts of Relevance to the Sub-sector

Embassy of Denmark	Ghana Avenue 1 P.O. Box 9171 Dar es Salaam, Tanzania Telephone: +255 (22) 216 5200 Mobile: +255 (0) 784 558 885 Fax: +255 (22) 211 6433 E-mail: daramb@um.dk	Dar es Salaam
EU Delegation	Umoja House-1st Floor Hamburg Avenue/Shabaan Robert Street P.O. Box 9514, Dar es Salaam, Tanzania Telephone: +255 22 216 4500 Fax: +255 22 211 3277 Email: delegation-tanzania@eeas.europa.eu	Dar es Salaam
Tanzania Industrial Fishing and Processors Association	Executive Secretary P.O. Box 14467, Dar Es Salaam, Tanzania. Email: info@tifpa.org Tel: +255 22 2664 265 Fax: +255 22 2664 264 Mob: +255 753 039 925	Dar es Salaam
Fisheries Education and Training Agency	Chief Executive Officer Fisheries Education and Training Agency P.O. Box 83, Bagamoyo, Tanzania. Tel & Fax: 0732 928 166 Email: mbeganifdc83@yahoo.com	Bagamoyo

Table 3 Small-scale Fish & Fishery Products' Processors and Exporters

Name	Address	Location	Products
ABDL High Quality Seafood	P.O. Box 101430 DAR ES SALAAM Tel +255 713 472 478 789 230 990 email: info@abdlseafood.co.tz	Kimweri Avenue - Msasani, Dar es Salaam	Frozen Prawns Live Crabs Live Lobsters
AB Marine Product Ltd	P.O. Box 54455, DAR ES SALAAM Tel:+255 713 250 270 lobster@hotmail.com	Ubungo, Riverside - Hekima Street	Frozen Prawns Live Crabs Live Lobsters

Table 4Small scale Fish & Fishery Products' Processors and Exporters (Cont.)

Name	Address	Location	Products
CODEX Seafood Co. Ltd	P.O. Box 5480, Dar es Salaam	Mbezi, Dar es Salaam	Live Crabs Live Lobsters
A.L.I. General Company,	P.O. Box 68067 Dar es Salaam. Tel: +255683 400 088/ +255 787 283 799 aligeneralcompany@yahoo.com	Msasani, Dar es Salaam	Live Crabs Live Lobsters
Aba juko Enterprises	P.O. Box 36436 Dar es Salaam	Kigamboni. Dar es Salaam	Live Crabs
E.M. Sea Foods	P.O. Box 23180 Dar es Salaam Tel: +255 713 771 202 / 0784 771 202 email: epkato2000@yahoo.com	Old B'moyo Rd- Msasani, Dar es Salaam	Live Crabs Live Lobsters
Kassanda Enterprises Ltd.	P.O. BOX 77172 Dar es Salaam Tel:+255 2221 29958 / +255 756 588 869 kassandaelf@yahoo.com	Magogoni St, Ferry Market Live	Live Crabs Live Lobsters
Masaki Sea Products	P.O. Box 45533 Dar Es Salaam Tel +255 784 829 753 +255 759 660 869	Kigmaboni Dar es Salaam	Live/ Frozen Crabs Live Lobsters
N.F. Trading Co. Limited	P.O. Box 36644 Dar Es Salaam Tel:+255 732 997 981	Kigamboni Dar es Salaam	Live Crabs Live Lobsters
K.N. Marine Enterprises	P.O. Box 36436 Dar Es Salaam Tel: 0782 446 494	Tuamoyo Dar es Salaam	Live Crabs Live Lobsters
J.S. Marine	P. O. Box 25058 Dar Es Salaam Tel: 0719 262 224 jsseafoodltdco@gmail.com	Temeke, Dar es Salaam	Live Crabs
Marine Food Products Ltd	P.O. Box 38232 Dar Es Salaam Tel:+255 784 645 414 +255 732 925 075 marinefoodproducts@yahoo.com	Kigamboni Dar es Salaam	Live Crabs Live Lobsters

Table 5 Small-scale Fish & Fishery Products' Processors and Exporters (Cont.)

Name	Address	Location	Products
Kayuyu Co. Ltd	P.O. Box 45207 Dar Es Salaam kayuyuseafoods@yahoo.com	Mavomero st. Tandika, Plot 107 Block K	Live Lobsters
Lim Trading Co. Ltd	P. O. Box 63243 Dar Es Salaam Tel: +255 782 446 494 limtradingcompany@yahoo.com	Kawe, Dar es Salaam	Live Crabs Live Lobsters
Royal Ventures Ltd	P.O. Box 105923 Dar Es Salaam Tel: +255 784 683 577 yusufalbeiti@gmail.com	Msasani, Dar es Salaam	Live Crabs Live Lobsters
Sasha Marine Ent Ltd	P.O. Box 20019 Dar Es Salaam Tel:+255 653 008 304	Kigamboni Urasa St, Block 689 Dar es Salaam	Live Crabs Live Lobsters
Zatafisco Co. Ltd	P.O. Box 22005 Dar Es Salaam	Kigamboni, Dar es Salaam	Live Lobsters
Codex Sea Food	P.O. Box 5480 Dar Es Salaam Tel: +255 713 781 930	Kimara, Dar es salaam	Live Crabs Live Lobsters
The Idom Ocean Foods	P.O. Box 65209 Dar es Salaam iddomarcycamp@gmail.com	Ilala, Dar es salaam	Live Crabs Live Lobsters
Dar Agro & Mineral Commodities Resources Ltd	Box 100120 Dar es Salaam Tel:+255 784 875 237	Tazara Temeke	Cowries/ Sea Shells
Dunstan Litopile Mkundi	P.O. Box 36396 Dar es Salaam Tel: +255 784 920 034	Mtongani St Mbezi Beach	Live Crabs Live Lobsters
Joseph Mpepo	P.O. Box 32519 Dar es Salaam Tel: +255 784 555 311	Kunduchi Kinondoni	Live Crabs Live Lobsters
Kassanda Ent. Ltd	P.O. Box 77172 Dar es Salaam Tel: +255 754 588 869	Kigamboni	Live Crabs Live Lobsters
Helic Sea Products	P.O. Box 582 Dar es Salaam	Kinondoni	Live Crabs Live Lobsters
Diamex Co. Ltd	P.O. Box 13429 Arusha Tel:+ 255 787 400 987	Kipunguni B-Kipawa, Ilala	Live Crabs Live Lobsters
C.K. Anderson	P.O. BOX 12666 Dar es Salaam Tel: +255 754 314 630 ck2anderson@yahoo.com	Chang'ombe, Temeke	Frozen Prawns / Lobsters
Dege Business Index	P.O. Box 72010 Dar es Salaam	Temeke	Live Crabs Live Lobsters

Table 6 Dried Fishery Products' Establishments

Name	Address	Location	Products
Kassim Abeid Ngozoma	P.O. Box 117 Mafia Tel: +255 713 989 919	Mafia, Pwani	Dry Seaweeds
Mwani Mariculture Ltd	P.O. Box 9712 Dar Es Salaam Tel: +255 22 286 2507 info@mwani.com	Mandela Rd, Chang'ombe	Dry Seaweeds
Nova Associates	P.O. Box 22642 Dar Es Salaam Tel:+255 22 2130 215/ +255 22 2137686/ Fax:+255 22 2130 215	Chang'ombe, Temeke	Sea Shells
Aqeel Traders Ltd	P.O. Box 8610 Dar es Salaam Tel:+255 22 2130 918/ +255 22 2861 909 Mob: +255 713 225 655 Fax: +255 22 2132 991 atl@cats-net.com	Chang 'ombe, Temeke	Sea Shells
Fida Hussein Co. Ltd	P.O. Box 816 Dar Es Salaam Tel: +255 22 2 8444 510-14 fidhuscocf@gmail.com	Vingunguti, Ilala	Sea Shells
Tambuli Co. Ltd	Tel: +255 712 469 916		Sea Shells
Safari Agencies Co. Ltd		Magomeni Mikumi, ILALA	Sea Shells

Table 7 Aquarium Fish Establishments

Name	Address	Location	Products
Mrisho Hamis	P.O. Box 1112 Dar es Salaam Tel:+255 759 463 894/ +255 652 593 893	Kinondoni 8 - Dar es Salaam	Live Aquarium Fish
Muhalo Cichlids Exporters	P.O. Box 13067 Dar es Salaam Tel: +255 752 305 313/ +255 783 669 949	Tabata - Dar es Salaam	Live Aquarium Fish
Nunu Mwamba Exp & Imp. Co. Ltd	P.O. Box 9998 Dar es Salaam Tel: +255 767 377 119/ +255 713 267 216	Mikocheni B Himo Street, Dar es Salaam	Live Aquarium Fish
Tanzania Cichlids Co. Ltd	P.O. Box 19089 Dar es Salaam Tel:+255 754 569 156	Mbezi Beach - Kinondoni	Live Aquarium Fish
Lake Co. Cichlids Ltd	P.O. Box 502 Kigoma Tel: +255 762 029 163	Kigoma	Live Aquarium Fish
Rift Valley Cichlids Ltd	P.O. Box 7280 Dar es Salaam Tel: +255 784 662 454 riftvalleycichlids@yahoo.com	Ukonga, Ilala	Live Aquarium Fish
Nyavita Aqu. Fish Exp. Ltd	P.O. Box 14568, Dares Salaam Tel:+255 754 671 342	Tabata Segerea - Ilala	Live Aquarium Fish
Hope Aquatics Co. Ltd	P.O. Box 13067 Dar es salaam		Live Aquarium Fish
Great Lakes Drivers Co. Ltd	P.O. Box 16510 Dar es Salaam	Kunduchi Salasala - Kinondoni	Live Aquarium Fish
Whiteboard Ent. Ltd	P.O. Box 1351 Dar es salaam	Msasani	Live Aquarium Fish
Sam Ornamental Fish Co. Ltd		Msasani	Live Aquarium Fish

Table 8 Establishments Approved for EU Exports

Name	Address	Location	Products
Tanperch Ltd	Ilemela. Mwanza Tel: +25 5 -28 -25 61338 -9 Fax: +255-28-256 1335/256 1336 tanperch@africaonline.co.tz	Ilemela - Mwanza	Nile Perch Fillets
Nile Perch Ltd	P.O. Box 1753 Ilemela Mwanza Tel:+255-28 -2570329 Fax:+255-28-2570430 kakajnpf@gmail.com	Mwanza/Tanzania	Nile Perch Fillets
Tanzania Fish Processors Ltd	P.O. Box 3001, Nyamagana, Mwanza Tel:+255 -28 -255 0105 Fax:+255 -28-255 0870 tfp@mwanza.com	Nyamagana - Mwanza	Nile Perch Fillets
Mwanza Fishing Industries Ltd	P.O. Box 348 Ilemela, Mwanza Tel: +255 -28 -2560 868 Fax:+255-28-2561 184 mwanzafish@africaonline.co.tz	Ilemela - Mwanza	Nile Perch Fillets
Omega Fish Ltd	P.O. Box 94 Ilemela - Mwanza Tel:+255-28 -2560 601 Fax:+255-28-2560 661	Ilemela - Mwanza	Nile Perch Fillets
Vic Fish Ltd	P.O. Box 1654 Nyamagana, Mwanza Tel:+255-28-255 2306/2550589 Fax:+25 5-28 -255 0597 vicmwz@vicfish.org	Nyamagana - Mwanza	Nile Perch Fillets
Prime Catch Exporters Ltd	P.O. Box 786 Makoko - Musoma Tel:+255-28 -2640 002 Fax.+255-28 -2640 003	Musoma Urban, Mara	Nile Perch Fillets
Musoma Fish Processors	P.O. Box 1149	Musoma Urban, Mara	Nile Perch Fillets
Kagera Fish Company Ltd	P.O. Box 180 Kemongo. Kagera:Tel: +255 744 000 888	Bukoba Rural, Tanzania	Nile Perch Fillets
VicFish Ltd – Bukoba	P.O. Box 1139 Bukoba Plot No. 37 Nyamkazi Area	Nyamkazi - Bukoba Urban	Nile Perch Fillets
Fruits De La Mer Ltd	P.O. Box 20728 Keko, Dar-es-Salaam Tel +255-22-2862 501/2 Fax +255-22-286111	Chang'ombe Dar-es-Salaam	Octopus, Rock Lobsters, Sand Lobsters
Alphakrust Ltd	P.O. Box 8316 Ilala, Dar es Salaam Tel: +255 22 2128 854; +255 22 212 8828 Fax: +255 5111 1069 Mobile: +255 784 900885 ganeshan.vedagiri@tz.alphaafrica.com	Kipawa - Bala, Dar es Salaam	Octopus, Prawns, Cuttle fish, Squids Crabs, Rock Lobsters, Sand Lobsters
Tanpesca Ltd – Tanga	c/o P.O. Box 8316, Ilala, Dar es Salaam; Tel: +255 22 2128854; +255 22 2128828 Fax: +255 5111 1069; Mobile: +255 784 900 885; ganeshan.vedagiri@tz.alphaafrica.com	Tanga, Tanzania	Octopus, Prawns, Cuttle fish, Squids Crabs, Lobsters
Bahari Foods Ltd	P. 0 Box 3978, Mwenge, Dar es Salaam; Tel: 255 22 2602 504/5;Fax: 255 22 2602 490; Mobile: +255 784 78 633;Bhagat@vicfish.com Bahari@naturesbounty.tz.com	Mwenge - Kinondoni, Dar es Salaam	Octopus, Prawns, Squids, Crabs, Lobsters
TanPesca Mafia Plant Ltd	c/o P.O Box 8316 Mafia, Tel: +255 22 21 28 854; +255 22 2128 828; Mobile: + 255 784 900 885; Fax: +255 5111 1069 ganeshan.vedagiri@tz.alphaafrica.com	Mafia - Pwani	Octopus, Prawns Squids, Crabs, Lobsters
Kawther Sea Food Co. Ltd	P.O. Box 12591 Keko, Dar es Salaam Tel: +255 773 000 011	Keko Mwanga - Temeke	Octopus, Prawns Squids, Crabs, Lobsters

Table 9 Aquaculture Operators

Name	Address	Location	Products
Jan Aqua Centre	Mr. John Noni Tel 0784488305		Hatchery
Eden Agri	Mr. William Bwemelo Tel 0784 541339 / 0767 541339 P. O. Box 20811, Dar es Salaam info@edenagroaqua.co.tz	Dar es Salaam	Manufacturer of floating fish pellets
Ruvu Fish Farm	Mr. Daudi Makobore Tel 0756 986 705 0784 833 844 huntdaudi©gmail.com	Bagamoyo	Tilapia hatchery and grow out
Alphakrust	Ali Mwinyi Rd, Block 72, Plot N0.40 P.0. Box 8316, Dar es Salaam Tanzania Tel: +255 -222-128828 Fax: +255 -222-111069	Mafia Island	Shrimp Aquaculrure Project

Table 10 Fish Import Companies

Name	Address	Location
Alpha Krust Co. Ltd	P.O. Box 8316 Da r es Salaam Tel: +255 22 2128 854 Fax: +255 5111 1069 Mobile: +255 784 900 885 ganeshan.vedagiri@tz.alphaafrica.com	Kipawa-Ilala
Shishi Zhengua Trading Co. Ltd	P.O. Box 2248 Dar es Salaam Tel: +255 713 260 997	Yombo Buza - Mtoni Temeke
Erythia Trading Co. Ltd	P.O. Box 36175 Dar es Salaam Tel:+25 571 3952209	Ferry – Kigamboni, Ilala
Ocean Fresh Foods Production (T) Ltd	P.O. Box 75553 Dar es Salaam Tel: 0713 283 284 oceanfreshfood.tz@gmail.com	Mivinjeni Kurasini- Temeke Plot 29 K
Amasa Fish Traders Co. Ltd	P.O. Box 36055 Dar es Salaam Tel: +255 782 61515	Tabata Bima, Ilala
Sunrise Food Co. Ltd	P.O. Box 32466 Dar es Salaam Tel: +255759 877 777 sunrisefood158@gmail.com	Isere Street, Kinondoni
AB Marine Products Co. Ltd	P.O. Box 54455, Dar es Salaam Tel :+255 713 250 270, lobster@hotmail.com	Ubungo-maziwa, Ilala
Lake Bounty Co. Ltd	P.O. Box 36242, Dar es Salaam Tel: +255 784 463 446 pillaikoip@gmail.com	Mji Mwema -Kigamboni. Temeke
Ithaca Ent Co. Ltd	Dar es Salaam Tel:+25 571 59181 42 davidlihenga@gmail.com	Ilala
N.F. Trading Co. Ltd	P.O. Box 36644 Dar es Salaam Tel:+255 732 997 981	Mji Mwema Kigamboni Temeke
Muki Sea Food Co. Ltd	Dar es Salaam Tel:+25 5 713 260 997	Magogoni St - Bala
Samaki Distributors Ltd	P.O. Box 11981 Dar es Salaam Tel: +255 773 000 011	Chang'o mbe Bora St - Temeke
Kawther Sea Food Ltd	P.O. Box 54182 Dar es Salaam Tel: +255 774 000 004	Mwanga - Temeke
Fruits De La Mer Ltd	P.O. Box 20728 Dar-es-Salaam Tel: +255 -22 -2862501 / 2 Fax: +255 -22-2 8611 1	Chang'o mbe - Temeke
Mshafishco Investment	P.O. Box 25256 Dar es Salaam Tel:+255 784 290 750/ 0655 061 515	Mbezi Beach - Kinondoni
LimFa Co. Ltd	P.O. Box 72662 Dares Salaam Tel:+25 5 762 999 666	Tazara, Temeke
Food Lover 's Market	P.O. Box 3030 Dar es Salaam	Msasani Pennisula, Kinondoni