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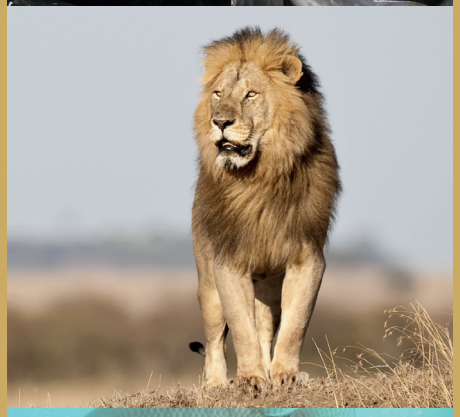
# Aquaculture in East Africa

## A regional approach

**November, 2014**



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LEI Wageningen UR
Wageningen, November 2014

IMARES C153/14
LEI 14-120
ISBN 2352-4243

LEI WAGENINGEN UR

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Rothuis, A., M. Turenhout, A. van Duijn, A. Roem, E. Rurangwa, E. Katunzi, A. Shoko and J. B. Kabagambe, 2014. *Aquaculture in East Africa; A regional approach.* Wageningen, LEI Wageningen UR (University & Research centre), LEI Report IMARES C153/14| LEI 14-120. 54 pp.; 16 fig.; 8 tab.; 37 ref.


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IMARES C153/14 | LEI 14-120

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# Management Summary

Aquaculture has the potential to make a significant contribution to food security and income generation. Dutch private companies, knowledge institutes and ministries are involved in various aquaculture projects throughout Africa. In a number of countries belonging to the East African Community (EAC) there is currently insufficient knowledge at governmental as well as at private sector level about: the fish value chain, inter-linkages of the value chain across East African countries, the potential for sustainable aquaculture development in the region, business opportunities for Dutch companies, and possible linkages to the FoodTechAfrica (FTA) project. Therefore the present study has been requested and financed both by the Dutch Ministry of Economic Affairs and the FTA consortium.

The linkages and interdependency of the fish and/or aquaculture value chain across the four EAC countries (Tanzania, Rwanda, Kenya and Uganda) have been analyzed. The biggest fish consumers are Uganda, Tanzania and to a lesser extend Kenya. In order to maintain present levels of fish consumption in these countries, considerable additional quantities of fish are required through aquaculture.

In EAC countries, considerable quantities of Tilapia are being fished and traded regionally. Trade in Tilapia is mainly price driven. This implies a potential risks for the development of tilapia aquaculture since aquaculture fish has to compete with wild catch and with imports. With stagnating wild catches and the strong increase in demand, competition between wild and cultured tilapia is considered to be a temporarily situation.

To stimulate the regional production of farmed fish, the EAC put a high import duty of 25% on fish from outside the EAC. However, only where the internal production cannot fulfil the total demand, import of cheap (pelagic) fish is becoming important. As well as fish, imported fish feed from outside the EAC is charged with an import duty (20%). The import duty on feed will encourage local feed manufacturing (within the EAC), but is presently a constraint in absence of locally produced high quality starter and grow-out feeds.

Aquaculture across the countries concerned is a modest industry, and at the present speed of development cannot cope with the expected strong increase in demand for fish and fish products. Therefore, considerable efforts are required in order to accelerate the development of aquaculture in the EAC. Among the main bottlenecks are the availability of high quality feed, access to investment and running capital, knowledge for sustainable high productive fish culture systems, and good quality fingerlings. A coordinated approach involving different public and private actors in the EAC region and from the Netherlands is essential in order to realize the aquaculture potential in the EAC.

The identified interventions include transfer of technology and capacity building at various levels, the development of simplified recirculation aquaculture technology for small holders, improved quality monitoring and control of fish feeds, and policy influencing to encourage governments to (temporarily) reduce import duties on high quality fish feeds. These interventions are preferable addressed through a concerted Food Security program focussed on aquaculture. Any future capacity building interventions should address the proper linkage between education & research and the professional sector.

For Tanzania and Rwanda the aquaculture value chains have been analysed in detail. In both countries the current status of aquaculture is very modest while natural resources are sufficiently available. On the input side, quality seeds/fingerlings and feeds, and access to investment capital are the major constraints. The demand for tilapia is high and will continue to grow in the coming decade as a result of population growth, increased buying power and popularity of tilapia, but the market potential is much better in Tanzania than in Rwanda. The cage culture of tilapia in Lake Victoria, Lake Kivu and possibly other lakes has a big potential provided that governments regulate a sustainable growth of this type of aquaculture.

# 1 Introduction

## 1.1 Background

Aquaculture has the potential to make a significant contribution to food security and income generation. This has been recognised by multilateral organisations such as Food and Agriculture Organization (FAO) of the United Nations and by a number of countries in the East African region. Recent studies by Wageningen UR confirm this potential (Rothuis *et al.* 2011 & 2012). It is also clear that such a development cannot be seen independently from the regional context, in particular the East African Community (EAC). Through the aquaculture value chain these countries are interlinked. Not only is the end product (fish) traded from one country to another, also inputs are sourced within the EAC depending on availability, price and quality. Therefore interventions in the aquaculture value chain need to take a regional approach.

In June 2013, the FoodTechAfrica (FTA; www.foodtechafrica.com) project started. This project, partly financed through the Dutch FDOV programme, aims to improve food security in East Africa through the establishment of a fully integrated aquaculture value chain. FTA is a public-private initiative combining the strengths of Dutch agro-food companies, knowledge institutes, governmental agencies and their East-African counterparts. FTA offers an integrated approach for developing sustainable high quality inputs (feed, fingerlings), productive yet sustainable farming methods and finally safe and efficient processing and cooled logistics. FTA concentrates on the following four main activities:

1. Establish and improve fish feed production to improve the local availability of high quality feed;
2. Establish and improve primary production systems of fish offering local availability of consistent volumes of reasonable quality fish;
3. Establish and improve processing of fish to increase added-value towards products, efficiently re-utilize waste products and increase food safety and transport, processing and cold-chain; and
4. Improve human resources and infrastructure (technical skills and support structure).

FTA is coordinated by Larive International and partners include Wageningen UR, Kenya Marine and Fisheries Research Institute (KMFRI), Fishion BV, The Roost, Nutreco, Almex BV, Dinnissen BV, Holland Aqua BV, Ottevanger BV, VIQON BV, Unga Farm Care, the Dutch Ministry of Foreign Affairs and the Royal Dutch Embassy in Nairobi. Local coordination of activities is executed by the local team of Lattice Ltd, Partner of Larive International. FTA has a five year timeframe (2013-2018) and is currently in phase 2.

Although FTA has a particular focus on Kenya, the project has a regional scope as its activities cannot be viewed separate from the East-African context. Aquaculture activities in other EAC countries (Uganda, Tanzania, Burundi and Rwanda) and South Sudan and Ethiopia need to be taken into account, as only a regional approach can create the critical mass needed to bring about structural change in the regionally interdependent fish value chain. This is also the case for the Eastern Democratic Republic of Congo (DRC) which is more turned to the EAC market. For example, feed producers will not invest in fish feed manufacturing as long as there is no sufficient demand for aquaculture feeds, while entrepreneurs will not invest into aquaculture farms as long as there is no fish feed available. This situation will persist as long as the critical number of farms and volumes of fish have not surpassed a certain threshold level (critical mass). Sourcing demand and supply on a regional rather than country level will be necessary. Businesses active in the aquaculture value chain cannot exclusively base their investment decisions on the Kenyan situation only. Furthermore, involvement at the government level is also required, for example to make agreements on liberalization of trade across east Africa borders, and on independent feed quality control which is something to be set up (by government) at a regional level.

## 1.2 Problem definition & aim

In a number of East-African countries there is currently insufficient knowledge at governmental as well as at private sector level about: the fish value chain, interlinkages of the value chain across East African countries, the potential for sustainable aquaculture development in the region, business opportunities for Dutch companies, and possible linkages to the FTA project.

Therefore, the aim of the current project is:

- To make a detailed assessment of the fish value chain in Tanzania and Rwanda, including the fish market, the present situation regarding aquaculture production, the current availability and quality of inputs such as feeds and stocking material, and the subsequent development potential of a sustainable environmentally sound aquaculture sector.
- To give an overview of the interdependence of the countries in the East-African region in the aqua value chain and identify the opportunities and interests of the countries involved and local producers (nutrition, employment, food security, economic);
- To identify interests and opportunities for Dutch involvement (public and private) in the aquaculture value chain in Eastern Africa, to investigate opportunities for strengthening of the aquaculture value chain (with Dutch private sector involvement), possible through linkages to and contribution from the FTA project, and through other instruments such as G2G and B2B and K2K.

The present study has been requested and financed both by the Dutch Ministry of Economic Affairs and the FTA consortium.

## 1.3 Approach

The approach used for this project consisted of the following steps:

- A desk study to investigate macro data.
- Per country, local consultants were contracted to collect all relevant micro data.
- A field mission to verify above information, undertake interviews with relevant stakeholders across the value chain, visit aquaculture farms etc.; list of persons met in Annex 1.
- An overall analysis across the various countries.
- Presentation of the main findings to the FTA consortium, the Ministry of Economic Affairs and other interested parties.
- Finalization of the report.

The present report starts with an analysis of the interdependency of the fish/aquaculture value chains in the East-African region, focussing on Tanzania, Rwanda, Kenya, and Uganda. Based on the current status, expected development potential, and observed common/regional bottlenecks, recommendations are made for strengthening of the aquaculture value chain through Dutch private sector and governmental involvement, and through the FTA project. In the subsequent chapters a more detailed analysis is being made of the situation in Tanzania and Rwanda.

# 2 Interdependency

## 2.1 The East African Community (EAC)

To operate as a healthy economic unit in the global economy, five nations in East Africa have decided to combine strength and seek deep economic and political integration. Kenya, Tanzania, Rwanda, Uganda, and Burundi comprise the modern iteration of the East African Community, formed in 2000. Widespread efforts have been made since that year to accomplish expansive integration plans, although progress has been painfully slow in some areas. Even so, the East African Community as a whole is capable of becoming one of Africa's leading economic powers if integration is successful and handled properly (Eyster, 2014).

In 2005 the EAC countries established a customs union and in July 2010 the EAC introduced the EAC Common Market Protocol to operate as a Common Market which provides free movement of goods, labour and capital within the region, with the goal of creating a common currency and eventually a full political federation (Turenhout *et al.*, 2013). In practice EAC countries have additional regulations which can cause barriers for the Common Market.

Due to increasing population numbers and economic growth the total demand for food (fish) in the EAC is growing. The fish production in all different regions is increasing, but the demand is even growing faster. Investments in aquaculture are growing in the last few years, in order to increase production capacity, but it looks like this will not be sufficient to ensure food security in the long term. Employment in the EAC aquaculture sector as a whole is also growing and can potentially grow further when investments by third parties (like the FTA consortium) will increase. The importance of aquaculture is growing and this sector will be of relative more importance for EAC economy in the coming years.

## 2.2 The EAC Aquaculture Value Chain

The linkages and interdependency of the fish and/or aquaculture value chain across the four selected EAC countries is best illustrated by the most critical parameters for aquaculture development: feed, fingerlings, fish production, quality, business environment and the market. In table 1 an overview of these parameters is given for each of the countries concerned, and mostly based on Tilapia, since this is the most popular species with the greatest aquaculture potential.

Table 1

*Overview of fish value chain parameters across EAC countries. Based on tilapia, except total fish consumption, and export/import. [1)]Based on current level of per capita fish consumption.[2)]Based on World Bank ease of doing business indicators, higher numbers indicate worse performance. [3)]Based on FCR of 1.5.*

| Category | Item | Tanzania | Rwanda | Kenya | Uganda |
|---|---|---|---|---|---|
| Business[2)] | Overall Ranking | 145 | 32 | 129 | 132 |
| | Availability of credit | 130 | 13 | 13 | 42 |
| Market | Per capita fish consumption (kg/year) | 7.0 | 1.4*** | 3.4 | 5.7** |
| | Current total fish consumption (mt) | 343,000 | 16,500 | 171,000 | 213,000**** |
| | Expected. increase total consumption 2018 (mt)[1)] | 51,000 | 10,000 | 21,000 | - |
| | Current farm-gate price tilapia (€/kg) | ~€1.60-2.00 | ~€2.15-2.50 | ~€2.20-2.40 | ~2.10-2.35 |
| | Current total export (mt) | 40,000 | 400 | 19,000 | 23,000* |
| | Current total import (mt) | 6,500 | 12,000 | 3,000 | 1,500* |
| Fish | Current aquaculture production (mt) | +/-3,600 | +/-1,500 | +/-16,100 | +/- 15,000 |
| | Required production 2018 (mt) | 51,000 | 10,000 | 21,000 | - |
| | Current Tilapia catches (mt) | 37,000* | 5,000* | 55,000* | 54,000* |
| Feed | Current commercial production (mt) | 0 | +/-100 | +/-2,000 | +/-3,000 |
| | Expected requirement 2018 (mt)[3)] | 77,000 | 15,000 | 32,000 | - |
| | Raw materials (mt) | Grain products: 7,655,000*<br>Soybeans: 3,550* | Grain products: 832,000*<br>Soybeans: 24,838* | Grain products: 4,023,000*<br>Soybeans: 3,000* | Grain products: 2,982,000*<br>Soybeans: 190,000* |
| Fingerlings | Current availability | + | - | + | ++ |

*Source: FAOSTAT; **Source: MAAIF (2011);*** figure corrected for unregistered exports to DRC; ****estimated value

From the table it is clear that the biggest fish consumers are Uganda, Tanzania and to a lesser extend Kenya. In order to maintain present levels of fish consumption in these countries, considerable additional quantities of fish are required through aquaculture. In turn, aquaculture requires feed and fingerlings. The latter are not an immediate bottleneck, although there are concerns about the quality of produced fingerlings. As commercial fish feed production is very limited at this moment, considerable investments are required in local feed manufacturing. Raw materials of plant origin are sufficiently available in the EAC region, however not much is known about possible competing claims from livestock and human consumption. Therefore, the FTA consortium will undertake a study on the sustainable sourcing of feed ingredients.

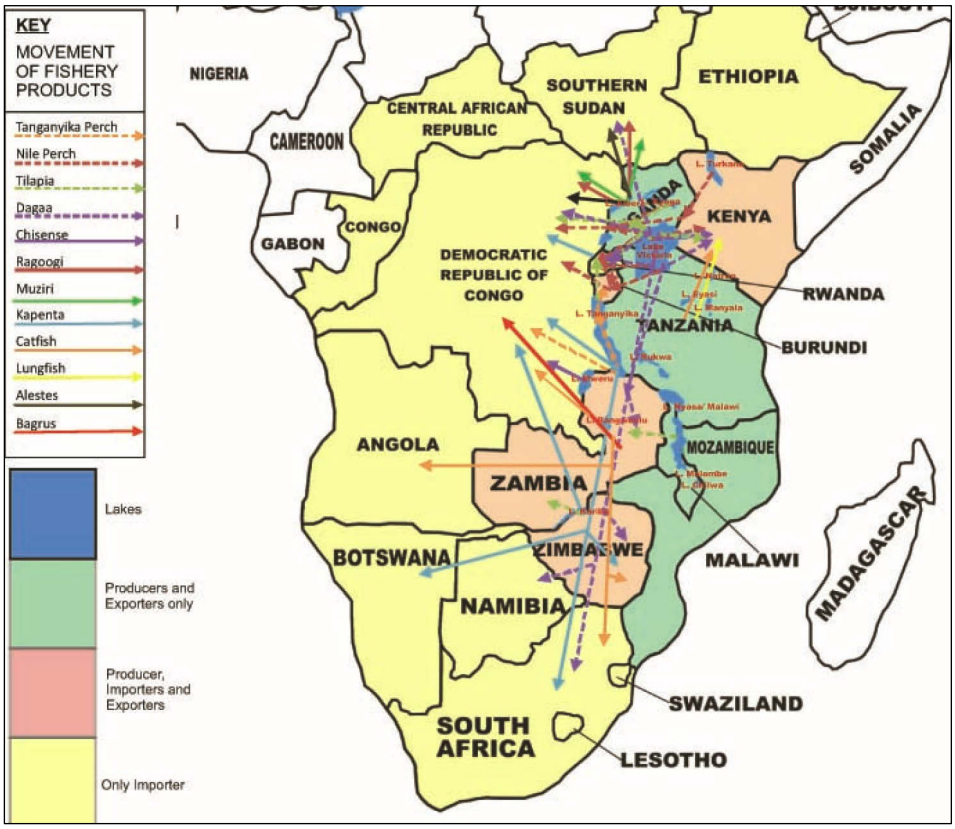


***Figure 1*** *The movement of fish and fish products in eastern and southern Africa in 2012 (IOC, 2012).*

In EAC countries, considerable quantities of Tilapia are being fished and traded regionally (Figure 2). Uganda is the main exporter of Tilapia (dashed green arrows) in the EAC. Uganda exports of Tilapias mainly go to DRC, Kenya and Rwanda. EAC countries like Tanzania restrict the export of Tilapia and reserve it for domestic consumption. Trade in Tilapia is mainly price driven.

This implies potential risks for the development of tilapia aquaculture since aquaculture fish has to compete with wild catch and with imports. With stagnating wild catches and the strong increase in demand, competition between wild and cultured tilapia is a temporarily situation.

The fish trade to Eastern DRC constitutes an important end-market for a big part of fish produced in the EAC. The main DRC market for Lake Victoria fish is the copper mine industrial area of Shaba (Katanga). In Lubumbashi dried salted Lates under the name of Capitain can be found. Dagaa is another fish species that is sold there. The transport of fish goes from Mwanza to Kigoma (Ujiji) and over Lake Tanganyika towards the DRC. Additional fish market studies, at least in transit cities situated on the borders of Rwanda and Uganda with DRC, are required in order to obtain the full picture of the trade of fishery products in the whole region.

To stimulate the regional production of farmed fish the EAC put a high import duty on fish from outside the EAC. The import duty for whole and filleted fish from outside this region is 25% (0% between EAC countries). However, only where the regional production cannot fulfil the total demand, import of cheap (pelagic) fish is becoming important. The numbers of fish imports (from overseas) are growing linearly. The main importer in the region is the Alpha group, which is operating in all EAC countries since 2013. Frozen Mackerels are the most imported fish species, but also the imports of whitefish like frozen tilapia and pangasius are growing. The increase of imported fish should not be seen as a risk for the development of aquaculture since the major commodities are cheap pelagic mackerels mainly intended for lower income groups, while frozen whitefish (only a small percentage) are imported for high income groups.

As well as fish, imported fish feed from outside the EAC is charged with an import duty (20%). This restriction is not imposed between the EAC countries. The import duty on feed will encourage local feed manufacturing (within the EAC), but is presently a constraint in absence of locally produced high quality starter and grow-out feeds.

## 2.3 Conclusions & Recommendations

Aquaculture across the countries concerned is a modest industry, and at the present speed of development cannot cope with the expected strong increase in demand for fish and fish products. Therefore, considerable effort is required in order to accelerate the development of aquaculture in the EAC. Among the main bottlenecks are the availability of high quality feed, access to investment and running capital, knowledge for sustainable high productive fish culture systems, and good quality fingerlings. A coordinated approach involving different public and private actors in the EAC region and from the Netherlands is essential in order to realize the aquaculture potential in the EAC. In table 2 bottlenecks and proposed actions are being listed from a Dutch perspective (business situation and available governmental support). The table also indicates where business opportunities are for Dutch companies.

Table 2

*Bottlenecks and proposed actions.*

| Bottleneck feed | Recommendation | Who | How |
|---|---|---|---|
| Availability | Invest in local/regional feed manufacturing | Private companies | Joint Ventures; Facilitation through FTA and other donor supported projects |
| Quality | -Invest in factory based feed quality management<br>-Improve feed quality monitoring & control | -as above<br>-Governments | -as above<br>-G2G |
| Utilization | -increase knowledge of fish farmers on feed and feed management | feed manufacturers, local research and extension agencies | ToT approach involving Dutch feed companies and knowledge institutes |
| High price (imported) feed | -as above<br>-lobby for reduced taxes on imported feed and raw materials for feed<br>-development of feeds adapted to small farmer culture systems | -as above<br>-Dutch government & embassies<br>-feed companies & research organisation | -as above<br>-lobby & awareness raising<br>-FTA & locally managed pilots |
| Bottleneck fingerlings | Recommendation | Who | How |
| Availability | Invest in modern hatcheries | Private companies | JV's; Facilitation through FTA and other donor supported project |
| Quality | Develop specific breeding programs for tilapia | Private companies & knowledge institutes | TA (training) and locally managed pilots |
| Utilization | Improve hatchery/farm management | Private companies & knowledge institutes | TA (training) and locally managed pilots |
| Bottleneck production | Recommendation | Who | How |
| Lack of high productive systems manageable for small holders | -small scale RAS systems<br>-Small holder organisation | -Private companies & knowledge institutes<br>-NGO's | -Feasibility study & locally managed pilots<br>-involve NGO's in aquaculture |
| Lack of (working) capital | Inform credit suppliers (banks, government) on benefits and risks of aquaculture | knowledge institutes & NGO's | Short workshops |
| Lack of capacity for sustainable development of cage culture | capacity building on risk assessment on cage aquaculture including carrying capacity of water bodies, regulation & permit systems etc. | Knowledge institutes & governments | Training (K2K & G2G) |
| Bottleneck approach | Recommendation | Who | How |
| Lack of focussed approach from public and private stakeholders reaching smallholder growers | Implement an aquaculture food security programme, focussed on viable models for domestic production and supply of affordable, nutritious and safe fish products | Local project management implemented in Kenya Supported by the FTA consortium and NGO partners.<br><br>The private sector, fish farms as well as small aquaculture farmers and cooperatives in the aquaculture sector, are the main target group of this programme. | Implement locally coordinated food security program focussed on aquaculture. |

*Transfer of technology.* Much of the above listed bottlenecks for aquaculture development trace back to a lack of knowledge on farm and hatchery management, feed management and (tilapia) breeding programs, and a general understanding of aquaculture business and risks. This expertise is available at various Dutch aquaculture companies (inside and outside FTA) and at Dutch knowledge institutes. At present IMARES, on assignment of the Ministry of Foreign Affairs, is conducting an inventory on where appropriate aquaculture expertise, training materials etc are available within the Netherlands (private companies, educational institutions, and research organisations). This is linked with the upcoming working conference on internationalisation of Dutch Agri & Food knowledge, and the international ambitions of the Top sector Agri & Food. It is recommended to develop an integrated aquaculture training package that is applicable in various countries of the EAC, for farmers and for capital/credit suppliers.

*Capacity building on risk assessment cage aquaculture including carrying capacity of water bodies, regulation & permit systems etc.* Cage aquaculture is generally considered to be one of the most promising ways for the development of industrial-scale fresh water aquaculture in Sub-Saharan Africa. Many of the large fresh water lakes, such as Lake Victoria have year round suitable temperatures for the production of Tilapia. In the Ugandan part of Lake Victoria cage aquaculture is practised since 2006.

At present Source of the Nile (SON) manages a commercial farm with an annual production of 1800-2000 MT. In Kenya, a small size cage unit had been established by Dominion Farms, but at present this company only operates a land based Tilapia farm. In Tanzania, experimental cage farming started in 2013. Based on the present study it is expected that cage farming in Lake Victoria could reach 10,000 MT within 5 years from now. Also in Rwanda cage farming is expected to increase (Lake Kivu and other lakes). However, large scale development of cage culture involves also a number of risks, these include water pollution. Pollution can be controlled if the number of cages (or the amount of feed used) does not surpass the carrying capacity of the lake. At present governments are struggling with the legislation and permits system for cage aquaculture. There is a clear lack of understanding of the ecological impact of cage farming and the instruments that governments could use to regulate a sustainable development of cage culture. Therefore capacity building in this area is urgently needed.

*Sustainable intensive fish farming for small holders.* FTA aims to improve food security in East Africa through the establishment of a fully integrated aquaculture value chain. The initial focus is on fish feed and the construction of a sustainable Recirculation Aquaculture System (RAS) farm. However, this technology is not immediately accessible by small holders due to the high capital and technological requirements. A simplified design using a modular approach based on existing local conditions could make RAS technology affordable and manageable by small holders. It is therefore recommended to develop, through a feasibility study and pilot project, such a small scale RAS unit.

*Quality control fish feeds.* Fish feeds currently available in Eastern Africa differ greatly in quality. Information on the label does not reflect the actual composition in terms of proteins and fats. This is not only a problem for fish farmers who are not sure of the quality of the feed that they are purchasing, but is also a limiting factor for Dutch companies that supply high quality feeds to Africa (level playing field). Governments in the EAC should establish a common fish feed quality monitoring and control system.

*Policy influencing.* Import taxes on fish feeds and feed ingredients are a constraint for aquaculture development in the EAC in absence of locally produced high quality starter and grow-out feeds. EAC governments should be encouraged to (temporarily) reduce import duties on high quality fish feeds.

*Implement concerted Food Security program focussed on Aquaculture.* To address the above issues in an integrated and regionally coordinated manner, we suggest to implement a locally-managed food security program which, in close cooperation with the Royal Dutch Embassy in Kenya and Rwanda and with the concerned governmental institutions. This program will aim to replace the predominant practice of subsistence aquaculture production with an economically viable, safe and environmentally friendly approach towards production, marketing and processing of cultured fish products. Through this program aquaculture will significantly contribute to food security, with viable models for domestic production and supply of affordable, nutritious and safe animal-based products. With the development and testing of these models, the program will contribute towards higher income levels of smallholder aquaculture farmers in the East African region, including demand and supply solutions and improved access to affordable and safe animal protein products among urban consumers. The programme will deliver outputs in relation to improved (smallholder) aquaculture production practices, increased consumer awareness on food safety and quality, improved aquaculture production, processing & marketing standards, and improved collaboration between supply chain partners and public sector support organisations, with focus on food security.

# 3 Tanzania

## 3.1 Macro context

### 3.1.1 Protein consumption

The average total protein intake for Eastern Africa and Tanzania projected against the world consumption between 2009 and 2011 is shown in Figure 2. In this period the world average animal protein intake was 39 per cent of total protein intake (31 gram/capita/day). The animal protein intake in Eastern Africa is only 19 per cent of total protein intake (11 gram/capita/day). This is a consequence of the poor constituting the largest share of the total population in Africa and their diets being largely starch and vegetable-based. Tanzania's animal protein consumption is lower than the East African average. With 9.9 grams/capita/day, the animal protein intake is 18 per cent of total protein intake. Fish and seafood in Eastern Africa and Tanzania provide only a small part of the total protein intake. Where the average world fish and seafood protein intake is around 16.5 per cent of total animal protein intake (5.2 gram/capita/day), Tanzania derives more than 20.0 per cent of their total animal protein intake from fish and seafood (2.2 gram/capita/day). The average Eastern Africa fish and seafood protein consumption is only 13.4 per cent (1.4 gram/capita/day). Measured in kilograms, the world average consumption of fish and seafood is 18.7 kg/capita/year, while the East African average is 4.7 kg fish and seafood/capita/year and the Tanzanian average is 6.1 kg fish and seafood/capita/year between 2009 and 2011. For 2013 the average fish and seafood consumption in Tanzania was estimated on 7.0 kg/capita/year (MLFD, 2014).

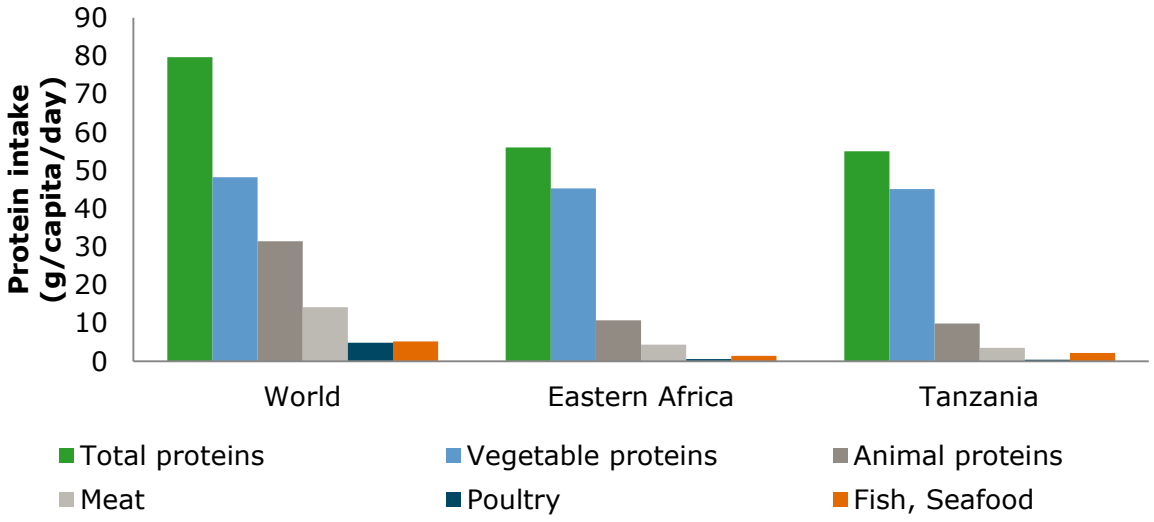


***Figure 2*** *Average protein intake (2009-2011) in gram per capita per day.*
*Source: FAOSTAT (2014).*

### 3.1.2 Fish production

From figure 3 it appears that inland capture fisheries delivers the highest production (322,000 tonnes in 2013), followed by marine capture fisheries (53,000 tonnes in 2013) and aquaculture (around 3,600 tonnes in 2012).

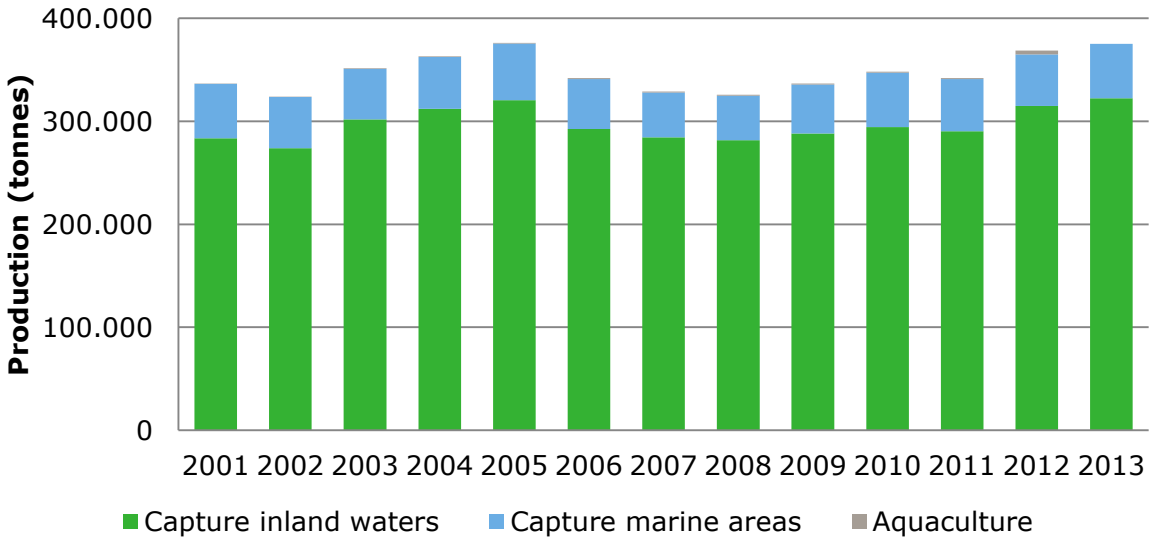


***Figure 3*** *Fisheries and aquaculture production in Tanzania (tonnes).*
*Source: MLFD (2012 and 2013).*

The inland capture fisheries subsector is host to over 146,000 fishers using 49,321 fishing vessels, where almost all are artisanal (MLFD, 2012). The most used fishing gear is long line (6,5 million) followed by gill nets (1,0 million). Inland fisheries are supported by three main fish stocks. These are Nile perch (*Lates niloticus*), Nile tilapia (*Oreochromis niloticus*) and the sardine like Dagaa *(Rastrineobola argentea)*. Lake Victoria covered most of the inland fisheries production. In 2012 over 75% (238,000 tonnes) of the inland fisheries production came from this lake. Lake Tanganyika covered almost 19% (59,000 tonnes) of the Tanzanian inland fish production. Nile perch contributes to 40% of the total catch from Lake Victoria. Dagaa and Tilapia respectively contribute to 39% and 16% of the total catch from Lake Victoria.

The marine subsector is host to over 36,000 fishers using 7,664 fishing vessels (almost all artisanal). Fishing is carried out in the near shore areas using simple boats. Over the last 10 years, the annual catch fluctuated between 43,000 tonnes and 55,000 tonnes. Scombridae, Lethrinidae, Aridae and Clupeidae are the main marine commercial species and contributed almost 20% of the total fish landings (*MLFD, 2012)*.

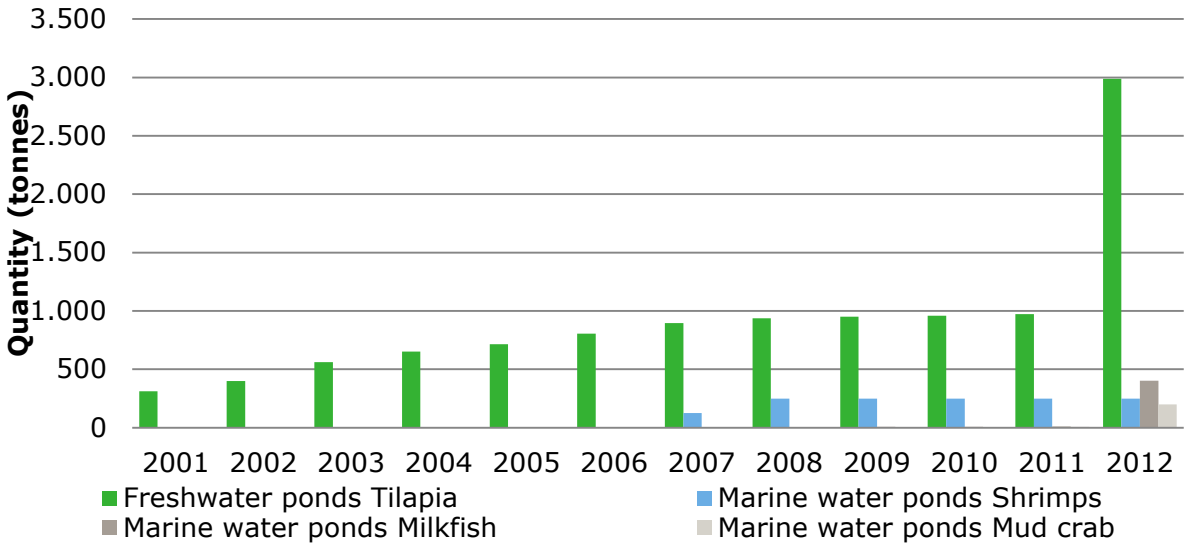


***Figure 4*** *Aquaculture production in Tanzania, year 2001-2012.*
*Source: MLFD (2014).*

Figure 4 gives an overview of the aquaculture production in Tanzania. The aquaculture sector is host to 17,726 fresh water fish farmers and 1,545 marine fish farmers (excluding seaweed farms) in 2013.

The fresh water fish farms in Tanzania are small scale, generally with 3 fingerlings per square meter stocking density. The average area of the fish ponds is 300 $m^2$ (15x20 meter). Ninety nine (99%) of the farmed fresh water fish is tilapia. Aquaculture production amounted to about 3,600 tonnes in 2012. The main areas where the fresh water tilapia is farmed are in the South, especially the Ruvuma (more than 43%), Njombe (almost 14%) and the Iringa (more than 11%) region.

Marine aquaculture farms in Tanzania produce milkfish (403 tonnes in 2012), shrimps (*P. monodon;* 250 tonnes in 2012) and mud crabs (around 200 tonnes in 2012). Almost all shrimps are produced by Alphakrus Ltd., the main distributer to retail and wholesale in Tanzania. In 2005 they started *P.* monodon aquaculture. At this moment they have 112 hectares of water area with semi-intensive ponds on Mafia island and producing >99% of the Tanzanian farmed shrimps. They get their brood stock from the wild and produce post-larvae in their own hatchery in Mafia. One to two cycles with an average production of 200 tons of shrimps (30-40 count) per cycle can be realised. Export (mainly head-on scale-on) goes mainly to Europe (Southern) but also to the EAC (lower quality). Recently small farmers in and around Mafia are starting with extensive shrimp farming.

### 3.1.3 Fish imports and exports

Figure 5 shows the import and export quantities for Tanzania. The overall trend in export shows a decline. Between 2009 and 2013 however, the fish export was stable and fluctuated around 40,000 tonnes per year. The import trend shows a linear increase from around 1,000 tonnes in 2009 to more than 6,500 tonnes in 2013.

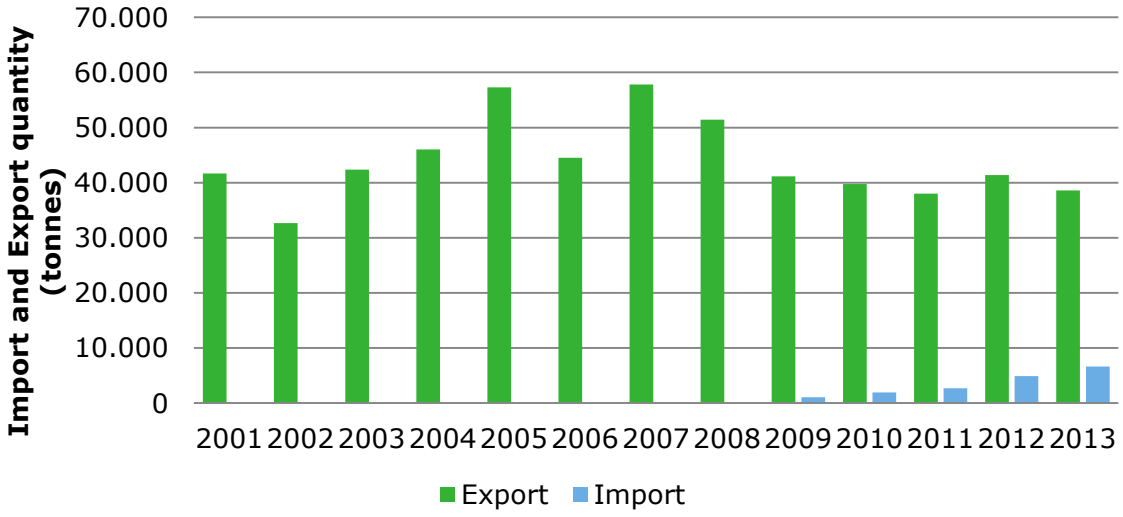


***Figure 5*** *Import and Export quantities Tanzania (tonnes). Only 2009-2013 data available for import. Source: MLFD (2012 and 2013).*

An overview of the export products from Tanzania is shown in annex 2. The most important export products in Tanzania are dried dagaa, fresh and frozen fish fillets and Nile perch by-products. In the year 2012 dried dagaa accounted for about 25% of total exports. Nile perch fillets, processed in Mwanza, accounted for about 55%.

Dried Nile perch fish heads, frames, maws and off cuts contributed for 7% of the total export quantity. Nile perch exports were mainly to Europe, the Middle East and Asia, and in 2012 major export destinations included Italy, the UAE, the Netherlands and Spain.

Products were most of the time sold as frozen fillets (56%), followed by fresh fillets (39%) and frozen headless & gutted Nile perch (5%).

In regions near the border of Kenya a substantial percentage of the caught Nile perch are smuggled into Kenya. Fishermen can get better prices for their fish in this country. The Nile perch by-products mainly go to the Democratic Republic of the Congo. The maws, heads, frames and offcuts are dried, packed and transported in trucks from mainly Mwanza.

Dagaa exports were mainly to Kenya (>90%), but also other regional countries. The Dagaa are transported by truck in 35 kg bags of around 60.000-85.000 TSH per bag (in 2014). Most of these fish are used for fish meal. Over the exported fish products a royalty (around 100-200 TSH per kg) need to be paid and the products need to be accompanied with the right export certificates. Beside this a transport permit is needed of around 5,000 TSH per ton.

Detailed import data are given in annex 2. In 2012, Tanzania imported almost 4,900 tonnes of fish and fishery products worth around USD3.5m. The most important import product in 2012 was frozen mackerel (mainly pacific and Indian mackerel, but also horse, (yellow) scad, Arabian and chub mackerel), accounting for around 86% of total import. Imports originated mostly from Asian countries, notably Yemen, India and China. Frozen mackerel is an interesting import product because of the affordable price. Frozen mackerel are sold on the Tanzanian market for around TSH1,000 per piece (200 grams).

Important to note is that while the import volumes in 2012 are 8 times smaller than the export volumes, the import value (USD3,5m) is almost 47 times smaller than the value of the export value (USD163,3m). This confirms the observation that Tanzanian consumers mostly consume unprocessed fish products which have much lower value than high value processed products that are mainly destined for export.

### 3.1.4 Fish availability

Almost the entire supply of fish available for consumption in Tanzania is produced locally. The total production of fishery products was around 375,000 tonnes in 2013 (Figure 3). Figure 5 shows that in 2013 39,000 tonnes of seafood products were exported and an additional 4,900 tonnes of seafood products were imported. Assuming that the farmed production in 2013 was the same as in 2012 (3,600 tonnes), in 2013 around 343,000 tonnes of seafood were consumed domestically.

### 3.1.5 Competition and development scenarios

In Tanzania there is almost no competition in the fish market between domestic and imported fish products. As marine and inland capture fisheries remain under pressure it is not expected that the fishery production will grow. An increase in the supply of fish products has to come from imports or aquaculture. With a per capita fish consumption of 7 kg per year and a population growth of 2.8%, the additional production volume required in order to maintain the present level of fish consumption can be estimated for different years for different consumption averages. Table 3 shows the expected scenarios for increasing consumption per capita per year. This scenario's give an idea about the growth potential for aquaculture in Tanzania.

Table 3

*Additional annual production required to maintain consumption at 7 kg, 8 kg and 9 kg per capita by 2013, 2018 and 2023.*

| | | Additional annual production (tonnes) | | |
|---|---|---|---|---|
| | Population (million) | 7 kg/cap/yr | 8 kg/cap/yr | 9 kg/cap/yr |
| 2013 | 49.2 | - | | |
| 2018 | 56.5 | 51,216 | 106,460 | 163,006 |
| 2023 | 65.0 | 108,521 | 173,439 | 238,357 |

Source: CIA (2014), Worldbank (2014) and MLFD (2013).

To maintain the current level of fish consumption in 2018 total annual fish production has to increase by approximately 51,000 tonnes. This means that each year aquaculture needs to increase with around 10,200 tonnes. In 2018 aquaculture production will need to be almost 20 times the production in 2013. To increase the consumption per capita to 9 kg per capita per year, total production in 2023 has to be approximately 238,000 tonnes.

To reach this amount of fish with aquaculture, production should be 90 times as high as the production in 2013. To increase fish production to the expected scenario quantities, considerable investments in aquaculture are essential.

## 3.2 Lake Victoria fisheries

Lake Victoria, Africa's largest fresh water Lake, is shared by Tanzania (49%), Uganda (45%) and Kenya (6%). Fishery resources of Lake Victoria are the major source of fresh water fish in the area. The volumes of Tilapia caught from the lake affect prices of wild and cultured fish in the entire region. Therefore, the status and trends of Lake Victoria fisheries are important since this will influence the potential of aquaculture development in the entire region of countries surrounding the lake.

The Tilapia species have become the most popular species in Lake Victoria. Nile tilapia *Oreochromis niloticus* was introduced into Lake Victoria in 1950's together with other non-indigenous tilapiines including *Oreochromis leucostictus* Trewavas*, Tilapia zillii* Gervais and *Tilapia rendalii* Boulenger from Lake Albert (Welcomme, 1967). Nile Tilapia started to appear in commercial catches in 1960 constituting less than 1% of the landings (Welcomme, 1967). By 1965, it featured prominently in the commercial catches and currently it is the most commercially important tilapiine, whereas the native species of *O. variabilis* and *O. esculentus* have largely disappeared (Witte and van Densen, 1995; Othina and Tweddle, 1999). Currently, Nile Tilapia constitutes the third most commercially important fishery in Lake Victoria, after the introduced *Lates niloticus* (Nile Perch) and endemic cyprinid, *Rastrineobola argentea* Pellegrin (Dagaa).

Data on important life history indicators and stock dynamics for Nile Tilapia are sparse and do not form long time series to facilitate definitive conclusions about the resource. However, studies from the catch assessment surveys provide indications on the trends on the fishery.

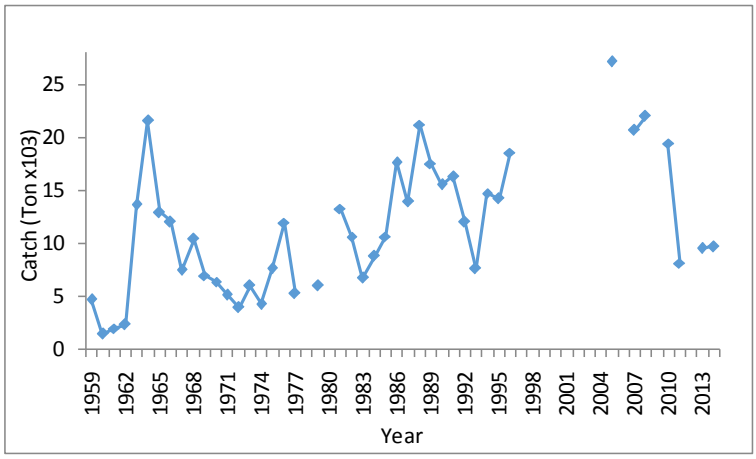


***Figure 6*** *Annual total catch (1000 MT) for tilapiines for the Tanzanian part of Lake Victoria 1959-2014*

As seen in Fig. 6 the total catch for the tilapiines has been going down especially since 2004 to 2013. The apparent equivalent of catches between the present time and the time in the sixties is due to the increase of the fishing pressure. The decline in catch rates per boat is observed between 2005 to 2011 ( Fig.7). Hand lines and gillnets are the two main gears used for Tilapia fishery.

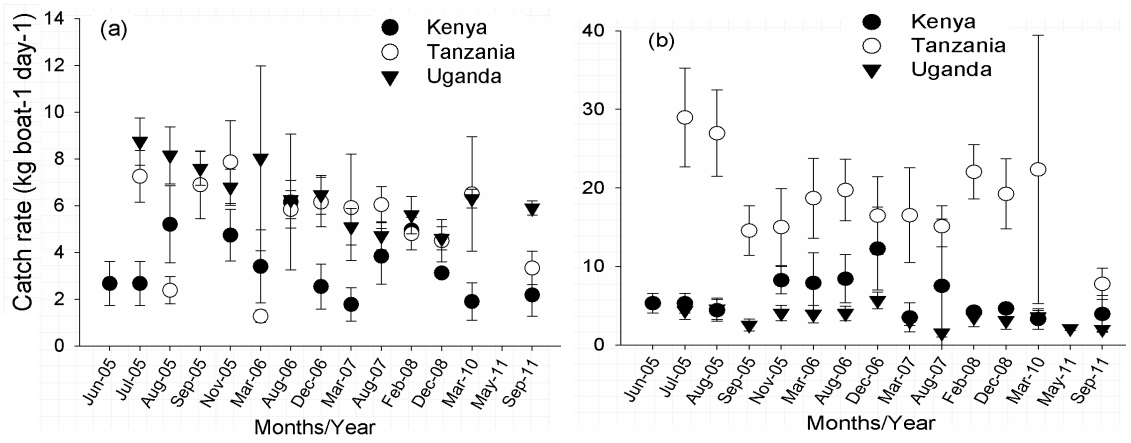


***Figure 7.*** *Tilapiine catch rates trends for Kenya, Tanzania and Uganda caught with gillnets (a) and hand line hooks (b).*

Nile perch was introduced in Lake Victoria in the 1950s in order to boost declining commercial fishery and to convert low value haplochromines to high value fish. It was until 1980s that substantial catches of Nile perch started being realized. During the late 1980s and early 1990s, the fisheries produced over 500,000 tonnes of fish, primarily Nile perch, annually. It attracted very large number of fishers and capital investment in terms of fish processing factories, consequently an exponential increase in fishing effort in term of number of fishers and boats over years was observed. Currents trends indicate that the stock of Nile perch is declining. Besides total biomass, also the population structure has changed significantly (Fig.8). Recent surveys indicate only one specimen of more than 100 cm total length while 99.3% of the fish caught were below 50cm total length, which is the legal minimum size (TAFIRI, 2014).

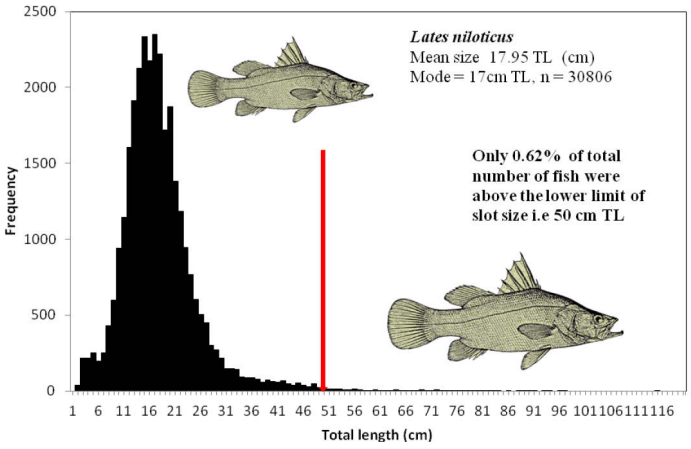


***Figure 8*** *Population structure of Lates niloticus from March-April 2014 survey.*

The Lake Victoria Fisheries Organization (LVFO) has the mandate to harmonize, develop and adopt conservation and management measures for the sustainable utilization of living resources of Lake Victoria (including fisheries) and to facilitate the development of aquaculture. It implements fisheries co-management in the Lake by legally empowering fisheries communities to undertake all levels of

management in collaboration with the national Governments. The LVFO has not been able to stop the decline of Nile tilapia and Nile perch, which is mainly caused by overfishing. Given the high local and regional demand for Nile tilapia, the easy entrance into tilapia fishery (simple gear, not much capital required), and the demand for undersized Nile perch (e.g. from DRC), recovery of both stocks and catches to its maximum levels is unlikely under the present exploitation level.

## 3.3 Aquaculture[1]

The introduction of trout in 1927 from Scotland which was released into streams around Kilimanjaro and Mbeya regions for sport fishing set the beginning of aquaculture in Tanzania (Balarin, 1985 ). Proper aquaculture in Tanzania started with experimental ponds in the 1950s stocked with tilapia fingerlings from Lake Victoria, Congo and Pangani Rivers. Tilapia fingerlings were distributed by the government to fish farms (both public and private) and to public water reservoirs. By 1960s Tanzania had some 10,000 ponds with a surface area of 1,000 ha (Mafwenga, 1993). A renewal of aquaculture development took place in the latter years of 1970s and 1980s. In these two decades, Tanzania witnessed numerous aquaculture development projects assisted by various donors. By 1990s, many projects failed to demonstrate their full potential and as a result many donors withdrew from further supporting aquaculture projects. Despite several interventions attempted aquaculture has not developed into its anticipated capacity given the existing potential. The contribution of freshwater aquaculture in Tanzania has remained very low and even declining. The main fresh water fish species cultured include Nile tilapia African sharptooth catfish (*C. gariepinus*), Mozambique tilapia (*O. mossambicus* Peters 1852) and Zanzibar tilapia (*Tilapia hornorum* Trewavas 1966), which are cultured under small scale fish farming, and rainbow trout (*Oncorhynchus mykiss* Walbaum 1792) which is cultured commercially in Arusha (Madalla, 2009, Shoko *et al.*, 2011). Tilapia, especially Nile tilapia, is the most widely cultured species and is employed by over 95% of small scale fish farmers in Tanzania. Other aquaculture activities though to a small extent are crab fattening and milkfish farming in the coastal areas, and sea weed farming and shrimp culture. According to available data, by 2008 Tanzania was estimated to have a total 14,750 ponds (Shoko *et al.*, 2011). Recent data from the Department of Aquaculture Development (DAD) shows that the total number of ponds in 2012/13 stood at 19,930 from about 17,511 fish farmers with a total production of about 3,993.8 tons per year.

## 3.4 Fish value chain

### 3.4.1 Fish marketing

Figure 9 illustrates the fish marketing in Tanzania. The marketing chain for the marine and freshwater fisheries is more complex than the marketing chain for aquaculture fish.

[1] Based on Shoko et al (2013)

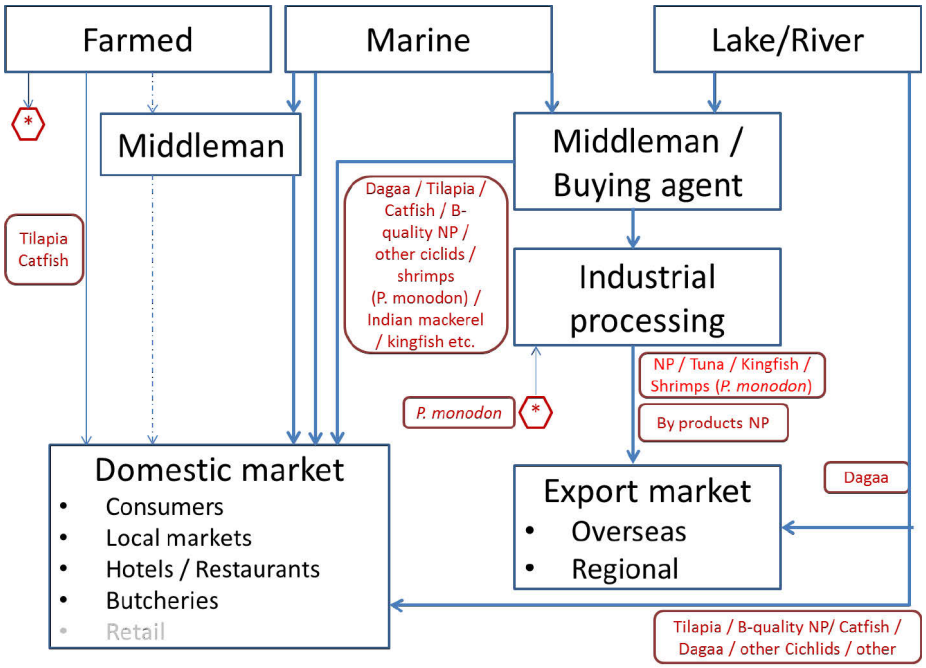


***Figure 9*** *Fish value chain structure in Tanzania.*

On the domestic market wild tilapia, Nile perch and Dagaa are the most popular fish species. Most of the Nile perch entering the local market do not meet the minimum size or the export quality standards. Aquaculture production of tilapia and catfish is minimal and only small quantities of farmed fish are sold for local consumption, mostly directly at the farm gate.

The fish is sold in small and affordable portions. The fish for the domestic market is mainly distributed by road. Most of the time the fish is transported in buckets on motorcycles, but also in refrigerated trucks. The transport between most cities in Tanzania can be done within one day. Dagaa and Nile perch by- products are exported to the region. Around 90% of the Dagaa goes to Kenya for producing fish meal. The Nile perch by-products go mainly to the DRC.

### 3.4.2 Domestic market

Local market: The local markets are the main areas where most households in Tanzania buy their food. The fish availability in the local markets depends on the size and location of the market. Markets in regions around lakes provide more fresh, sun-dried, smoked and salted Dagaa, Tilapia, Catfish, Nile perch and Haplochromines (*Furu*) than markets further away from water resources. Large proportions of illegal (too small fish) and rejected fish for export, are also traded at these markets. Markets in coastal regions provide more marine fish products, like Indian mackerel, shrimps, squid and kingfish. Market prices vary between TSH200 for a hand full of dagaa to TSH11,000/kg for kingfish.

Hotels and restaurants: Fish can be found on the menu of restaurants and hotels. The number of hotels is growing and creates a high demand for (local) fish. According to the Tanzania Fisheries Research Institute (TAFIRI), local fish are preferred (even if price is more expensive). Different kind of local fish dishes are offered, but fried or stewed tilapia (between 300-500 grams) or shrimps combined with vegetables and rice/potatoes are the most popular. Prices vary mainly between TSH9,000 and TSH12,000/kg for above mentioned products.

Butcheries: Butcheries prepare and sell fresh and frozen cuts of animal products. Around the lakes and sea there are butcheries selling different kind of fish. The high-end butcheries sell domestic fish, but also imported fish, like pangasius (Vietnam), mackerel (India, China, Yemen) and tilapia (India and Vietnam). Most of the time fish are sold per kg instead of piece. In the regular butcheries mainly domestic fish are sold per piece or chopped slices.

Where beef and poultry are sold for around TSH6,000/kg and TSH7,000/kg respectively, fish prices vary between TSH4,500/kg for Pacific mackerel and TSH15,000/kg PUD shrimps from Alphakrus Ltd. Tilapias are sold for around TSH6,000-6,500/kg.

Retail: In Tanzania the number of retail markets is relatively low. Only the few larger retail markets have fish products in their assortment. Most of the fish are processed and/or imported. Products that are found in the larger retail markets are frozen PUD shrimps, Kingfish steaks, Squid rings, Pangasius steaks and Tilapia fillets. Frozen tilapia fillets from China are sold for TSH18,000/kg. In the smaller supermarkets only dried dagaa is sold in trays for a price of around TSH2,500 per 125 grams.
On average, Tilapia prices range from TSH 5,000-8,000/kg (€2.21-3.53/ kg), depending on the location (near or away from fishery grounds). A detailed overview of fish prices in Tanzania is available in annex 3.

In figure 10 the actual year prices and corrected year prices of Tilapia (Euro/kg) are given for the period 2001-2013. The actual and corrected year prices decrease over time. Rapid inflation rates could cause this decrease.

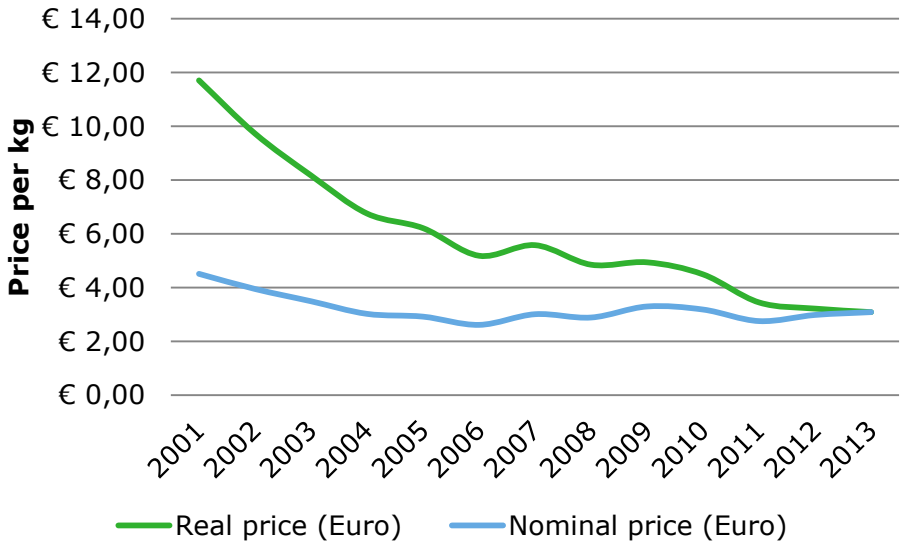


***Figure 10*** *Nominal prices (blue line) and Real prices (green line) of Tilapia in Tanzania. Sources: www.quandl.com; www.oanda.com.*

## 3.5 Potential for aquaculture development

### 3.5.1 Production systems and areas

A potential for increased aquaculture production in Tanzania exists and is yet to be fully realized (Wetengere, 2008; 2009; 2010). The area considered suitable for aquaculture development is estimated at 58,000 and 64,300 square kilometres of fresh and marine waters respectively, an area equivalent to 30% of the land area in Tanzania (URT, 1997). Figure 11 indicates regions and spatial temperature variations. Yellow to orange areas are suitable for pond culture of tilapia.

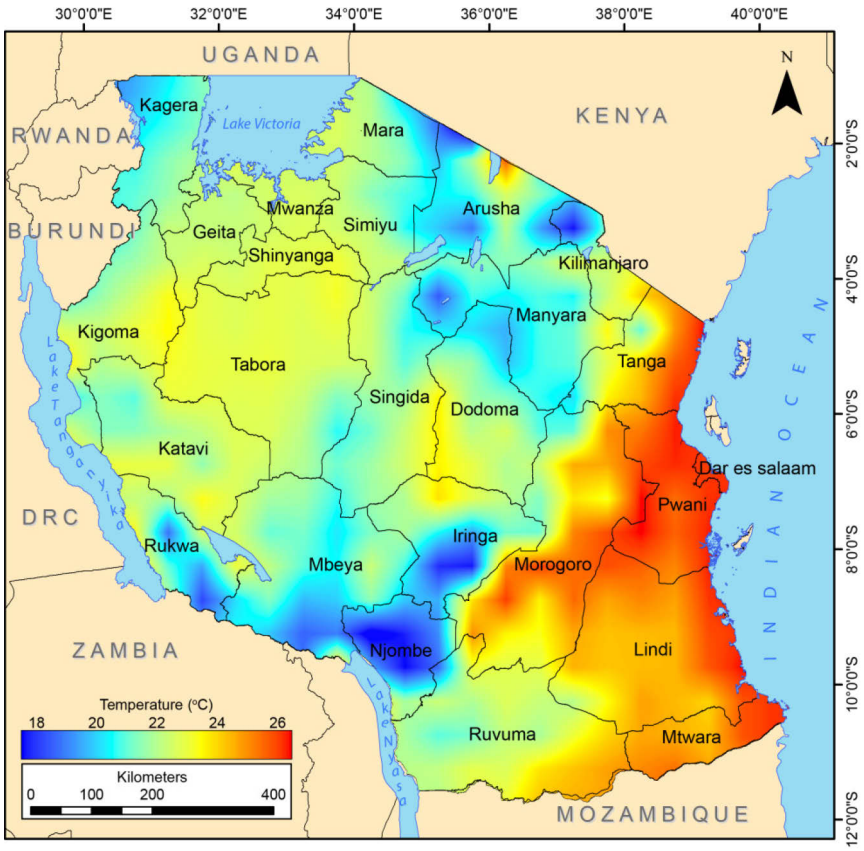


***Figure 11*** *Tanzania Mainland Map showing regions and spatial temperature (By courtesy of Mr M. Semba of the Nelson Mandela African Institution of Science and Technology, P.O. Box 447, Arusha, Tanzania: E mail: lugosemba@yahoo.co.uk).*

Experimental cage farming in Tanzania started in 2013 with a study to test the effect of different stocking densities of Nile tilapia on growth, survival, Food Conversion Ratio, and impact on water quality. Although the experimental results were influenced by relative high mortality during the early phase of the experiment, the highest final biomass after 6 months was in the order of 11kg/$m^3$. Commercial productivity at SON farm in Uganda is in the order of 50 kg/$m^3$ after a 7 month production cycle, indicating the potential for higher yields. No environmental impacts (based on pH, oxygen and other water quality parameters) in the direct vicinity of the cages was observed. The study recommended the use of cages in the lake provided that site studies are made with regard to wave flushing and continuous monitoring of the environmental parameters (TAFIRI 2013). The report with recommendations will be submitted to the Ministry of Livestock Development and Fisheries and the LVFO, for approval of commercial cage farming in the Tanzanian part of Lake Victoria. Meanwhile, several parties have expressed an interest to develop a cage farm in Lake Victoria. Among them is VicFish, a Nile perch processing company in Mwanza. VicFish factories are presently operating at only 50% capacity (25 MT/day) due to declining Nile Perch catches, severely affecting the profitability of the company. VicFish is developing two aquaculture projects, one on land and a cage farm. Both projects are awaiting governmental approval.

With a coastline of over 1400 km (including the islands of Zanzibar, Pemba and Mafia), suitable water and temperatures, there is considerable potential for coastal aquaculture development in Tanzania. Despite past initiatives and research projects, at present only one commercial shrimp farm is operational (Alphakrus Ltd.). General concerns about environmental degradation, disease problems in shrimp farming, and lack of inputs and technology, have hampered coastal aquaculture development so far.

### 3.5.2 Availability of inputs (for tilapia culture)

Reasonable numbers of Nile tilapia fingerlings (both mixed and monosex) are available through various small (semi-) commercial hatcheries and governmental stations (see Annex 4).

Although not much is known about the quality and productive performance (none of the hatcheries are using breeding programmes for genetic improvement), at the present stage of tilapia aquaculture in the country the availability of fingerlings is not immediately constraining further development.

Raw materials of plant origin for incorporation into tilapia feed, such as rice bran, wheat middling's, maize, maize bran, cassava, cotton seed cake and soybean meal are readily available but may be in competition with use for livestock feeding. There are presently no factories that produce formulated fish feeds in Tanzania. Farmers either use farm made feeds (meals or simple (extruded) pellets), or purchase simple feeds from TAFIRI or other governmental stations. The absence of manufactured fish feed is caused by a low and scattered demand, mainly due to lack of knowledge on feed and feed management at the farm and the benefits accrued from using manufactured feeds.

### 3.5.3 Institutional setting

The Fisheries Development Division, under the Ministry of Livestock and Fisheries Development (MLFD), is the designated Competent Authority in all matters pertaining to fish and fishery products. This is in accordance with the Fisheries Act No. 22 of 2003 and Fisheries Regulations of 2009 and the Fisheries (Laboratory Fees) Regulations of 2012. Among other things, the Fisheries Development Division is responsible for monitoring, control and surveillance of fishing, efficient fisheries resources utilization, marketing, and the certification of fish and fishery products and ensures that they meet national and international quality and safety standards requirements.The Department of Aquaculture Development (DAD) under the MLFD was established in September 2008, to oversee aquaculture development in the country. Following its establishment, DAD has put in place National Aquaculture Development Strategy (NADS) which is currently at implementation stage. The Department has two sections, a fresh water aquaculture section and marine aquaculture section (see annex 5).

The National Fish Quality Control Laboratory (NFQCL) Nyegezi, Mwanza which is under the Fisheries Development Division in the MLFD was established in 1997. NFQCL is responsible with safety and Quality assurance of the fish and fish products in order to comply with the national Fisheries Legislation and the international market standards and requirements. The NFQCL achieved its accreditation status in 2007 through South African National Accreditation System *(*SANAS*)*. This was purposely done in order to increase consumer's confidence with the safety of the fishery products exported from Tanzania to foreign markets such as the European Union (EU) member countries, United States of America (USA), Japan and Australia. In order to meet this obligation, the NFQCL is required to comply with ISO/IEC 17025 standards. The Quality system undertaken by the laboratory ensures that the requirements of the standards ISO 9001 and ISO/IEC 17025 are met.

Other governmental bodies related to fisheries & aquaculture include the National Environment Management Council (NEMC), the Marine Parks and Reserves Unit (MPRU), the Board of External Trade (BET), and the Tanzania Foods and Drugs Authority (TFDA), see for detailed description Annex 6.

Tanzania Fisheries Research Institute (TAFIRI) was established by the Act of Parliament No. 6 of 1980 to promote, conduct, and co-ordinate fisheries research in Tanzania. This is the only Fisheries organ mandated by the government to carry out different researches on fisheries matters. Its core functions include carrying out research in the fields of fisheries statistics and stock assessment; Fish biology, taxonomy and fisheries of commercially important fish species; Socio-economic and marketing; Hydrobiology and water pollution; Gear technology and Aquaculture.

Department Aquatic Sciences and Fisheries of the University of Dar es Salaam was established in April 2009 from the two teaching departments that existed in the former Faculty of Aquatic Sciences and Technology (FAST) following the restructuring of the University of Dar es Salaam that resulted in

merging of FAST and the former Faculty of Science (FoS) to form College of Natural and Applied Sciences (CoNAS).

The breadth and scope of DASF encompasses programs for undergraduate and postgraduate teaching, research and public services in basic and applied aquatic sciences with an emphasis on fisheries management and aquatic resource conservation.

The department offers diploma in Fisheries, B.Sc. in Fisheries and Aquaculture, B.Sc. in Aquatic Environmental Science and Conservation. The Department also offers postgraduate programs leading to M.Sc. and Ph.D. in Aquatic Sciences including aquaculture.

The Department of Animal Science and Production (DASP) of Sokoine University of Agriculture (SUA) which is located in Morogoro, was established in 1969. During that time DASP was part of the University of Dar Es Salaam. SUA was then established on 1st July, 1984 by Parliamentary Act No. 6 of the same year. The breadth and scope of DASP encompasses programs for undergraduate and postgraduate teaching, research and public services in basic and applied Animal Science, Aquaculture and Range Management. The department offers B.Sc. Animal Science, B.Sc. in Aquaculture, B.Sc. in Range Management, M.Sc. and Ph.D. Programs in Animal Science, Aquaculture and Range Management. Plans are also underway to establish M.Sc. in Livestock Production and Entrepreneurship.

The Fisheries Education and Training Agency (FETA) was established in accordance with the Executive Agency Act No 13 of 2009 of the United Republic of Tanzania to provide excellent non-university tertiary education and training in fisheries, aquaculture and related disciplines. It is fully registered and accredited by the National Council for Technical Education (NACTE) to offer qualifications up to National Technical Award (NTA) level VI. The high standard that has been established has made it possible for the agency to conduct regional fisheries training programmes and enrol students from Tanzania and other countries in the region. The major role of FETA is to implement capture fisheries and aquaculture development objectives as expressed in the National Fisheries Sector Policy and Strategy Statement (1997) and National Aquaculture Development Strategy, 2009 (NADS 2009), including education and training, consultancy, applied research, provision of fingerlings and feeds, business promotion, and to produce boats, gear and aquaculture equipment.

There are no professional associations of fisherman or fish farmers. However there are Beach Management Units (BMUs) which are legally empowered and work in close collaboration with the government in managing fisheries resources in Tanzania including that of Lake Victoria. Fish processors around Lake Victoria are organized as the Lake Victoria Fish processors association (LVFPA; see Annex 6).

International (regional) organizations relevant for fisheries and aquaculture in Tanzania include the Lake Victoria Fisheries Organization, The Lake Victoria Research (VicRes) Initiative, and the The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), for details see Annex 6.

Only one international donor funded project on aquaculture has been implemented in Tanzania recently, this is *Building public private sector partnership to enhance the productivity and competitiveness of aquaculture in the East and Central African (ECA) region* project, funded by the World Bank and coordinated by ASARECA. The overall goal of the Project was to contribute to the development of a sustainable and productive aquaculture sector for food security and market led growth in the ECA region. The project was implemented in partnership with World Fish, National Fisheries Resources Research Institute (NaFIRRI), Kenya Marine and Fisheries Research Institute (KMFRI) and TAFIRI. The duration of the project was two years from January 2012-December 2013. Project activities included fish seed and feeds, market potential and capacity building.

Several of the interviewed stakeholders indicated that the links between government, academics and private sector are still weak in Tanzania. Any future capacity building interventions need to address the linkage between education and the professional sector.

### 3.5.4 Policy and regulation

The MLFD has published a fisheries sector development program (MLFD, 2010) that includes aquaculture development component, research, training and extension.

However, the identified activities are not very specific, nor is it clear if the required budget for the implementation of the development program is actually available. According to the director of the Aquaculture Development Division of MLFD, the aquaculture policy has been reformed recently giving more importance to the development of commercial aquaculture and allowing cage culture in Lake Victoria.

For the latter a "strategic" environmental impact assessment is required in order to obtain a license. Through national aquaculture development centers fish feed and fingerlings are made available to (small scale) farmers at subsidized rates. It is expected that the new policy will contribute towards a professionalization of the aquaculture industry making it more attractive for foreign companies to invest.

Regulation concerning the import, transport and handling of live fish (section 29 and 33 of Aquaculture regulations) indicate that permits from MLFD are required for the import of any live fish into the country. Such permits will only be given if the need for importation has been ascertained by TAFIRI and will most likely (initially) be issued only for experimental purposes. There is no specific regulation concerning the import of fish feed or raw materials for the manufacturing of fish feed. However, in order to prevent dumping, the Government of Tanzania may impose import restrictions if it is not proven that local market exists for the imported product. Concerning import taxes, the National Treasury may exempt import tax on imported agriculture equipment, including products for aquaculture.

### 3.5.5 Business environment

Tanzania performed poorly in a number of the World Bank's global Ease of Doing Business indicators, ranking 136$^{th}$ and 145$^{th}$ in 2013 and in 2014, respectively. When compared to other EAC countries, Tanzania ranks lowest (see Table 4).

Table 4

*Tanzania's ranking compared to other EAC countries in 2014.*

| Country | Global rank | Regional rank |
|---|---|---|
| Rwanda | 32 | 1 |
| Kenya | 129 | 2 |
| Uganda | 132 | 3 |
| Burundi | 140 | 4 |
| Tanzania | 145 | 5 |

Ranking out of 183 economies: 1= best and 189 is the worst performer.

Source: World bank (2014).

Table 5. Provides some more detailed information on doing business in Tanzania and other EAC countries. The overall score has slightly declined in 2014, reflecting lower scores for most of the indicators. The top constrains for firms to investment in Tanzania were access to finance (38.7%), electricity (23.0%), tax rates (8.3%), practices of the informal sector (6.5%) and access to land (5.2%) (World Bank & IFC, 2013).

Table 5

*Selected business indicators in Tanzania and EAC.*

| Doing business 2014 | Rwanda | Kenya | Uganda | Burundi | Tanzania |
|---|---|---|---|---|---|
| Starting a business | 9 | 134 | 151 | 27 | 119 |
| Dealing with construction permits | 85 | 47 | 143 | 126 | 177 |
| Registering property | 8 | 163 | 126 | 52 | 146 |
| Getting credit | 13 | 13 | 42 | 170 | 130 |
| Protecting investors | 22 | 98 | 115 | 34 | 98 |
| Paying taxes | 22 | 166 | 98 | 143 | 141 |
| Trading across borders | 162 | 156 | 164 | 175 | 139 |
| Enforcing contracts | 40 | 151 | 117 | 177 | 42 |

Ranking out of 183 economies: 1= best and 189 is the worst performer.

Source: World bank (2014).

The lack of access to investment capital was also mentioned by the Policy Officer Trade Promotion and Bilateral Economic Cooperation of the Embassy of the Kingdom of the Netherlands, as being a major bottleneck for private sector involvement in agriculture, including aquaculture. Banks are reluctant with the provision of loans, which is partly caused by the inability to make a proper risk assessment of the project concerned due to a lack of aquaculture expertise at the banks.

### 3.5.6 Socio-economic potential

In Tanzania the market potential for fish is high. This is mainly due to the Tanzanian fast growing population and increased buying power. When it comes to market differentiation, three main segments can be distinguished: low income, middle income and high income. The low income group prefers imported mackerel (per piece), small-sized whole fish or small portions of a larger fish. This allows them to buy one fish or piece for each family member. The middle-income group prefer small to medium-sized whole fish, while the high-income group prefer big fish, often purchased at restaurants or high end butcheries. The market prices of tilapia will follow wild-caught tilapia prices of the Lakes: around TSH4,000/kg (€1.77) for the farmer and TSH1,000-2,000/kg for the middle men. This is more than tilapia prices in Egypt, the largest market in Africa, where farmers get €1.40-1.50/kg tilapia. Large aquaculture farms will be able to bypass the middleman and to distribute directly to make a higher profit.

Tanzania has most of the key ingredients for fish feed available in the country. In Kenya production of fish feed costs around €0.90 per kg fish, where it is expected that in Tanzania production will cost around the same. Feed cost make up around 65% of the total production cost, which make the total production costs around €1.39/kg. The above mentioned costs and revenues show a positive economic potential to produce tilapia in Tanzania.

### 3.5.7 Conclusions

- Current status of aquaculture in Tanzania is modest with a production of approximately 3600 MT/year.
- Natural resources (water, land, climate) are sufficiently available and suitable for aquaculture development.
- On the input side, quality seeds/fingerlings and feeds, and access to investment capital are the major constraints.
- The demand for tilapia is high and will continue to grow in the coming decade as a result of population growth, increased buying power and popularity of tilapia.
- Although real prices of tilapia have declined, it is expected that future price development will be positive due to a strong increasing in demand
- Based on current market prices and feed costs, tilapia aquaculture is a profitable business
- Cage culture of tilapia in Lake Victoria (and possibly other lakes) has the biggest potential
- Several investors are waiting to start cage farming following the successful example of SON in Uganda. However, completion of the decision making processes for the issuing of cage licences will require probably one more year.

- A realistic scenario for the coming 5 years is the production of 1000 to 2000 MT in cages in the Tanzanian part of Lake Victoria and other lakes and reservoirs.
- The major risks for this development scenario are the poor business environment and lack of access to investment- and operational capital.

# 4 Rwanda

## 4.1 Macro context

### 4.1.1 Protein consumption

Figure 12 shows the average total protein intake for Eastern Africa and Rwanda projected against the world consumption between 2009 and 2011. Rwanda's animal protein consumption is lower than the East African average. With 5.3 grams/capita/day, the animal protein intake is only 10 per cent of total protein intake. Eleven per cent of this total protein intake Rwanda derives from fish and seafood (<1.0 gram/capita/day). Measured in kilograms, the Rwandan average is three times less than the Tanzanian average (1.9 kg fish and seafood/capita/year between 2009 and 2011).

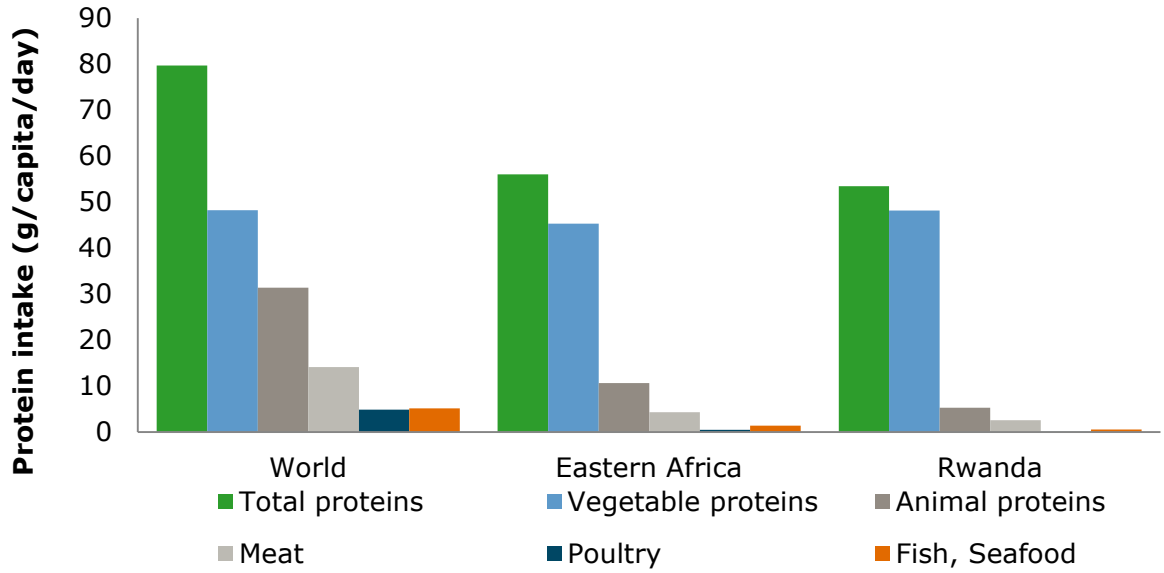


***Figure 12*** *Average protein intake (2009-2011) in gram per capita per day.*
*Source: FAOSTAT (2014).*

### 4.1.2 Fish production

Figure 13 shows the fish production in Rwanda for the years 2001-2013. There was a rather stagnant fish production before the PAIGELAC project started in 2006. This project realised a substantial production growth. In 2013 the fish production had increased by 15,000 tonnes to almost 25,000 tonnes (AFP, 2014). Only a small part (6%) of the total production came from aquaculture (less than 1,500 tonnes).

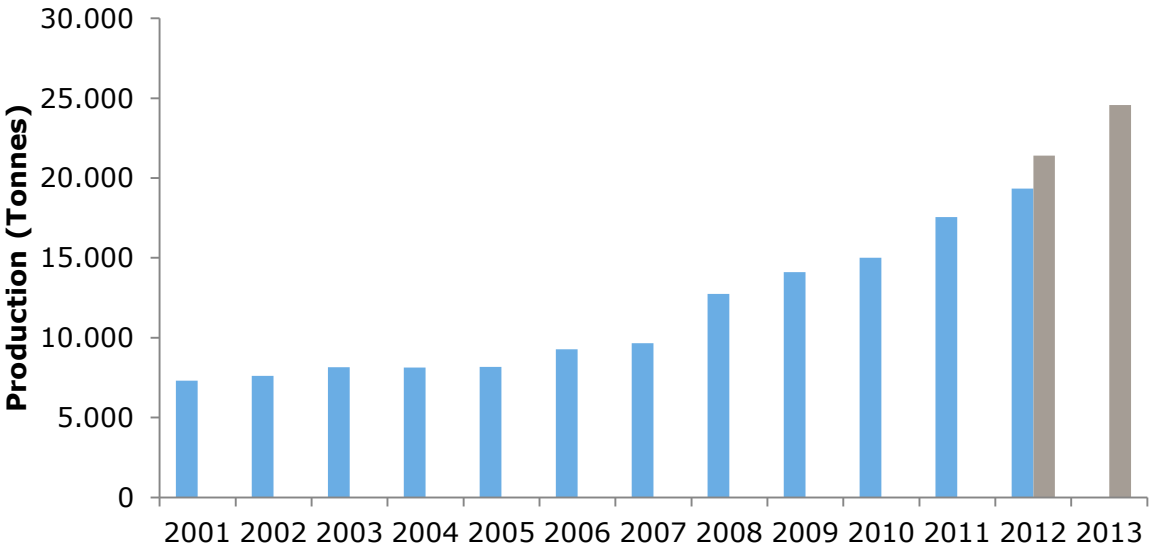


***Figure 13*** *Fish production in Rwanda (tonnes). Source: MINAGRI (2013; Blue) and AFP (2014; grey).*

The inland fisheries are supported by three main fish stocks. These are sardines (*Limnothrissa miodon*) introduced from Lake Tanganyika, also called "Lake Tanganyika sardines", endemic mouth brooding cichlids (*Haplochromis spp.*) and Nile tilapia (*Oreochromis niloticus*). Lake Tanganyika sardines cover two third of the total catch (FAOSTAT 2014). Most of the country's inland fisheries production takes place in Lake Kivu. In 2013, over 75% (18,000 tonnes) of the inland fisheries production came from this lake. Lakes of the Gisaka and the Bugesera zones covered respectively 7% (almost 2,000 tonnes) and 5% (over 1,000 tonnes) of the Rwandan inland fish production. According to Fisheries Statistics, the annual volume of tilapia production from capture fisheries in three important fishing zones (Kivu, Ruhengeri and Rwamagana) declined from 913 tons in 2008 to 238 in 2011 (MINAGRI Fisheries Statistics 2008-2011).

The fish farms in Rwanda are small-scale and primarily produce tilapia. Aquaculture production amounted to about 1,500 tonnes in 2013 (around 500 tonnes in 2012 (FAOSTAT 2014 and MINAGRI 2013)). The fish were raised in ponds (55%), cages (36%) and in dams (9%). Most of the ponds are found the Southern province of Rwanda. The cages are mainly placed in Lake Burera, Lake Kivu and Lake Ruhondo (see Annex 7).

### 4.1.3 Fish imports and exports

Figure 14 shows the import and export quantities for Rwanda. There's a growing trend for fish import into Rwanda, mostly from Tanzania, Uganda and Burundi. In 2010, Rwanda imported nearly 6000 tonnes of fish: 4200 from Tanzania, 1400 from Uganda, 300 from Burundi and only 22 from Kenya. In the same period, Rwanda imported fish from China, European countries such as Belgium, Netherlands and Germany in low quantities. However, in 2012 around 12,000 tonnes of, mostly dried, fish was imported from above mentioned countries. This represents an increase of 100% of fish imports in 2 years.

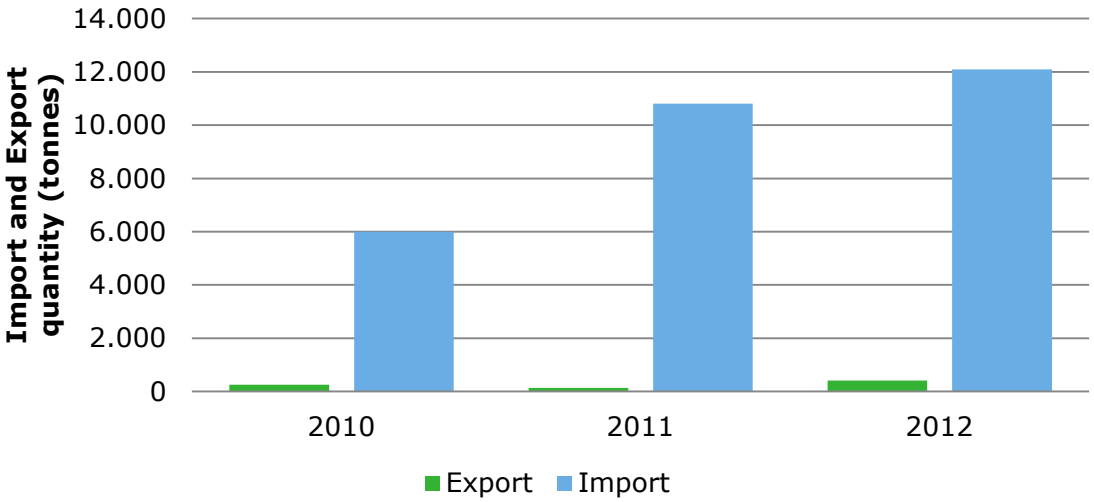


***Figure 14*** *Import and Export quantities Rwanda (tonnes). Only 2010-2013 data available. Source: Comtrade. 2010 import quantity comes from Jean Bosco Kabagambe).*

According to the official trade statistics Rwanda is predominantly a fish importer and not a fish exporter. However, up to 80% of the Rwandan fish production (20,000 tonnes in 2013) goes through the border of DRC unregistered. The wild caught fish are brought to the DRC border by trucks. The fish are unloaded from the truck in Rwanda and transported unregistered to DRC in baskets and buckets. This makes the country in fact a net exporter of fish.

### 4.1.4 Fish availability

The total production of fishery products was around 25,000 tonnes in 2013 (Figure 13). However, up to 80 per cent of this quantity is exported (mainly unregistered) to the DRC where producers get a better price for their products. Figure 14 shows that in 2012 only 400 tonnes of registered seafood products were exported and an additional 12,000 tonnes of seafood products were imported. Assuming import and export (including unregistered export to DRC) didn't change for 2013 around 16,500 tonnes of seafood were consumed domestically.

### 4.1.5 Competition and development scenarios

In Rwanda there's no competition in the fish market between domestic and imported fish products. People prefer to eat imported fish, because these fish are frozen and can be hold for a longer period. Most of the fish caught and farmed goes to DRC (registered and unregistered). In Rwanda also Pangasius from Vietnam is imported by Alpha Choice Ltd. and sold in butcheries and the retail market. As inland capture fisheries remain under pressure it is not expected that the production will grow. An increase in the supply of fish products has to come from imports or aquaculture. With a per capita fish consumption of 1.4 kg per year (taking into account the unregistered export to DRC of about 80% of the production) and a population growth of 2.6%, the additional production volume required in order to maintain the present level of fish consumption can be estimated for different years for different consumption averages. Table 6 shows the expected scenarios for increasing consumption per capita per year, indicating the growth potential for aquaculture in Rwanda.

Table 6

*Additional annual production required to maintain consumption at 2 kg, 3 kg and 4 kg per capita by 2013, 2018 and 2023.*

| | | Additional annual production (tonnes) | | |
|---|---|---|---|---|
| | Population (million) | 2 kg/cap/yr | 3 kg/cap/yr | 4 kg/cap/yr |
| 2013 | 11.7 | 7.121 | | |
| 2018 | 13.4 | 10,386 | 23,794 | 37,203 |
| 2023 | 15.4 | 14,102 | 29,370 | 44,637 |

Source: CIA (2014), Worldbank (2014), COMTRADE and ARAFP (2014).

To realise a fish consumption level of 2 kg per capita in 2018 total annual fish production has to increase by approximately 10,000 tonnes. This means that each year aquaculture needs to increase with around 2,000 tonnes. In 2018 aquaculture production will need to be almost 2 times the production in 2013. To increase the consumption per capita to 4 kg per capita per year, total production in 2023 has to be approximately 45,000 tonnes. To reach this amount of fish with aquaculture, production should be 4 times as high as the production in 2013. To increase fish production to the expected scenario quantities, considerable investments in aquaculture are essential.

## 4.2 Lake Kivu fisheries

Lake Kivu (2700 $km^2$) is one of the African Great Lakes in the Albertine Rift shared between the DRC (58%) and Rwanda (42%). The fish diversity of the lake is very low compared to its great neighbours in the region with only 29 species of fish described among which 5 have been introduced (Snoeks *et al.*, 2012). The majority of the remaining native species are Cichlids (tilapiines and haplochromines). Species with economic value include the Nile tilapia (*Oreochromis niloticus*), the African catfish (*Clarias gariepinus*) and *Haplochromis sp*. Other species found in the lake are introduced *Stolothrissa tanganicae* and endemic *Barbus* sp. The introduction in 1959 of *Limnothrissa miodon*, a clupeid endemic to lake Tanganyika known as the Tanganyika sardine and locally called Isambaza, resulted in a progressive colonisation of the lake and the development of a productive pelagic fishery in the 70's, particularly due to the promotion of fishing techniques by a UNDP/FAO project in the Rwandan part of the lake. Following this introduction, the sardine has gained substantial economic and nutritional importance for the lakeside human population.

The fishery of *Limnothrissa miodon* and *Haplochromis* species dominates at >99% on Lake Kivu and contributes to over 70% of the national inland fishery production. Nowadays the future of the sardine fishery of the lake is endangered by the expansion of *Lamprichthys tanganicanus*, an invasive species of fish from Lake Tanganyika with niche overlap (Snoeks *et al.* 2012; Muderhwa and Matabaro, 2010). *L. miodon* is essentially zooplanktivorous in its early life but becomes omnivorous at the adult stage, feeding on diverse prey: zooplankton, insect larvae and adults, other small fishes, including their larval and juvenile stages (Isumbisho *et al.*, 2004). *Lamprichthys* feeds mainly on mesozooplankton offshore, whatever its body size. There are also indications of overfishing on Lake Kivu. The highest production records were registered in the 1990s but since then production has fallen. Although fishing regulations including a periodic ban on fishing to allow fish to breed are reinforced in Rwanda, fishermen from Congo continue with unregulated fishing using illegal gear that catches premature fish.

Besides the sardine fishery on Lake Kivu, other important fisheries in the country are of tilapia and catfish in the lakes of the Akagera National Parc and the Bugesera lakes (Fisheries Statistics 2008-2011). The fishery production in the Rwamagana zone has significantly declined from a total annual production of 3,316 tonnes in 2008 to 492 tonnes in 2011. As a consequence of unregulated fishing, fish stocks in most lakes have collapsed. Practices included the use of under sized mesh nets and destructive gears, striking of water surface (typhooning), use of chemical attractants, poison fishing and beach seining. To many fishermen, illegal, unregulated, non-reported fishing were also observed before regulation measures were taken.

Fish are also caught in big rivers such as the Nyabarongo river, especially the lung fish, *Protopterus aethiopicus* and the African catfish *Clarias gariepinus*, and sold directly on the fish market in Kigali.

Lake and river fishery alone cannot supply the needs in fishery products of the country and for export to Eastern DRC. Intensive aquaculture is the solution. Fishermen are organising themselves in cage fish farmer cooperatives or fishermen associations. To achieve the target of a fish production of 112,000 tons in 2020 predicted by the national master plan for fisheries and aquaculture, the Vision 2020 and the EDPRS 2008 – 2012, recommended the profound transformation of the fish sector from subsistence into a productive high value, market oriented sector including intensification of sustainable fish production systems. Given the present situation, it is doubtful if this is a realistic target.

## 4.3 Aquaculture[2]

Fish farming in Rwanda has started during the monarchy and Belgian colonial administration at the end of the 1940s (MINAGRI 2011). The category of aquaculture that was promoted until now was subsistence fish farming characterized by low inputs and low outputs, based on pond fertilisation from livestock wastes. Between 1960-1965 aquaculture developments stand still. From 1969 renewal of aquaculture development took place. Various FAO/UNDP projects, focussing on small holder subsistence aquaculture, caused a boom production during the project times. In the 80-90's, Belgian inter-university cooperation (K.U.Leuven, University of Namur) and USAID funded projects such as the pond dynamics/collaborative research support program (PD/CRSP) focused on aquaculture research and development projects which allowed a flow of knowledge and technology into the country. However, each time at the expiry of the project, productions declined and ponds were abandoned.

The latest project promoting aquaculture came from the Inland Lakes Integrated Development and Management Project (PAIGELAC). PAIGELAC started in 2006 and officially closed the activities on 31$^{st}$ March 2013 after a period of 6 years and its activities are nowadays managed by Rwanda Agriculture Board. The project has rehabilitated nearly 218 ha of fish ponds and stocked them with fingerlings. Moreover, cage farming (known locally as kareremba) has been found by PAIGELAC a viable means to increase fish production in Rwanda and hence this activity has been encouraged whereas cages have been recently placed in Lake Kivu and other lakes in Rwanda. A total of 678 cages for intensive tilapia farming on lakes Bulera, Ruhondo, Kivu and Muhazi have been secured, most of which are 8 m$^3$ each while others are 27 m$^3$ each. A total of 5,600,000 *Oreochromis niloticus* fingerlings were purchased and distributed to cooperatives of fish (MINICOM, 2014). Recent data from MINAGRI shows that the total production from ponds, dams and cages in 2013/14 stood at a total production of 1,500 tonnes. However, it is expected that production will decline again in the coming year because the PAIGELAC project support and subsidies have ended in 2013. A detailed list of farms is provided in Annex 7. Nevertheless and despite constraints, during the recent years an establishment of commercial fish farms to supply fish to urban markets has been observed. Lakeside Fish Farm is one of them.

## 4.4 Fish value chain

### 4.4.1 Fish marketing

Figure 15 illustrates the marketing in Rwanda. The marketing chain for Rwanda is less complex than the marketing chain for Tanzania.

[2] Based on MINAGRI (2011) and MINICOM (2014)

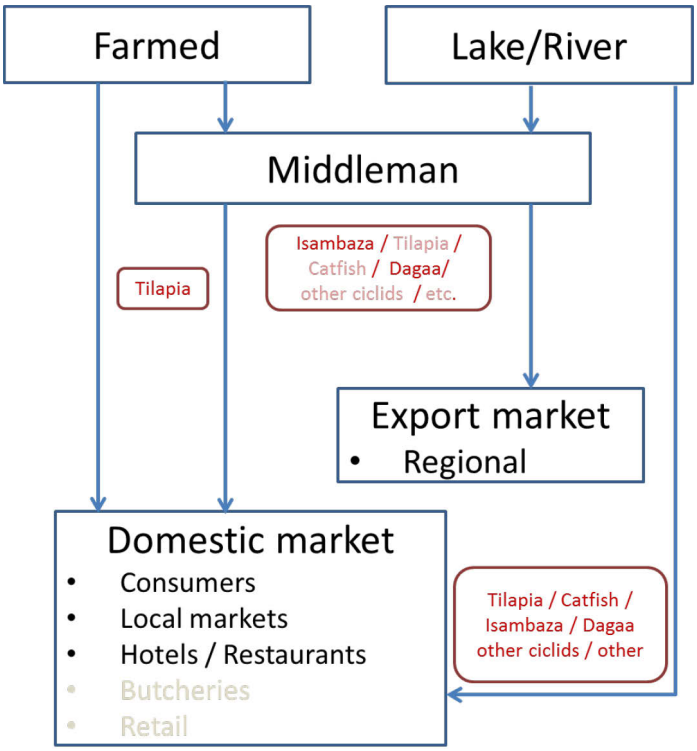


***Figure 15*** *Fish marketing structure in Rwanda.*

On the domestic market in Rwanda imported fish products and local small sardines (Isambaza) and tilapia are the most popular fish species. Since 2012 Alpha Choice, an exporter entering the Rwandan market, started to import tilapia from Uganda, Mackerel from Japan and Pangasius from Vietnam. In 2014 this importer is selling around 20 40-feet containers with frozen fish to the Rwandan market. Aquaculture products are mostly sold at the farm gate or on the local markets around the ponds or the cages. The fish for the domestic market is mainly distributed by road. Most of the time the fish is transported in wooden boxes on motorcycles, but also in refrigerated trucks (imported fish from Alpha Choice). The transport between all cities in Rwanda can be done within 5 hours.

### 4.4.2 Domestic market

Local market: The local markets are the main areas where most households in Rwanda buy their food. The fish availability in the local markets depends on the size and location of the market and is less abundant as in Tanzania. Markets in regions around lakes provide more fresh, sun-dried and smoked Sardine like species, Tilapias and Haplochromines, than markets further away from water resources. In de bigger cities, like Kigali, half of the supply is frozen and imported. Market prices vary between RWF500 for a big hand of sardine like fish to RWF5,500/kg for frozen Nile perch fillets.

Hotels and restaurants: Fish can be found on the menu of restaurants and hotels. However, the fish is not always available when ordering it. The number of hotels is growing and can create a growing demand for (local) fish. Rwandan people prefer fillets above whole fish. The Rwandese are not familiar with fish and don't want to struggle with bones. Mainly Nile perch menus are served, but also tilapia dishes. These Tilapia's are most of the time imported from neighbouring countries. The fish (most of the time fried or cooked) are combined with vegetables and rice/potatoes. Prices vary mainly between RWF6,000/kg and RWF10,000/kg for above mentioned products.

Butcheries: In Rwanda butcheries sell mainly frozen imported fish products. These butcheries sell the fish, like pangasius (Vietnam), mackerel (India, Japan) and tilapia (Uganda), to the middle-income households. Fish are sold per kg.

Beef is sold for around RWF1,900/kg and chicken for around RWF4,000/kg. The fish prices vary between RWF2,500/kg for frozen whole tilapia from Uganda and RWF5,500/kg for frozen Nile perch fillets from Lake Victoria.

Retail: As in Rwandan butcheries, supermarkets mainly sell imported products. Frozen tilapia (whole) and Nile perch (fillets) from Uganda/Tanzania were sold the most. Dried sardine like fish are sold on a regular base in 500 grams or 1000 grams bags. Frozen whole tilapia are sold for RWF3,500/kg, Nile perch fillets for RWF5,500/kg and the dried sardine like species for RWF10,000/kg.

A detailed overview of fish prices in Rwanda is available in annex 8.

In figure 16 the nominal year prices (blue line) and real year prices (green line) of Tilapia (Euro/kg) are given for the period 2009-2014. The actual and corrected year prices increase over time.

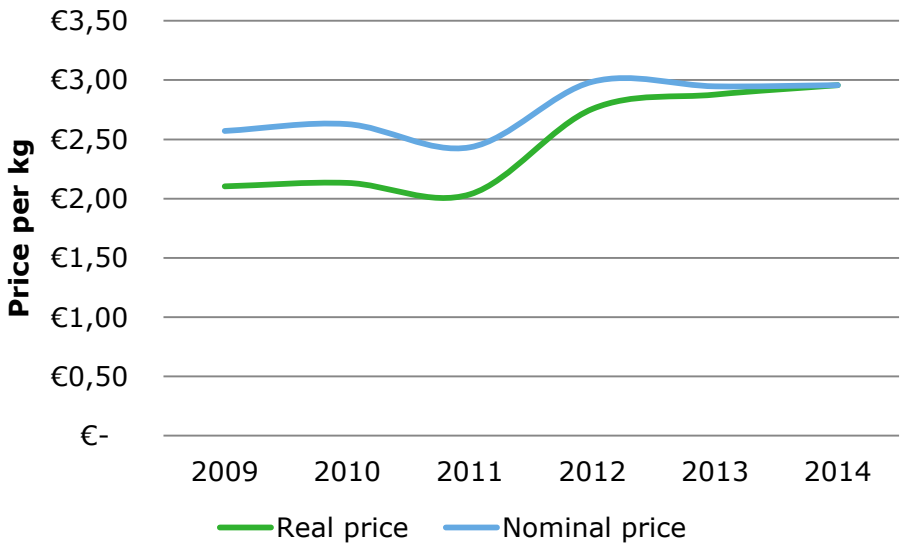


***Figure 16*** *Nominal prices (blue line) and real prices (green line) of Tilapia in Rwanda. Sources: www.tradingeconomics.com; www.oanda.com*

## 4.5 Potential for aquaculture development

### 4.5.1 Production systems and areas

Intensification of present extensive and semi-intensive earthen ponds and further development of cage culture are expected to become the major production systems in the near future. Intensification of pond based fish production is only expected from cooperatives of smallholder fish producers concentrated in a particular location which are market- and profit-oriented. These can negotiate good prices and buy inputs and sell fish collectively, provided that in a short term pond inputs, mainly quality fingerlings and feeds, become available and affordable and fish markets are organised beyond selling at the farm gate. Presently fish farming is being carried out on only 218 ha and 718 cages operating in over 186 cooperatives.

Significant growth in fish production in Rwanda is particularly expected to come from further development of cage farming. In contrast to (individual or cooperative) ponds which are scattered across the country and far from each other's, cage farms are concentrated on particular water bodies to a certain scale that can facilitate access to primordial inputs (seeds, feeds, capital, knowledge) and mobilise investment capital from owners and eventual shareholders and convince financial institutions to facilitate aquaculture bank loans.

The country is endowed by a dense hydrological network made of several lakes, rivers and wetlands. Around 8% of the country surface is covered by water.

Lakes occupy about 128,000 ha, rivers about 7,260 ha, water in valley and wetlands covers about 77,000 ha and several irrigation dams/reservoirs with depth above 5 m cover about 47 ha. Most of these water bodies, more particularly lakes, are suitable for cage fish farming. It has been estimated that 2% of Rwandan part of Lake Kivu area i.e. 2,000 ha can be used for cage culture. Assuming a low stocking density (50 kg/$m^3$) and a production of 500 tons/ha, the total production from this part of Lake Kivu alone would be 1,000,000 tons of fish. An additional 63,000 tons of fish can be produced from Lake Burera (35,000 tons) and Lake Ruhondo (28,000 tons). Cage farming is a viable mean to increase fish production in Rwanda and hence this activity has been encouraged with the recent start-ups of cage farming in Lake Kivu and other lakes of the country. PAIGELAC has supported and organized cooperatives in cage farming in the neighboring districts of Karongi, Rusizi, Nyamasheke and Rubavu. The size of cages ranges from 8$m^3$ to 27$m^3$.

According to the Rwanda Fisheries and Aquaculture Master Plan (2012), fisheries sector is planned to produce 130,000 tons of fish annually at the horizon of 2020, with Lake Kivu providing the major contribution. It has been estimated that Lake Kivu based cage aquaculture parks in 5 districts: Rusizi, Nyamasheke, Karongi, Rutsiro and Rubavu bordering the lake can produce annually 125,000 tonnes of fish using low density high volume cages of 8 $m^3$ and a stocking density of 150 kg/$m^3$ (Rwanda Fisheries and Aquaculture Master Plan 2012). There are several bays across the five districts suitable for cage farming with Nyamasheke and Karongi having the highest number and adequate infrastructure.

A recent consultancy study by Mbabazi in August 2014 to assess the suitability for cage fish farming on Lake Kivu estimated the sustainable level of cage farming production to 143,030 tons per year for the whole lake based on its carrying capacity. The study advised the use of high volume/low density cages in contrast to the fisheries master plan that recommended low volume/high density cages to take advantage of the lake morphology and physico-chemical characteristics, particularly its high depth and oxygen levels. With good aerated depths and large bays, the study recommended cages of 4 to 10 m in diameter and emphasize on cages of 5 to 10 m deep. As an example at Karongi District on the shores of Lake Kivu, water is clean, water temperature is 24-25°C, and dissolved oxygen concentration is 8 ppm in the 10 m layer. Water temperature of Lake Kivu ($25^0$C) is considered optimum for Nile tilapia which is the species of choice in cage farming in the lake. If the cage farming technology is proved, there are other lakes in the country which are also suitable for cage farming. Cage farming is already practised on Lake Kivu, Bulera, Ruhondo, Muhazi, Mugesera and Mirayi.

In a timeframe of less than 3 years, commercial cage farms are establishing in the country, mainly on Lake Kivu. Lakeside, an operating commercial fish farm since 2011 on Lake Mirayi in the Bugesera region exploits 27 cages on Lake Kivu with an estimated output of 1 ton/week of Tilapia with size between 400 and 500 g each. Themistocles, an aquaculture graduate from India and a pond fish farmer near Kigali since 2011, intends to start cage farming in Lake Kivu. Deo Rutayisire, another pond fish farmer near Kigali, a starting fish feed producer and soon to become a fingerling producer has recently received approval from the Rwandan Government to put up 200 cages in Lake Kivu.

### 4.5.2 Availability of inputs (for Tilapia culture)

The Rwandan Agriculture Board (RAB) has an own governmental station at Kigembe in the Southern part of the country to produce (both mixed and monosex) fingerlings. The breeders were two natural strains imported from Lake Albert and Victoria in Uganda. This hatchery does not have currently its own breeding program for genetic improvement. According to Emeritus Professor Jean-Claude Micha (University of Namur, Belgium), RAB plans to begin in 2014 a breeding program using a GIFT breeding scheme at Kigembe station. The hatchery at Kigembe Fish farm Station has a production capacity of 3.5 million tilapia fingerlings per year. The fingerlings are used to stock the overfished lakes in the country, but also to stock the aquaculture farms in Rwanda and Burundi. However, most of the fish farmers cannot afford to buy fingerlings (the fingerlings are subsidised by the government and cost

around RWF30 per piece) and use low quality fingerlings gathered from their own ponds or quit farming.
Most of the raw materials needed for to produce fish feed are readily available, like rice bran, maize, maize bran, cassava and wheat middling's. Cotton seed cake and Dagaa are available on the market but imported from Uganda or Tanzania. Annual soybean production in Rwanda was estimated at 28 000 tons in 2010 (Mujawamariya, 2012).

There are presently no factories that produce formulated fish feeds in Rwanda. Some entrepreneurs make simple feeds (like meals or simple (extruded) pellets) and try to sell it to local farmers. However, most of the feeds are imported from Uganda (Ugachick), and in smaller quantities from Israel and Europe. Also in Rwanda, the absence of manufactured fish feed is caused by a low and scattered demand, and lack of knowledge on feed and feed management at the farm.

### 4.5.3 Institutional setting

Aquaculture is a relatively new agricultural practice compared to crop and livestock husbandry. It remains unfamiliar to several stakeholders including advisory service providers. In many aspects aquaculture is a technology-driven sector that requires farmer responsive research. Presently the Rwanda Agriculture Board (RAB) is the institution mandated to undertake aquaculture and fisheries research and training in Rwanda. Limited research aspects of aquaculture and fisheries are undertaken by the College of Agriculture, Sciences and Veterinary Medicine of the University of Rwanda. The university research station (20 ha) at Rwasave (Butare) is used for training and teaching aquaculture focused to producing extension agents. Absence of research institutional capacity underlies the paucity of information on the water quality environment, ecology, fish stocks, reproductive and feed ecology, fish migrations, gear technology, aquaculture technologies such as induced spawning, feeding, genetics and selective breeding, production systems design, post-harvest processing, value addition, product development, data collection, socio-economics and others.

Currently there is no institution offering professional training in the domain of aquaculture and fisheries in Rwanda. However, some colleges and the University of Rwanda (former NUR) offer some aspects of aquaculture and fisheries as modules or course units. On the whole however, training in fisheries and aquaculture is weak and does not produce manpower that is responsive to the changing needs of stakeholders in the sub-sector. The limited training offered by some tertiary institutions produces underprepared manpower which compounds the technology question through wrong advice to the resource managers, fishers and farmers. The shortage of trained staff in aquaculture and fisheries is discernable at Districts and lower levels where the sector is a responsibility of professionals of other disciplines.

The fisheries desk officer in RAB is responsible for Advisory services in Aquaculture and fisheries in the whole country. Presently AFAS Rwanda Ltd, a private company offers technical support to a number of cooperatives and fishers. The capacity for both RAB and AFAS Rwanda Ltd to offer advisory services to the stakeholders is limited by manpower, logistical support, and technical infrastructure. There are a few private consultants but they are also unable to meet demand from increasing numbers of people interested in fish farming.

### 4.5.4 Policy and regulation

Management and implementation of fisheries policies and aquaculture is a mandate of RAB which is one of the agencies of the Ministry of Agriculture and Animal Resources (MINAGRI) (Annex 9 Organisation structure). Under RAB the Fisheries and aquaculture section is headed by a desk officer. Prior to the formation of RAB, fisheries and aquaculture was under the department of Animal Husbandry which also included Animal Production, Veterinary Services, and Fisheries and Aquaculture divisions. This structure was reduced to a desk and transferred to RAB at its set up in July 2011.

At local government level Fisheries and Aquaculture is the responsibility of the Veterinary or Agricultural officers. The District Veterinary Officer is in charge of livestock activities, including extension work and implementation of the fishery and aquaculture policy. The only fisheries officers at

the local level are 3 former staff members of PIAGELAC. There is a weak administrative structure for fisheries and aquaculture. The sector is managed by staff whose training is not directly related to fisheries discipline.

The law n° 58/2008 determining the organization and management of aquaculture and fishing in Rwanda was enacted on 10/09/2008 to repeal the decree law of 21April 1937 relating to Game and Fishing. The ministerial order n° 007111.30 of 18/11/2010 determines the terms and conditions for granting fishing licenses which may be for sport, professional or for research.

The ministerial order n° 011/11.30 of 18/11/2010 regulates the importation, marketing and distribution modalities of aquaculture and fisheries products, equipment and materials.

The ministerial order n° 006/11.30 of 18/11/2010 determines the form and content of the aquaculture and fishing concession contract and finally the ministerial order n°010/11.30 of 18/11/2010 determines aquaculture and fishing zones.

Fishing licences and fishing concessions in Rwanda are regulated by law no 28/2008 of 10/09/2008 determining the organization and management of aquaculture and fishing in Rwanda and the ministerial order determining the form and content of aquaculture and fishing concession. The Mayor of the Administrative District where the fishing/aquaculture activity takes place, elaborates a report on which basis the competent Ministerial authorities can issue fishing licenses. Depending on the site location and size of ponds, application may be addressed to the mayor of the District (small scale farms) or to the Ministry of Natural Resources (large scale farms). The application letter should be accompanied by the project proposal and the proposal for environmental impact assessment (EIA). The procedure is fast and the fee for an aquaculture concession costs 35000 RWF (€38.00). The district inspection is conducted within 7 days following application and generates an EIA report which is endorsed by the Mayor of the District. All documents are submitted to the Reception Desk or the Public Relations office of the Rwanda Development Board (RDB) or the Rwanda Environmental Management Agency (REMA). This service is free of charge, but in case a detailed EIA is required, investor pays 1 to 2 million RWF (€1100-2200.00) for it.

### 4.5.5 Business environment

Rwanda performed well in a number of the World Bank's global Ease of Doing Business indicators, ranking 54th and 32th in 2013 and in 2014, respectively. When compared to other EAC countries, Rwanda ranks highest (see Table 7).

Table 7
*Rwanda's ranking compared to other EAC countries in 2014*

| Country | Global rank | Regional rank |
|---|---|---|
| Rwanda | 32 | 1 |
| Kenya | 129 | 2 |
| Uganda | 132 | 3 |
| Burundi | 140 | 4 |
| Tanzania | 145 | 5 |

Ranking out of 183 economies: 1= best and 189 is the worst performer.

Source: World bank (2014).

Table 8 provides some more detailed information on doing business in Rwanda and other EAC countries. The overall score has improved a lot in 2014, reflecting higher scores for most of the indicators. In six of the ten pillars of doing business Rwanda improved herself. The top constrains for firms to investment in Rwanda were trading across borders and dealing with construction permits (World Bank & IFC, 2013).

Table 8

*Selected business indicators in Rwanda and EAC*

| Doing business 2014 | Rwanda | Kenya | Uganda | Burundi | Tanzania |
|---|---|---|---|---|---|
| Starting a business | 9 | 134 | 151 | 27 | 119 |
| Dealing with construction permits | 85 | 47 | 143 | 126 | 177 |
| Registering property | 8 | 163 | 126 | 52 | 146 |
| Getting credit | 13 | 13 | 42 | 170 | 130 |
| Protecting investors | 22 | 98 | 115 | 34 | 98 |
| Paying taxes | 22 | 166 | 98 | 143 | 141 |
| Trading across borders | 162 | 156 | 164 | 175 | 139 |
| Enforcing contracts | 40 | 151 | 117 | 177 | 42 |

Ranking out of 183 economies: 1= best and 189 is the worst performer.

Source: World bank (2014).

### 4.5.6 Socio-economic potential

Compared to Tanzania, Rwanda is not a fish eating country. However, the market for fish is increasing due to the fast growing population and increased buying power. The market prices of tilapia will follow wild-caught tilapia prices of the Lakes: around RWF2,500-2,800/kg (€2.70-3.00) on the market and RWF2,000/kg (€2.15) at the farm gate. This is much more than tilapia prices in Egypt, the largest market in Africa, where farmers get €1.40-1.50/kg tilapia. Rwanda has most of the key ingredients for fish feed available in the country. Production costs of fish feed will be around RWF750 (€0.80) per kg fish. Feed cost make up around 65% of the total production cost, which make the total production costs around €1.23/kg. The above mentioned costs and revenues show a positive economic potential to produce tilapia in Rwanda.

### 4.5.7 Conclusions

- Current status of aquaculture in Rwanda is modest with a production of approximately 1,500 MT/year.
- Natural resources (water, land, and climate) are sufficiently available and suitable for aquaculture development.
- On the input side, feeds, seeds and access to investment capital are the major constraints.
- Rwanda is not a real fish eating country. However, there is a growing demand for tilapia and this will continue to grow in the coming decade as a result of population growth, increased buying power and increased awareness of the product. Overall quantities though will remain modest.
- Nominal prices of tilapia have increased in time, it is expected that future price development will stay positive due to a growing demand.
- DRC is an important (unregistered) export market for fish from Rwanda.
- Based on current market prices and feed costs, tilapia aquaculture is a profitable business
- Cage culture of tilapia in Lake Kivu (and possibly other lakes) has the biggest potential but this but will require a better access to investment capital.

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# Annex 2 Import & export data Tanzania

*Export fish and fisheries products Tanzania 2012.*

| FISH PRODUCTS | WEIGHT IN KGS | FISH PRODUCTS | WEIGHT IN KGS |
|---|---|---|---|
| Dried Fish Heads/NP | *87,000* | Fresh G&G Fish | *417,105* |
| Dried Clarias/L.Tang. | *267* | Frozen Lobster/ w | *10,488* |
| Dried Clarias/ L.Vict. | *1,420* | Frozen Lobster /Tails | *1,644* |
| Dried Dagaa/L.Rukwa | *12,191* | Frozen Octopus | *1,095,246* |
| Dried Dagaa/L.Tang. | *1,143,163* | Frozen Cuttle fish | *12,576* |
| Dried Dagaa/L.Vict. | *7,729,769* | Frozen Prawns/ farmed | *116,688* |
| Dried Dagaa/marine | *385,436* | Frozen Prawns/ wild | *146,246* |
| Dried Dagaa/L.Nyasa | *35,365* | Frozen Prawns /PUD | *3,376* |
| Dried Fish Maws | *204,664* | Frozen Squids | *28,850* |
| Dried Fish Offcuts | *126,000* | Frozen Crabs | *12,527* |
| Dried Fish /Kayabo | *35,650* | Frozen Fish Fillets | *12,730,686* |
| Dried Fish/ L.Tang. | *183,604* | Frozen Fish Off cuts | *775,995* |
| Dried Furu/ L. Vict. | *454,002* | Frozen Fish Belly flaps | *5,000* |
| Dry salted Perege/L.Rukwa | *384,793* | Frozen Fish Chests | *256,050* |
| Dried Dagaa/L.Rukwa. | *121* | Frozen Fish Heads/NP | *197,500* |
| Dried Perege/L.Vict. | *676* | Frozen Fish Maws | *1,292,165* |
| Dried Perege/Mtera dam | *3,072* | Frozen Fish/marine | *66,986* |
| Dried Uduvi/ marine | *300* | Frozen H & G Fish | *1,128,203* |
| Fish Frames | *2,592,496* | Live Crabs | *248,197* |
| Fish Meal | *300,008* | Live Lobster | *60,861* |
| Fresh Fish Fillets | *8,789,288* | Nile Perch Oil | *200* |
| Fresh Fish /L .Vict. | *300* | Sea shell/ Cowries | *61,730* |
| Fresh Fish Maws | *12,786* | Smoked Fish/L.Tang. | *2,464* |
| Fresh Fish / L.Tang. | *241,114* | | |
| GRAND TOTAL | | | *41,394,267* |

Source: MLFD (2012)

*Import fish and fisheries products Tanzania 2012.*

| Type of Fish and Fish Products | WEIGHT IN KG | COUNTRY OF ORIGIN |
|---|---|---|
| Dried Dagaa/L.Nyasa | *470* | Malawi |
| Fresh Fish/ Mozambique | *3,200* | Mozambique |
| Fresh Fish/Tilapia | *17,630* | Mozambique and Tanzania |
| Frozen Bogus | *11,540* | China |
| Frozen Fish | *27,000* | India |
| Frozen Horse Mackerel | *50,380* | India |
| Frozen Kwakawa | *27,000* | Yemen |
| Frozen Mackerel | *1,144,150* | China, Korea and Yemen |
| Frozen Pacific Makerel | *1,908,119* | Yemen, China, South Korea, Korea and Hongkong. |
| Frozen Sardines | *107,470* | Yemen |
| Frozen Scad Mackerel | *54,000* | China and Yemen |
| Frozen Tail Scad | *26,000* | Yemen |
| Frozen Tilapia | *49,000* | India and Vietnam |
| Frozen Arabian Mackerel | *52,000* | Yemen |
| Frozen Arabic Scad | *81,000* | Yemen |
| Frozen Chub Mackerel | *125,000* | Yemen |
| Frozen Indian Mackerel | *962,590* | Yemen, India, China, Korea and Vietnam |
| Frozen Sardines/marine | *26,880* | China |
| Frozen Yellow Tail Scad | *133,260* | Yemen |
| Frozen Yellow Tunna | *27,000* | Yemen |
| Frozen YelowScad Mackerel | *52,000* | Yemen and Oman |
| TOTAL | *4,885,689* | |

Source: MLFD (2012)

# Annex 3 Fish prices Tanzania (June 2014)

| Butcheries | | | Euro (€1=TSH 2,264) |
|---|---|---|---|
| Pacific mackerel | TSH 4,500 / kg | Per piece (25-35 cm) | €1.99 / kg |
| Nile perch (local) | TSH 6,700 / kg | Slice / piece | €2.96 / kg |
| Chinese pangasius fillet | TSH 5,500 / kg | Per kg | €2.43 / kg |
| Chinese pangasius steak | TSH 6,000 / kg | Per kg | €2.65 / kg |
| Indian mackerel | TSH 5,000 / kg | Per piece (25-35 cm) | €2.21 / kg |
| Sea brass | TSH 5,000 / kg | Per piece (25-35 cm) | €2.21 / kg |
| Snapper | TSH 7,000 / kg | Per piece (25-35 cm) | €3.09 / kg |
| Black tiger shrimps (PUD) | TSH 14,600 / kg | Per 500 gram | €6.45 / kg |
| Squid rings | TSH 15,200 / kg | Per 500 gram | €6.71 / kg |
| Panga steak | TSH 6,000 / kg | Per kg | €2.65 / kg |
| Panga fillet | TSH 5,500 / kg | Per kg | €2.43 / kg |
| NP fillet | TSH 8,500 / kg | Per kg | €3.75 / kg |
| Kingfish slice | TSH 11,000 / kg | Per kg | €4.86 / kg |
| Tilapia | TSH 6,000 / kg | Weighted | €2.65 / kg |
| | | | |
| Beef (minced) | TSH 14,000 / kg | Per 500 gr | €6.18 / kg |
| Chicken | TSH 6,500 / kg | Per piece (Interchick) | €2.87 / kg |
| | | | |
| Retail market | | | |
| Beef (minced) | TSH 10,500 / kg | Per kg | €4.64 / kg |
| Beef sausages | TSH 6,300 | Per 400 gram | €2.78 / 400 gr |
| Shrimps (PUD) | TSH 11,000-13,000 / kg | Per kg | €4.86-5.74/ kg |
| King fish | TSH 15,000 / kg | Steaks per kg | €6.63 / kg |
| Tilapia | TSH 18,000 / kg | Fillet IVP per kg import | €7.95 / kg |
| Pangasius | TSH 7,000 / kg | Steaks per kg import | €3.09 / kg |
| | | | |
| Marine seafood market | | | |
| Nile perch | TSH 7,000 / kg | Slice / piece | €3.09 / kg |
| Shrimps (HOSO) | TSH 13,000 / kg | per group | €5.74 / kg |
| Mackerel | TSH 4,500-5,000 / kg | Per piece | €1.99-2.21/ kg |
| Kingfish | TSH 10,000 / kg | Per piece | €4.42 / kg |
| Snapper | TSH 6,500-7,000 / kg | Per piece | €2.87-3.09/ kg |
| Dagaa | TSH 500 | big hand | €0.22 per hand |
| | | | |
| Sales per carton seafood market | | | |
| Pacific mackerel | TSH 3,333 / kg | Box 10.5 kg | €1.47 / kg |
| | | | |
| Small market | | | |
| Dagaa | TSH 300 | Big hand | €0.13 per hand |
| Nile Perch | TSH 6,000-6,500 | Slice / Whole | €2.65-2.87/ kg |
| Haplochromines | TSH 1,000 | Big hand | €0.44 per hand |
| Tilapia | TSH 6,000-6,500 / kg | Per piece | €2.65-2.87/ kg |
| Catfish | TSH 5,000 / kg | Per piece | €2.21 / kg |
| Dagaa | TSH~2,000 per kg | | €0.88 / kg |
| | | | |
| Fishermen/Farmer | | | |
| Tilapia | TSH 3,500-4,500 / kg | Per piece | €1.55-1.99/ kg |
| Nile perch | TSH 3,500-4,500 / kg | Per piece | €1.55-1.99/ kg |
| | | | |
| Overall | | | |
| Chicken | TSH 7,000 / kg | | €3.09 / kg |
| Beef | TSH 6,000 / kg | | €2.65 / kg |
| Tilapia | TSH 5,000-8,000 / kg | Dep. on location (avg. TSH 6,700) | €2.21-3.53/ kg |

# Annex 4 Date hatcheries and fingerling production Tanzania

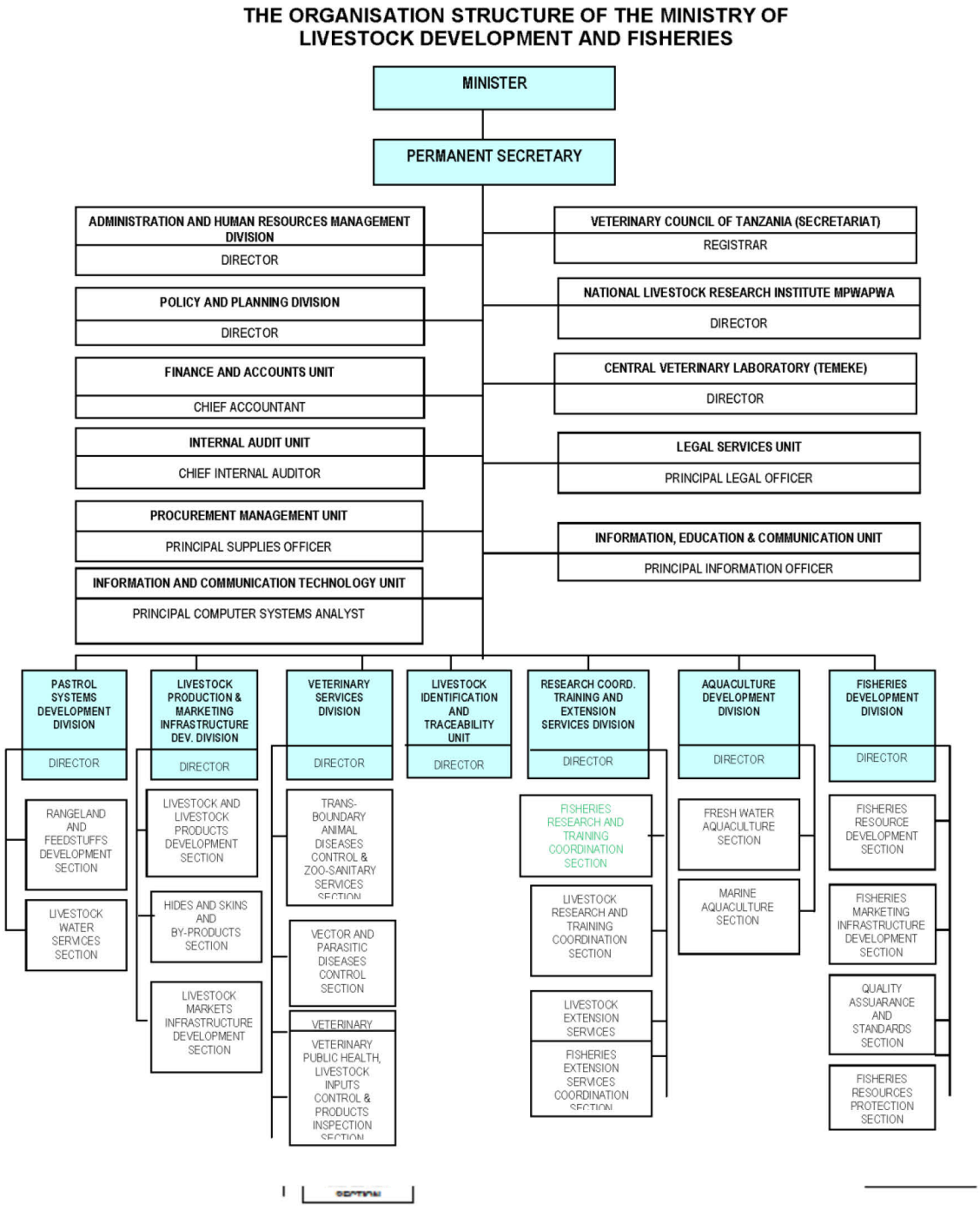
*Fish Fingerling Production (in numbers) (Source: MLFD, 2014)*

| Year | Government Centre | Private Centre | Government Figure (000) | Private Figure (000) |
|---|---|---|---|---|
| 2000/1 | 1 | 1 | 500 | 400 |
| 2001/2 | 1 | 1 | 500 | 400 |
| 2002/3 | 1 | 1 | 500 | 400 |
| 2003/4 | 1 | 1 | 500 | 400 |
| 2004/5 | 1 | 1 | 500 | 400 |
| 2005/6 | 1 | 1 | 500 | 400 |
| 2006/7 | 1 | 1 | 500 | 400 |
| 2007/8 | 1 | 1 | 1000 | 400 |
| 2008/9 | 2 | 2 | 1000 | 440 |
| 2009/10 | 2 | 2 | 1000 | 600 |
| 2010/11 | 2 | 3 | 3311.5 | 2500 |
| 2011/12 | 2 | 3 | 3000 | 2600 |
| 2012/13 | 3 | 3 | 2500 | 2600 |

*List of commercial hatcheries (producing more than 20,000 fingerlings/week).*

| No. | Name of Farm | Fish type | Capacity (fingerlings/yr) | Location |
|---|---|---|---|---|
| 1. | Eden Farm | Tilapia | 2,000,000 | Dar es Salaam Region |
| 2. | Faith Aqua Services | Tilapia | 540,000 | Coast Region |
| 3. | J & B Luhanga FF | Tilapia | 250,000 | Muleba, Kagera region |
| 4. | Montfort Agric SC | Tilapia | 200,000 | Mbarali, Mbeya region |
| 5. | Alphakrust | Prawns | 60,000,000 | Mafia, Coast Region |

# Annex 5 Organisation structure Ministry of Livestock Development and Fisheries



# Annex 6 Fisheries related agencies in Tanzania

**National Environment Management Council (NEMC)**
The National Environment Management Council (NEMC) came into being in 1983 when the Government of Tanzania enacted the National Environment Management Act No. 19 of 1983. NEMC was established with a broad mandate in response to the national need for such an institution to oversee environmental management issues and also implement the resolutions of the Stockholm conference (1972), which called upon all nations to establish and strengthen national environmental Councils to advise governments and the international community on environmental issues. The enactment of Environmental Management Act No. 20 of 2004 (EMA, 2004) by Parliament in October 2004, repealed the National Environmental Management Act No.19 of 1983 and re-established NEMC. It has a legal and institutional framework for sustainable management of the environment, prevention and control pollution, waste management, environmental quality standards, public participation, environmental compliance and enforcement. Furthermore, NEMC has a mandate to undertake enforcement, compliance, review and monitor environmental impacts assessments, research, facilitate public participation in environmental decision-making, raise environmental awareness and collect and disseminate environmental information.

**Marine Parks and Reserves Unit (MPRU)**
Marine Parks and Reserves Unit (MPRU) was established by the Marine Parks and Reserves Act of 1994. MPRU which mainly deals with conservation of resources is managed by the board of Trustees whose role is to oversee the management and administration of marine parks and reserves to ensure sustainable use of the marine resources.

**Board of External Trade (BET)**
The Board of External Trade (BET) of Tanzania is a government organization with a mandate to promote Tanzanian exports through collaboration with stakeholders in export market such as Ministry of Trade and Industry, producers, processors, exporters, etc. The Board is dedicated to establish global business partnership through organizing and managing international and specialized trade fairs, solo exhibitions, product and market research development missions, buyer-seller meetings and contact marketing programmes. BET comes out regular trade information dissemination and offers consultancy services to producers, exporters and importers to enable them to effectively participate in the global market place.

**Tanzania Foods and Drugs Authority (TFDA)**
Tanzania Food and Drugs Authority (TFDA), is a regulatory body responsible for controlling the quality, safety and effectiveness of food, drugs, herbal drugs, cosmetics and medical devices. TFDA which is under the Ministry of Health and Social Welfare was established by the Tanzania Food, Drugs and Cosmetics Act, 2003 with the mission of protecting and promoting public health by ensuring quality, safety and effectiveness of food, drugs, cosmetics and medical devices. In order to achieve its goal TFDA conducts pre-marketing evaluation of products so as to ensure that they meet standards of quality, safety and effectiveness before the products are allowed into the market.

**The Lake Victoria Fish Processors Association (LVFPA)**
This is a professional association of the fishery industry on Lake Victoria. It consists of Nile perch fish processors and exporters whose headquarters is located in Mwanza.

It is coordinated by a Secretariat based in Mwanza and its main roles include promoting marketing of Nile perch fisheries products, liaison with other relevant organizations, formulating and facilitating implementation of fisheries industry code of practice and ensuring quality standards, training of company staff on quality standards and implementing projects which promote the fisheries sector, as an institution or jointly with other partners.

**Lake Victoria Fisheries Organization (LVFO)**

Lake Victoria Fisheries Organization (LVFO) has the mandate to harmonize, develop and adopt conservation and management measures for the sustainable utilization of living resources of Lake Victoria and facilitate the development of aquaculture. It implements fisheries co-management in the Lake by legally empowering fisheries communities to undertake all levels of management in collaboration with the national Governments. The organization also has the role of guiding, supporting and implementing the building of the capacity of the riparian communities for ease participation in the management process. In 2002, The Council of Ministers of the LVFO directed the Secretariat to promote aquaculture in the Lake Victoria basin as a means of increasing fish production so as to reduce pressure on wild stocks. This has raised awareness within the region though at a small pace. Aquaculture being a relatively new enterprise in East Africa has so far been carried out at a subsistence level. In addition to the potentially significant contribution to food security, it is also being promoted as an activity that can create employment, generate foreign income and otherwise contribute to the economic growth. The potential for aquaculture in the region is very high because of large number of productive natural waters.

Recent initiatives by the organization have been:

- Reviewing the status of aquaculture in EA region and provision of guidance on development of aquaculture in the basin through the Aquaculture Regional Working group ARWG).
- Through the EU funded IFMP project, assisted the ARWG to finalize the production of standard operating procedures on aquaculture production of several publications.
- Through support by FAO the organization requested the assistance to strengthen the institutional capacity of LVFO to guide and facilitate harmonised and sustainable development of aquaculture around Lake Victoria.
- The LVFO has developed a regional strategy for aquaculture research and development in the Lake Basin and is to source for funds for its implementation.

**The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)**

The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) was established in 1994 by ten African member states of Eastern and Central Africa with the major objective to develop policies and programs aimed at deepening co-operation in agriculture, livestock and fisheries for the mutual benefit of all stakeholders. The Association aims at promoting regional collective action in research for development, extension and training, for enhancing economic growth, fight poverty, eradicate hunger and increase productivity.

The association has the overall goal of enhancing sustainable productivity, value added and competitiveness of the sub- regional agricultural, livestock and fisheries systems. In collaboration with Lake Victoria riparian states of East Africa i.e. Kenya Tanzania and Uganda ASARECA has implemented a project *"Building Public Private Sector Partnership to Enhance the Productivity and Competitiveness of Aquaculture in the ECA Region"* with the purpose to:

- Improve aquaculture technologies and market innovations.
- Improve policy options for aquaculture development.
- Strengthen capacity for gender responsive aquaculture research for development in the ECA region.
- Enhance access to information on aquaculture.

The project conducted a value chain baseline survey that collected basic information on selected aquaculture value chains of Nile Tilapia *Oreochromis niloticus* and African catfish *Clarias gariepinus.* The survey has provided a full range of information of all key chain participants of fish farming and has formed the basis for interventions in the coming phase.

**The Lake Victoria Research (VicRes) Initiative**

The Lake Victoria Research (VicRes) Initiative is a regional collaborative-multidisciplinary research programme of the Inter-University Council for East Africa (IUCEA).

It was established in 2002 following consultations among scientists, senior administrators and other experts drawn from Kenya, Uganda and Tanzania and, staff of Sida/SAREC. It is funded by the Government of Sweden through the Swedish International Development Cooperation Agency (Sida) under the framework of the Lake Victoria Development Partnership (LVDP) Programme. VicRes

provides support to Universities and research institutions to undertake multi-disciplinary, gender sensitive and regional research to enhance the scientific understanding of the poverty-environment nexus through generation and dissemination of information and technological innovations. VicRes awards research grants on a competitive basis open to researchers in universities, research institutions and government agencies in the East African Community (EAC) Partner States. The programme is implemented through a regional coordination office located in IUCEA secretariat in Kampala, Uganda.

# Annex 7 Pond and Cage distribution Rwanda

| Distribution of ponds per District | | | | |
|---|---|---|---|---|
| **Northern Province** | **District** | **No of ponds** | **Total area (ares)** | **Average area (ares)** |
| | Gakenke | 14 | 190.75 | 13.63 |
| | Rulindo | 79 | 1095.1 | 13.86 |
| | Musanze | 25 | 238.4 | 9.54 |
| | Burera | 27 | 290 | 10.74 |
| | | 145 | 1814.25 | 12.51 |
| **Western Province** | | | | |
| | Nyabihu | 48 | 306.89 | 6.39 |
| | Ngororero | 21 | 246.1 | 11.72 |
| | Rutsiro | 5 | 42.68 | 8.54 |
| | Rubavu | 8 | 60 | 7.50 |
| | Karongi | 25 | 259.8 | 10.39 |
| | Nyamasheke | 86 | 546.56 | 6.36 |
| | Rusizi | 72 | 438.2 | 6.09 |
| | | 265 | 1900.23 | 7.17 |
| **Southern Province** | | | | |
| | Gisagara | 72 | 852 | 11.83 |
| | Huye | 101 | 634.3 | 6.28 |
| | Nyamagabe | 10 | 59.3 | 5.93 |
| | Nyaruguru | 28 | 237.6 | 8.49 |
| | Nyanza | 26 | 476 | 18.31 |
| | Ruhango | 42 | 469 | 11.17 |
| | Muhanga | 79 | 644 | 8.15 |
| | Kamonyi | 31 | 288 | 9.29 |
| | | 389 | 3660.2 | 9.41 |

Figures are related to farms that were assisted by PAIGELAC project.

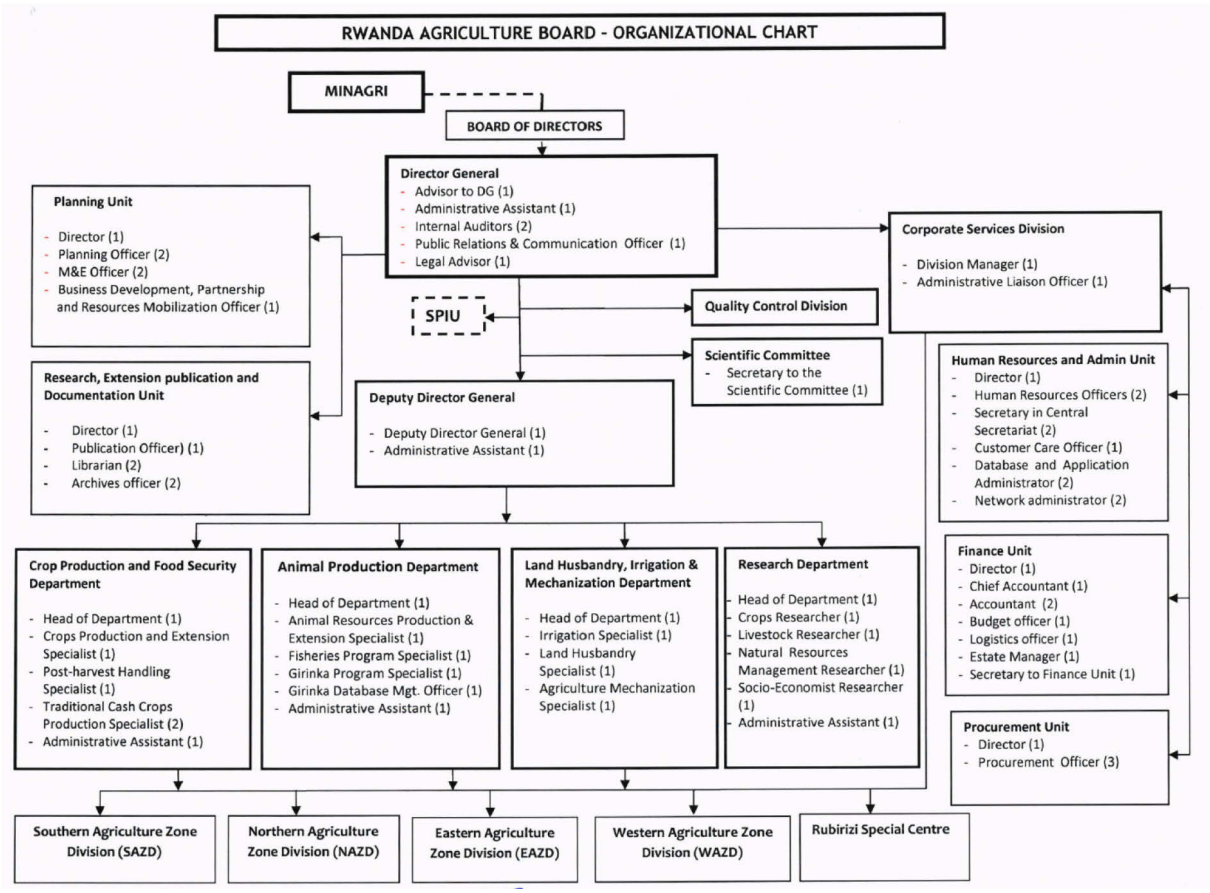
*Distribution of cages per District.*

| Name of the Lake | District | Number of cages | Total volume cubic meter |
|---|---|---|---|
| Kivu | Karongi | 50 | 400 |
| | Nyamasheke | 50 | 400 |
| | Rusizi | 50 | 400 |
| | Rubavu | Not specified | - |
| Burera | Burera | 195 | 1660 |
| Ruhondo | Burera | 130 | 1040 |
| Muhazi | Rwamagana | 20 | 240 |
| Total | | 495 | 4140 |

# Annex 8 Fish prices Rwanda (August 2014)

| Butchery (imported from Alpha choice) | RWF/KG | EURO/KG €1=RWF926 | |
|---|---|---|---|
| Whole tilapia | 2,500 | 2.70 | Frozen / Uganda |
| Pangasius steaks | 3,300 | 3.56 | Frozen / Vietnam |
| Mackerel | 2,500 | 2.70 | Frozen / Japan |
| Nile Perch fillet | 5,500 | 5.94 | Frozen / Uganda |
| | | | |
| Beef | 1,900 | 2.05 | KG |
| Chicken | 4,000 | 4.32 | KG |
| | | | |
| TUFMAC United Ltd ( gathered from company owner, September 2013) | | | |
| Fresh iced Tilapia | 2,600 | 2.81 | Uganda |
| Fresh iced Nile Perch | 2,600 | 2.81 | Uganda |
| Fresh iced Tilapia | 3,000 | 3.24 | Rwanda |
| Tilapia fillet | 3,500 | 3.78 | Uganda |
| Nile Perch fillet | 3,800 | 4.10 | Uganda |
| Tilapia and Nile Perch high grade fillet | 4,000 | 4.32 | Uganda |
| Fresh iced Thompson | 2,400 | 2.59 | Uganda |
| Fresh iced Sardine | 2,000 | 2.16 | Uganda |
| Fresh iced Mirama | 1,000 | 1.08 | Uganda |
| Imikeke | 5,000 | 5.40 | Burundi |
| Makayabo | 4,200 | 4.54 | Tanzania |
| | | | |
| KIMIRONKO market | | | |
| Tilapia Whole 500 grams | 3,000 | 3.24 | Rwanda |
| Tilapia Whole 250-450 grams | 2,700 | 2.92 | Rwanda |
| Tilapia Whole 1000 grams up | 3,000 | 3.24 | Uganda |
| Mackerel frozen | 2,500 | 2.70 | Japan |
| Pangasius fillet frozen | 4,000 | 4.32 | Vietnam |
| Nile perch fillet frozen | 5,000 | 5.40 | Uganda/Tanzania |
| Nile perch whole frozen | 3,200 | 3.46 | Uganda/Tanzania |
| Dried sardines | 10,000 | 10.80 | Tanzania / Uganda / Rwanda |
| | | | |
| Supermarket | | | |
| Beef without bone | 2,800 | 3.02 | |
| Beef with bone | 2,400 | 2.59 | |
| Local chicken | 4,000 | 4.32 | |
| Imported chicken | 3,200 | 3.46 | |
| Nile perch fillet | 5,500 | 5.94 | |
| Dagaa | 10,000 | 10.80 | |
| | | | |
| Importer price | | | |
| Pangasius steaks frozen | 2,760 | 2.98 | |
| Nile perch fillet frozen | 4,700 | 5.08 | |
| Whole tilapia frozen | 1800-2150 | 1.94-2.32 | |
| Mackerel frozen | 1700-1800 | 1.84-1.94 | |
| | | | |
| Farmgate prices | | | |
| Tilapia fresh <500 grams | 2,000 | 2.16 | |
| Tilapia fresh >500 grams | 2,300 | 2.48 | |

# Annex 9 The organisation structure of the Rwanda Agriculture Board (RAB)



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IMARES C153/14
LEI 14-120
ISSN 2352-4243

LEI Wageningen UR carries out socio-economic research and is the strategic partner for governments and the business community in the field of sustainable economic development within the domain of food and the living environment. LEI is part of Wageningen UR (University and Research centre), forming the Social Sciences Group together with the Department of Social Sciences and Wageningen UR Centre for Development Innovation.

The mission of Wageningen UR (University & Research centre) is 'To explore the potential of nature to improve the quality of life'. Within Wageningen UR, nine specialised research institutes of the DLO Foundation have joined forces with Wageningen University to help answer the most important questions in the domain of healthy food and living environment. With approximately 30 locations, 6,000 members of staff and 9,000 students, Wageningen UR is one of the leading organisations in its domain worldwide. The integral approach to problems and the cooperation between the various disciplines are at the heart of the unique Wageningen Approach.

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