

# Decent Jobs for Youth and Improved Food Security through Development of Sustainable Rural Enterprises Programme



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Analysis of market system underpinning the Fish Value Chain in Zambia

A study carried out by the WorldFish Centre(Lusaka) for the International Labour Organisation

# Decent Jobs for Youth and Improved Food Security through Development of Sustainable Rural Enterprises Programme

## ANALYSIS OF MARKET SYSTEM UNDERPINNING THE FISH VALUE CHAIN IN ZAMBIA

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## EXECUTIVE SUMMARY

The following study is supported by the ILO and describes the fish value chain in Zambia. It further explores areas of growth able to generate youth employment and increase food security in Zambia through the development of the aquaculture sub-sector. It is part of a larger approach that also includes the soya value chain, another key agricultural activity being promoted in the country. The aquaculture industry is largely dependent on soya that provides excellent vegetable proteins that has the capacity to substitute the natural animal proteins in fish diet. The soya and aquaculture value chains are therefore closely linked and their simultaneous examination is relevant.

This report presents the findings and analysis of WorldFish on the fish value chain in Zambia. It has been conducted by a team of five experts covering both technical, social, financial and marketing aspects of the fish value chain. It is the result of documentation review, two weeks field work in Zambia and several meetings and workshops.

In the fish value chain, the focus of the study is the aquaculture sub-sector<sup>1</sup>. In Zambia, the fisheries value chain provides a livelihood to about 55.000 fishers, processors and traders. However, the natural resources are fully exploited or over-exploited in some cases. The development potential and further employment opportunities are therefore limited in the capture fisheries sector. On the other hand, aquaculture is under-developed while offering good potential in Zambia thanks to its abundant water resources in various regions of the country.

The study confirms that the aquaculture sub-sector shows positive trends in terms of production as a result of a strong market demand, the entrepreneurship of the private sector and the support of the Government of Zambia.

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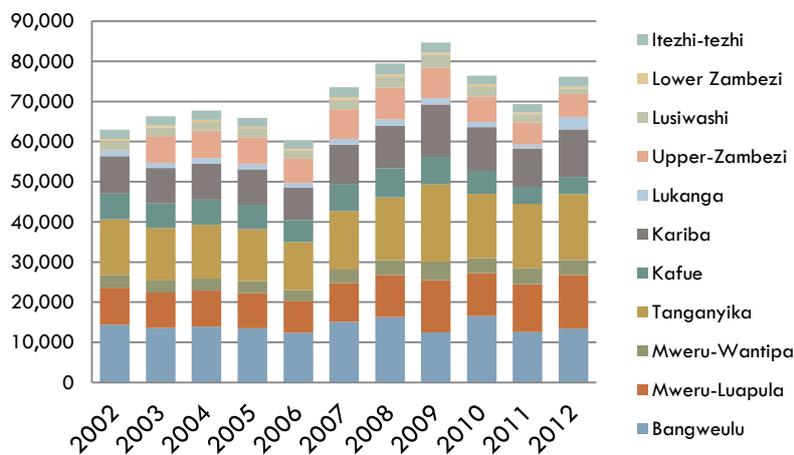
<sup>1</sup> The fisheries sector can be divided into two sub-sectors: aquaculture and capture fisheries. Aquaculture produces farmed fish (grown in either floating cages on lakes or in ponds), whereas capture fisheries produces captured or wild fish.

The study and recommendations concern, and focus on, commercial aquaculture as a source of employment rather than subsistence aquaculture.

## GENERAL OVERVIEW OF FISHERIES AND AQUACULTURE SITUATION IN ZAMBIA IN ITS REGIONAL CONTEXT

Thanks to its generous natural resources, the actual production from *capture fisheries* in Zambia is estimated at 75.000 t of fish per annum (2013). With a population of 14 million, fisheries should provide about 5,3 kg of fish per capita per year. Capture fisheries have remained in the range of 60.000 to 85.000 tons per annum (tpa) from 2002. The Illegal Unreported and Unregulated (IUU) captures are obviously more difficult to evaluate, but add to the fish production offer in the country.

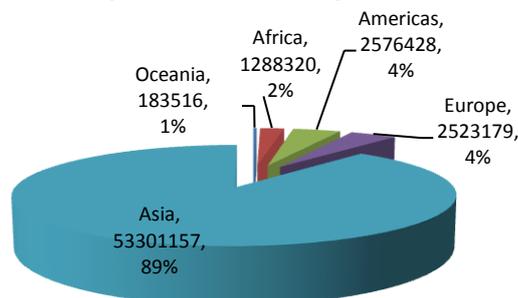
**Table 3: Zambia's Captured Fish Output in tonnes**



It is commonly agreed that the fishing effort on the wild stock cannot be increased and that capture fisheries yields have reached their full potential.

*Aquaculture* in Africa is finally blossoming since about a decade ago but still represents a modest proportion of the world aquaculture production. The pie chart below shows the share of each continent in terms of aquaculture production. Africa accounts for 2%, but Sub-Saharan Africa represents around 0,6% (as Egypt accounts for a large part of 2%)

**Table 5: Aquaculture Vol in 2010 by Continent**

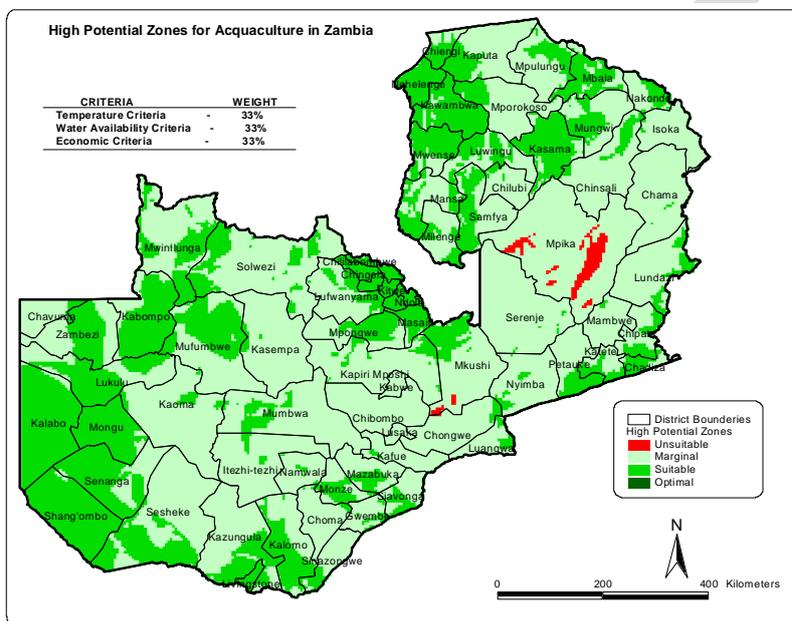


The aquaculture growth potential in Africa is however considerable and, in that context, Zambia is blessed by its natural resources that are favorable to both crop growing and aquaculture development, thanks to its climate and water resources.

Although the water resources are abundant in the country, the temperatures vary significantly as a function of altitude. Under these latitudes, the best temperatures for tilapia and catfish are found below 1000 m in the Zambezi valley, the Luangwa river and the Lake Tanganyika. Most Zambian waters are sub-optimal temperature for tilapia and catfish. The winter effect is also more pronounced with altitude.

The implications are that tilapia and catfish won't breed all year long, and that their growth will be adversely affected during cold times. Breeding activity will decrease with temperature and will stop below water temperatures of 22°C. Growth performances will be optimum at water temperatures of 27-29°C. When temperatures get to 20°C or less, the fish growth becomes very slow. The aquaculture sub-sector is still under-developed in Africa. In certain countries, it is almost non-existent.

The conclusion of the above is that Zambia has good potential, but the sites must be selected carefully so that the optimal regions are targeted first. Although this sounds common sense, many aquaculture projects in Africa have been developed in areas with low potential for growth.



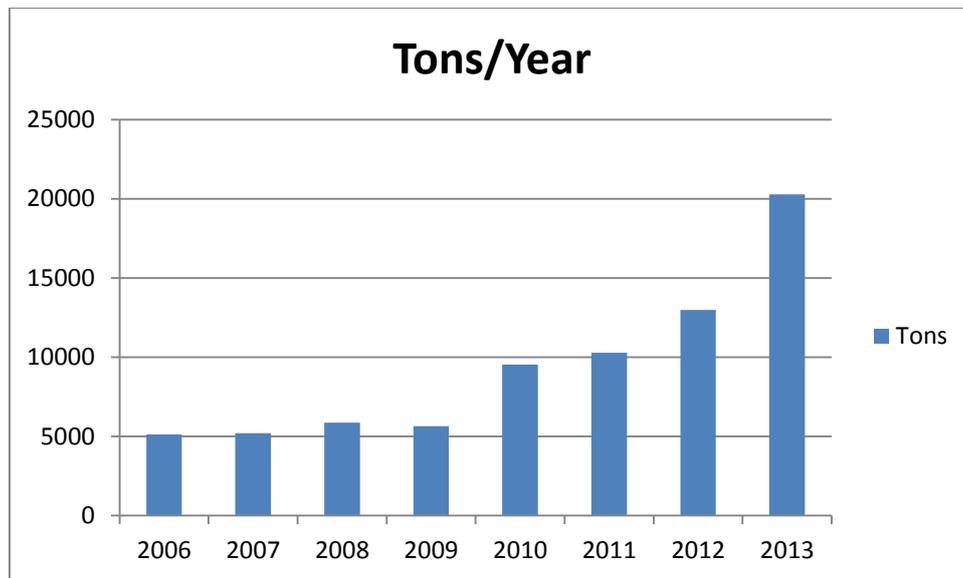
Source: National Aquaculture

Development Plan Overcoming the Slow Growth of Aquaculture in Zambia 2009-2011 DOF Chilanga

The map above shows that there are no optimal areas for tilapia in Zambia all year long, however, many are suitable and represent a considerable production potential. The optimal condition for tilapia farming is constant water temperature all year long set at 28/29°C; this can only be found in specific low areas in equatorial regions.

Despite absence of perfect water temperature conditions, one could state that Zambia has potential to produce all the fish that is needed and more within the country. Zambia has near optimal conditions in many low-lying parts of the country. Zambia has also the potential to grow other types of fish that perform well at lower temperatures such as carps, if the market could be developed.

In Sub-Saharan Africa, Zambia is reported to have a good potential aquaculture output of 0,79 kg/capita as, though this figure is considered to be out of date. As per the figure available today, Zambia would be at 1,42 Kg/capita if the 20.000 t of production in 2013 are confirmed.



The above graph shows the aquaculture production over the last 8 years as reported by the Department of Fisheries. It indicates a clear positive trend.

**Aquaculture Output in Kg per capita by Key African Producer 2010**

Country	kg per capita
Egypt	11.34
Zanzibar	3.84
Uganda	2.84
Nigeria	1.27
<b>Zambia</b>	<b>0.79</b>
Madagascar	0.53
Ghana	0.42
Kenya	0.30
Zimbabwe	0.21
Malawi	0.21
Tanzania	0.16
<b>Africa</b>	<b>1.64</b>

Source: Fishery & Aquaculture Statistics FAO Yearbook 2010

In the table above, there are 2 remarks to be made: 1) Zanzibar’s production is almost entirely made of seaweed, 2) Uganda’s production is known to be largely inflated.

The above table indicates that Zambia is amongst the most dynamic countries as far as aquaculture development in Africa is concerned. It shows a positive trend that has been perceptible during the field visit and it indicates that the country has already the basis on which to build on.

Zambia is very well positioned to be a centre for fresh water aquaculture in the region. Many of the neighbouring countries have unrealized aquaculture potential for which Zambia could be a hub.

**DEFINITION OF THE FISH VALUE CHAIN SYSTEM IN ZAMBIA**

“A **value chain** is a chain of activities that a firm operating in a specific industry performs in order to deliver a valuable product or service for the market. The concept comes from business management and was first described and popularized by Michael Porter in his 1985 best-seller, *Competitive Advantage: Creating and Sustaining Superior Performance.*” (Wikipedia)

The fish value chain represents the different steps of production of fish or fish products. In the present report, we restrict our study to the fish destined to human consumption, being from wild/capture or farming activities with a specific emphasis on the latter. Capture fisheries and aquaculture products do not follow exactly the same value chain, but share some of its links. In the present study, we will emphasise the aquaculture value chain since this offers better prospects than capture fisheries in respect of development, sustainability, employment creation and food security.

## Fisheries value chain

From the interviews of fishers on Lake Kariba, it is clear that wild fish stocks are on the decline. This manifests itself as lower harvested volumes and a decrease in fish sizes. It concerns commercial fishing (mainly kapenta – *Limnothrissa miodon*) as well as artisanal fisheries that target a wide range of fresh water fish. The use of monofilament nets is common as it is the most efficient and cost effective while compromising the sustainability of fisheries on the medium to long term.

The kapenta fishery is more industrial and is at the origin of an elaborated value chain where fishers also process their catches (drying) and sometimes pack them in retail packs. From there, the products are distributed through formal channels such as traders, retail shops and supermarket chains. The quality of the product is high but the prices fluctuate with supply and demand, themselves dependent on seasonality. For dry kapenta, the recent wholesale price variation has been from 3,50 to 6,00 USD/kg.

Illegal fishing of kapenta is especially severe in Zambia compared to Zimbabwe. The last frame survey (conducted in 2011) reported a large number of illegal (non-licensed) fishing vessels in Zambia. While the protocol agreed between Zambia and Zimbabwe in 1999 allocated 275 licenses in Zimbabwe and 225 in Zambia, the number of rigs reported was 379 and 719 respectively. This situation is leading to overfishing and the unsustainability of the industry. It also impacts the profitability of the fishing companies, hence a negative effect on employment, economic growth and food security.

Theft on rigs is reported to represent at least 40% of the fishing effort. It increases the Illegal Unreported and Unregulated (IUU) fishing figures, leading to post harvest and/or quality losses.

Various stakeholders confirmed the overfishing situation in natural water bodies. The study does not recommend an increase fishing efforts but rather refers to previous recommendations that advise to take actions against IUU and enforcement of protocols and legislation.

The areas of improvement at post-harvest level are:

- Post-harvest handling within the fishing communities by providing equipment such as dryers, cooling facilities and providing ice in a continuous manner.
- Improved communications to facilitate fish trade.
- Reduce the number of rigs operating on the lake to the agreed levels.
- Taking measures against theft on rigs

## Aquaculture value chain

### Definition

The aquaculture value chain starts effectively with fish breeding and continues with the successive links ending with final consumer eating the fish or fish product. The production of feed especially and other inputs generally are so poorly developed in Zambia that these have also been considered in this value

chain analysis. Aquaculture can also be seen as part of the value chain of certain crops, given that it transforms vegetable proteins into animal proteins, just as the chicken industry does.

### **Identification of strengths and weaknesses**

Of the aquaculture trends in Zambia, the positive elements include:

- Some big operators are developing their production (Yalelo, Kariba Harvest, Kafue Fisheries and Mpende on Lake Tanganyika).
- Community projects, although still at an early stage, are producing fish in cages such as Siavonga Nutrition Group. Others are developing pond farming in the Northern part of the country.
- A number of small holders are reported to come back on a regular basis to purchase new fry batches in hatcheries.
- Stakeholders confirm the interest of individuals, including youth, for aquaculture business
- The value chain is becoming more specialized (feed, hatcheries, grow-out farms, ...). This is an important indicator of development.
- The market for farmed fish exists and is expanding.
- One stop shop for acquisition of cages, fry and feed is available (Savanna)
- Aquaculture Associations are being created (AAZ)
- Aquaculture Policy is being revised.

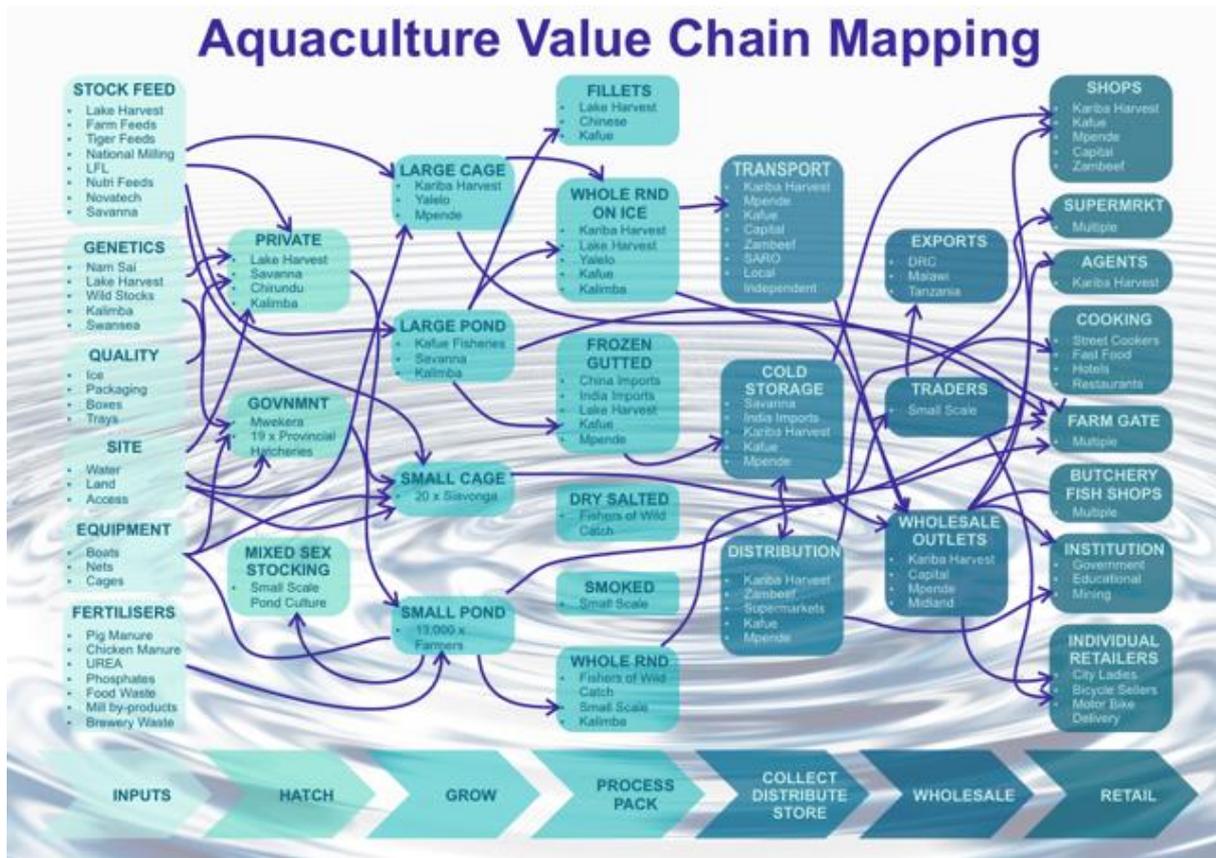
The remaining constraints are:

- Lack of practical skill and experience mainly amongst small stakeholders
- Financial resources remain difficult to obtain
- Fry supplies remain limited and sometimes poor survival rates are observed.
- Feed quality remains unsatisfactory.
- Beneficiary management, i.e. women's group, sometimes difficult (un-equal motivation inside the groups)
- More technical, financial and marketing support would be needed for the community groups.
- Transport and distribution of fish on the markets remain difficult
- Land and water access (site selection) remains a problem, especially for youth.
- Aquaculture policy and strategy might still not being conducive enough.

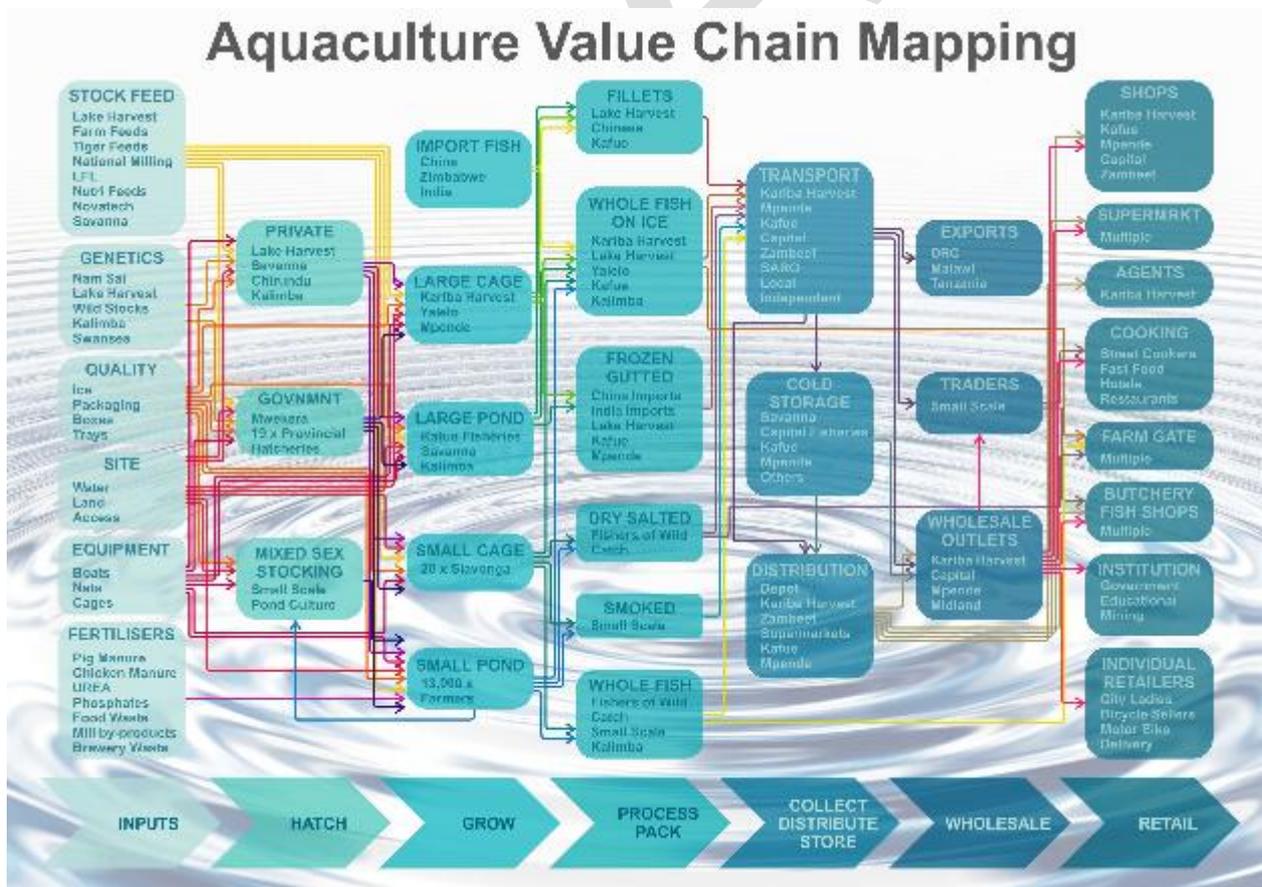
### **Aquaculture Value Chain Map in Zambia**

The Value Chain Map presented here below shows the various links between the stakeholders involved with the aquaculture chain in Zambia, mentioning some of the main actors and their indicative numbers when it is known. The aquaculture VC can be complex and the links can be few or many according to business size, location, etc. These are the 2 drafts that we have at the moment but they will be worked on at the workshop and re-combined in 1 single one for the final report.

Map 1.



Map 2



## Value Chain Links

### 1) Breeding

The first step in aquaculture production is breeding the fish, in the case of Zambia, mostly tilapia species (*Oreochromis* spp), but also some catfish (*Clarias gariepinus*) or carps (*Cyprinus* spp). Tilapia is mainly known as “bream” in Zambia and Zimbabwe. The rearing of tilapia is demand driven as it remains the preferred fish amongst the consumers. It seems that in the consumers’ mind, tilapia is the top choice and then “fish”. As a result, it seems appropriate to focus on tilapia production initially while developing other species with potential. For instance, catfish offers good Food Conversion Ratios (FCRs) and grows rapidly at high densities. Carps would find ideal temperatures in many areas in Zambia that are sub-optimal for tilapia or catfish. However, these species will need a significant marketing effort to penetrate the market.

Hatcheries consist mainly of facilities, such as tanks, ponds, etc. for breeders holding and selection. The hatchery itself is the area where eggs and fry are produced. The hatchery can also include the production of “fingerlings” (juvenile fish) that are grown to a certain size. In fact, “fingerling” suggests that the fish has more or less the size of a finger; practically they can be sold much smaller and, in the case of tilapia, it can just be the size of a nail (1 – 2 g).

Breeding and hatching fish is almost always done on a land based operation, hence implies access to land. Depending on the production targets and the system used (more or less intensive), the activity requires a relatively modest surface area. A couple of hectares and a modest amount of water exchange can be enough to produce a few million fry per year. Under the latitude of Zambia, the determining factor for site selection for a hatchery is the water temperature throughout the year as the non-breeding season must be minimized. Tilapia will breed above a water temperature of 22°C and will be optimal from 27°C. The winter effect will obviously be greater with higher altitudes.

The choice of tilapia species is a tricky issue. Zambia hosts a number of indigenous tilapia species such as *Oreochromis andersonii*, *O. mortimeri*, *O. tanganicae* and a few more. *O. niloticus* is the most reared within the *Oreochromis* species due to its hardiness and growth performances. The “*niloticus*” has been introduced in Zambia decades ago for farming purposes but its use remains controversial as it can have an impact on local species.

In the particular case of Zambia, *O. niloticus* is present in most of the country and its water systems. In the Zambezi basin, the *niloticus* has become abundant as a result of the aquaculture development while its presence is less abundant in the Congo / Tanganyika basin. The position of the Department of Fisheries is to allow the use of *niloticus* in the Zambezi system, including the Kafue, but to encourage the use of *andersoni* and *mortimeri* in the Northern part of the country. *O. tanganicae* is recommended on Lake Tanganyika where *O. niloticus* is formally forbidden. This seems good practice, but it might penalize the producers in the North as compared to producers in the South. This issue has to be addressed and comparative growth trials need to be done or re-done to quantify the economic effects. Moreover, to encourage the use of local species, genetic selection programmes should be implemented to improve the strains of these species. It must be brought to attention that certain parts of the country are already penalized by the lower temperatures compared to the Zambezi valley; the use of less performing species could potentially penalize them further.

Zambia has also allowed the import of improved strains of tilapia from Thailand. These are the Chiltralada strain and the GIFT strains, both being *O. niloticus*. It seems that this introduction has been made with all sanitary precautions as no disease outbreaks have been reported. The introduction of these improved strains is favorable to the farmers as they are proved to be fast growing and presenting good adaptation to intensive rearing. These imports are not risk-free and therefore need to be done under strict sanitary control.

The inputs into hatcheries are mainly high quality breeders (genetic selection) and high quality feed that allows production of healthy fingerlings. Good feed for breeders and fry will have a positive impact all along the fish life in terms of growth performances and health. The quality of feed available in Zambia is still on the low side and needs improvement. Feed impact in the total fish production costs is normally in the region of 70%; this emphasises the importance of having good feed available.

The level of employment in hatcheries is relatively low, but suits both genders. The activity is extremely important in the value chain because, as the upstream activity, it will impact the whole growing cycle of the fish. The quality of the work can significantly impact the businesses downstream and a single hatchery can supply several farmers. It is therefore an area that needs support from the authorities and the donors. From experience, we can extrapolate some figures to state the following:

*In a large hatchery, the ratio of production can be: 1 employee produces 1 to 1,5 million fry per year. One million fry, allowing a mortality of 50% over the whole rearing period and a harvest size of 400 g, could then result in the production of 200 t of fish. In other words, each hatchery employee can be at the origin of 200 t of tilapia per year.*

## 2) Grow-out

Fish grow-out can be performed in various facilities and systems. Facilities can be earthen ponds, liner ponds, concrete tanks, cages, recirculating systems etc. The aquaculture systems are often qualified as extensive (low fish densities), semi-intensive (medium rearing densities), intensive (high densities) and hyper intensive. The systems are adapted to the site conditions and the environment. Zambia offers possibilities to all systems as it has large water bodies as well as rivers.

No one system is preferred; the selection should best suit the site and the operators. It is possible and more sustainable where both large and small operators co-exist and collaborate.

The large operators have the merit to develop the industry and create employment opportunities. By creating an industry, they indirectly create entrepreneurship opportunities for smaller stakeholders as inputs and market opportunities are created. Technology transfer (with good technical skills) occurs through employees and former employees. However, to create this favorable environment, it implies that the big players do not lock the entire value chain and create a monopolistic situation where small holders have no opportunities.

The inputs for on-growing operations are mainly, fry, feed and water. Energy is another input that varies from nothing to high according to the systems used. For example pond farming in flow through system using gravity or cages situated near the shore will require low energy inputs while recirculating systems or large cages situated off-shore will require higher energy consumption.

The employment opportunities in fish grow-out are high, especially in extensive and semi-intensive systems. The level of mechanization will also impact on labor. It would be worthwhile to carefully compare job creation related to the different production systems and to business sizes. We know that investors always look at economy of scales in all aspects of their business including labour. What we observed in the context of this mission and based on the consultants' knowledge, the production per employee in cage rearing systems can vary considerably according to cage sizes and business sizes. The production in tons per employee per year can be from 15 to 50 t. These figures correspond to large farms and include only the people employed to service the facilities. All other jobs such as accountants, management, drivers, mechanics and the numerous other positions to be filled in a large company come on top of these figures. A fully integrated farm would probably have a ratio of 7 to 15 t of fish output per person employed (all positions included).

A possible extrapolation, at this stage, would be that, if large cage farms were developed in Zambia to reach an additional global production of 60.000 t per year, they would create about 6.000 direct jobs.

It is likely that smaller units would generate more employment opportunities due to reduced economy of scale; probably 50% more. The way forward is therefore to find the right compromise between job creation, sustainability, profitability and competition ability of the projects in their economic and social environment.

Grow-out activities suit both genders in most of the tasks. Harvest operations on large scale farms can however imply heavy physical work. The activities do not pose any health risks for people, but good training of certain tasks as well as adequate equipment can reduce the physical efforts (technique for pulling net, carrying water and fish, etc.).

Large enterprises often develop a CSR plan that benefits workers and the community while smaller ones have less opportunity to do so.

### 3) Processing

Processing of fish can be basic, such as icing whole fish, or more elaborate processing fish fillets, or even to prepare ready-to-cook meals. It can also be cooking, smoking, drying, etc. The preferred fish presentation in Zambia is mainly “fresh on ice” which implies very little processing hence low employment opportunities. Dried and smoked fish is also popular in Zambia and Congo, and salted fish is traditionally consumed in Congo. This might offer opportunities for the sale of any future production surplus. However, these types of processing should be seen as a way to preserve value rather than value addition as the selling price of dried or smoked fish will only compensate the yield loss of the process.

Filleting fish for the export market is often seen as an option, but this only applies to large companies targeting sales in Western countries, where a market for fish fillet exists. The export of fish fillets requires large investments in processing plants that meet international standards. Traceability concerns of Western markets will preclude the involvement of small scale farmers, without the introduction of sophisticated systems and infrastructure.

This might evolve with time but we do not see important employment opportunities in fish processing. Regional exports market, for example to the Congo, could however generate opportunities in the future as the exports could necessitate freezing and packing the fish.

The inputs are mainly equipment and tools, clean water, packaging materials, source of energy, etc.

### 4) Storage and distribution

Fish are stored in appropriate facilities, such as cold stores or dry rooms by wholesalers. They are distributed to various distribution channels which can be informal to formal. This link is only a cost (no value addition), and efforts should be made to make this step as efficient as possible by consolidation of volumes.

Inputs are mainly facilities and equipment; sometimes transport.

Employment opportunities are low in this segment. It suits both genders, although heavy handlings operation might have to be done by males. This step is capital intensive.

### 5) Retail / selling

There is a multitude of ways to sell fish. It can be sold in shops, supermarkets, street markets, restaurants, canteens etc.

Inputs are facilities, equipment and energy.

Employment opportunities are high. It is well-suited to both genders with a high proportion of females. The increase in aquaculture production will obviously translate into more opportunities for traders, retailers, street sellers and restaurants or street cooking.

A street vendor will typically sell in the region of 20kg of fresh fish per day. If half of the potential 60,000 tpa were retailed in this manner, it would create over 8,500 vending opportunities.

6) Consumption

Households or public areas.

### Aquaculture production systems

In this chapter, we will describe the main aquaculture systems adapted to tilapia that has the best potential of growth. We will point out the main characteristics of the systems and what they imply for the operators.

#### Pond farming

Pond farming is certainly the most ancient way of growing fish. It is a rather simple system that consists of digging ponds in a way that they can be filled and drained easily with good water quality. The sizes can vary from a few square meters to several hectares. In practice, the size of pond is dictated by the means available to service them both in terms of equipment and manpower. Available data suggest that the size of ponds has decreased in Zambia over the last decade; certainly to ease the management of these facilities. The main characteristics of natural ponds are the following:

ADVANTAGES	WEAKNESSES & CONSTRAINTS
No high technology required	Extensive systems (characterized by low stocking density) have lower production per ha used, as compared to intensive systems.
Can be fed and drained by gravity (no power) if the site is well selected	Predation control can be difficult (frogs, birds, ...)
Accessible to small holders; can be dug by hand	Undesired breeding difficult to control (tilapia)
Possible to avoid formulated feed by using "green water" fertilized by manure and agriculture by-products, including integrated farming.	Low rearing densities (1 – 3 kg/m <sup>3</sup> ) limited by O <sub>2</sub> available (especially at night in green waters).
Possible to cover the whole cycle (breeding, fry production and on-growing) on one farm	Can be exposed to floods

Pond farming is one of the 2 main possibilities to increase fish production in Zambia. There is a unique example of integrated farming in Zambia. Kafue fish farm is certainly the biggest integrated system in the whole continent with a production of 1200 tpa of tilapia alongside the production of 6000 pigs per year. The system is based on water fertilization by pig manure and an additional feeding with formulated feed. The production seems to be optimal with a production of 12,5 tons per hectare per year, but the system requires water aeration at night using electric aerators.

Pond farming production varies a lot with the water availability, the feed used and the complementary aeration by mechanical means. Practically, the production varies from 1 tpa to over 10 tpa according to site conditions and systems used.

### Cage farming

Cage farming in Africa was initiated by large operators in Zimbabwe, Ghana and Uganda. The cages size can vary from a few cubic meters to 3000 m<sup>3</sup> or more. The bigger the cage, the more sophisticated the equipment must be to service them (larger boats with cranes). The main characteristics of cages are the following:

ADVANTAGES	WEAKNESSES & CONSTRAINS
No water pumping.	Good quality formulated feed necessary
High densities possible as O <sup>2</sup> availability is high if cages well positioned (up to >50kg/m <sup>3</sup> )	Risk of losses in case of storm or predation (tiger fish, crocodiles)
Easy monitoring (fish more visible and easy to catch for sampling)	Theft can be a problem. High fuel costs. Difficulty in monitoring activity in remote cages.
No land issue / access	People safety (drowning)
Infrastructures can be built at reasonable cost	Dependence on fry availability, unless self-produced on land.

Cage farming is certainly a excellent option for boosting aquaculture production in a country that has large water bodies like Zambia. It is considered to be a major contributor to the production increase in the next few years.

### Recirculating systems

The Recirculating Aquaculture Systems (RAS) can be described as follows:

The principle is to grow fish in water that is continuously recirculated after being treated to remove solid wastes, toxic gazes and ammonia. Only a small part of water is changed on a daily basis; maximum 10%. The idea is attractive, but it implies a certain level of technology to treat the water and the system relies entirely on power to re-circulate the water and aerate it.

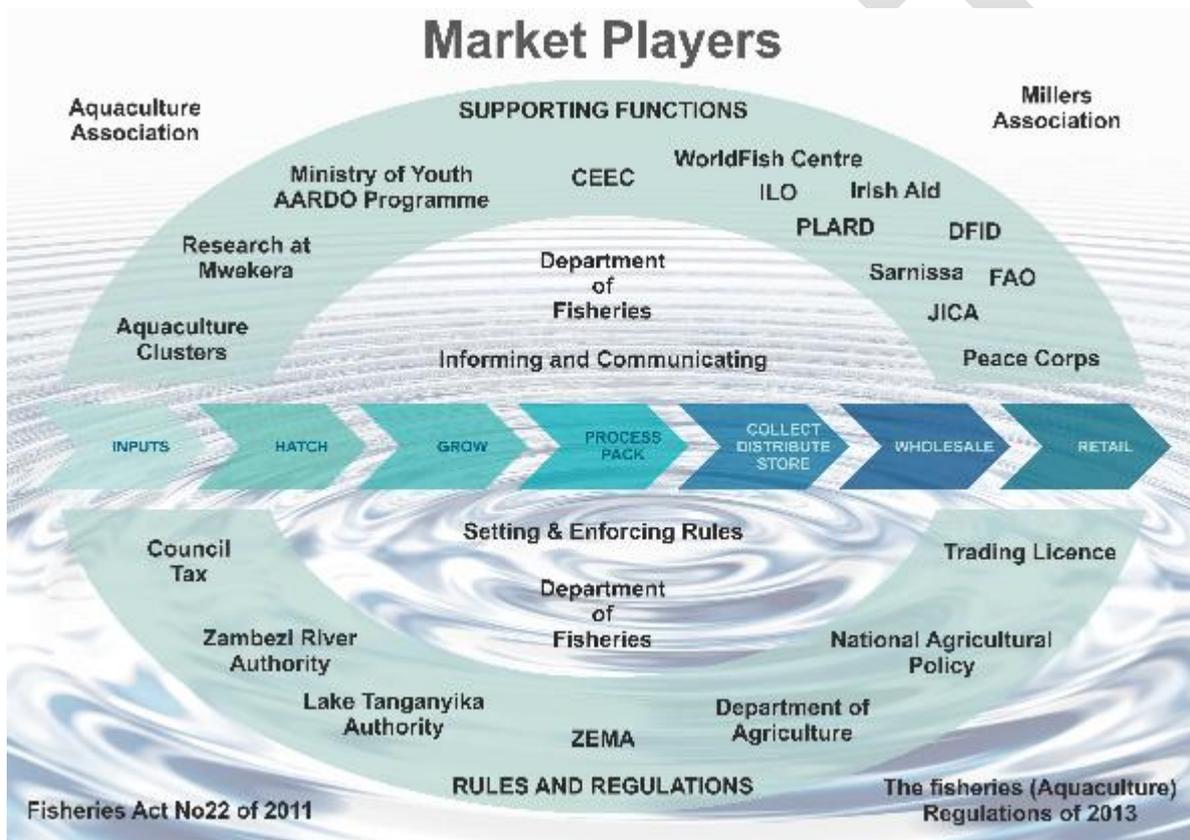
ADVANTAGES	WEAKNESSES & CONSTRAINS
Increase security against theft and predation as often in-house	High quality formulated feed essential
Intensive system, so less labor required	High building and operating costs
Can be developed near market	Entirely dependent on power – risk of fish losses in case of power failure
Possibility of temperature control	High skill of operators
Low volume of water required	High rearing densities necessary to contain costs
Low environmental impact	

There are examples of RAS in Africa, including Zambia, but they are often examples of failures. This is due to poor design, lack of appropriate management, high running costs, power failures etc.

We do not encourage the development of this system for fish on-growing, but it can successfully be used for hatcheries / egg incubation.

This does not mean that RAS has no future. It will develop with time and it will probably become necessary when the use of natural water bodies reaches a sustainable level and additional production is needed. At this point the skills level in country will be significantly higher.

## DESCRIPTION OF THE MARKET PLAYERS' NETWORK.



## LOCAL, REGIONAL AND INTERNATIONAL MARKET ANALYSIS

### Local / national market

The Zambian market is the first target for locally produced fish because Zambia remains a net importer of fish products. Aquaculture development has the primary aim to supply the local population. There are several ways to evaluate the supply gap for fish in a country like Zambia. Let us have a look at some key figures first:

Zambian population (capita)	14.000.000
Fisheries average production (tons/year)	70.000

Aquaculture production (tons/year)	12.000
Fish imports (tons/year)	29.000
Fish exports (tons/year)	137
<b>Net volume of fish available in Zambia (tons/year)</b>	<b>111.000</b>
<b>Net volume of fish available in Zambia kg/cap/year</b>	<b>7.9</b>
Fish consumption – World average (kg/cap./year)	18,5
Fish consumption – Africa average (kg/cap/year)	10
Fish consumption – Zambia (kg/cap/year) 1970's	11.4
Fish consumption – Zambia (kg/cap/year) 2012	6.4
Desired fish consumption (kg/cap/year) - arbitrary	12
<b>Fish deficit (tone/year). Extrapolation</b>	<b>57.000</b>

There is a discrepancy between the consumption figure (kg/cap/year) and the total fish available (kg/cap/year), whereas they should match. It is not easy to determine which figure is accurate, but we can assume that the reality is somewhere in between the two figures.

In the actual situation, to compensate the deficit of fish consumption compared to the 1970's, the aquaculture production should increase by about 60.000 tpa.

The trends on the Zambian demography indicate a large increase of population:

(<http://zambia.opendataforafrica.org/rgoeeab/zambia-demographic-trends>). The population might increase by 10 million by 2030. This is to add to the challenge of aquaculture in the coming years as it demands an additional 120.000 t of fish per annum (assuming fisheries and fish imports remain stable).

The imports of fish into Zambia contribute around \$60M negatively to the country's balance of payments. With the increasing production of soya and other inputs into aquaculture, increased domestic production can potentially reduce this.

The above is a theoretical approach; in reality it would be hazardous to state that the market for aquaculture products corresponds to theoretical gaps. The market for fish is guided by different factors such as the price of other fish and other animal proteins and the buying power of the population. Typically, a commercial fish farmer will need a selling price of around 2,5 USD/kg (at farm gate, not processed) to have a profitable business. We are referring to commercial farms using formulated feed. Other systems such as green ponds farming or ranching with no or little feed inputs can have lower costs, but the rearing cycles are longer and the contribution to food security decreases with low efficiencies.

In Africa, and Zambia does not seem an exception, the benchmark for fish at retail level is chicken. Rarely can the price of fish can exceed that of chicken; if so, it is only by a small margin. So, globally, the fish prices are often comprised between 3,00 to 4,00 USD/kg at retail level and it varies with the type of outlet.

<sup>2</sup> The price noted for tilapia in Zambia at retail level were in the region of 22 to 25 ZMK/kg. Farmers currently sell at about 15 to 18 ZMK/kg.

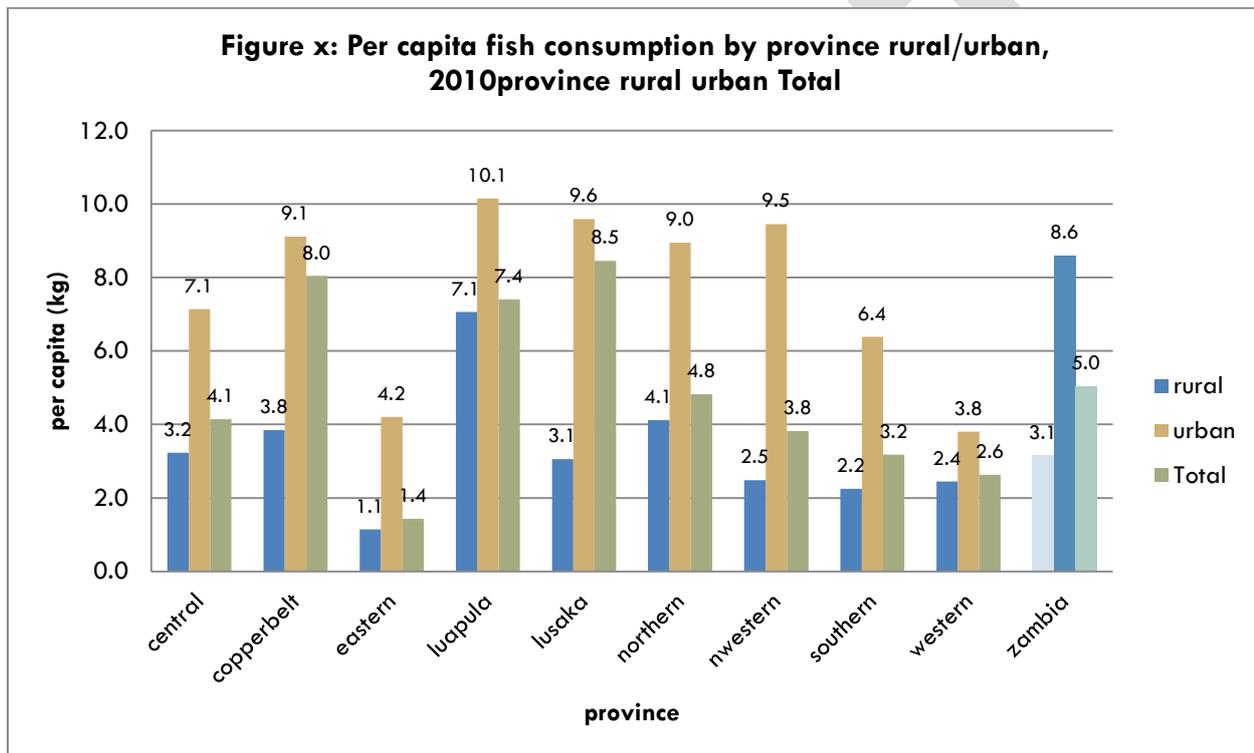
## Fish Demand and Supply- the Zambian market

### FISH DEMAND

Fish demand is estimated using household expenditure on fish collected from the Central Statistics Office (CSO) Living Conditions Monitoring Survey (LCMS) in 2010. The survey collects actual expenditure on food which we converted to quantities using the prevailing prices.

Zambia’s per capita fish consumption has remained low, at about 5 kgs per person (Figure XXX). The data suggest that fish consumption in the country is higher in the urban areas with 8.6 kgs per person, while the consumption in the rural areas is only 3 kgs per person. Fish farms and cages located near large urban areas therefore have competitive advantage of high demand and proximity to markets which are critical for a successful fish farm.

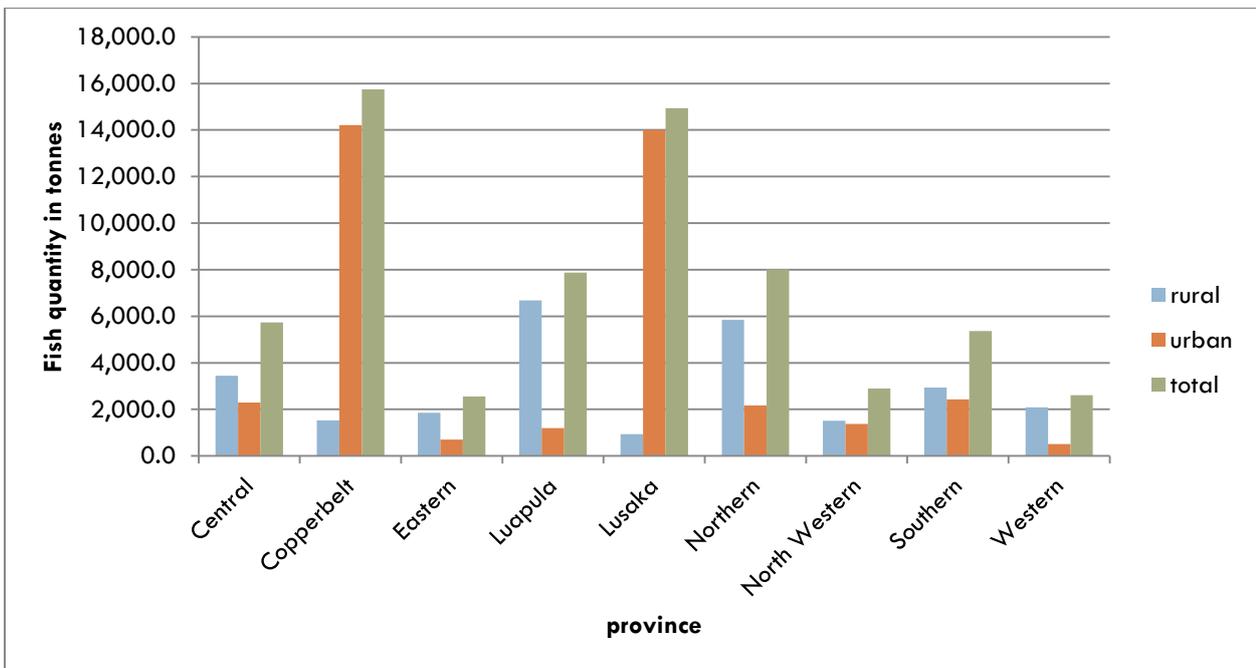
**Figure XYZ: Per Capita Fish Consumption by Province**



Source: CSO LCMS, 2010 and Census of Population 2010

Fish consumption is highest in highly populated provinces of Lusaka and the Copperbelt. Given the presence of the mines on the Copperbelt and other industries in both provinces, incomes are higher compared to the other provinces which in turn increase fish consumption. Rural consumption is higher than urban consumption in all the provinces apart from the Copperbelt and Lusaka provinces. This is not surprising given that that most provinces have very few urban towns. In addition most of the fishing activities are concentrated in the rural parts of the provinces. Eastern province has the lowest consumption of fish, suggesting that fish from the Luangwa river, the only river passing through the province, is mostly consumed in Lusaka.

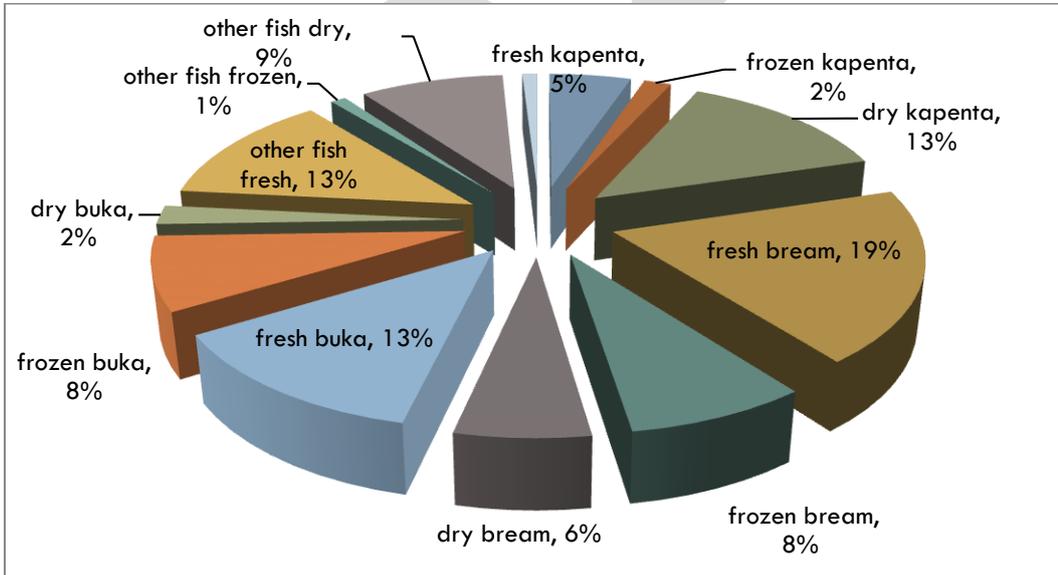
**Figure xxx: Annual Fish Consumption by Province and Location**



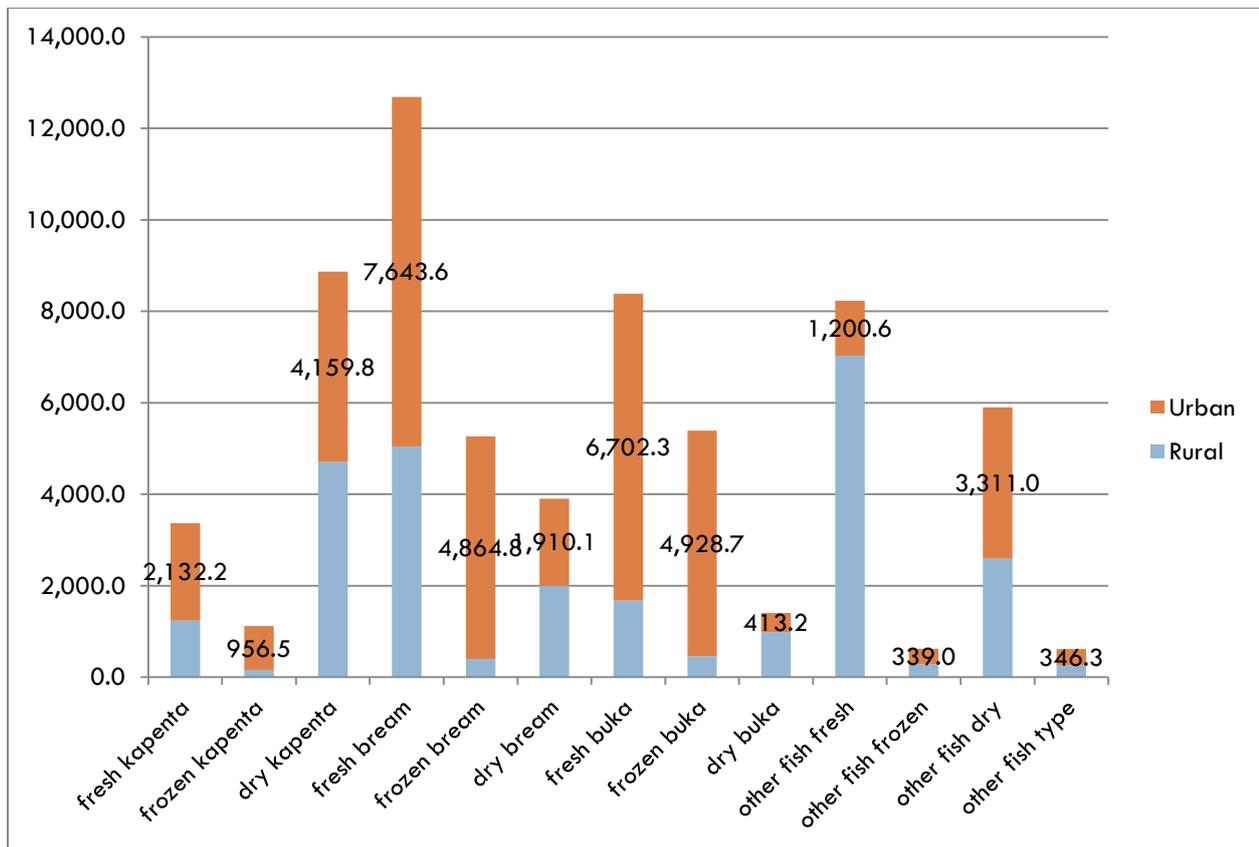
Source: CSO LCMS, 2010

**Figure xxx: Annual fish consumption by fish type**

As expected, taking into account the eating patterns of Zambians, the Fresh Tilapia (Bream) is the most consumed constituting 19% of the total fish consumed.



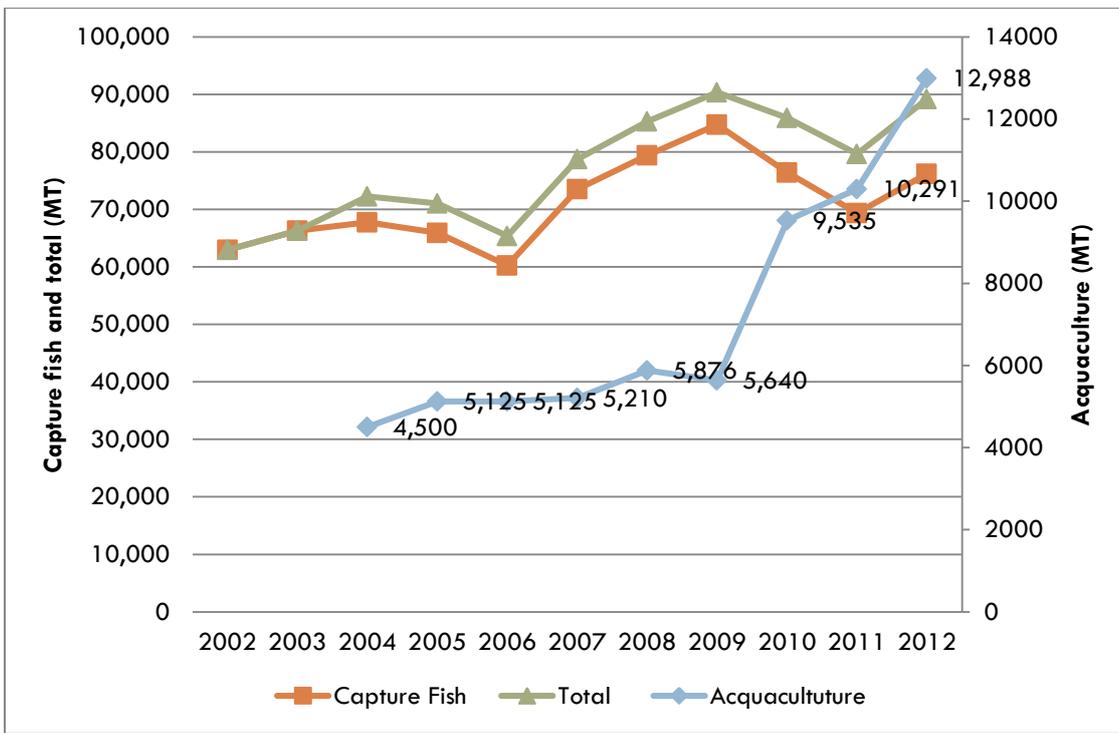
**Figure x: Annual fish consumption by fish type and location**



Source: CSO LCMS, 2012

### FISH SUPPLY

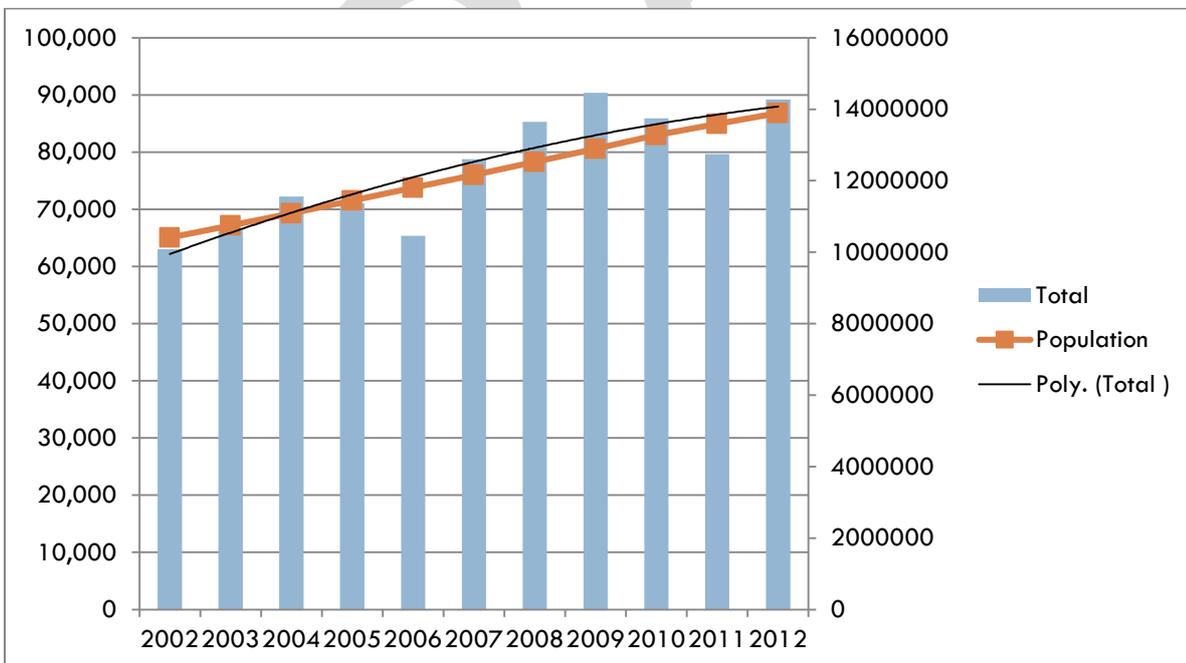
Fish supply is estimated using figures from Frame survey conducted by the Department of Fisheries (Fisheries, 2012). In the last decade, fish production through both aquaculture and capture fisheries has significantly increased from about 4,500 metric tonnes in 2004 to nearly 13,000 metric tonnes in 2012 (Figure XXX).



Source: MAL, Department of Fisheries.

Fish supply in relation to population growth indicates a downward trend of supply in the last four year. Assuming that Zambians consumed only local production without imports, the fish per capita consumption stands at 0.

Figure XXX: Total Fish Production and Population Growth



The seasonal fishing ban from December to March and seasonal reductions in catches affect supplies to urban markets and present opportunities for farmed fish. In spite of these opportunities, there is still little recognition of possibilities open to aquaculture in urban environments. Promotion of fish farming technologies for urban areas is therefore also needed.

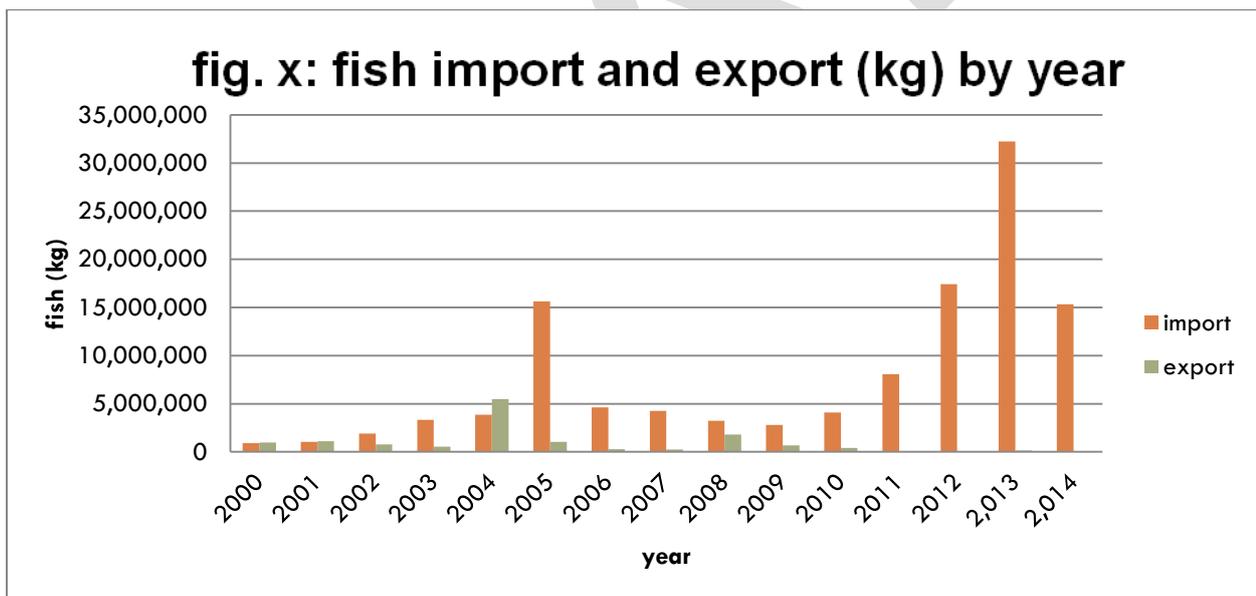
**Table XXX: Fingerling production in 2012**

Station	Number of fingerlings	Value (KR)
Chilanga	-	
Chipata	256, 828 (includes what was stocked at the station)	102, 731.20
Fiyongoli	43, 062	17, 224.80
Misanfu	59, 489	23, 795.60
NARDC	223, 155	89, 262.00
Solwezi	-	
<b>Total</b>	<b>582, 534</b>	<b>233, 013.60</b>

Source: Department of Fisheries, 2013

### Fish Imports and Exports

Zambia is currently importing more fish than it exports which helps to meet the growing demand especially from the urban areas. Most of the imports are from far-east Asia and it is in all different types. Some of the imported fish is processed and then re-exported to other countries in the region. Zambia has potential to produce enough fish for export. Table XXX shows the imports and exports.



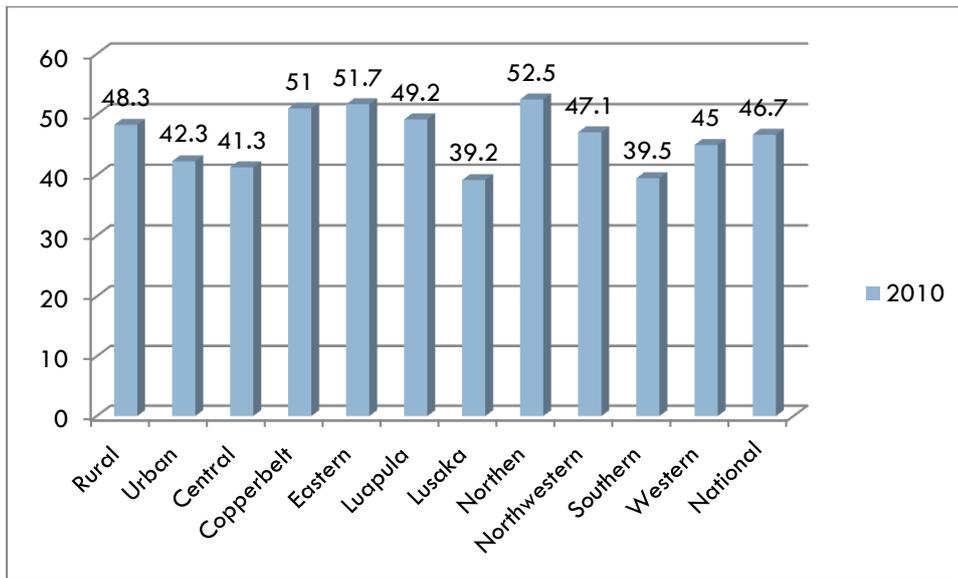
### 1. Potential for Nutrition and Food Security

Zambia is one of the countries in the world with very high malnutrition levels. The rural areas are most hit with stunting levels of 48.3% (Table XXX).

The Eastern Province has the highest levels of malnutrition in the country and the lowest total consumption and per capita consumption of fish. Investing in fish production in the province provides potential to reduce the malnutrition levels. Fish are not only high in protein but also has critical micro-nutrients that are necessary for the health of the body (Table XXX). Such micro-nutrients include calcium and iron.

Unfortunately fish remains expensive because of low availability and most rural households that capture fish mainly sell it and leave very little for consumption.

**Table xxx: Malnutrition Levels in Zambia by Province**



Source: CSO, 2010

**Table XXX: Nutrient composition per 100g of fresh bream Tilapia**

Nutrient	Energy	protein	Fat	Calcium mg	Iron mg	Nicotine Acid	Riboflavin
Fresh Tilapia	91	17	2.6	50	2	1.5	0.05
Kapenta dry	209	65	6.3	3000	8.5	6	0.2
Beef	227	23	15	15	4	3.5	0.2

## Regional market

The main regional markets are the net importing countries in the region. The 2 immediate markets that we know of are the DRC and Malawi where fish deficit is important.

Although these markets are not an immediate target, they can be useful for bordering regions of Zambia if these markets offer a price premium and are easy to access. If the aquaculture industry develops rapidly in Zambia, as it seems to be the trend, these markets will gain importance.

These markets can also be source of foreign currency earnings that are useful to the country and for the exporter.

## International market

The EU or Middle East markets are sometimes targeted by fish producers in Africa. It is the case of the Nile perch being exported from Kenya, Tanzania and Uganda. The attraction of foreign currency earnings is the main motivation as well as the value that the importers are ready to pay.

The other example is Lake Harvest in Zimbabwe that used to export 90 % of its production to the EU under the form of tilapia fillets (fresh or frozen). These exports to Europe have almost entirely stopped in favour of the local and regional markets, Zambia representing 60 – 70 % of sales.

The international markets can be interesting in monetary terms as it sells in strong currencies, either USD or Euros. The downside of these markets is the implication of heavy investments in EU standards processing facilities. The monitoring of product quality represents also constraining procedures and high costs linked to the regular analysis to be performed on products.

Another negative aspect of distant exports is related to the carbon footprint that they generate. The risk of spoilage due to delays and cold chain failures remains present. This sometimes leads to fish wastage and significant financial losses.

Under the present circumstances in Zambia, the exports to overseas markets are not advisable until the local and regional markets are saturated.

## SWOT ANALYSIS OF THE AQUACULTURE VALUE CHAIN IN ZAMBIA

### SWOT analysis on aquaculture development in Zambia

<p><b>Strength</b></p> <p>Water resources and sites availability</p> <p>Appropriate climatic conditions for tilapia (spp) and other species such as catfish and carps farming in some regions</p> <p>The industry has already taken foothold with expansion possibilities</p> <p>Existing fish feed production</p> <p>Availability of local ingredients, especially soya and maize</p> <p>At least two hatcheries selling good quality strains of fry (GIFT).</p>	<p><b>Weaknesses</b></p> <p>Quality feed too low although extruded</p> <p>Some regions are too cold.</p> <p>Distances to markets and poor road network in some places.</p> <p>Low income population</p> <p>Insufficient skill in fish farming</p> <p>Not enough training centres</p> <p>Ambitious aquaculture policy and strategy (?)</p>
<p><b>Opportunities</b></p> <p>Growing population</p> <p>Growing economy</p> <p>Market demand for fish locally and regionally</p> <p>Demand for fish food, hence opportunity for producers (established or new)</p> <p>Existing development of aquaculture is still low</p> <p>Develop a regional market</p> <p>Attracting investors and development</p>	<p><b>Threats</b></p> <p>International competition (Zimbabwe, Asia, ...)</p> <p>Raw material costs increase</p> <p>Finance availability</p> <p>Currency risk</p> <p>Disease from imported fish strains</p>

<p>organisations</p> <p>Preference for fish in local markets.</p> <p>Preference for fish to be purchased fresh</p> <p>Good price for fish</p> <p>Initiatives exist to promote raw material production (soya)</p> <p>Government support (CEEC, AARDO, ..</p> <p>Supporting institutions (ILO, WFC, GIZ, IFAD, FAO, Peace Corp, ...) especially for youth</p> <p>Declining fish supplies from fisheries.</p>	
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### Main bottlenecks to aquaculture development

The bottlenecks to aquaculture development that prevail in Zambia are shared by many countries in Africa.

#### Policy and strategy

The aquaculture policy in Zambia is part of the broader Agriculture Policy. It is currently under review and, although drafted, it cannot be consulted yet as it is still at cabinet level for signature before becoming public. A detailed policy and a strategy form the basis of the aquaculture development in a country.

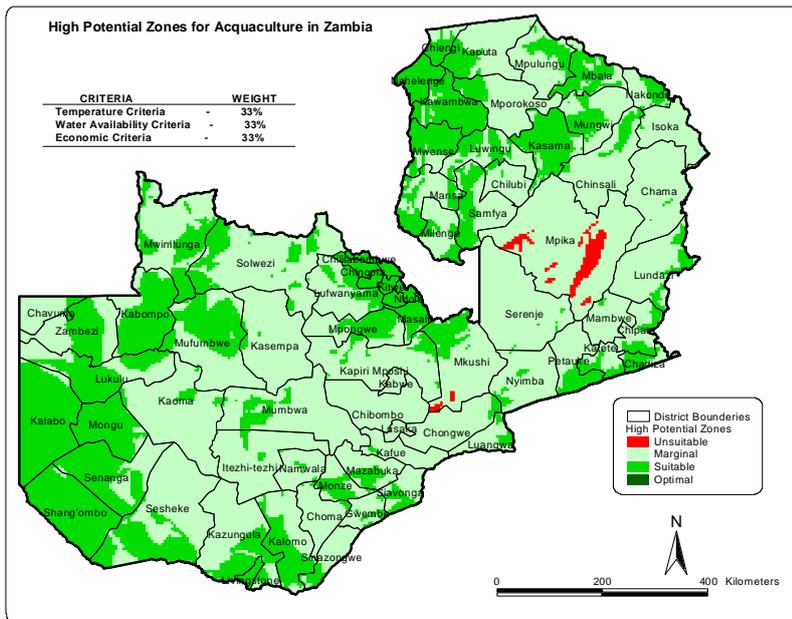
A policy has to be framed by legislation. Zambia has a Fisheries Act (2011) and The Fisheries (aquaculture) Regulations (2013) that provides guidance and rules to develop aquaculture projects.

A realistic and progressive policy and the positioning of aquaculture development as a priority would attract the eligibility to EU finance, for instance via the 11<sup>th</sup> European Development Fund (11<sup>th</sup> EDF), or World Bank funded projects. We are aware of plans for aquaculture development targeting women through a forthcoming World Bank project with the Ministry of Gender. The European Commission's Afro Caribbean Pacific program is also exploring opportunities for entrepreneurially based aquaculture development across the 3 regions.

Asian tilapia is offered at around 1,00 USD/kg Cost and Freight (C&F) to African ports. On the surface this would appear to be unfair competition to locally produced fish. A detailed investigation is warranted to establish if this fish is produced under decent conditions for the workers and with respect to environmental concerns. It is our opinion that this situation compromises the development of tilapia farming in Zambia and other African countries, and that this should be addressed at national and regional levels (SADC, COMESA).

#### Suitable sites

Too many examples of poor locations for fish farms are found in Africa where there are many excellent sites available. The field mission carried out over 2 weeks cannot confirm the situation across the whole of Zambia, but it is necessary to point out this crucial element in the context of this report. There is a need to carry out studies and research on the best suited zones and sites for aquaculture development. The mapping of these sites helps the private sector for their projects location and will prevent them from targeting areas that should be protected or which would not offer long term viability. This mapping exists in Zambia:



Source: National Aquaculture

Development Plan Overcoming the Slow Growth of Aquaculture in Zambia 2009-2011 DOF Chilanga

There are important water resources in Zambia which have sub-optimal temperatures for the rearing of tilapia. Carps are good candidates for these sites that are at higher altitudes with lower temperatures. Carps offer a better tolerance of low water temperatures. Carps are not traditionally eaten in Africa, but no marketing efforts have been made to promote this fish that, besides being cold tolerant, has also very low demand in proteins and can be grown on a wholly vegetarian diet. In order to meet the region's demand for fish in the next decade, it might be necessary to farm these species. The farming of these non-native species needs, however, to be studied carefully to avoid any environmental negative effects.

### Quality seeds (fry and fingerlings)

The seed issue is always raised by stakeholders in Zambia. Good quality seed is one of the keys to the success of a project. Hatchery management is a specialised task that needs a lot of attention and husbandry. Tilapia (*Oreochromis* spp) will preferably be sourced from a good and known genetic strain and will be all male to assure good growth and optimal conversion ratios. Several issues have to be addressed to ensure sustainable aquaculture development in terms of seed production:

- **Quality:** Good genetics are essential and, as for other animals, the notion of certified sources or “pedigree” needs to be developed.
- **Affordability:** The seeds need to be produced economically so that they can benefit the maximum number of stakeholders.
- **Accessibility:** Methods of live fish transport need to be improved.
- **Quantity:** The current production is still low.

The introduction and use of new species or strains always generates tense debates between stakeholders. The use of “improved strains” such as the GIFT tilapia (WorldFish– developed in Asia) or other tilapia such as the “Chitralada” strain are subject to debate in Zambia. The final decision of issuing a permit to a farmer to use particular strains of tilapia belongs to the Director of the Department of Fisheries. This discretionary function is a vulnerability of the system. A change of director could lead to significant changes in policy. Any uncertainty is generally viewed unfavourably by business.

### **Quality feed**

Quality feed is important in semi-intensive systems and essential in intensive systems such as cages. Production of fish feed require specific skills, more complex than chicken or other animal feed. Quality feed can cut production costs dramatically as it lowers significantly Food Conversion Ratios (FCRs), increases survival rates, and speeds up fish growth. The quality of feed in Zambia remains low from the samples that we have seen and interviews conducted. This is a major obstacle to the development of aquaculture as it generates high FCRs and has more impact on water quality.

Fish feed should be formulated with locally available raw materials in order to control costs and reduce carbon footprint. Ingredients such as soya are essential in fish feed formulation so that addressing simultaneously both soya and fish value chain is a good approach.

Feed quality is determined by many factors such as quality of raw materials, good formulation and processing etc. Quality control and certification must be put in place to ensure viability of farms. Feed accounts for 60-70 % of fish production cost and is therefore an essential input.

As for seed, affordability, accessibility and volumes are all essential to meet production targets.

### **Expertise and technical know-how**

Zambia has good academic capacity in aquaculture, but has still few experienced aquaculture technicians. Centres of excellence are needed to ensure training and research. Model commercial farms are also needed to reinforce academic knowledge with practical and managerial training. The trainings must cover technical and managerial aspects as aquaculture projects are complex to operate efficiently and profitably. Centres of excellence and model farms should aim to be self-sustainable up to a certain extent so that they do not entirely rely on public subsidies. In that respect, PPP projects should be encouraged.

### **Financial resources**

Aquaculture is capital consuming as it involves not only a high level of investment in facilities and equipment, but also because it requires working capital to build up a biomass. This biomass corresponds generally to about a third of the annual production of a fish farm i.e. a farm that produces annually 600 t of fish will always hold a standing stock of about 200 t of fish. These 200 tonnes of fish are an immobilised capital.

There is a need to document success stories to give confidence to bankers and other institutions to lend or co-invest with promoters. Guarantee from the Authorities would also facilitate credit extension to the private sector.

There is a need for modelling business plans that suites to financiers' analysis and that can help them to understand the aquaculture business and make credit decisions.

### **Equipment**

As the aquaculture subsector is still under-developed, equipment for fish farming is sometimes difficult to find locally and small stakeholders are not in a position to order equipment from overseas. A value chain approach in the policy will ensure that the area of inputs is integrated. Aquaculture projects should be exempted of duties and VAT for all equipment and construction materials to encourage investment in aquaculture.

## Markets

Zambians like fish, especially tilapia, buka-buka (*Lates spp*) and small fresh water pelagic fish such as kapenta. There is no real marketing effort to be made to convince people that they should eat fish as it is the case in Zimbabwe for instance. The market exists also in the nearby Congo where fish has high demand and where the resources are becoming depleted and aquaculture is under-developed.

In short, the market is not currently a bottleneck as such in Zambia, but access to it might be a challenge. The effort should be made on the sanitary conditions in certain outlets, especially on street markets or along the roads.

Another topic of concern is the competition of Asian tilapia as indicated earlier. At 1,00 USD/kg C&F African port, there is a suspicion of dumping. When the processing, packing and transport of fish in refrigerated containers all the way to Africa is considered, there is not much value left for the fish itself and for the work that has been done to it.

## Conclusion

Failing to benefit from all of the above elements, an aquaculture venture is weakened. Only major investors can develop fully vertically integrated projects that provide solutions for all of these components.

For the development of SMEs, it is important that all of these aquaculture parameters are addressed.

## AREAS OR GROWTH AND SUPPORT TO YOUTH IN THE FISH VALUE CHAIN, WITH PARTICULAR EMPHASIS ON THE AQUACULTURE VALUE CHAIN.

The fish value chain, specifically aquaculture in this case, offers entry points for youth to find decent work and contribute to the food security of their country and above. Aquaculture offers a tremendous potential as it is still a largely under-developed sector. Moreover, the country has important water resources and agricultural potential that are essential to aquaculture development.

The first entry point is situated upstream of aquaculture activities. Aquaculture is situated downstream from the crops value chain, especially soya and maize. Aquaculture activities then induce employment potential for crop farmers. Considering a Food Conversion Ratio of 1,7 ( 1,7 kg of dried feed for 1 kg of fish), every ton of fish produced will require over 1,5 ton of soya and maize or other cereals (as the proportion of vegetal meals represent over 90% of total feed formulation). Every 10,000 tpa of fish produced will require approx. 5,000 ha of soya and 1,500 ha of maize. This represents market for thousands of farmers with small plots of land.

Second entry point is in fish feed production as every 10.000 tpa of fish produced could generate employment for 100 workers in feed plants.

The third entry point for employment creation is in the production of live fish, specifically in the grow-out (fattening) that requires more labour. As indicated earlier every 10.000 t of fish produced in aquaculture will generate employment for 600 to 900 people, globally.

Further down in the value chain, the retail level, including value addition in the case of street cooking and restaurants, represents a fourth entry point. Unlike Western countries where the fish get distributed mainly through supermarkets, Africa offers much more opportunities for individuals in fish distribution and sales.

## RECOMMENDATIONS

In order to meet the two main objectives of the study - the creation of decent jobs for youth and the contribution to the country food security – we believe that all sizes of business need to be developed and co-exist. To meet the actual and future demand, the different production systems (ponds and cages) will

need to be developed. In terms of production systems, we would however discourage the recirculating ones (RAS) for the near future.

## Policy and strategy

We cannot comment on the new aquaculture policy and strategy for Zambia until it is published. Amongst other things, the following topics must be addressed in the policy:

1. Production targets for the region with milestones that can be periodically verified.
2. Strategy to mobilise funds for the subsector.
3. The Policy must encourage projects that are economically sound i.e. production costs and market price driven.
4. Encourage a Regional Aquaculture Network
5. Organise an interface between research and end-users within the country and beyond.
6. Aquaculture policy should express a global vision and goals.
7. Aquaculture Policy must put in place an information and mobilisation strategy of stakeholders.
8. Aquaculture Policy should be revised every 5 years in order to fit with:
  - actual needs of the population;
  - new and appropriate technologies;
  - environmental changes;
  - social changes within the country.
9. Climate change considerations must be integrated at policy level, insisting on the sustainable characteristic that the projects must meet for approval.
10. Monitoring tools must be developed to control the aquaculture activities and the milestones achieved.
11. All commercial aquaculture projects will be subject to the Environmental Impact Assessment (EIA)
12. Small scale aquaculture projects not exceeding certain volumes to comply with the Environmental Project Brief
13. Good Aquaculture Practices should be developed and implemented.
14. Aquaculture Policy should encourage or promote Aquaculture Parks creation in order to ease the entry of smaller scale farmers.
15. Maximum carrying capacity of all major water systems should be carried out in order to preserve the water resources.
16. Areas of particular biological interest (breeding areas, swamps, etc.) must be identified and protected by the Aquaculture Policy.
17. The Aquaculture Policy should adopt a clear position on the introduction of exotic **species** or **strains** of fish.
18. The introduction of GMO fish should be examined in the Aquaculture Policy.
19. The use of GMO crops for production of stockfeeds should be considered.
20. The Aquaculture Policy should encourage the development of programmes for genetic improvement of species (broodstock production) and gene banks.
21. The use of drugs and chemicals has to be regulated, including the use of antibiotics, hormones, fungicides and pesticides.
22. The Aquaculture Policy should also put in place a certification process for fish feed to ensure quality and food safety as well as profitability of fish farms.
23. An animal welfare component should be part of the EAC Aquaculture Policy.
24. Corporate Social Responsibility (CSR) plans should be encouraged for large companies
25. Aquaculture policy should define and document the social requirements of the aquaculture subsector.
26. Gender issues have to be addressed so that the employment of women and youths are encouraged.
27. Information on tax incentives on aquaculture inputs should be widely advertised.
28. The Aquaculture Policy should also envisage the protection of its aquaculture industry from cheap fish, especially tilapia from Asia.

## The recommended systems

Pond farming: natural earth ponds or liner ponds if the soil is permeable but natural clay ponds have to be privileged as liner can generate technical problems. Sizes of ponds have to be adapted to the project and the promoter.

Cage farming is a cheap way to produce fish and is accessible to many people if inputs are available. It needs large water bodies.

There is no size of business to be encouraged, but a minimum production needs to be reached to attain economy of scale and generate enough revenue for a family based business. Units of minimum 10 tpa should be encouraged.

## Aquapark creation:

A good model to explore is the aquaculture park (or aquapark) concept, although it has not been developed yet in Africa, but has successfully been implemented in some parts of Asia (Philippines).

An aquapark is a site that has been identified and designated for aquaculture development. It is generally a large zone on a lake or a river that is dedicated to aquaculture, sometimes in combination with other agricultural activities such as sugar canes, vegetables or crops farming.

It can be a government initiative, but the ideal situation is to have a PPP. The government allocate the land and water use and the private sector develops the activity. There should be some incentives such as duty free imports of equipment or consumables dedicated to the project. A global EIA is performed for the whole site, which reduces the costs for the beneficiaries and therefore gives access to certain stakeholders who would otherwise have had difficulties to develop their project on their own.

The recommended formula would be to have a central farm that produces fry for all the satellite farms. The aquapark system can be created for both pond and/or cage farming. It would be better to start with one and then develop new aquapark projects in different areas in case of success and based on the first experience.

Fish feed production would also be developed on site or nearby in an existing mill if the occasion arises.

The central farm would be used as a training and research base for the aquapark. The central farm would have to offer a technical assistance and business monitoring for a couple of years to the satellite farms in order to optimise the success of the operation.

An aquapark requires important financial resources to be invested in the central farm and its satellites farms. The finances sourcing should be done for the whole project, in partnership with a local or international development bank.

The aquapark would also offer a marketing service to satellite farms, especially if the aquapark is distant from its markets.

The concept would need to be developed further and the above is to give some ideas on a possible way to promote aquaculture.

## ANNEXES

### Notes from field trip

**Monday 19<sup>th</sup> May**

**Séverin Mellac EU Delegation – Harare, Zimbabwe**

The EU has a programme in Zimbabwe for Natural Resources Management and Food Security . This is divided into three programmes – Forestry, Tourism and Fisheries & Aquaculture. The Fisheries and Aquaculture is a 4 year programme with over €4M granted to the development of fish farming.

The EU also has a regional programme for fisheries integration and harmonization in the EAC. This is looking at both policy / legislative issues and initiatives to engage with the private sector, as well as building capacity of Government Staff

The purpose of the visit was to understand the scope of the fisheries and fish farming initiative in Zimbabwe and to ask if there is a regional dimension to it.

The focus of the initiative in Zimbabwe is targeting the poorest famers in areas that are the most in need. There is a community development aspect to the programme and while it is still in early stages, there could be valuable lessons to be learned from this once up and running.

There is no current initiative for regional policy for the fisheries or fish farming industries. The 11<sup>th</sup> EDF is still open to the end of 2014 and proposals would likely be welcome to the SADC member in charge of fisheries at SADC Headquarters in Gabarone. See the SADC position attached.

## **Monday 19<sup>th</sup> May**

### **Kirstine Primdal**

#### **ILO – Harare, Zimbabwe**

The ILO has conducted several initiatives for fish farming in Zimbabwe. These have included a pond system in Norton, which was owned by a group of 25 youth. The programme was not a success for several reasons. The fry supplied were not of great quality. The land identified as being suitable was owned by a politician which lead to all sorts of complications, including the diversion of resources.

The feed supply was, however, the major constraint for the programme. The quality was appalling and what was delivered was too little too late.

There was also a lack of technical ability. This is typical of most of eastern and southern Africa, where there is not the culture of fish farming as there would be, for instance, in Asia.

While it is recognised that a scheme with a single owner would stand a much higher chance of success, it is not possible to have so much invested into a single person. It is more important for these programmes to show that they are reaching the maximum number of people, even if that means compromising the likelihood of a successful outcome.

## **Tuesday 20<sup>th</sup> May**

### **Nesbert Mapfumo, Nitma (Pvt) Ltd - Kariba, Zimbabwe**

Nesbert has a Kapenta fishing company with 11 rigs, as well as drying, freezing and fish trading company. He has grown his business through profits. Nesbert is also the chairman of the Kapenta Fishers Association in Zimbabwe.

Over the past two to three years Nesbert has seen a depletion of the kapenta catches in Lake Kariba. Originally, Nesbert was like every other Kapenta fisherman, with one rig sun drying his kapenta on racks. This used to be a good enough business and allowed him to slowly build up his business. Concerned with theft, he would take care to have a member of his own family on every rig, to ensure that the catch was not being sold.

In years gone by it was not unusual for a rig to catch over 500kg on a single evening. Now (in winter) a rig will return with typically 50kg or in the better season (in summer) 150 to 200kg.

Nesbert had to diversify his business in order to survive. He has been assisted by the SmartFish programme in a few occasions. He purchased a freezer and started to make and sell ice. He has taken fresh kapenta and frozen it to sell in the supermarkets. This frozen Kapenta has a higher margin than dried kapenta. Nesbert has also taken to purchasing tilapia from the fishing camps – both dried and fresh – and trading that with the supermarkets and hotels in Kariba. He has also noted a marked decline in the size and the volume of bream available.

In Nesbert's opinion there are far too many rigs on Lake Kariba. He believes that there are many more fishing today with a license than there ever has been in the past and that the whole licensing issues have become corrupt. His understanding is that in the 80's there was an agreement signed between Zimbabwe and Zambia to limit the number of rigs on Lake Kariba to 275 on the Zim side and 275 on the Zambian side. Nesbert believes that today there are 402 operating the Zimbabwe side and 1,600 operating on the Zambian side. Many kapenta business have gone into liquidation and it is necessary to reduce the number of rigs on the lake to make the industry sustainable.

Nesbert is employing 37 people full time and up to 25 on contract. He is currently investing in a processing room to produce fillets and other value-added products.

#### Some Prices

- Fresh fish from fishing camps – buying \$1.30 selling \$2.50 per kg.
- Dried fish from fishing camps – buying \$1 selling \$3.50 per kg
- Kapenta Frozen Fresh – 200g \$0.60; 400g \$1.20; equiv 3 per kg
- Dried Kapenta - \$6 per kg (was \$5 in Feb/Mar)

**Tuesday 20<sup>th</sup> May**

**Keith Nicholson, Kariba Bream Farm – Kariba, Zimbabwe**

Feed that Keith uses

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Keith is currently using croc feed waste to feed his fish because:

- 1) Keith cannot reliably source quality fish feed from Zambia.
- 2) Keith can get croc feed waste at a very low cost of \$30/ton from the neighbouring croc farm.

While this croc feed waste is cheap, it is not ideal because:

- 1) It is not consistent (too wet or dry)
- 2) There is a lot of wastage
- 3) It contains too much protein for fish

Keith has historically sourced his fish feed from Zambia, where he has paid up to \$1,200 / ton for feed. He is now paying \$700 / ton for low quality Finisher feed, but does not have Starter or Grower. 2 years ago Keith asked Agrifoods to make fish feed, but nothing happened.

He is currently getting a 2.2 FCR on the Nutrifeed product that he uses (\$600/ton).

Feed needs: Keith needs 140 tons of feed for his fish farm.

Fingerling Care and Mortality Rates

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Keith has very low mortality rates on his fingerlings of around 1%.

One of the most important factors in fingerling mortality is water temperature changes, which can lead to fungus disease.

It is also important to take care in moving fingerlings and fry between tanks. Keith drains his fry tanks 3-4 times per day to collect the fry.

Keith also maintains 6 breeding ponds to maintain DNA integrity and prevent in-breeding.

Keith's fish farm

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Set up

Keith believes that tank aquaculture is more profitable than cages in a lake.

Pond setup:

- 35,000 fish per ½ Ha pond
- 3 feeds per day, except Sunday
- 3% body weight in feed given per feeding
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Growth Cycle

It takes a total of 7 months for Keith to grow 1 adult fish:

- 1) Keith's fry take 2 months to grow into 2g, at which point he transfers them to a pond.
- 2) After another 5 months, the fish will reach its 200g final adult weight.

Keith runs his fish farm between October and May, with production stopping in June and July due to the winter season.

Keith believes that he can improve productivity if he had better quality feed:

- 1) Higher stocking density
- 2) Better water quality

Keith wants to move to super intensive tank culture to increase yields:

- 6m diameter, 1.2m deep tanks
- 33m<sup>3</sup> water volume
- Theoretically can yield 60 kg / m<sup>3</sup> (Keith thinks 40kg is more realistic)

#### Keith's fingerling sales

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Keith notes that most of his customers are pretty clueless about fish farming. Unfortunately, there are also very few dedicated places where people can go to learn about effective fish farming.

His customers come from all over Zimbabwe, including as far as Beitbridge and Harare.

His sales fluctuate a lot from year to year:

Last year – 1.5 million fingerlings (large order from Aquaculture Zimbabwe)

This year – ~500,000-600,000 fingerlings

#### Problems getting title to land

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Keith wanted to buy a title deed to his land in 1989. However, he was only able to get title to his land in 2010 after 20 years of legal wrangling. In the mean time he was unable to borrow money because he could not use his title as collateral.

### **Wednesday 21<sup>st</sup> May**

#### **André Zwaga, Yalelo – Siavonga, Zambia**

Yalelo is a new company, which aspires to be one of the largest commercial fish farms in Africa. Unlike the Lake Harvest model, Yalelo is engaging with the community and intends to develop this further. When the production is able to support it, Yalelo intend to offer fingerlings and feed for sale to third parties and will willingly take part in schemes where the youth are empowered in the fish and fisheries value chain.

They are building a large 25ha hatchery with lined ponds. The genetics come from Tim Fuller in Chirundu Bream Farm and from Keith Nicholson at Kariba Bream Farm. From the hatchery the fish are taken to 25m diam floating cages. These cages are some way off shore.

Yalelo is already supporting a community project at Lake Bangwela. This is expected to produce several 100t of fish.

At the moment, Yalelo is not purchasing its own feed. It was getting from Coppens in Holland – but that proved to take too long and was too expensive. Similarly from Mauritius – the feed was just at its best before date by the time it arrived on the farm. The feed is being purchased from National Milling and Savanna. These are not able to produce pellets below 4.5mm. Farm Feeds in Lusaka has also begun to produce feed (CP 38%) but it is not of great quality either.

Feed supply is a serious problem.

The plan is this year to produce 1,000t and currently employs around 150 people. The intention is to continue with expansion, which will lead to more employment. Expected production is to be 7,000t by 2016 and to expand even beyond that.

The majority of the produce is being sold to “City Ladies” in Lusaka who purchase 5 or 10kg at a time and take this away in baskets to be sold. They are currently paying between K15,500 to K16,000 per kg (c. \$2.30 per kg).

This year Yalelo has produced 6.5M fry for its own use.

The business is currently short of cash and is trying to raise more finance.

## **Thursday 21<sup>st</sup> May**

### **Malcolm Dimuna - Siavonga Nutrition Group, Zambia**

Musuka is the Project Coordinator. Malcolm has been the project officer for 2 years. He was previously working in the ministry of

The Siavonga Nutritional Group [SNG] is an NGO in Siavonga town. They have several projects on going – including the Kariba Women’s Fishing Projects. This was originally supported by Self Help Africa and MAEF. The funding has dried up however, but the SNG has secured some small amount of government funding.

There are two groups, Kabyobylo with 23 women participating and Buyantashi with 12 women participating.

Both projects consist of a set of 4 cages. The first cycle was funded and consisted of the cage infrastructure, the fingerlings (from Chirundu) and enough feed to see the cycle through to harvest. The fish were then sold to a local trader for K14 per kg who then on-sold the fish.

This first cycle was funded by Self Help Africa. This funding ended.

The project originally started with cages of 3 x 3 x 4m. These were locally built and were stocked by with 7,200 fry from Chirundu Bream Farm. The feed came from National Milling.

Subsequently, the project has sourced government finance through a project administered by the Department of Fisheries. For this second phase of the project, Savanna Streams has established itself as a key partner in the CEEC programme. It supplies turn-key solutions for small scale projects in the cage culture business. They will supply the cages and nets, the fingerlings, the feed needed for one cycle and the feeding sheets setting out the volumes and timings to optimize growth.

A 3 x 3 x 4m unit complete with anchors, cages, nets, feed and fingerlings will cost K36,059 (\$7,200 at FX 5.0). The project officer Malcolm expressed dissatisfaction at the quality of the units, and of the fingerlings. He was experiencing poor survivals losing over 50% of his placed fingerlings (which compares to less than 5% losses when using Chirundu fingerlings).

The cost of the fingerlings from Savanna Streams and Chirundu to Siavonga Nutrition Group are:

**Chirundu Bream Farm – K0.30 each**

**Savanna Streams – K0.35 each**

Malcolm is also concerned about the cost of the cages. These are very rudimentary cages. The nets, and especially the predator nets, are light material. There is a high risk of further losses through predation. There is also a high risk of short working life of the cages due to their simple and light construction and material choice.

Malcolm considers Savanna Streams to be the best feed available in Zambia. This is a poor indication of the state of the aquafeed industry of Zambia. The feed ingredients were poorly milled. The gelatinization of the starches was poor. There was a strong smell of poultry meal, which is an indicator of the use of feather meal in the diet – which is a difficult ingredient to get available protein from. The fact that the feed floats combined with the poor gelatinization would indicate a surprisingly high level of carbohydrates in the diet. All-in-all the feed will be giving sub-optimal results.

The cost of the feed to Malcolm from Savanna is:

- Fry Meal 47% CP 50kg – K350
- Crumbles 42% CP 50kg – K320
- Starter 35% CP 50kg – K300
- Grower 30% CP 50kg – K200
- Finisher 25% CP 50kg – K150

One positive aspect of the new cages from Savanna is that they are bigger and Malcolm thinks that these are much better suited. These are 6 x 6 x 6m and will take 18,000 fry each. In Malcolm's opinion the 3 x 3 x 4m are too small to be an economic unit for a community approach.

The typical harvest size is 250 to 300g. There would be a better economic gain if the harvest was pushed to 500g, but the extra time needed is too much for the community to bear.

Malcolm thinks that buying turn key solutions from Savanna Streams is not good value for money. He believes that to make your own cages is much better. The net from Savanna is K1,800 whereas a bundle of the same material is K1,400.

Malcolm believes that it is a good idea to include young people in the farming of fish. They are enthusiastic and can make a success of it.

However, Malcolm has had many problems with the community approach. With a group involvement, there are always those who want to progress and those who are not willing to put in either the work or time or resources needed. This is amply demonstrated by the Buyantashi Group.

It would be much better to have an individual responsible for their own cage.

**Thursday 21st May**

**John Jakubowicz, King Kapenta - Siavonga, Zambia**

John has been fishing Kapenta in Siavonga for more than 20 years. His model was to keep his business small to keep overheads down. However, increasingly he is finding it harder to compete with those businesses that have many rigs.

King Kapenta has 6 rigs which fish when there is no full moon. The catches on Lake Kariba used to be much higher. King Kapenta averages 3 boxes of 20kg of wet kapenta per rig per night.

The small kapenta businesses are not able to compete with the larger. Maks Holdings has 52 rigs in Sinazongwe. These large companies dry the kapenta and freezer it when the catches are higher and the prices are lower. They can store the kapenta like this for over 6 months. When there is a scarcity in the market they will sell the kapenta to take advantage of lower prices.

There are too many rigs on the water to maintain a sustainable economic catch. Over 800 rigs have been licenced on the Zambian side alone, and according to John there have been approximated to be 162 unlicenced rigs fishing illegally in Zambian Kariba.

Apart from the reduced catches, the biggest single problem for small scale kapenta operators is theft. Despite the best efforts of security patrolling at night and use of cameras and evidence to police, King Kapenta estimates that it receives only 60% of its catches.

King Kapenta would like to diversify into fish farming as well – however the difficulties with permits and licences is discouraging.

#### **Thursday 21<sup>st</sup> May**

##### **Simon Buleke, Fisherman – Siavonga, Zambia**

Simon has been fishing on Lake Kariba for more than 5 years. He fishes every day. He uses a boat with gill nets to catch the fish. The nets are monofilament approximately 60mm.

The nets catch a variety of fish including bream, tiger, bottlenose, Cornish jack and squeaker.

Simon has a motorized boat with a 5Hp motor.

Simon is finding it increasingly hard to make a living fishing. Over the time he has been catching, he has experienced a significant reduction in the level of catches.

He has been watching the Siavonga ladies with their cages and thinks that farming fish looks attractive. He would like the opportunity to try for himself. He thinks that he would be better employed as a fish farmer rather than a fisherman.

Simon is getting K10 per piece (c. 300 to 400g).

The large fish (like Cornish jack +15kg) he will get K30 per piece.

Simon sells to marketer in Siavonga.

#### **Thursday 21<sup>st</sup> May**

##### **Musuka Mutondo - Siavonga Nutrition Group, Zambia**

The larger turn-key solutions from Savanna Streams (6x 6 x 7m) are K49,000

The target group has proven to be quite difficult. Their skills are limited and they do not have enough education to understand the concepts quickly.

The approval required for the project from ZEMA was slow to come and was expensive. This is proving to be a barrier to entry for small scale farmers. This was an Environmental Project Brief (EPB) rather than a full EIA. Musuka understood that the EPB does not need to be carried out by an approved officer (unlike the EIA which does) and is significantly less onerous than an EIA. Nonetheless it was a real difficulty for the project.

Access to finance is always a challenge. The CEEC has been a help lately. 40 people have been successful in their applications. It is a loan which is payable after 36 months. The value is K80,000 with interest being K5,000 over that period.

Some of these loans have been given to cooperatives, some have been given to individuals. Savanna have been proactive in their involvement in this scheme, but there are serious problems with their fry survivals.

The first cycle of the projects got better results. The harvests were around 600kg per cage. In the second year there was a significant drop off in enthusiasm.

The project harvested yesterday (20<sup>th</sup> May) 1.2t at 250g from 11,000 fingerlings. This was a great success. It took around 6 months to get to this size.

There is not any proper data on the growth performance on the project.

In the first cycle, feeding was 3 times per day. It increased to 4 times per day on the second cycle.

There have often been times when the feed has not been available. This leads to significant losses in performance of the whole scheme.

6 months is a very long cycle time for a community to wait for the payback. Especially for women, their husbands complain to them that they work on this day after day, spending money on feed, but there is no return until much later.

The benefits of the farming will have to be learned over time and with experience. Still, the ladies working together is proving to be very difficult. Not all want to participate in the work all the time, but there is still the expectation to share in the benefits.

The ability of the ladies to fish in deeper water is seen as a real benefit. At least they come home with something to eat for the house which is seen in a positive light.

Musuka would like to build a retail outlet to capture more of the value of the harvests and see more money coming in more regularly. He says that selling the fish is no problem at all.

Siavonga has a population of 41,000 and with Chirundu has combined pop of 89,000.

Traders continue to come to Siavonga looking for fish. This price is going up all the time. Demand far outstrips supply.

Locals are now taking the fish up into the Congo to realize even better value. There was a cold store next to the border where they took the fish previously, but now they go right in to the country. This is fresh fish.

People come to buy fish, put it into refrigerated trucks and take it into the Congo.

**Friday 23<sup>rd</sup> May**

**Gladis Pieters, Lake Harvesters and Aquaculture Advisory Group - Siavonga**

Lake Harvesters was formed in 1981. Gladis has been active with the AAG for more than 9 years. She is also very active with the District Environmental Committee.

The AAG is not active at the moment. Lake Harvesters had placed cages in the water with the help of Chirundu Bream Farm. The EPB was completed, but due to the lack of a clear regulatory framework, the ZEMA interpreted the then legislation in a different manner. They dismantled the cages of Lake Harvesters for being in contravention of the law. It was reported in the press that this action was taken by an over-zealous officer. In the opinion of Lake Harvesters ZEMA was then in greater contravention of the legislation when ZEMA arranged to have the fish dumped which caused a pollution issue which was more serious than the original contravention.

Since then, the AAG (formed with the help of the FAO) has succeeded in bringing together ZEMA and Department of Fisheries and the private sector. This resulted in new legislation which brought greater clarity for each of the stakeholders. Fisheries have done a lot since that time to have better trained officers and these are proving to be an asset to the industry. They have achieved this again through the assistance of the FAO.

There has been more emphasis on the development of small farms in the part of the country closer to the Copper Belt. There is scope for much more to be done in Kariba.

Since the legislation was passed the AAG has lost momentum. There was a move to begin an Association, but this was rather taken over by businessmen who were more interested in opportunities instead of fish farmers. It has taken time to make it more fish production centered. It still has not really taken off, but members include Capital Fisheries, Kalimba Farm, Lake Harvesters, Savanna Streams and Yalelo.

When Lake Harvesters was producing fish, it was selling the product in Lusaka as well as locally in Siavonga.

The farm benefitted greatly from the help of a consultant Cholwe Mudenda.

Lake Harvesters went to great pains to keep careful data on its production. They achieved an average FCR of 1.2 with some cages as low as 0.98. They were growing their fish up to 450g and were using feed from Tiger Feeds.

They were using 6 x 6 x 3m cages and stocking with 18,000 fingerlings from Chirundu.

Gladis thinks that all of the fishing villages along the Kariba shore will be interested to grow tilapia in cages. It would be a great benefit to have a demonstration farm where would-be farmers could come to have some hands on experience on how to handle fish properly.

The hotels in Siavonga have grown fish at one time or another. Both Kariba Inns and Lake Safari Lodge have cage units for sale.

There exist already areas in Lake Kariba which are zoned with small scale fish farmers in mind. It is a pity that big companies like Lake Harvest and Yalelo have been allowed to encroach on those areas.

**Friday 23<sup>rd</sup> May**

## **Brilliaw Choombe, Julichong Enterprises, Siavonga**

Brilliaw is in charge of sales for Julichong Enterprises. They realized that there was no where in Zambia to buy fishing and fish farming equipment. The owner of the shop travelled to China and found a reliable supplier of well priced and good quality materials. They have a steady stream of customers and feel that their supply business is growing especially in the aquaculture equipment sales. A selection of their prices follows.

## **Friday 23<sup>rd</sup> May**

### **Tim Fuller, Chirundu Bream Farm – Chirundu**

Chirundu Bream Farm is a hatchery that sells 1 to 2g fingerlings. It has been operational for 12 years. Because of the difficulty and delays in getting permission to begin operations, it began by growing and selling bananas. The banana operation is still on-going. The main business is the hatchery.

Tim has been involved with various programmes in the past. This includes working with the National Rural Development College. Chirundu Bream Farm offered practical courses that were to compliment the academic work being offered by the College. This was not formalized into the long term as the Dept of Agriculture did not officially approve it.

The breeding stock for Chirundu Bream Farm are GIFT fish from Thailand. The farm has been careful to keep separate all the family lines. Many families have been brought in over the years. They did consider to bring in Genomar fish, but they concluded that the GIFT fish from Nam Sai was superior.

Over the years, Chirundu has supplied a lot of fish to small scale projects as well as larger scale. As well as the Siavonga projects, there have been a cooperative project in Chiawa (downstream the Zambezi). This project is on its third cycle, with the group harvesting once per year.

Chirundu Bream Farm has supplied the Government Institute, which buys fingerlings for Choma. The Chirundu School is another customer. There have also been many small scale farms in the Copperbelt, in Kabwe and Kipiri Mposhi as well as in Livingstone.

The farm has a capacity of around 4M fry per year. The sales of fry are currently running at over 3M per year, and they have had years with sales over 4M. All the fry are sex reversed.

The difficulties with sustainability of the small scale is a lack of knowledge and the inability to understand the need for quality in all aspects of the business.

Individually owned initiatives work significantly better than those which are cooperatively owned. The cooperatives have difficulty as their ideas for how to operate the farm are not common, especially where there are differing levels of education in the group.

Chirundu Bream Farm is currently supplying around 10 small scale farmers.

A Danish Consultant called Ole Otterby gave some excellent advice to Chirundu Bream Farm. He can be contacted through his wife who owns Amoyo Health – the health clinic at Arcades shops.

Chirundu Bream Farms typically ship their fry at 0.7g in 15 litres of water with 30 litres of oxygen with 2,000 in a bag. The price is \$50 per 1000 fry.

Some people worth contacting:

Chad Makwere who has had training in the Philipines 0977 450 950

Sean Cornelius – farmer with 30 to 40 Ha of ponds in Kitwe 0966 922 607

Nsobe Lodge – 6 ponds producing 3t per month – 0977 568 455

Kalakantapa – a scheme on the Chipata Road.

## **Saturday 24<sup>th</sup> May**

### **Jurre Zaal, Kafue Fisheries – Kafue**

Kafue Fisheries began operations in 1982. It is an integrated pig and fish farming operation. Over the years they had tried different combinations of chicken and fish and other animals with fish, but the pig / fish combination proved to be the most successful.

The farm is currently owned by Speedy Holden. It was set up by TAP, a Swedish asbestos company, which was then bought by Turner Nuel (?) before the current owner.

Their farm is 1,500 Ha. The current production is 1,200tpa fish and 6,000 pigs. The plan is to keep expanding to an eventual capacity of around 2,000 tpa fish.

The farm has tried many species over the years, including andersonii, rendalli, mozambicus, as well as various carp species. They have settled on the niloticus as it is by far the best performer.

They have tried a variety of sources of niloticus including from Savanna and wild captured fish. The best performers have been from Chirundu Bream Farm and while the farm has its own hatchery, it is not producing enough to satisfy its needs so it continues to purchase from Chirundu. There is an expansion of the hatchery operation currently taking place. The hatchery on the farm uses the same GIFT fish from Thailand as well as YY supermales from Swansea.

All the fish gets sold in Lusaka, split between its own outlet in Kamwalla (Farmers Market) and Roberts fish and veg in Vallengue. There is currently more demand than they can supply.

There is a balance kept on the farm between pigs and fish numbers and all of the pig manure is consumed in the fertilization of the ponds.

In addition to the green farming, the fish are given supplementary feed. This is an 18% CP pellet from Farm Feeds. The cost of this feed is K107 per 50kg bag. The FCR is 2.5. They used to use Nutri-feeds, but the farm changed then to Farm Feeds.

The water temperature in the morning is currently 21 – 22 °C and 24°C by midday. In Summer the temps range from 21 to 31°C

The harvest size is typically around the 250g range. The stocking of ponds is normally at 2g.

Growing time is between 10 to 16 months.

There is quite a predation problem with crocs, cormorants and leguans.

There are 130 ponds, each of approximately ¾Ha each with a total of 92Ha under water.

Stocking density in the ponds is 6 fish per m<sup>2</sup>.

## Monday 26<sup>th</sup> May

### Yandrathi Pardha Saradhi, Savanna Streams, Kafue River

Savanna Streams has been working with the Zambia Bureau of Standards, to create a standard system for fingerlings feed and other aquaculture and fish related activities – including kapenta fishing and drying of fish etc. This was funded by Smartfish and Kariba Harvest also participated in the programme. Capital Fisheries also was invited but they did not participate.

Savanna has been very involved in the CEEC programme set up by government to encourage small fish farmers. The scheme is administered by CETZAM. The farmer will be awarded K80,000. CETZAM are meant to vet the applicants and will distribute the finance. CETZAM will take K12,000 for their services.

Savanna will supply a 3 x 3 x 3m cage to an individual. They will supply the fish and the feed.. The total cost is c. K 36,000.

The farmer should expect to harvest around 3t from this at a price of K15 per kg. This will yield K45,000.

The second cycle will require only fingerlings and feed and this will cost around K20,000. It will of course also yield K45,000 in revenue.

There were 20 cages deployed in December 2013 in Siavonga. The farmers there sell to fish traders in Siavonga itself.

Not all of the cages are successful. There are differing levels of commitment. Savanna requested funding to assist with the monitoring of the cages, but this was not available. This is a weakness in the programme as the continuous monitoring is necessary for the scheme to really be successful.

The cages were given to individuals rather than to communities.

Savanna Streams are official distributors of the South African Company Alnet in Zambia.

The Predator net used is called Anchovy Net.

There are ponds which are benefitting from the CEEC programme. These are in Rufunca, 220km from Lusaka on the road towards Chipata. There has been no proper survey done as to where farming will best work. It is solely focused on boosting the economy Province by Province. There are 80 farms in the Rufinca area and Savanna Streams have provided the feed and the fingerlings.

There is another scheme planned under the CEEC for fish farms in the Lusaka area with a budget of K4M.

At Savanna Stream's facility at Neganega (off the Kafue River, 33km off the road for the Nickel Mine Monoli). There is 1,000Ha Farm. 20 Grow-out ponds and 45,000 female broodstock. They stock GIFT, Chitridada and the Thai Red all from Nam Sai. They are not sure if there will be a real demand for the red, but they hope so. The growth so far is very good, but they are prone to predation. Savanna Streams was under the impression that all imports from Thailand have been stopped. Savanna Streams have imported 3 times from Thailand.

Savanna have applied for the licence for their 2 sites in Siavonga. They are preparing for a 2,000 tpa production facility. They then intend to convert their Neganega facility in Kafue to crayfish Macrobracia. The Nursery is next to the Yalelo facility. The 2,000t production facility will be next to Gwena Island. The plan is to use 10 6x6m cages, but they are looking to bring in 10x10m cages from China.

They have a Processing plant on the Great East Road – where they can freeze 15t per day and store 400t.

In the Luapula Province, they are starting a project with Andersonii on Lake Magwelu.

Savanna believes that the biggest threat to the current schemes is the lack of technical knowledge.

Bigger fish from China are now getting more expensive. Poultry imports into Zambia have been banned to help the local producers.

At the moment there is no problem for fish farmers to sell their products. There are no wild fish left.

Indians are not big consumers of tilapia. The supply from India is only wild catch fish. Triton is the main company exporting fish from India – also CM Kennedy.

Savanna have a soya crushing plant where is makes high protein feeds. It can process 2,500t per month. They believe that the soya production is around 230,000 tpa in the country. The cost of soya is around K2.5 per kg and maize is K1.5 per kg. All the soya processed at Savanna is local.

Savanna are looking for partners for their 2,000 tpa farm. The believe that they can achieve an FCR of 1.6 up to 300-350g. The think that the total investment needed for the 2,000 tpa farm is \$4M – with the cages coming from Turkey. It includes an ice plant. They are expecting to complete their EIA next month.

Their fry production is 8M per month – but they have capacity for 20M per month on a 6 to 7 month annual cycle.

Savanna can manufacture around 300t per month of feed.

There is no issue in selling the fish into the market. Most of the mackerel from Namibia goes straight to Congo.

Savanna are trying to partner up with Livestock Services – to stock Aquaculture Equipment. Livestock Services are already supplying the other livestock industrites.

Savanna sees their main business as fingerlings and feed.

Savanna's office is off the Mumba Road – Opposite Zamanita.

A good place to visit would be Rivondale farm – on the Luwansha Turnoff on the way to Kitwe. See Nathan Aldright 0961690322. He has a small hatchery and sells fingerlings to the congo.

## **Tues 27<sup>th</sup> May**

### **Pity Halwinde – Ministry of Youth**

Pity is a Senior Youth Development Officer. It is her job to action the government policies to empower young people.

Most of her activities involves working with the AARDO (Afro-Asian Rural Development Organisation). The ministry is the focal point for the programme.

The initiative will give loans, especially to youth oriented proposals. The proposals need to be entrepreneurial to be able to make payments. AARDO will give loans to entrepreneurs who have a good business idea. It can be in any area or field.

The loans are given to individuals, clubs and associations, where the youth is involved (18 to 35). The loans attract 4% interest. The maximum loan is K50,000. No security is required for the loan, but the proposal will need a guarantor who is not a family member.

Over 400 loans were awarded in 2013. No loans have been awarded yet for fish farming. A television programme is currently being made to highlight some of the success stories.

The Ministry of Justice is being asked to recover non-performing loans. It has been set up as a revolving fund so the recovery of the loans is important.

The number of youth employed is an important aspect of any proposal.

Some of the schemes to date have involved youth resettlement - especially with soya schemes.

## **Tues 27 May**

### **Sepiso Mathe Ministry of Agriculture**

Sepiso is an economist with the Ministry. She works in Policy and Planning. However, she has a background in fisheries science and has therefore got a keen interest in Fisheries and Aquaculture. She describes herself as “passionate” about fish farming.

There is a new Agricultural Policy, but it is still in draft form, so not yet ready for public consumption. Some of the aspects of the new policy are already being implemented. For aquaculture, the main difference is the realization that the industry needs to be organized into clusters. These clusters should be organized around an extension worker who can assist the farmers. Not clear yet how many farmers should be to an extension worker. It is clear, however, that the government is backing fish farming and is taking it very seriously.

Crop farming in the country is generally doing very well. PPP are strongly encouraged. Government wants to help through the ministry of Agriculture with extension workers and officers – especially on the technical assistance. This is all part of the Aquaculture Strategy.

ZEMA is involved where there is an existing natural water body.

Department of Fisheries will intervene when inputs are required.

It was, in fact, the Department of Agriculture who advised the ILO to look to aquaculture as a sector for development.

## **Wed 28<sup>th</sup> May**

### **Bryan McCoy, Yalelo,**

Bryan was explaining some of the difficulties of forming an aquaculture association in Zambia. There was an association for some years, but this has many legacy issues. The belief of the farming community is that a new association needs to be formed. This again has been hampered because of theft of documents and general administrative hiccups. Expectation is that a new association will be formed soon and will be called the Aquaculture Development Association of Zambia.

Yalelo should begin sales in July and expectation is for 2,000t of sales in 2014 and 7,000t of sales in 2015.

They have plans for a second fish farm in the north of Zambia.

All fish coming from Kariba is subject to a K0.50 Siavonga Tax. This is really hampering the development of the business.

ZEMA cost Yalelo around \$40,000 fee plus the cost of the EIA itself, which Bryan recalled to be around \$20,000.

### **Wed 28<sup>th</sup> May**

#### **Alexander Kefi, Chief Research Officer – Aquaculture, Department of Fisheries (Chilanga)**

The government in general and the DoF in particular have put Aquaculture as a high priority. The latest figures from capture fisheries show catches of 75,000 tpa and these are in decline.

In the past 5 years, aquaculture has grown from 4,500 tpa to 20,000 tpa in 2013. If you combine all the lake based and land based fish farmers – the total numbers in the country are in the region of 13,000.

Both land based and lake based are growing and there is a particular interest at the moment in cage culture. The biggest challenge in the cage culture set up is the accessibility of the water. There are often conflict of uses of the water.

When considering cage farming – one needs to take cognisance of:

- Fisheries Act 22 of 2011
- Water Act
- Land Act
- Wildlife Act

The area of most weakness in the aquaculture establishment is finance. This is particularly for the inputs and especially for feed and fry.

Land based aquaculture also is in need of a demonstration farm – which is well set up and managed. This will be a hub for the inputs. A shop for materials, a hatchery and a feed plant.

The FAO contracted a consultant to advise on Aquaculture development.

The government in Namibia has a feed plant which was public funded. Feed is an issue which continues to dog the industry. DoF carried out proximate analyses of fish feed and discovered major discrepancies in stated nutritional values and actual.

DoF is proposing to have clusters of fish farmers – in a sort of aquapark setting. This would be where there is a high concentration of fish farmers.

FAO have financed an initiative to map out the following areas – Siavonga, Chinepo, Chifumsa, Mugwe. FAO contact is Mr Mulenga.

Government actively wants to lue Private Sector into Aquaculture. Government is always reviewing taxation, and continues to do so – to the favour of Aquaculture.

Aquaparks would enable successful utilization of CEEC loans.

Guidelines have been written on the use of catchments of wetlands.

Species that are used in Zambia are niloticus and andersonii mostly. DoF would like to dissuade every potential farmer from using niloticus. However, GIFT fish may continue to be imported with the permission of the Director of Fisheries. It is accepted for use in Kariba for instance.

Farmers can get seed from government hatcheries.

The FAO have offered matching grants for hatchery producers. See Chafambumba in the Copper Belt – he is using niloticus in his hatchery – although fisheries don't like it.

District fisheries officer in Luansha is worth visiting 0965 863685

Also Ian Bbole of the Government Research Centre in Mwekera. They do Andersonii and Rendalli and Catfish and Carp. This has a capacity of 2M fingerlings, but only sells 250-300,000 annually.

There is a project on-gong at the moment with 3 farmers – looking to an improved Andersonii strain.

DoF also encourages the use of Oreochromis Tanganyikae – DoF is excited about the growth characteristics of Tanganyikae, but it only breeds older than niloticus, and has less eggs.

Catfish is a possibility, but the market is only in the north of the country.

Japanese have been supportive of Aquaculture – through their JICA.

The Finnish also have been supportive through PLARD.

#### **Thu 29<sup>th</sup> May**

##### **Peter Goneos – Mpende Fisheries.**

Mpende Fisheries is a large fisher of Buka Buka on Lake Tanganyika. They have also recently embarked on a farm to produce Oreochromis Tanganicae.

The catches of Buka Buka are in serious decline, although Peter does not have figures. Year on year there is a marked reduction in both the total catches and in the size of the fish.

Chinese Tilapia are prevalent in fish retail markets. Wholesale prices are....

\$1.58 1-200g WR 10% ice

\$1.80 2-300g WR 10% ice

Kugula (set up by Seedex from Harare). There seems to be no control on any of the products imported into Zambia.

Capital is bringing in 40 containers per month of Chinese Tilapia. There are more and more players getting involved in importation. Capital is opening many retail outlets for their products throughout the country. This has been motivated by a difficulty in relationship between the traditional suppliers of fish and the new importers.

Lake Harvest is also retailing its fish throughout the country. It is sending 2 trucks per week to Chipata near the Malawi Border.

Lake Harvest delivers 1.2t per day of fresh tilapia to Mpende.

The customers express a clear preference in Tilapia. This is in order of highest preference first

- Tanganykae tilapia
- Lake Harvest tilapia
- Kafue Tilapia
- Chinese Tilapia

Lake Harvest prices to Mpende

- K18.70 WG Frozen
- K18.50 WR Frozen
- K18.00 WR Fresh

The infrastructure is improving in the Songo area where the farming is taking place. The roads are developing with the discovery of gold in the area. There is electricity there, but the quality of the electricity is poor, but should improve with the opening of a new hydro plant in June.

There is a tax on all fish out of Tanganyika of K0.40 per kg. This leads to a significant under declaration of fish out of the lake.

Last month has been a very good month for fishing. There was 80t landed. The previous month was only 7t. This variation creates problems in marketing and logistics.

Last month everyone was catching lots of buka buka. In Mpulungu every cold store was completely full. There is 5 to 600t of storage capacity in the town.

The fish farm has had lots of troubles. Over \$0.5M has been lost in weak management. The AfDB is very keen to finance aquaculture in the area – esp with the inclusion of an outgrower and third party sales.

Farm is currently 12 breeding tanks, cages of 40m circ and 60m circ.

Small crumble (35% CP) is sourced from LFL, and is \$28.63 per 25kg bag. Transport on top of that is over \$500 per tonne.

Growth of the fish is currently 1yr from 5g to 400g.

Breeding is much slower than they have read about for niloticus. Current breeding ratios are 3F to 1M.

Department of Fisheries refuses to allow niloticus in the lake. Will only allow farming of tanganyicae. This is despite irrefutable evidence of the existing presence of niloticus in the lake.

Expected production is 80t per month. 15.5t Jun, 42t in July and 85t in Aug.

The market has changed. It used to be 80% buka buka with a little tilapia. Now the market is predominately tilapia.

Tanganyicae tilapia is retailing at K22.

Apart from their imported feed from LFL, Mpende get their feed from National Milling. The FCR is not good at 1.8. Tiger Feeds had a much worse FCR of 2.5 to 3.

LFL feed is giving Mpende FCR of 0.9 to 1.1 from 0 to 50g.

Watson did visit the farm. He was saying that from hatching to 1.6/1.7g in 3 weeks is very good growth. From 1.7g to 5g takes 1 month. Plan is to take a batch of fish through to harvest on the LFL feed and see how it performs.

The Dec fry should be ready for harvest in Sept / Oct.

Water temp in the lake varies from 28C to 25C over the year.

Lindsey Rodgers does bream and carp in Kitwe.

If Silver Barbel could be farmed efficiently, Peter thinks there would be a very good market for it.

## **Thu 29 May**

### **Ian Bbole – National Aquaculture Research and Development Centre – Mwekera**

The NARDC has various species :

Tilapias – Andersonii, Macrochir, rendalli, tanganicae and niloticus (GIFT from Chirundu)

There are also Clarias gariepinus and C. ngamensis

Also carp – mirror and common.

Finally Labeo from the Luangwa River.

The NARDC has done comparative studies on the growth and performance of each of these fish.

The temp of their ponds is 24+C in summer and 15C in winter.

The centre sells fry at K0.14 each and sells approx. 220,000 per year. Has the capacity to produce several million. Customers come to collect the fry.

They encourage the indigenous fish and discourage especially the use of niloticus.

The centre formulates and makes its own fish feed – using soya maize vits and mins.

There is a growing interest in catfish fingerlings esp from the Congo

There are restrictions on the use of niloticus. There are no restrictions on the use of andersonii.

The centre has started its own selective breeding programme on andersonii and and has begun to collect fish from around the country.

Typical small scale farmer will have 6 ponds of 20 x 20m and these will be done alongside crop farming.

Mostly fish farming is a side business, with crop farming being the main business. Farmers have no trouble to sell the fish they produce.

More farmers are getting involved year on year – and there is a keen interest.

There are lots of rivers which flow all year round. Some young people do express and interest in fish farming. However town jobs are more attractive for young people. Most people do have pieces of land. Education and knowledge is a problem. Some farmers feed their fish – others use green water systems. Many feed with maize bran. The centre does not sell its fish feed.

The centre does training sessions. These have to be paid for and are normally paid by a sponsor. A good percentage of farmers in the region are Mine Retirees. Having to construct ponds is a limiting factor. Many young people don't own their own land.

Ian believes aquaculture production is currently at around 13,000 tpa mostly tilapia.

### **Fri 30 May**

#### **Philip Chabala Chimumba – Luansha Extension Worker**

There are approx. 60 farmers in the district. Many of the existing farmers are now extending their ponds. Rivondale is a commercial operation that is now selling fingerlings. They sell different species, mainly niloticus. Makwera hatchery is the government hatchery near Kitwe. They offer all the species. They supply mixed species. They say that andersonii grows as big and as fast as niloticus (nearly). Macrochir grows slower. Catfish are okay but tilapia comes first. Catfish are cheaper – not such good value on the market. The selling price of tilapia is K18 -19 per kg. Can go over K20 per kg is over 400g. These prices have been stable for over a year.

Finance is the biggest challenge for any farmer.

### **Fri 30 May**

#### **Alex Simutenda – Simutenda Aquaculture Solutions**

Alex is increasing his aquaculture production by extending his ponds. He is benefitting from the CEEC loans, but is greatly hampered by several execution issues with the loan. First is the fact that the finance institutions take a proportion of his loan for fees. Second is the need for 3 quotations on every spend that he has. Third is the length of time taken by institutions to disperse funds. This is making the whole lending process ineffective in terms of developing his farm.

Alex started farming in 1998. He was catching fish in his local area and managed to bring some home alive just by chance. He placed these in a small pond by his house. Later he returned to find that there were now many fish and this sparked his interest.

Alex has since been helped a great deal from the DoF extension workers, and in particular Mr Chimumba.

The CEEC has a formula to disperse its funds. There is an allocation of funds for each of Fingerlings, Feeds, Labour, and Security.

Alex feeds his fish with both fertilizer and pellets. His 10 ponds can produce around 10t of fish per annum. He has sourced his feed mostly from National Milling, because they have an outlet in Kitwe. He has also used Tiger Feeds in the past. National milling supply fishmeal, juvenile feed, starter feeds, grower feed and finisher feed.

Alex employs 3 to 4 people at K500 per month in the building, harvest and maintenance jobs. A fence around his ponds would enable Alex to employ goats to help to maintain his grass.

Feeding and the finance of feeding is his major problem. Alex received training at the NARDC. The extension workers are not effective in their role because they have no means of transport.

Theft has never been a problem for Alex.

Comparing fertilization to pellets – Alex much prefers pellets. Fertilization is not easy as he has to source the fertilizer. He can just as easily use Urea or P but he also has to travel to purchase this and would therefore prefer the pellets. He is trying to improve his farm such that he can harvest twice per year.

All work on the farm is done by hand. He has no electricity and water movements is done by gravity.

The nearby farmers formed a co-operative, but its not that active. He is a fervent fish farmer and encourages everyone he meets to take it up. He is very happy to have farmed fish most of his adult life and thinks that it has given his family the opportunity to be educated. He is encouraging his children to farm fish and they are keen to do so.

Phone 0977 693 860, 0963 208 270

Email [alexsimutenda@gmail.com](mailto:alexsimutenda@gmail.com)

Rivendale sells at K18 /kg

Alex sells at K15 per kg.

Alex gets mixed breams from NARDC.

### Questionnaire used to interview stakeholders

The interviews have been conducted on a conversation type with no formal questionnaire to fill in. However, the frame of the interviews has followed the the frame below and adapted according to the stakeholders' profiles:

#### General

- What is the company structure and ownership?
- For how long has it been operating?
- What are the activities (level of vertical integration)?

#### Technical questions

- Description of facilities
- Production figures
- Food conversion ratios (FCRs)
- Growth cycle and rearing parameters, including water temperatures.
- Technical problem encountered

#### Human resources

- How many people are employed?
- Gender repartition
- CSR in place?

#### Marketing

- Business volumes
- Access to market – target markets.
- Market trends and prices
- Product preferences

## General business constrains and opportunities

- What are the main bottlenecks and constrains in your business.
- What are the main opportunities

## Analysis of Gross Margin in different aquaculture models.

These tables will be presented under the chart model as for “Large Scale Cage Farming” in the report.

### 2. Gross Margin analysis at Production

The gross margins analyse two aquaculture systems i.e the Pond Fish and the Cage systems. The first part analyses the pond system for three scenarios; a small-scale pond of 300m<sup>2</sup> with no fish feed, a small-to-medium scale of 300m<sup>2</sup> with fish feed and a large scale pond of 2400m<sup>2</sup> with recommended feeding. The analysis is based on previous studies (e.g FAO/MAL Yasakwa Fish Farming analysis) and recommendations by the department of fisheries of the Zambian Ministry of Agriculture and Livestock.

#### 2.1 Small-scale fish pond

Table XXX shows the gross margin analysis of fish ponds for an average smallholder farmer in Zambia. As a practice, most small-scale farmers only apply manure to the ponds. As a result, they are not able to make enough gross profits to cover the production costs. Expanding the fish pond, increasing stocking rates and feeding the fish with recommended feed increases the output.

**Table XXX: Gross Margin for Small Scale Pond Farm (Pond Size 300m<sup>2</sup> and Harvest after 6 months)**

1. Variable Costs	Unit Cost (ZMW)	Quantity	Total cost (ZMW)	Notes
<b>i. Fingerings</b>				
Fingerlings/piece	0.5	600	300	Assuming stocking rate of 2 fingerings/m <sup>2</sup>
<b>ii. Feeds and Fertilizer</b>				
Fish feed/kg	0	0	0	
manure/50kg	20	7	140	
<b>iii. Equipment</b>				
Nets (depreciation cost)	300	1	300	10% of purchasing price
<b>iv. Labour</b>				
Casual labour	300	6	1800	Assuming monthly wage of K500.
<b>Total variable costs</b>			<b>2540</b>	
<b>2. Income</b>				
i. Table size fresh fish (250g)	15	195	2925	Assuming 5% mortality rate and harvest rate of 0.7 kgs/sq metres. Less home consumption and gifts.
ii. Quantity consumed and processed and stored for consumption	15	10	150	
iii. Quantity given out as gifts	15	5	75	
<b>Total income</b>		210	<b>3150</b>	
<b>Gross Margin (Total income less total variable costs)</b>			<b>610</b>	

## 1.2 Small to Medium scale fish pond

The small to medium fish pond gross margin analysis assumes that the size of the fish pond is also 300m<sup>2</sup> but the farmers increase the stocking rate from 2 fingerings per m<sup>2</sup> to 3 fingerings 3 m<sup>2</sup>.

**Table XXX: Gross Margin Analysis for Small to Medium Scale Fish Pond Farmer (Pond Size 300m<sup>2</sup>)**

1. Variable Costs	Unit Cost (ZMW)	Quantity	Total cost (ZMW)	Notes
<b>i. Fingerings</b>				
Fingerings/piece	0.5	900	450	Assuming a stocking rate of 3 fingerings/m <sup>2</sup>
<b>ii. Feeds and Fertilizer</b>				
Fish Feed/50kg				Assuming feed required to grow fish from 5 gms to 300 gms at a conversion ratio of 1.1,5:1 for 900fingerings less 5% mortality = 252 kgs (5 bags)
Fertilizers/manure/50kg	180	5	907	Assuming 3 kg per 100 m <sup>2</sup> /day for 7 months = 1890 kgs
	7	37.8	264	
<b>iii. Equipment</b>				
Nets (depreciation cost)	300	1	300	
<b>iv. Labour</b>				
Casual labour	150	7	1050	Assuming a wage rate of 150 per month (working 3 hrs per day).
<b>Total variable costs</b>			<b>2971</b>	
<b>2. Income</b>				
i. Table size fresh fish (300g)	18	210	3,780	Assuming a harvest rate of 8 tonnes/ha = 0.8 kgs/m <sup>2</sup>
ii. Quantity consumed and processed and stored for consumption	18	25	450	
iii. Quantity given out as gifts	18	5	90	
<b>Total income</b>			<b>4,320</b>	
<b>Gross Margin (Total income less total variable costs)</b>			<b>1,349</b>	

## Gross Margin Analysis for Large Scale Fish Pond Farmer (Pond Size 2400m<sup>2</sup>)

Item	Quantity	Unit price	Value (K)	Explanation
<b>1. Variable Costs</b>				
Fingerlings	4,800	0.5	2,400	4800 fingerlings purchased at K 0.5 each
Fish feed (50Kg)	40	180	7200	Assuming feed required to grow fish from 5 gms to 300 gms at a conversion ratio of 1.5:1 for 4800 fingerlings less 5%. = 2701kgs (54 bags). Purchased at K 180 per 50 Kg bag
Fertilizer/ Manure (50Kg)	345	7	2415	Manure applied at the rate of 3 Kg per 100m <sup>2</sup> per day. For 2400m <sup>2</sup> this will be 72 Kg of manure/day *240 days. = 17280 kgs (115 bags)
Labour for pond management (e.g. fertilizing, fish feeding, harvesting etc.)	16	500	8,000	Estimated 2 workers for 8 months at K500/month
<b>Total Variable costs</b>			<b>20,015</b>	
<b>1. Income</b>				
<b>Table Size fish 400g</b>	2,280	15	41,040	Assuming a harvest rate of 10,000kgs/ha for production cycle of 8 months assuming 5% mortality
Other costs (e.g. transport, packaging materials)			2,000	
Total Income			39,040	
<b>GROSS MARGIN</b>			<b>19,025</b>	

Table XXX: Gross Margin For Small-Scale Tilapia Cage System (27m3)

1. Variable Costs	Quantity	Unit Cos	Total Costs	Notes
Fingerlings	200	0.5	100	Assuming stocking rate of 200 fingerlings/m3.

				purchased at K 0.5 each
				Assuming feed required to grow fish from 10 gms to 300 gms at the rate of 5% body weight. Average increase in body weight is 300-10 = 290 gms/fingering. Daily feed per fish 290*.05 =14.5 gms. Total feed = 14.5*200*.95*240days/1000 = 661.2kg. Purchased at K 180 per 50 Kg bag
Fish feed (50Kg)	13.22	180	2379.6	
Labour for pond management (e.g. fish feeding, harvesting etc.)	40	500	20,000	Estimated local labour for 8 months for 5 workers
Transport			10,000	
Other costs (e.g. Stationary, communication)			10,000	
<b>Total variable costs</b>			<b>42,480</b>	
<b>1. Income</b>				
Table Size fish 300g	7695	15	115,425	Assuming a harvest rate of 300/m3 and 5% mortality
Marketing costs including packaging			5,000	
<b>Total marketing costs</b>			<b>110,425</b>	
<b>GROSS MARGIN</b>			<b>67,945</b>	

**Table XXX: Gross Margin Analysis for Large Scale Cage Tilapia Fish (Cage Size 116m3) if selling at wholesale price of K12.**

Item	Quantity	Unit price	Value (K)	Notes
<b>1. Variable Costs</b>				
Fingerlings	2,000	0.5	1,000	Assuming stocking rate of 2000 fingerlings/m3. purchased at K 0.5

				each
				Assuming feed required to grow fish from 10 gms to 300 gms at the rate of 5% body weight. Average increase in body weight is 350-10 = 340 gms/fingering. Daily feed per fish 340*.05 =17 gms. Total feed = 17*2000*.95*240days/1000 = 7752kg. Purchased at K 180 per 50 Kg bag
Fish feed (50Kg)	155	180	27900	
Labour for pond management (e.g. fish feeding, harvesting etc.)	120	2000	240,000	Estimated local labour for 8 months for 15 workers
other costs including communication, stationary packaging materials)			20,000	
Transport, fuel and lubricants			30,000	
<b>Total Variable costs</b>			<b>318,900</b>	
<b>1. Income</b>				
Table Size fish 350g	143640	12	<b>1,723,680</b>	Assuming a harvest rate of 700/m3 and 5% mortality
Marketing costs including packaging			40,000	
<b>Total income</b>			<b>1,683,680</b>	
<b>GROSS MARGIN</b>			<b>1,364,780</b>	

### 3. Gross Margin analysis For Fish Trading and Proceeding

Fish trading profits vary according to the form of the fish being traded. The DOF (2013) observe that the value of fish increases with its freshness and that farmers that deliver live fish to the market get the best possible fish market prices. These section analyses gross margins for Tilapia fish trading and processing enterprises.

#### 3.1 Gross Margin Analysis for Fresh Tilapia Fish trade (Small Scale 1 tonne per month).

Item	Unit Cost	Quantity	Total Cost	Notes
Fresh Tillapia/ kg	12	1000	12000	Assuming the trader buys fish at 12/kg
Transport			600	Assuming the trader uses 60

Labour	2	500	1000	litres of diese for buy and sell the fis 2 casula workers at K500 each
Cost of Refridgerating/day	10	20	200	
Other costs		300	300	
<b>Total Costs</b>			<b>14100</b>	
Income	18	950	17100	
<b>GROSS MARGIN</b>			<b>3000</b>	
<b>ANNUAL GROSS MARGIN</b>	<b>3000</b>	<b>12</b>	<b>36000</b>	

### 3.2 Gross Margin Analysis for Drying and Selling Tilapia Fish (Small Scale 1 tonne per month).

Item	Unit Cost	Quantity	Total Cost	Notes
Fresh Tillapia/ kg	12	1000	12000	Assuming the trader buys fish at 12/kg
Transport	10	60	600	Assuming the trader uses 60 litres of diese for buy and sell the fis
Labour	2	500	1000	2 casula workers at K500 each
Cost of Processing (Drying)			500	
Other costs		300	300	
<b>Total Costs</b>			<b>14400</b>	
Income	25	950	23750	

<b>GROSS MARGIN</b>			<b>8,950</b>
<b>ANNUAL GROSS MARGIN</b>	<b>9350</b>	<b>12</b>	<b>112,200</b>

### List of people met

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