Extent of Small Scale Fish Farming in Three Districts of Lusaka Province

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Abstract A study on the Extent of small scale fish farming in three Districts of Lusaka Province was conducted between June and July 2014. Questionnaires were used to collect data, from 30% of the total number of fish farmers interviewed. The data was analyzed using Microsoft Excel and SPSS. Findings of the study indicated that most fish farmers had few ponds with a stocking density of 3fish/m². Almost 60% of the farmers purchased their indigenous fingerlings from Government fish farms, while Oreochromis niloticus was procured from private fish farms. Furthermore, about 95% of the respondents relied on the seller’s advice to assess the quality of fingerlings. Results of this study have also shown that, these farmers were more dependent on natural food, which was as a result of fertilization using organic manure. Most of the respondents fertilized their ponds twice per cycle with either chicken/duck or Pig manure. It was alleged that compounded or complete feed was very expensive, such that the majority of them fed their fish only once per day, hence, low fish productivity. As such only 2.5% of the farmers were producing between 5,000kg and 10,000kg of fish per cycle, with an average income of K10, 000.00, which was equivalent to approximately $900.00. The majority of farmers (95%) produced in the range of 200g to 400g, weight of individual fish. In the same vein, the government was accused of not offering any incentives such as loans to farmers to purchase machinery and inputs to boost their production. It was further established that 97% of the respondents bought their feed from National Milling and only a partly 3% purchased theirs from Tiger Animal Feed.

Keywords Small scale; Fish farmers; Extent; District; Lusaka Province

1 Introduction

Millions of poor people in the developing countries of Asia and Africa rely on a combination of fishing and farming to earn their livelihoods and feed their families (World Fish, 2014). Small-scale fish farming can be environmentally sustainable. World Fish and its partners have developed several fish species that thrive under low-input production conditions. Expensive feedstocks are not needed; farm by-products such as kitchen waste, leaves and crop residue can be used (World Fish, 2014).

The bulk of aquaculture in Zambia was concentrated in the small-holder category, which relied on family labour and practised extensive culture too (ACF/FSRP, 2009). The adoption of small-holder aquaculture helped in poverty alleviation, improved rural household food security and better nutritional status compared to non-fish farming families (Mudenda, 2006; DoF, 2011; Musuka and Musonda, 2013). A variety of species are farmed, including breams, the common carp, Nile tilapia and crayfish (FAO, 2007). The commonly cultured breams that were readily acceptable to the consumers included: Oreochromis andersonii, Oreochromis macrochir and Tilapia rendalli (Musuka and Musonda, 2013). Most small scale fish farms employ polyculture of these indigenous breams. However, the more successful large scale operations practice mono-culture of Oreochromis andersonii (Mudenda, 2009).

Machena and Moehl (2001) further observed that, small scale systems tended to be “rural”, if not in location then in the sense that they did not rely upon urban markets for their product, with most consumed by the family or sold on the pond bank. Mudenda (2009) also reported that, small-scale farmers generally produced fish for consumption and very few of them produced for the market.

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Small scale fish farming was encouraged by the government in provinces and areas that had abundant water resources but did not have major capture fishery to supplement food production (Mwango et al., 2002; DOF, 2010; D.O.F., 2010). The integration of aquaculture processes with existing agricultural systems has been viewed as a particularly beneficial concept (Blehle, 1998). According to Brummet (2000), a farmer participatory view in terms of development of sustainable aquaculture within integrated agricultural systems was tested in Malawi in 1998. Based on the author's study, the production of fish harvested from ponds increased from 900 to 1500 kg/ha when integration of fish farming with sustainable agriculture was achieved. This study was therefore, conducted to assess the “Extent of small scale fish farming in three Districts of Lusaka Province”.

2 Materials and Methods

2.1 Study area
The areas of study were: Lusaka, Chilanga and Kafue in Lusaka province, one of Zambia's ten provinces. The provincial capital is Lusaka, which is also the national capital (From Wikipedia, the free encyclopedia).

2.2 Data collection
Data for the study was collected from the Department of Fisheries in Lusaka province as well as small scale fish farmers in three districts of Lusaka, Chilanga and Kafue. Primary data was collected using questionnaires, interviews and observation.

In order to obtain more information on fish production in Lusaka Province, secondary literature was obtained from Fisheries and Aquaculture journals, internet and books.

3 Sample Size and Design
Out of a total of 169 small scale fish farmers in Lusaka, Chilanga and Kafue only 50, which was approximately 30 per cent, were sampled. The nature of the information required that the survey characters key players involved in fish farming were interviewed alongside Fisheries officers within the province. The parameters that were considered included: number of ponds each farmer had, the area of the pond, the species cultured, input costs, the level of management and the total production per fish farm.
3.1 Data Analysis
Data was analyzed using Statistical packages for social sciences (SPSS version 16.0), which was robust in deriving descriptive statistics, cross tabulation and frequency tables. Microsoft Excel was also used to come up with tables and graphs.

4 Results and Discussion
4.1 Gender of fish farmers
Results of this study showed that more men (87%) were involved in fish farming than women (13%) (Figure 2). The participation of men in aquaculture activities and agriculture in general was always very high. Most men are perceived to possess a strong will power to achieve great things. They can inherit land through customary law and use such land as collateral when borrowing money from the bank to start any business.

The low participation of women in fish farming could be attributed to some of these factors: inability to access land to be used as collateral whenever, they lack desire to apply for a bank loan to start fish farming activities, traditional beliefs that women should not take part in any fisheries related activities, little sensitization to encourage women to venture into aquaculture and lack of government incentives offered to encourage women to start up fish farming. The result of the study agrees with the findings of Chizana (2002), who observed that in the majority of households men were responsible for implementation of fish farming activities. Kwesiga et al. (1999) also reported that there was evidence that female headed households and women in male headed households had less access to resources such as land and capital, and were crippled in decision making hence their low participation in fish farming activities. However, according to Simataa and Musuka (2013), reasons advanced for low participation of women in fish farming were: (1) Labour intensiveness of the venture, especially pond construction phase; and (2) Inability to own land of their own, where traditionally the land was owned by the male folks and the need for married women to seek approval from their husbands before participating in any venture.

4.2 Education level
The study has revealed that fish farmers attained basic, primary, secondary and tertiary education. According to Figure 3, 32% of the farmers had attained basic level of education, 30% had completed primary education, 25% had secondary education and 13% had attained tertiary level of education.

Most of the people were unable to attain tertiary level of education because of the expenses involved. Very few people could afford to pay higher fees charged by educational institutions of higher learning. The majority of people,
who went into informal sector like fish farming, were those who were unable to find employment because Zambia was too poor a country to employ its ever increasing population. In 2010, a World Bank report showed that while real GDP expanded significantly in Zambia, job creation only increased by 1% per year, of the estimated 6 million labour force, only about 14.6% were formally employed and the remainder of the workforce was either engaged in the informal economy or unemployed. However, having a large percentage of people not attaining tertiary education had an effect on fish production among small scale fish farmers because farmers needed to keep records of total production, fish mortality and diseases, input costs, total money raised from fish farming and determining its profitability.

4.3 Number of ponds owned by fish farmers

The study revealed that the respondents had between one and ten fish ponds each (Figure 4).

According to World Fish (2014), the challenge of ensuring access to fish grows tougher every day. Most of the world's poor still rely on catching wild stocks of fish from coastal and inland waters near their homes, but these stocks have fallen steadily in recent decades due to overfishing, climate change, pollution and other factors. It was further reported that Aquaculture can play a pivotal role in meeting the rising demand for fish in Asia and Africa (World Fish, 2014).

The study also showed that, their fish pond area ranged between 20 and 1500m$^2$, with the majority having ponds with areas between 200 and 500m$^2$ (Figure 5).
It was observed that average pond size per farmer among small scale farmers had remarkably reduced from 400 m$^2$ in the eighties to 246 m$^2$ today. That was so partially due to the emphasis on rural aquaculture through household subsistence ponds rarely exceeding 100 m$^2$ each (Mudenda, 2009). Furthermore, these findings were in agreement with Central Statistical Office in 2012 which stated that 72% of all small scale farm households cultivated less than 2 hectares of land annually and were incapable of producing enough surplus for sell in order to benefit from government spending on agriculture. However, an earlier report by Musuka and Musonda (2013) indicated that Lusaka Province had 254 small scale fish farmers, with 1,305 ponds, covering an area of 22ha and total fish production of 159.6 tons. If these fish farmers were able to attain maximum production, they could satisfy Zambia’s growing demand for fish and the country could stop importing fish from other countries. After all, the main objective of that class of farmers was household food security.

4.4 Fish pond type

Figure 6 shows that the majority (95%) of respondents used earthen ponds, while only 5% of them had Concrete ponds.

In earthen ponds some species like *Cyprinus carpio* and catfish were able to suck and burrow in the mud at the pond bottom, whereas little plants grew at the bottom of the pond for herbivore fish to feed on. The other reason advanced by respondents, why they preferred earthen to concrete ponds had to do with low construction costs, but in terms of durability, a concrete pond had a longer life span as it was not easily damaged to require constant repairs.

4.5 Fish pond status

Both earthen and concrete ponds were all stocked with fish, an indication of the dedication farmers had towards fish farming. In general, small scale pond culture productivity was low, partly because aquaculture extension officers were unable to visit fish farmers regularly to advise and encourage them on the need for good management systems, need for pond fertilization and supplementary feeding. Farmers therefore, desired extension service support to encourage them upscale their production of fish by changing their attitude. However, Aquaculture extension officers were not able to provide farmers with the necessary information on how to access finances for purchasing of fish feed. They were not encouraging farmers to consider aquaculture as another form of business where they could maximize profits by improving on management systems. Extension officers were also unable to visit some fish farms in far flung places due to lack of transport, eventually some of them ended up abandoning fish farming.

4.6 Stocking rate of fish ponds

Since most farmers practiced low level management, the study revealed that the majority stocked their ponds with 3fish/m$^2$ in order to safe guard the fish from higher competition for natural food and oxygen (Figure 8).
4.7 Fish species cultured by farmers

The study has shown that there was more *Oreochromis niloticus* being cultured compared to *Oreochromis andersonii*, *Oreochromis macrochir* and *Tilapia rendalli* (Figure 9).

Based on this study, *O. niloticus*, was still the most preferred fish to other species for its faster growth, easy cultivation in organic manure fertilized and composite fed ponds. This was also acknowledged by Peterson (1998), who reported that to most farmers, fast growth was by far the most important fish characteristic. Simataaa and Musuka (2013) also reported that *O. niloticus* was the fastest growing bream in Zambia, harder and more resistant than *O. andersonii* and because 70% of its diet was plankton it was easier and cheaper to feed, as such the fish grew faster, especially the males, which gave the farmers good returns. According to Thornton et al. (2010), *Oreochromis niloticus* has been particularly prevalent; however it reigns more prominently outside of Africa. Within Africa *O. niloticus* is more of a delicacy, although many rural villagers use it as a protein supplement for their meager diets. Similarly, Nsonga (2014) observed that marketability was the first consideration in selecting a species for culture because the last step in a successful culture operation was to sell fish at a profit. Expanding small-scale aquaculture could bring enormous benefits in sub-Saharan Africa (World Fish, 2014).

4.8 Source of fingerlings

The study also showed that most of the respondents sourced their fingerlings from government (GRZ) fish farms and those who sourced from private seed producers were just about 10% (Figure 10).
The government fish farm at Chilanga, produced *O. andersonii*, *T. rendalli*, and *O. macrochir*, which they supplied to farmers. The farmers on the other hand trusted a government agency because it was assumed they produced high quality fingerlings compared to private seed producers. In the same vein, most small scale fish farmers preferred to buy *T. rendalli* seeds because the fish was considered to be very tasty. However, at the time of this study, the farm was facing a serious water problem as the pump had broken down for almost a year. Equally, the water level in the dam that supplied the fish farm by gravity was very low and unable to reach the ponds. That problem heavily affected the number of fingerlings being produced and later alone the number of fish farmers who purchased fingerlings from indigenous species.

Some hatcheries produced more of *O. niloticus* fingerlings than fingerlings of indigenous species because it grows faster and is very hardy. Since it has been withdrawn, many hatcheries are now producing more fingerlings of indigenous species, (Mudenda, 2009).

### 4.9 Assessing quality of fingerlings

Most fish farmers relied on advice from the sellers, and the extension officer to assess the quality of fingerlings, although some of them could not tell the quality on their own but only observed from the growth of fish. Those which were growing slowly were considered stunted and of bad quality. About 95% relied on seller’s advice and only 5% dependent on others for quality and other factors (Figure 11).

### 4.10 Type of culture system and duration of production cycle

Figure 12 shows that, 77.5% were practicing. Polyculture, while only 22.5%) of the respondents were practicing monoculture.
Most farmers practiced polyculture system because they did not have sufficient financial resources to purchase inputs like feed, but believed that fish could utilize both the pelagic and littoral zone to feed. At small scale level where fish farmers felt commercial feed was to be too expensive, polyculture was considered ideal as the fish will utilize all the natural food in the pond and with a bit of supplemental feed fish production can increase. Polyculture also ensured that farmers sold a variety of fish species although that has resulted in cross breeding among the *Oreochromis* species.

It was established that their production cycle lasted for a minimum of six months. Some small scale fish farmers in Lusaka province also practice monoculture, as it depends on which fingerlings of a species were more available at the time they were purchasing them. Monoculture is also good as only a species which attains fast growth and maximum weight in a short time will be cultured, thereby increasing production too.

### 4.11 Type of fertilizer used and frequency of fertilization

The study further revealed that, all the farmers relied on natural food which was boosted by manuring and supplementary feeding to help growth of fish and improved production. Lusaka province produces a lot of poultry; some of which comes from small scale fish farmers who are integrating it with aquaculture. The poultry manure when applied in the pond, helps to boost the growth of natural food for fish, reduces on the amount of feed and increases fish production.

Figure 13 shows that 90% of the respondents used organic manure twice per cycle, 7% once per cycle and only 3% six times per cycle.

The most common type of aquaculture among small-scale farmers involves pond fertilization using the crib system. This is a method where vegetative material (farm vegetable wastes, farm weeds and other green manures) is deposited in an enclosure constructed within a fishpond. The crib is widely used, particularly among small scale rural farmers without livestock. Another form of pond fertilization commonly used was integration with livestock, such as pigs, a common feature among the large and medium scale commercial farmers. In peri-urban areas chicken wastes, either obtained from the farm itself or from other sources is less common. However, chicken and cow manure are utilized among farmers who will not employ piggery wastes for religious reasons (Mudenda, 2009). Chicken manure was used by most of the farmers because it was very cheap, costing just about ZMK5 or 45 Cents per 50Kg bag.

### 4.12 Sources and frequency of feeding

The study showed that all the respondents used commercial feed, which they bought from either National Milling Corporation (97%) or Tiger Animal Feed (3%), to supplement natural food and ensure faster growth (Figure 14).

Farmers purchased feed depending on which one was readily available at the local store. They also purchased more of the feed which was slightly cheaper, due to lack of finances to help them improve their pond production system.
Table 1 Cost of inputs

| Item          | Cost (ZMK) |
|---------------|------------|
| Starter feed  | 208.00     |
| Grower        | 145.00     |
| Finisher      | 128.00     |
| Manure        | 5.00/50kg  |
| Fingerlings   | 0.30       |

Figure 15 shows that 95% of the respondents fed their fish once per day, and only 5% fed them twice per day. Supplementary feeding of fish using commercial feed was done once per day because they considered it expensive to do it twice or thrice, since they also fertilized their ponds to boost natural food production.

Figure 16 shows fish production in the three districts of Lusaka Province. Today, less than 2% of Africa's total fish supply comes from aquaculture. Projections show that if fish farming is adopted on only 1% of the 250 million hectares in Africa identified by the U.N. Food and Agriculture Organization as suitable for aquaculture, the continent could produce 3.5 million more tons of fish each year (World Fish, 2014).

Often reasons advanced for low productivity include: low stocking densities, usually one fish per square meter and poor pond fertilization, often without fertilization and inadequate crib design and maintenance. The government was therefore, exploring a number of measures to improve productivity of small scale operators and to improve profitability through commercialization in accordance with the Fifth National Development Plan (Mudenda, 2009). According to Central Statistical Office small business owners highlighted that credit was only one aspect of the challenges they faced in 2012. For the majority of small businesses in Zambia, their needs include physical access to financial services and collateral, which was a major challenge for small businesses.

4.13 Total fish production per farm

Due to low feeding of once per day, heavy reliance on natural food and low stocking density as a result of low level management, the end result was low fish production in tons. In as much, as there was low pond production, something should be done to address the trend of low small scale farm productivity. Brummett et al. (2008), observed that the ponds generally produce from 10 to 50 kg of fish per year and harvests depend on species fecundity, water quality and management, and fingerling availability.

Figure 17 shows that 72.5% of the respondents produced less than a ton, 25% produced between 1 ton and 5 tons and only 2.5% produced between 5 and 10 tons per cycle.
There was need to boost fish production among small scale fish farmers by encouraging them to purchase inputs required to increase production so as to supplement shortage of fish from capture fisheries. According to Nsonga (2014), the country had the potential to increase fish production by 300% by 2030 owing to an influx of both smallholder and commercial cage culture entrepreneurs.

By the year 2015, Zambia’s population forecast was estimated to be 15.2 million, requiring per capital fish consumption levels of around 10 kg per year or 152,000 tons of food fish per annum (World Fish, 2013). Therefore, the country will require over 140,000 tons of fish to meet both domestic consumption at current levels and export requirements. This implies invariably an increase of 82,000 tones in fish production over and above the current levels of 70,000 tons will be required in 2015 (World Fish, 2014).

**4.14 Average size of fish at harvest**

Figure 18 shows that, the majority of the respondents (95%) harvested their fish when it was between 200 and 400g, only 5% did so when the fish was between 250 and 500g.

The type of harvest method employed was both partial and complete harvest using a seine net. If management level was improved, their pond productivity would increase too.

**4.15 Income realized from fish sales**

Most of the fish was sold locally soon after harvest. The money raised from fish sales ranged between K1, 000 and K20, 000.00 ($1,800), with the majority of the respondents making between K5, 001 ($450) and K10, 000 ($900) per pond (Figure 20).
The income from fish sales was perceived to be inadequate to meet expenses related to paying tax, purchasing more feed for ponds, payment for labour and electricity to pump water. It seemed as though there was very little left to expand the fish farm through construction of new ponds. According to Central Statistical Office (2012), Small businesses and Business Chambers reported that the tax rate was unfairly applied as smaller businesses were taxed on turnover while big businesses paid their tax on profit. Small businesses were made to pay tax even where they made a loss. Most small businesses, especially in rural areas, made very small profit margins and were therefore not expected to pay tax.

5 Conclusion
Overall, the study revealed that, the main constraints attributed to poor fish production among small scale farming sector in Lusaka province were mainly: lack of effective extension service, expensive feed, fish predators and thefts. Fluctuations in production could also be attributed to the attitude of farmers and inconsistent government policies. A deliberate policy was required for banks to be flexible to allow individual farmers without collateral to borrow money in order to boost their fish farming activities. In instances, where such was not possible, the government should encourage farmers to form cooperatives to access such financial assistance from banks. More and more women should be encouraged to venture into fish farming to effectively contribute towards increased fish production.

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