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Factors Attributed to Low Aquaculture Production in the Copperbelt Province of Zambia: A Case Study of Kitwe and Chingola Districts

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ABSTRACT

This study was conducted in Kitwe and Chingola districts of the Copperbelt province. Simple Random sampling was used to select 50% of all registered farmers, both small-scale and commercial in each of the two districts. Semi-structured questionnaires were administered to all the selected farmers. In addition, data was collected through observations, personal interviews and the responses from fish farmers were recoded for subsequent data analysis using Microsoft Excel. Results indicated that more men (76%) were involved in fish farming and 44% of the farmers were in the age group between 31 and 40 years. On the other hand, low women and youth participation in the sector had contributed to low aquaculture production. It was therefore, necessary for the Citizen Economic Empowerment Commission (CEEC) to engage women and youths through empowering them with loans, and grants for them to effectively participate in aquaculture production. The study also showed that few farmers attained tertiary level of education, whilst the majority were semi-illiterate, which made it difficult to keep records of fish production, diseases outbreaks if any, input costs, net revenue and profitability. Based on the results of this study, 46% of the farmers were startups, 70% were small-scale, 4% large-scale and 26% were emergent farmers. Forty-four per cent had small farm sizes and owned 1 to 5 ponds. Extension services were also not effective enough to improve productivity of aquaculture, therefore there was also needs to introduce farmers association to be working hand in hand with extension workers. The finding also revealed that the most cultured species of fish in the two districts were breams, which included C. rendalli (49%) and O. andersonii (44%), with a few exceptions where fishes like catfish, carp, and others were cultured too. Fish seeds were normally procured from both government and private hatcheries. Besides, 84% of farmers bought their aquafeed from NOVATEK and Tiger Animal Feed whilst a partly 16% used own-farm made feed. Overall, the study revealed that the main constraints attributed to low aquaculture production among fish farmers in the Copperbelt province were mainly, little participation of women and youths, lack of stable capital base, Low literacy levels, majority of farmers were startups, presence of few land-based commercial farmers, lack of certified fingerlings in the two districts and high cost of commercially formulated feed. The study recommends that hatcheries, especially government ones, should improve on the quality of fish seed supplied to farmers to help them to improve their fish production.

Keywords: *Fish farmers, Low production, Profitability, Aquaculture, Copperbelt province.*

INTRODUCTION

Worldwide, nearly half a billion people derive their income from fisheries and aquaculture, and fisheries products provide about 15% of the animal protein in the diets of three billion people according to FAO (2010). Aquaculture can potentially contribute to the livelihoods of the rural poor because it generates food of high value, especially for the vulnerable groups such as pregnant and lactating women, infants and pre-school children (Coche, 1998). Increased production of farmed fish could help improve the food and nutrition insecurity situation in many of the country and contribute positively to overall economic growth (Brummet and Williams 2000; Beveridge *et al*., 2010).

Government and donor-driven programs have set the pace and alignment of aquaculture development in Africa, mostly through targeting smallholder production to increase food and nutrition security at the household level (Brummett *et al.*, 2008). The African contribution to world aquaculture production is still insignificant (~2.7%) (Halwart, 2020) albeit

significantly increasing with larger-scale investments in Egypt, Nigeria, Uganda and Ghana producing substantial quantities of fish (Babatunde *et al*., 2020).

The contribution of sub-Saharan Africa to global aquaculture production remains very small but is increasing significantly (Handisyde, Fridman, Bostock, 2014).

Fish farming in Zambia started over 40 years ago (Harrison, 1996). Aquaculture has yielded positive results such that Zambia is now ranked the sixth largest producer of farmed fish in Africa (Genschick *et al.,* 2017). According to DoF report (2015), in Zambia aquaculture productivity is higher among large scale sector than small scale farmers yet the country has few large-scale farmers. The aquaculture sector contributes around 30,000 metric tons (27% of total fish production) (World Fish, 2020). According to Sather (2012), the current status of fish farming production in Zambia contributes over 1.8% to the Gross National Product (GNP).

The growth of the small-scale aquaculture sector is however affected by several challenges and remains largely supported by national and international development programmes (Genschick *et al*., 2018).

The Zambian government has recognized the importance of the Fisheries and Aquaculture sub-sector and it has made several attempts over the years to increase their productivity through institutional reforms and various economic measures. Among which include a subsidy for inputs and exemption from tax for fishermen (Dada, 2004). Despite these government efforts, there is still a deficit in the supply of fish due to constraints faced by small scale fish farmers, some of which include high feed prices and lack of credit facilities for aquaculture businesses (Dada, 2004).

The aim of the study was to investigate factors associated with low aquaculture production in Kitwe and Chingola districts and to establish possible solution to those challenges faced by the aquaculture sub sector in the province.

Materials and Methods

The study was conducted in two districts of the Copperbelt province namely; Kitwe and Chingola.

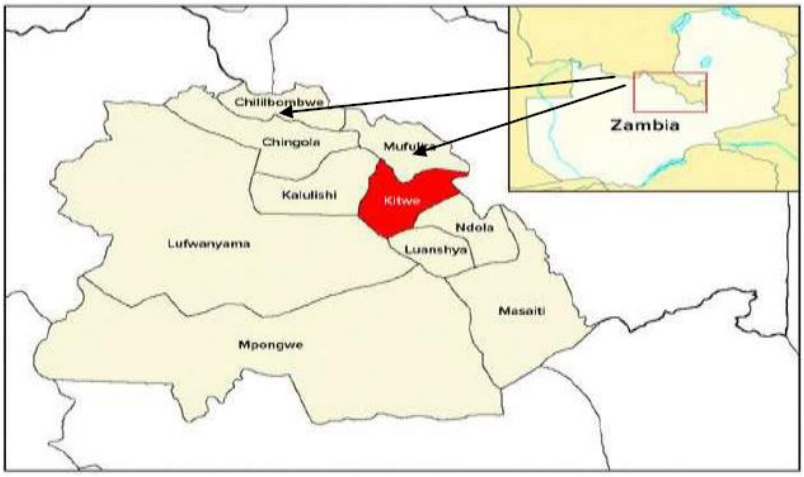

Figure1. *Map showing study areas*

Procedure

Simple Random sampling was used to select 50% of all registered farmers, both small-scale and commercial in each of the two districts. Semi-structured questionnaires were administered to all the selected farmers. Also, personal interviews were conducted and the responses from fish farmers were recoded for subsequent data analysis.

Data Collection

Primary data was collected through questionnaires and personal interviews of farmers, fisheries officers and other stakeholders in the mentioned districts of the Copperbelt province. Besides, data were collected through observations.

Data Analysis

Data which was collected from fish farmers were entered and analyzed with the aid of the computer software, Microsoft Excel. The results were appropriately coded (assigning numbers and/or symbols to responses in the field).

Results and Discussion

Figure 2, shows the number of men and women who were involved in fish farming in the two districts of Kitwe and Chingola. Based on figure

2, there was little participation of women in fish farming because most of them did not own land, as such, it was one of the factors attributed to low aquaculture production in the Copperbelt province.

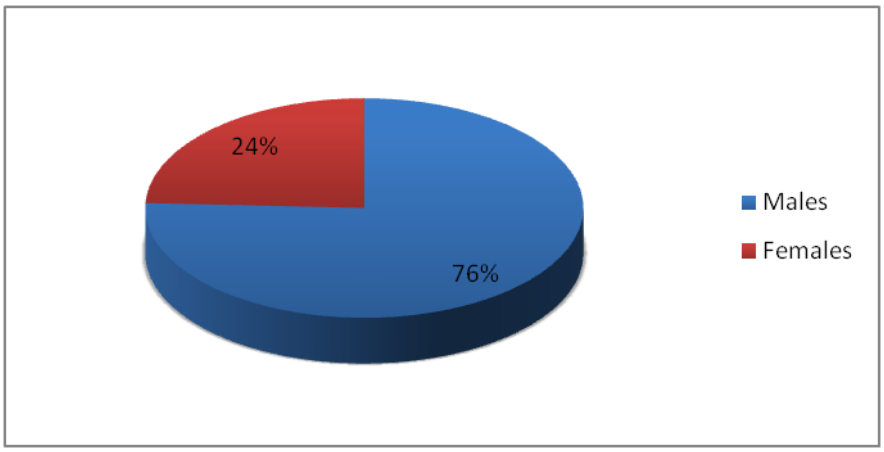

Figure2. *Gender of respondents*

Kapembwa and Samboko (2020), reported that most of the fish farmers were males. Similarly, Simataa and Musuka (2013), highlighted some of the reasons for low women participation in aquaculture. The authors attributed the low participation of women in fish farming to inability to own land, labour intensiveness of the venture, especially the pond construction phase and lack of capital Mainza and Musuka, (2015), Chenyambuga *et al*., (2011) also reported that "in Morogoro region, very few women-owned fish ponds and most of them were widowed, divorced or unmarried." Aquaculture was indeed labour intensive, especially when it comes to pond construction. Women do not have the strength to construct ponds compared to their male counterparts, hence their low participation in the sector aquaculture.

Figure 3 shows the age groups of most farmers, which were between 31 and 40 years.

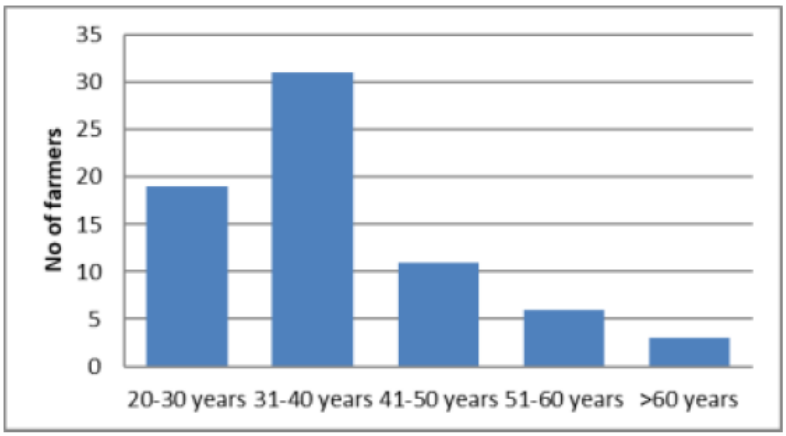

Figure3. *Age Group of respondents*

This agrees with Nsonga (2015) who reported that the average age of fish farmers was 40 years. In contrast, Kapemba and Samboko (2020) reported that the average age of fish farmers was 53 years. In this study, there was low participation in aquaculture by young people below the age of 31 years. Young people or youths are more active as compared to old people. Therefore, there is need to engage youths in fish farming by offering them incentives such as youth empowerment funds, loans and grants through Citizen Economic Empowermenr Commision (CEEC) to enable them to increase fish production in the province. Deotti and Estruch (2016) contended that young people were moving away from farming as their source of income for their livelihood, due to lack of capital and land ownership. With such kind of incentives, these rates of operations can upscale. By involving young people as well as women, aquaculture can reduce poverty of households and communities in the country (Béné *et al*., 2016). However, the Zambian government was available to support both large

and small-scale fish farmers (Arulingam *et al*., 2019).

Figure 4 presents information in terms of the education level of fish farmers in the two districts. Accordingly, 43% were illiterate, 23% attained a primary level of education, 21% had a secondary level of education, and 23% went up to tertiary level.

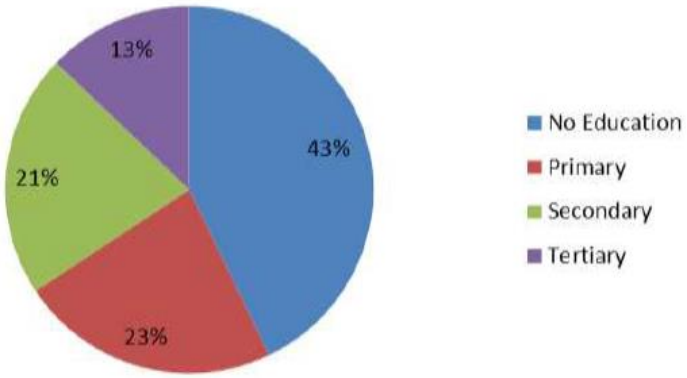

Figure4. *Education level*

Education is one of the things that are important to human life (Noviyanti *et al*., 2015). The low education level of fish farmers may affect the adoption of improved fish farming methods (Muddassir *et al*., 2017). Secondary level of education, later alone tertiary level, were expensive to attain, as such, most people failed to do so (Mainza and Musuka, 2015).

Education played a vital role in the adoption process because it was easy to understand and get the required information by educated persons than the uneducated ones (Muddassir *et al*., 2017). All learning needs required by these groups are meant to improve their life survival skills, so that they can overcome difficulties they encounter or in other words, they can overcome the environmental challenges, both physical and social environment (Wantah *et al*., 2018).

Fish farmers require record-keeping of fish production, fish mortality and diseases, input costs as well as determining profitability the venture. Fish farmers need to be taught the principles of fish farming and the importance of record-keeping to improve on their pond management practices (Nsonga, 2015). Record-keeping becomes a challenge when few farmers have attained some level of education.

Alternatively, non-formal education could be introduced. Non-formal education is any type of educational activity which is organized outside formal education system, either implemented separately or as a part of larger activity, which serves particular learners with specific learning objectives (Wantah *et al*., 2018).

Unfortunately, most of the farmers ventured into aquaculture to earn an income due to lack of employment. This is in agreement with Mwaijande and Lugendo (2015) who reported that aquaculture was an approach for economic transformation as well as alleviating poverty. Figure 5 gives information on the fish farming experience. The results show that many of the fish farmers in Kitwe and Chingola had not been in it for a long time.

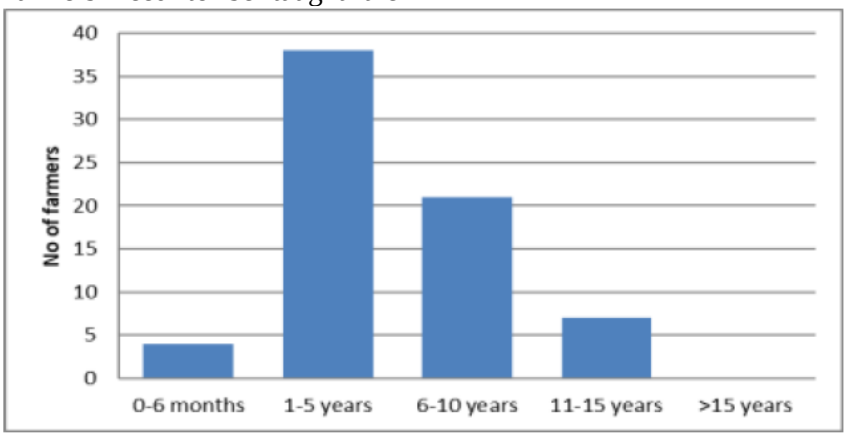

Figure5. *Fish Farming experience*

Simataa and Musuka (2013) reported that farmers who were engaged in fish farming for 9 years and above were very few compared to those below. In this study, the majority had a maximum of 5 years in fish farming. This shows that when the majority of people were start-ups, they had little knowledge of the sector.

Bhatt and Pattel (2018) observed that if very few fish farmers had recommended level of knowledge regarding the various practices of aquaculture, it may result in producing low tons of fish. No fish farmers association existed in both districts; the existence of such association could help them share ideas on how to go about their farming activities and in the long run improve on productivity.

Figure 6 represents the scale of fish farming in the Copperbelt province. The study shows that 70% were small scale farmers, 26% emergent farmers, and 4% commercial farmers. Since there were few land-based commercial farmers in the two districts, hence the reason why there was low fish production.

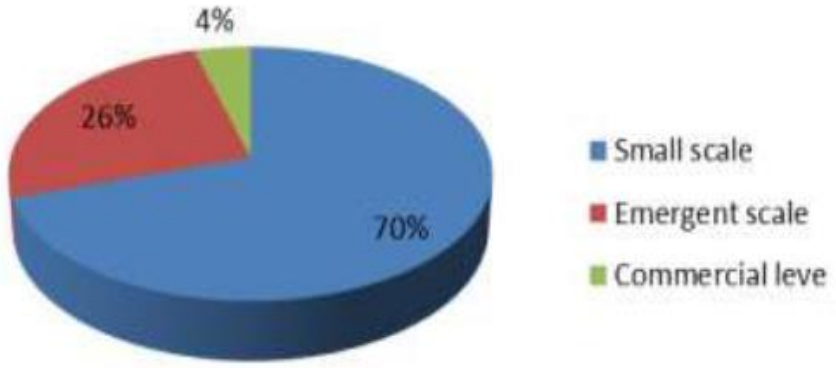

Figure6. *Farming scale*

According to Genschick *et al.*, (2017), most of the farmed fish in Zambia today was produced by the large-scale commercial sector compared to that coming from small scale farmers. DoF reports (2012; 2015) indicated that of the 38,000 mt produced from aquaculture, cage aquaculture contributed about 71% to overall production in Zambia.

Figure 7 gives information about farm sizes. Majority of farmers owned farms whose sizes were below one hectare while a smaller number owned less than ten hectares of land.

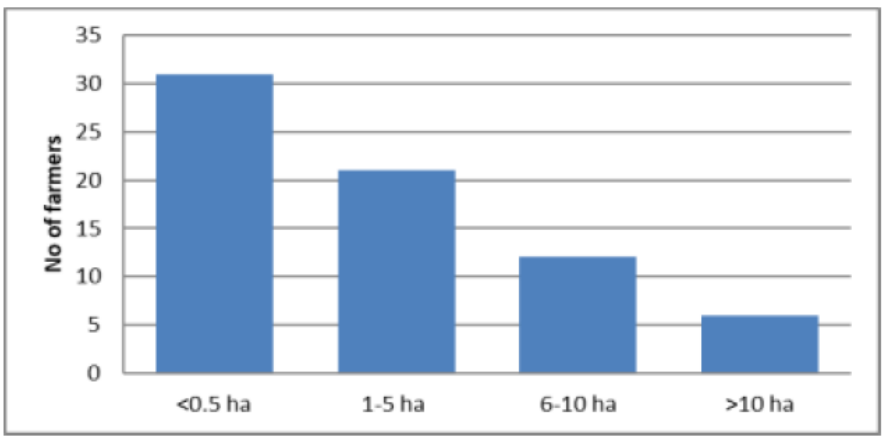

Figure7. *Farm sizes*

Figure 8 represents the number of ponds owned by different fish farmers in the two districts under study. Accordingly, many farmers owned a small number of ponds. This study shows that the majority of respondents had between 1 and 5 ponds. Figure 8 represents number of ponds owed by different fish farmers in the two districts under study. Accordingly, many farmers owned small number of ponds. This study shows that the majority of respondents had between 1 and 5 ponds.

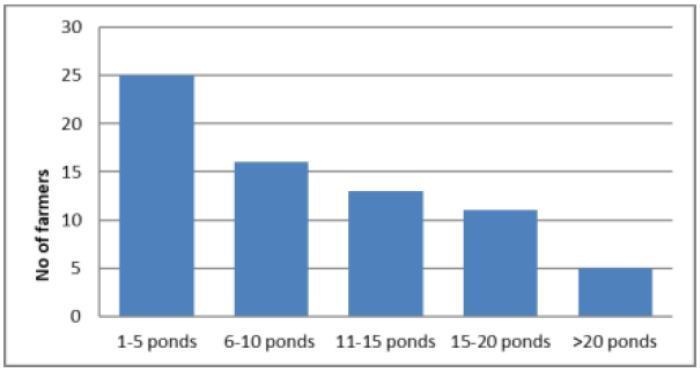

Figure8. *Number of ponds owned*

In a study conducted by Nsonga (2015), the author noted that most of the small-scale fish farmers owned 2 to 10 ponds, whose sizes ranged between 100m2 and 150m2. The findings were in contrast with a study conducted by Mainza and Musuka (2015), whose findings were that most of the fish farmers in Zambia owned ponds ranging between 1 and 10. However, the authors, indicated that 72% of small-scale farmers cultivated less than 2 hectares of land annually (Mainza and Musuka, 2015). Meanwhile, Musuka and Musonda, (2013), also reported that Lusaka Province had 254 small scale fish farmers, with 1,305 ponds, covering an area of 22ha in total.

One other factor attributed to low aquaculture production was inadequate extension services offered to farmers to improve their farming activities. This agrees with Nsonga (2015), who equally observed that there were insufficient extension services in fish farming. According to Musuka and Musonda (2013), extension services failed to sustain the skills and inputs required to reach an optimal level of productivity in the rural fish-farming sector in Zambia. Similarly, Genschick *et al*., (2017) reported that extension services and a multitude of private enterprise actors and service providers can better support the small-scale sector, especially in the more urbanized provinces such as Lusaka and Copperbelt.

Figure 9 shows that bream was the most cultured species of fish in all the two districts. These included *C. rendalli* (49%) and *O. andersonii* (44%) with a few exceptions where fishes like catfish, carp fish, and others were cultured too.

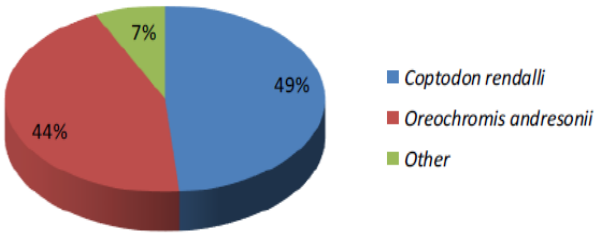

Figure9. *Fish species stocked*

Generally, farmers of all sizes are legally permitted to farm Nile tilapia (*Oreochromis niloticus*). *O. niloticus* is the most preferred fish to other species for its faster growth, easy cultivation in organic manure fertilized and composite fed ponds. But also, they cultivate local species such as the three-spotted bream (*Oreochromis andersonii*). Simataa and Musuka (2013) also reported that *O. niloticus* was the fastest-growing bream in Zambia, harder and more resistant than *O. andersonii* and *Coptodon rendalli* 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 (Mainza and Musuka, 2015). According to Kefi and Mwango (2018), There was no evidence to show that farmers who were using *O. niloticus* were performing better than those farmers using *O. andersonii* since the productivity of the farmers culturing the non-indigenous *O. niloticus* (4.7 tons/ha/year) did not differ significantly from

those farmers using *O. andersonii* (4.6 tons/ha/farmer).

However, *O. niloticus* fingerlings were not available in the GRZ hatchery, therefore, most of the farmers cultured *Coptodon rendalli* and *O. andersonii* because most of them purchased fingerlings from government hatchery. Kefi and Mwango (2018) made strong recommendations for deliberate efforts to promote *O. andersonii* both at production and consumption levels in order to create demand for the fish species. At the same time Genetic studies should be conducted to establish the genetic variability and strains of the indigenous fish species in Zambia. Furthermore, there was an urgent need to establish gene banks for most indigenous fish species to conserve the genetic resources for aquaculture and capture fisheries (Kefi and Mwango, 2018). The government in partnership with World Fish through Zambia Aquaculture Enterprise Development Project (ZAEDP) aims to develop a genetic improvement program for *O. andersonii* to provide an improved strain of indigenous fish for farmers located outside of the *O. niloticus* zone (Genschick *et al*., 2017).

Figure 10 gives information on the sources of fish seeds that respondents used. And the results indicated that the majority of fish farmers in the Copperbelt province sourced their fingerlings from government (GRZ) fish farms and those who sourced from private seed producers were just about 26% and 18% produced their own seeds.

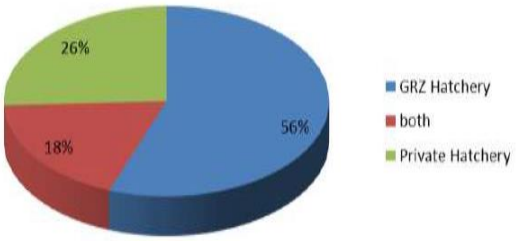

Figure10. *Fish seed source*

Nsonga (2015) reported that most farmers were concerned about input and production constraints, such as the inadequate quality of fingerlings. Some respondents preferred to buy fingerlings from private hatcheries because they were perceived to be of good quality as compared to those coming from the government hatcheries (Mainza and Musuka, 2015). The authors further reported that most of the fish farmers in Lusaka province sourced from the GRZ fish farm in Chilanga. In the case of the current study, the government fish farm in Mwekera produced *O. andersonii*, *Coptodon rendalli* as well as *O. macrochir* (Mainza and Musuka, 2015). Most of the small-scale fish farmers preferred to buy *Coptodon rendalli* seeds because the fish was considered to be very tasty (Mainza and Musuka, 2015).

Mushili and Musuka (2015) reported that a small number of farmers sourced fish seeds from GRZ hatchery as compared to those buying from private sectors. In contrast, Genschick *et al*., 2017, revealed that private hatcheries, only supplied seeds for their private grow-out operations, and almost all of them were found in cities such as Lusaka, Kitwe and Ndola. Figure 11 shows that most of the respondents used commercial feed, which they bought from NOVATEK, Tiger Animal Feed and National Milling Corporation and few of them used their own-farm made feed.

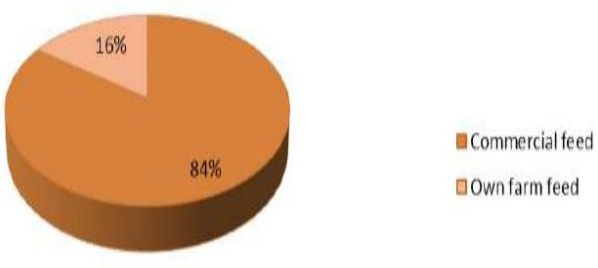

Figure11. *Type of feed used*

Difficulties in accessing secure supplies of high-quality feed and seed are often described as the biggest barriers to aquaculture development in Africa (Brummett *et al*., 2008; Beveridge *et al*., 2010). Ume *et al*., (2016) noted that due to the high cost of feed poor farmers tended to stop feeding their fish and resumed when the feed prices were low. Maulu *et al.,* (2019), revealed that farmers also purchased more of the feed which was slightly cheaper, due to lack of finances to help them improve their pond production system

According to Nsonga (2015), most farmers with fish in their ponds fed their fish with kitchen wastes and less than half (30/86) reported that they also applied organic manures. Maulu *et al.,* (2019), also observed that the small-scale producers usually attempted to feed and fertilize their ponds in integrated systems using locally sourced materials.

The use of commercial feed is most common among the large-scale commercial producers resulting in higher productivity (Maulu *et al.,* 2019). Equally, Kefi and Mwango (2018), reported that productivity was highest in those farmers using commercial feed (6.4 tons/ha/year) compared to those using single ingredients or fertilization or a combination of the two. The correct use of commercial feeds has been found to improve productivity and thus should be promoted at farm level (Kefi and Mwango, 2018).

CONCLUSION

Low aquaculture production was partly attributed to little participation of women and youths below the age of 31 years in fish farming because most of them did not have land of their own and lacked capital. There is a need to engage women and youths in fish farming by offering them empowerment funds.These can be resolved by offering them incentives in form of empowerment funds, loans and grants through CEEC. With such kind of incentives, women and youths were capable of upscaling fish production in the province. As such, many of them would be enabled to earn an income and in the long run, think less of formal employment.

Low education level was another area of great concern. There was a need to introduce literacy classes among illiterate or semi-illiterate fish farmers to enable them to acquire knowledge in record keeping and general farm management. Low education levels affected the adoption of improved fish farming techniques. Besides, regular training in basic fish farming would help the majority of people who were startups, to acquire knowledge and make them realize the importance of the sector. More training for fish farmers should be organized to help upcoming fish farmers have a clear understanding about fish farming. Farmers', especially uneducated ones require to be taught how to keep farm records to help them practice good management.

Another reason for low aquaculture production was that there were few land-based commercial farmers in the two districts. The majority were at the small-scale level and owned not more than 5 ponds whose average size was 150m2, an issue attributed to inadequate extension services offered to farmers to improve their farming activities. Extension services were not effective enough to improve aquaculture production at farm level. Therefore, regular interaction with extension agents in conjunction with farmers association would help individual farmers to efficiently and effectively manage their farms.

The fish seed was one of the biggest challenges faced by fish farmers. Although many of the farmers cultivate indigenous species, such as *O. andersonii, C. rendalli*, and *O machrochir*; these do not grow as fast as *O. niloticus*. Although farmers of all sizes were legally permitted to farm Nile tilapia (*Oreochromis niloticus*), which was most preferred fish to other species for its faster growth, easy cultivation in organic manure fertilized and composite fed ponds. Most hatcheries, especially GRZ ones were incapable of providing *O. niloticus* fingerlings. Instead, they supplied farmers with mostly inferior quality fish seeds, which hinders effective aquaculture production. Nevertheless, the government in partnership with world fish through ZAEDP aims to develop a genetic improvement for these indigenous fish species.

The price of commercial feed was beyond the reach of many farmers. The study took note of complaints raised by many respondents who expressed dissatisfaction in the prices charged for a 25kg bag of aquafeed. Many poor farmers could not afford to purchase the required number of bags of feed as advised because of the high cost of commercially formulated feed and instead called for a reduction in the price of the same.

There is a need to engage women and youths in fish farming by offering them empowerment funds. More training for fish farmers should be

organized to help upcoming fish farmers have a clear understanding about fish farming. Farmers', especially uneducated ones require to be taught how to keep farm records to help them practice good management. Extension officers are supposed to be visiting farmers at least once per week to check on how farmers were doing with their farming activities. At the same time, input (feed) prices should be reduced to enable farmers to upscale their activities.

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