Smallholder Fish Farmers' Population Census Report 2020: Northern and Luapula Provinces, Zambia

MUSIKA
Making Agricultural Markets Work for Zambia

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Executive Summary

Introduction. The main objective of the census was to understand the smallholder fish farmers' landscape, especially women and youth. It provided a baseline data for the Aquaculture technical, vocational, and entrepreneurship training for improved private sector and smallholder skills project implemented by WorldFish in partnership with Musika in Northern and Luapula Province. The aquaculture value chain development goal of the project is to increase the number of human resources working for the private sector and the number of smallholder commercial fish farmers with enhanced aquaculture knowledge and up-to-date practical skills to help sustainably grow the sector and make it more inclusive. The census collected data on (i) the demographic characteristics of the smallholder farmers; (ii) fish farming background; (iii) smallholder resources and fish species cultured; (iv) gender, youth and division of roles in fish farming; (v) access to input and output markets; (vi) production constraints and opportunities; and Global Positioning System (GPS) at the farmers' household.

Demographic characteristics of the smallholder farmers. There was a total of 2,341 smallholder farmers with Northern Province having the highest number of farmers at 61.0 percent (1,427). Of the total number of farmers in the two Provinces, 72.1 percent were actively involved in fish farming and 27.9 percent had abandoned fish farming at the time of the census. Males made up the highest percentage of fish farmers in the two provinces (86.0 percent). The largest percentage (60.8 percent) of smallholder farmers were mature adults in the ages 36 to 64 years). Youths (35 years and below) only made up 29.8 percent share of the smallholder farmers. The least were the elderly population (65 years and above) at 9.5 percent. The average age of the farmers was reported at 44.3 (±0.3) with the youngest farmer at 15 years of age whilst the oldest was 93 years old. Most of the farmers had a primary level of education at 47.7 percent, and 5.0 percent went up to tertiary level of education. The percentage of female farmers who never went to school was slightly higher compared to their male counterparts. In terms of marital status, 88.5 percent were married. Female farmers had the largest proportion of farmers who were widowed, divorced and separated. Each household of fish farmers had an average of 7 (±0.01) people at the time of the census. Luwingu district had the largest number of farmers with 18.0 percent (421), followed by Mbala district at 16.0 percent (374) and Kawambwa district at 15.3 percent (358). Chipili district had the least with 4.2 percent (98) smallholder fish farmers.

Fish Farming Background. The largest percentage of smallholder farmers (73 percent) had 1 to 5 years of experience in fish farming. This correlates with the country's aquaculture production that has witnessed a steady increase in fish production from 22,753 metric tons in 2015 to 38,800 metric tons in 2019 – representing 70.5 percent increase over a period of 5 years. The majority of the smallholder famers (66.2 percent) started fish farming in order to have fish for both consumption and income. Others (17.5 percent) stressed that they were doing farming only for consumption, and only 16.4 percent pointed out that their sole reason for farming was to earn income. Generally, almost all the farmers (89.9 percent) had land for fish farming, and only a small proportion (0.7 percent) rented. The proportional of women who owned land was slightly lower than men at 74.5 percent and 92.4 percent, respectively. Of the 653 farmers (27.9 percent of the total) who had abandoned fish farming at the time of the census, 29.1 percent indicated that they stopped farming due to inadequate access to seed/fingerlings, 24.1 percent who were discouraged due to theft by humans, 23.4 percent were affected by shortage of water, 12.4 percent lost their fish from predators, 4.3 percent did not have feed, 4.1 percent were hit by floods and 2.5 were constrained by limited finances.

Smallholder Resources and Fish Species Farmed. Almost all the farmers (99.9 percent) used earthen ponds for their fish farming. There was a sum of 5,090 fish ponds in both Northern and Luapula Provinces at the time of the census. The smallest size of the fish pond was at $4m^2$ (2mx2m) and the largest was $15{,}000m^2$ (150mx100m) (see annex c for more information of the number sizes of the fish ponds). Most of the farmers (60.1 percent) stocked 1 fingerling per square meter and 35.2 percent stocked 2 to 3 fingerlings per square meter. The main source of water for fish farming was from underground followed by water from the streams harvested using a drainage. The largest percentage of farmers cultured *tilapia rendalli* with 39.5 percent, followed by a combination of *Oreochromis macrochir* and *tilapia rendalli* with 23.2 percent, 15.8 percent cultured *Oreochromis macrochir*, 12.8 percent practiced a tilapia polyculture, 4.4 percent cultured *Oreochromis tanganicae*, 2.3 percent *Oreochromis niloticus*, 1.3 percent tilapia sparmani, 0.5 percent *Oreochromis andersonii*, and the least were farmers who cultured a combination of *Clarias gariepinus* and *Oreochromis species* with 0.2 percent. The basic agriculture tools here included the following tools hoe, axe, pick, shovel, bucket, and basket. The average cost for constructing a pond size of $\leq 100m^2$ was at ZMW175.7 (±14.2), and a fish pond size of $>500m^2$ was at ZMW988.0 (±77.6).

Gender, Youth and Division of Roles in Fish Farming. Overall, the smallholder aquaculture was dominated by male farmers as they mostly reported to be the owners of the farm. Analysis of the results by sex reveals that married farmers work jointly with their spouses to undertake various farming activities although there some minor percentage differences in favor of male farmers. For example, in key activities such as land allocation, the largest percentage of farmers (46.1 percent) revealed that the husband was responsible for making such decisions. The second were farmers who made the decisions jointly with the husband and wife with 30.7 percent. 50.0 percent of the female farmers said that decisions to allocate land was done jointly by the husband and wife. Decision making around acquiring fingerlings showed that the proportional of female farmers who said that decisions to acquire fingerlings were jointly done by spouses was slightly higher compared to their male counterparts with 58.1 percent and 42.4 percent, respectively.

Access to Input Markets. The government hatchery, wild resources, NGOs (Peace Corps and others) and few private hatcheries are the primary sources of fingerling for smallholder farmers. There are also secondary sources which involves farmer to farmer and/or recycling fingerlings. The majority of the smallholder farmers got their fingerlings from their fellow farmers with 36 percent. Thirty-three percent of the smallholder farmers recycled their own fingerlings, and 19 percent sourced their fingerlings from the Government hatchery. The least was local breeder farmer with 2 percent. Almost all the farmers did not use sex-reversed fingerlings at the time of the census. 85.9 percent did not have a specific month in which they stocked the fish ponds with fish (meaning they could stock in any month of the year whenever they accessed fingerlings). The largest percentage of farmers used non-commercial feed with 81 percent, 16 percent use both commercial and non-commercial feed, and only 3 percent exclusively used commercial feed to feed their fish at the time of the census. Sixty-five percent of the farmers who used commercial feed had to travel over 20 kilometers (km) to access commercial feed, 31 percent covered 0 to 5km, 3 percent moved 6 to 10km and only 1 percent traveled a distance of 11 to 20km to access fish feed at the time of the census. The largest percentage of farmers used animal manure with 70.6 percent and the least used inorganic fertilizers with 0.9 percent.

Access to extension services. Of all the active farmers, 78.7 percent stated that they had not met with a fisheries extension service officer in the past 12 months at the time of the census. The percentage differences for farmers who were visited by a fisheries officer between male and female farmers were very small at 20.8 percent and 24.3 percent, respectively. The largest proportion of the farmers sourced information about

fish farming from their fellow farmers with 62 percent, followed by farmers who got information from both extension officers and Peace Corps with 26 percent. The least source of information was from private consultants with 2 percent.

Access to Output Markets. Most of the smallholder farmers (81.9 percent) practiced partial harvest, 9.5 percent had never harvested and 8.6 percent practiced complete harvest of their fish at the time of the census. This made it difficult to estimate the quantity of fish the farmers harvested. However, the results showed that smallholder farmers who carried a complete harvest produced an average of 35.0 (±3.7) Kgs of fish in each production cycle. Overall, 49.5 percent sold their fish to neighbors at farmers' farm, 42.5 percent had not sold fish at the time of the census, and the least, 0.3 percent sold their fish at church. The average price of fish was at ZMW20.4 (±0.2) per Kg with the lowest price at ZMW10 per Kg and the highest price at ZMW40 per Kg. The average income from fish farming was recorded at ZMW1,263.3 (±101.8) per growing cycle. The lowest amount of income earned was ZMW5 and the maximum income earned was at ZMW36,000.0 at the time of the census. Most of the smallholder farmers (63 percent) had a production cycle of 7 to 12 months, followed by farmers with production cycle of 6 months with 34 percent, and 3 percent had a production cycle for over 12 months. Farmers who produced fish for consumption indicated that they only ate fish at the time harvest.

Production Constraints and Opportunities. The largest percentage of farmers were constrained by no access to fingerlings with 48.8 percent. The second was no access to feed with 36.4 percent and the least was poor soil quality with 0.1 percent. The challenges faced by male and female farmers were almost the same with minor percentage differences. Despite of these challenges faced by the farmers, 86.4 percent of the smallholder farmers ascertained that they had a financial capacity to buy commercial feed if it was made available in their locations.

Conclusion. There are a lot of people venturing into smallholder aquaculture in Northern and Luapula Provinces with an average of two fish ponds at the back of their yard in almost every village you visit. The farmers are culturing various tilapia and *oreochromis* species, and in most cases practice a combination of species in one fish pond. The smallholder farmers know that aquaculture can help them earn income and can be a source of fish for consumption though most of them seem not to understand that culturing fish requires greater commitments in terms investment in inputs and time to continuously monitor the growth of the fish as well as the markets and costs associated with farming. As a result, smallholders are just producing small quantities most for consumption and selling within the neighborhood. However, there are many reasons surrounding low productivity of the smallholder aquaculture. One of them is inadequate infrastructure, particularly inputs and output markets to support the aquaculture sub sector in the northern region. There is a very limited access to extension services as a result farmers depend on their fellow farmers for supply of farming inputs such as information about fish farming practices, source of fingerlings and feed. The smallholder farmers have resorted to recycling fingerlings and feeding their fish with farm materials such as vegetables, termites and waste materials from the kitchen. This has significantly affected their production, productivity and profitability.

Acknowledgement

The smallholder fish farmers' census in Northern and Luapula provinces of Zambia was carried out in 2019 under the Aquaculture Technical, Vocational, and Entrepreneurship Training for Improved Private Sector and Smallholder Skills Project (AQ TEVET) implemented by WorldFish in partnership with Musika. The project is an initiative by WorldFish under the CGIAR FISH in Agri-Food systems with funds from the Norwegian Agency for Development Corporation (Norad). The authors wish to thank the Department of Fisheries staff at all levels in the districts especially the Fisheries Officers, Fisheries Assistants and Agriculture Camp Officers in the Ministry of Agriculture who worked tirelessly during the identification of all the fish farmers in the districts. We also wish to thank the smallholder fish farmers for finding time to respond to the survey questions. It is hoped that the information generated will be used to improve their farming practices for better livelihoods.

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List of Abbreviations and Acronyms

AEZs	Agro-Ecological Zones
AQ TEVET	Aquaculture Technical, Vocational, and Entrepreneurship Training
CSO	Central Statistical Office
FAO	Food and Agriculture Organization
FISP	Farmer Input Support Programme
GIS	Geographic Information System
GPS	Global Positioning System
HH	Household
Kg	Kilogram
Km	Kilometer
m	Meters
MoLF	Ministry of Fisheries and Livestock
Musika	Musika Development Initiative
n	Sample size
NGO	Non-Governmental Organization
Norad	Norwegian Agency for Development Corporation
PPP	Public Private Partnership
SSFF	Small scale Fish Farmers
ZMW	Zambian Kwacha

1.0 Introduction and Background

The smallholder fish farmers' population census was conducted from 2nd November 2018 to 30th April 2019 in Northern and Luapula Provinces of Zambia. The main objective of the census was to understand the smallholder fish farmers' landscape, especially women and youth smallholders. It provided a baseline data for the Aquaculture technical, vocational, and entrepreneurship training for improved private sector and smallholder skills project implemented by WorldFish in partnership with Musika. The aquaculture value chain development goal of the project is to increase the number of human resources working for the private sector and the number of smallholder commercial fish farmers with enhanced aquaculture knowledge and up-to-date practical skills to help sustainably grow the sector and make it more inclusive. The census data would be used to update the smallholder farmers' registers, and identifying and selecting commercial-oriented fish farmers and eventually organize them for easier training and skills development, input supply, and linkages with output markets. The census enumerators together with District Fisheries Officers went out visiting all households and fish farms whether actively involved in fish farmers or abandoned were counted and collected detailed information on (i) the demographic characteristics of the smallholder farmers; (ii) fish farming background; (iii) smallholder resources and fish species cultured; (iv) gender, youth and division of roles in fish farming; (v) access to input and output markets; and (vi) production constraints and opportunities; and (vii) Global Positioning System (GPS) data at the farmers' household.

2.0. Research Methodology

2.1 Description of the study areas

The census was conducted in Northern and Luapula Provinces where WorldFish and Musika are implementing the AQ TEVET project. The northern region has the highest number of smallholder fish farmers in the country (CSO, 2019). This region is highly endowed with water resources with average monthly temperature above 20 ^{o}C, that supports aquaculture. Zambia has three distinct Agro-Ecological Zones (AEZs), and Luapula and Northern Provinces are in the northern zone that receives highest amount of rainfall in the country. The northern region receives from 1000 to 1,500 mm of rain fall each year with the rain season lasting from 140 to 200 days (Braimoh et al., 2018) and also cited in (World Bank Group, 2019).

2.2 Sample Design

Purposive sampling was adopted to select the districts for the census count (see table 2.2.1). This was done in consultations with the Provincial and District Fisheries Officers. All districts that were reported to have fish farmers who were either actively involved in fish farming or had abandoned prior to the census were selected to take part in the census. Active fish farmers were defined as any farmer who had aquaculture facilities such as a fish pond and had stocked it with fish or harvested in the past 6 months prior to the census. On the other hand, abandoned fish farmers were defined as farmers who had aquaculture facilities such as fish pond but had stopped fish farming in the past 1 year prior to the census. Fish farmers' registers were used to identify the farmers. In addition, in communities were fish farmers were hard to find, snowball sampling was employed, and this involved requesting identified farmers to recruit their fellow farmers into the census count. The census enumerators together with District Fisheries Officers went out visiting all households and fish farms whether actively or abandoned farmers were counted.

Table 2.2 1: Selected Districts for the Census

Northern Province	Luapula Province
Kasama	Mansa
Mungwi	Samfya
Luwingu	Chipili
Mbala	Kawambwa
Mporokoso	

2.3 Data Collection Methods

A structured questionnaire with closed responses and few open ended questions was used to collect the data. Mobile data collection was adopted and a questionnaire was installed on a tablet. Responses were recorded on the tablet and transmitted to the server after the interview. The questionnaire was pre-tested in Kasama District, and to this effect Kasama District was excluded from the census.

2.4 Data analysis

Quantitative methods were used to analyze the census data. The data was analyzed using STATA software version 14 and 16. Descriptive statistics such as frequency tables, pie charts, mean, sum etc. were used to describe and interpret the census results.

3.0 Results

This section presents the census findings. The findings are presented in six different sections as follows: (i) demographic characteristics of the smallholder farmers; (ii) fish farming background; (iii) fish farming activities; (iv) gender, youth and division of roles in fish farming; (v) access to input and output markets; and (vi) production constraints and opportunities.

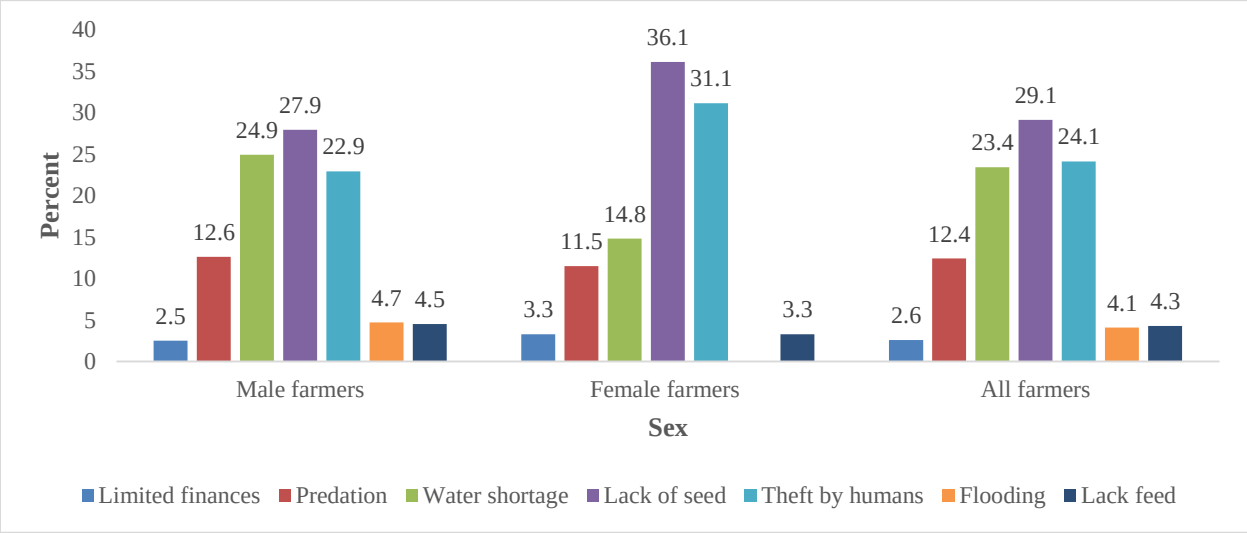
3.1 Demographic characteristics of the smallholder farmers

Table 3.1.1 shows the total number of smallholder fish farmers by province. There were more farmers in Northern Province than in Luapula Province. Northern Province had 61.0 percent (1,427) smallholder farmers compared to 39.0 percent (914) in Luapula Province. Of the total number of farmers in the two Provinces, 72.1 percent were actively involved in fish farming and 27.9 percent had abandoned fish farming at the time of the census. Males made up the highest percentage of fish farmers in the two provinces (86% men).

Table 3.1. 1 Total Number of Smallholder Fish Farmers by Province

Province	All fish farmers		Active farmers %	Farmers currently not active %
	Number	Percent		
Total	2,341	100.0	72.1	27.9
Northern	1,427	61.0	77.9	22.1
Luapula	914	39.0	62.9	37.1

Figure 3.1. 1: Reasons for Abandoning Fish Farming



Farmers who were not actively involved in fish farming at a time of the census were asked to provide reasons for abandoning farming and the results are displayed in figure 3.1.1. Overall, 29.1 percent said that they stopped farming because of lack of seed, 24.1 percent were discouraged due to theft by humans and 23.4 percent were affected by shortage of water. Farmers who were affected by shortage of water explained that they use underground/spring water for their fish ponds and when water dries out it becomes difficult for them to set up a drainage to pull water from the nearby source hence they end up abandoning their fish

farms. Figure 3.1.1 further shows that both male and female farmers were heavily constrained by lack of seed at 27.9 percent and 36.1 percent, respectively.

Table 3.1. 2: Percentage Distribution of Fish Farmers by District

District	All fish farmers		Active farmers %	Farmers currently not active %
	Number	Percent		
Luwingu	421	18.0	88.6	11.4
Mbala	374	16.0	83.2	16.8
Kawambwa	358	15.3	50.0	50.0
Mansa	267	11.4	88.4	11.6
Mporokoso	243	10.4	71.6	28.4
Mungwi	225	9.6	72.0	28.0
Samfya	195	8.3	51.8	48.2
Mpulungu	160	6.8	57.5	42.5
Chipili	98	4.2	60.2	39.8
Total	2,341	100.0	72.1	27.9

Table 3.1.2 shows the percentage distribution of smallholder farmers by district. Luwingu district had the largest number of farmers with 18.0 percent (421), followed by Mbala district at 16.0 percent (374) and Kawambwa district at 15.3 percent (358). Chipili district had the least with 4.2 percent (98) smallholder fish farmers. Luwingu and Mansa districts had the highest percentage of farmers who were actively involved in fish farming at 88.6 percent and 88.4 percent, respectively. Kawambwa (50.0 percent) had the largest proportion of fish farmers who abandoned farming followed by 48.2 percent in Samfya and 42.5 percent in Mpulungu. The map in figure 3.1.2 shows the distribution of farmers in the two Provinces. See more information on the percentage distribution of farmers by camp and district in annex 1.

Figure 3.1. 2: A Spatial Distribution of Smallholder Fish Farmers by District

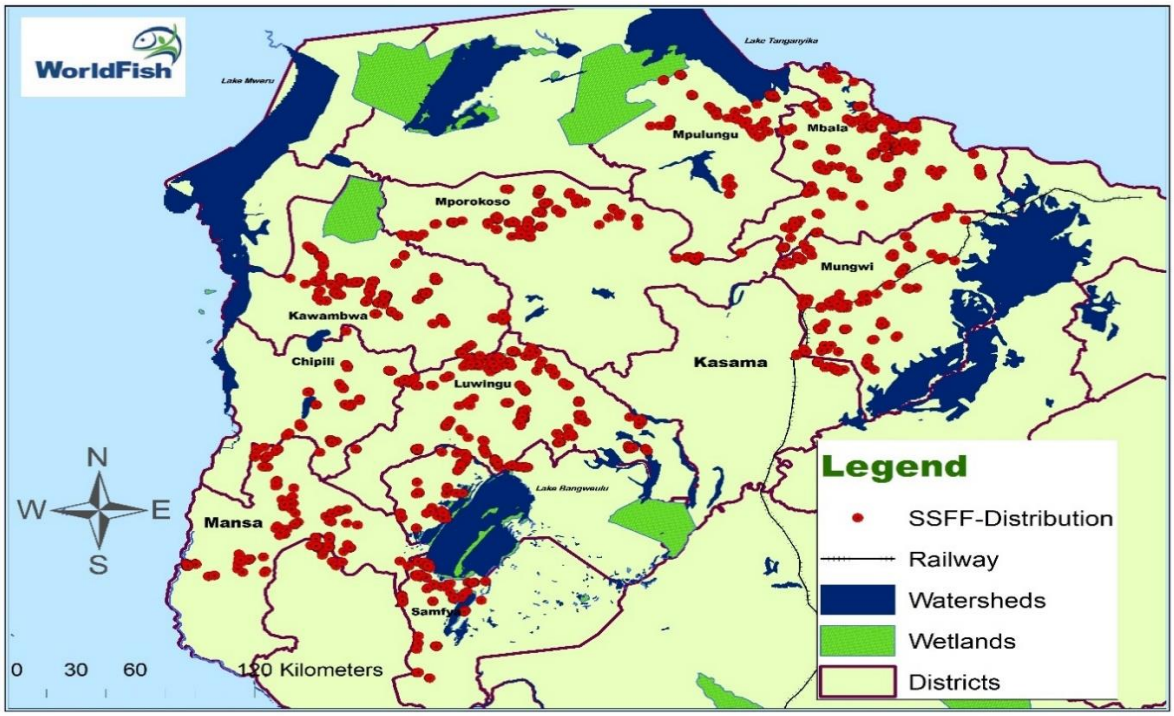
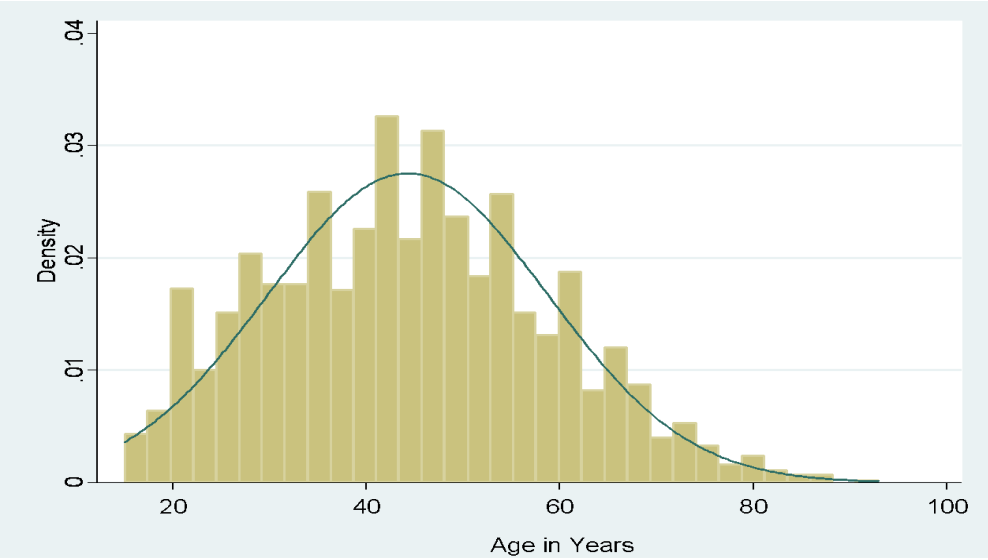


Figure 3.1. 3: Age Distribution of Smallholder Farmers



The age distribution of smallholder fish farmers is depicted in figure 3.1.3, and figure 3.1.4. Overall, the largest percentage (60.8 percent) of smallholder farmers were mature adults in the ages 36 to 64 years). Youths (35 years and below) only made up 29.8 percent share of the smallholder farmers. The least were the elderly population (65 years and above) at 9.5 percent. The average age of the farmers was reported at 44.3 (±0.3) with the youngest farmer at 15 years of age whilst the oldest was 93 years old.

Figure 3.1. 4: Age Distribution of Smallholder Farmers by Sex

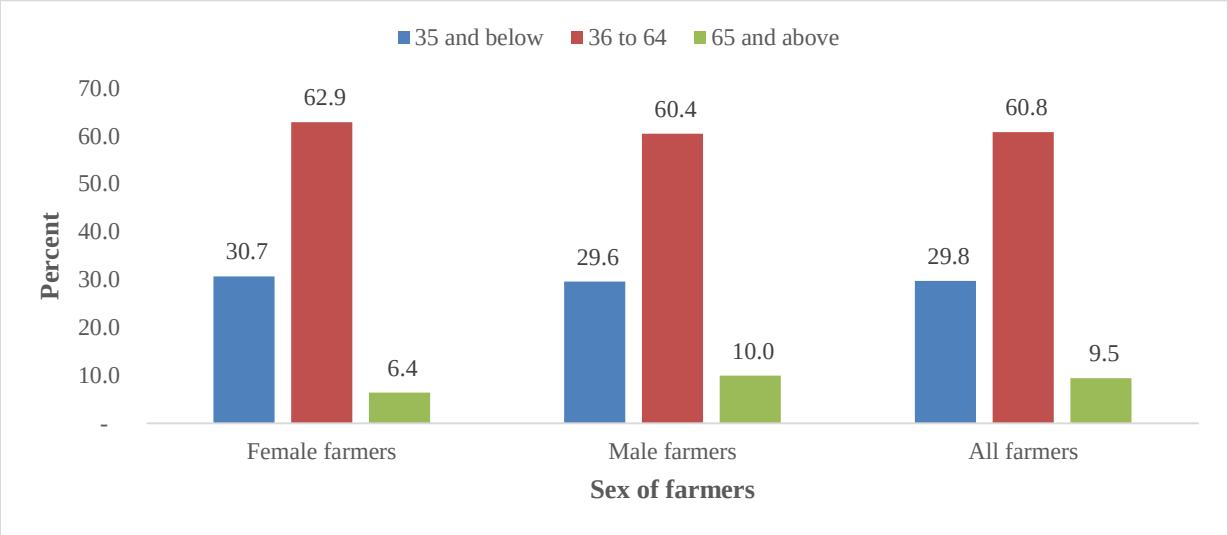


Table 3.1.3 displays the percentage distribution of smallholder fish farmers by level of education and sex. Most of the farmers had a primary level of education at 47.7 percent, followed by farmers with secondary level of education at 44.0 percent and tertiary at 5.0 percent. The least were farmers who never went to school at 3.3 percent. Of the total number of female farmers, highest percentage had primary level of education at 65.6 percent while the largest percentage of male farmers had secondary education at 46.8

percent. The percentage of female farmers who never went to school was slightly higher at 4.9 percent compared to 3.0 percent for male fish farmers.

Table 3.1. 3: Percentage Distribution of Smallholder Fish Farmers by Level of Education and Sex

Level of Education	Male farmers % n=2,013	Female farmers % n=328	All farmers % n=2,341
Primary	44.8	65.6	47.7
Secondary	46.8	26.8	44.0
Tertiary	5.4	2.7	5.0
None	3.0	4.9	3.3
Total	100.0	100.0	100.0

Table 3.1.4 shows the percentage distribution of farmers by marital status and sex. Of the total number of farmers, 88.5 percent were married, 7.3 percent were single, 2.7 percent were widowed and the farmers who were divorced and separated made up 2.7 percent and 0.9 percent, respectively. Only one (0.1 percent of the male farmers) farmer was cohabiting at the time of the census. Almost all the male farmers (91.3 percent) were married, and 71.0 percent of the female farmers were married. Female farmers had the largest proportion of farmers who were widowed, divorced and separated. Each household of fish farmers had an average of 7 (±0.01) people at the time of the census (see figure 3.1.5).

Table 3.1. 4: Percentage Distribution of Farmers by Marital Status and Sex

Marital Status	Male fish farmers % n=2,013	Female fish farmers % n=328	All fish farmers % n=2,341
Married	91.3	71.0	88.5
Single	7.3	7.3	7.3
Widowed	0.6	15.9	2.7
Divorced	0.5	3.7	0.9
Separated	0.3	2.1	0.6
Cohabiting	0.1	“na”	0.0
Total	100.0	100.0	100.0

“na” denotes not applicable

Figure 3.1. 5: Household Size, mean = 7 (± 0.1)

3.2 Fish Farming Background

Figure 3.2.1 shows the percent share of fish farming experience among smallholder farmers. Most of the farmers (73 percent) had 1 to 5 years of experience in fish farming. This correlates with the country's aquaculture production that has witnessed a steady increase in fish production from 22,753 metric tons in 2015 to 38,800 metric tons in 2019 –representing a 70.5 percent increase over a period of 5 years.

Figure 3.2. 1: Percent Share of Fish Farming Experience among Farmers

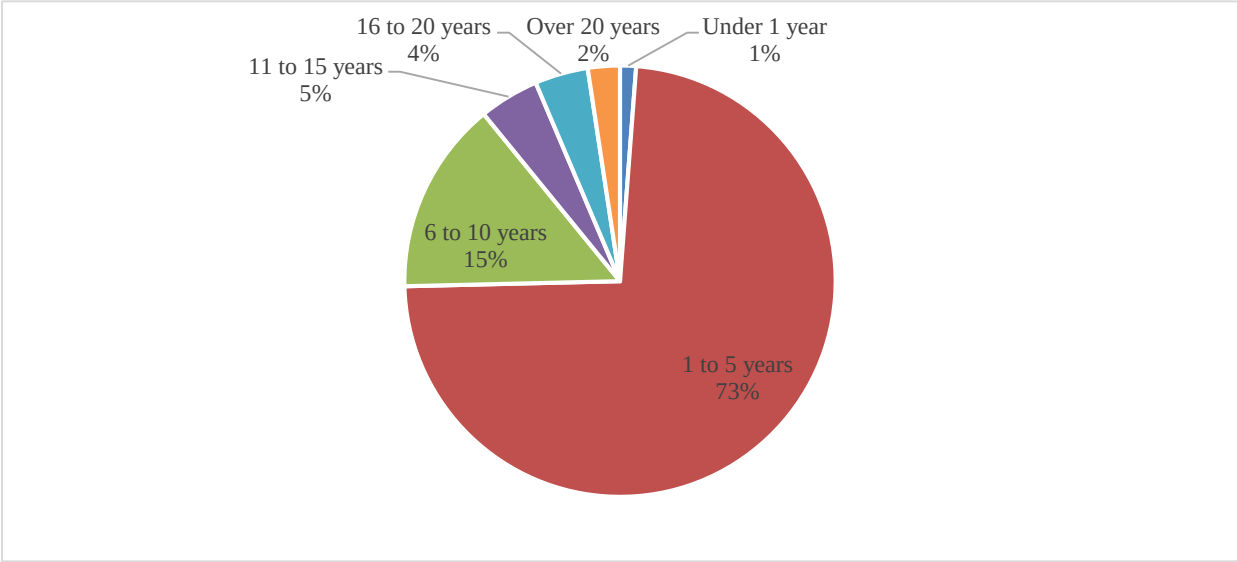
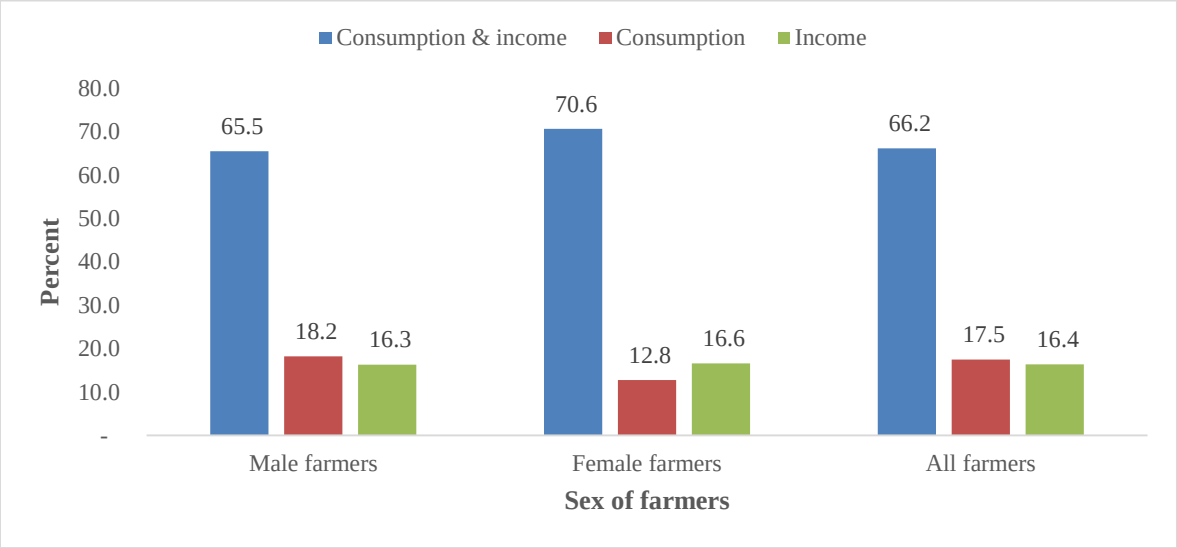


Figure 3.2. 2: Motivation for Starting Fish Farming by Sex



Farmers were asked to indicate the primary reason for venturing into fish farming and the results are shown in figure 3.2.2. Of all the farmers, 66.2 percent said that they started fish farming in order to have fish for consumption and income, 17.5 percent said their primary reason for fish farming was for consumption only, and 16.4 percent stressed that they started fish farming so that they could earn income only. The proportional of women farmers who said that their fish was for consumption and income was slightly higher compared to men at 70.6 percent and 65.5 percent, respectively.

Table 3.2. 1: Land Ownership for Conducting Fish Farming by Sex

Land Ownership	Male active farmers (%)	Female active farmers (%)	All active farmers (%)
	n=1454	n=235	n=1,689
Self-owned	92.4	74.5	89.9
Extended family land	5.3	7.2	5.6
Spouse owns	0.3	11.5	1.8
Customary	1.3	4.3	1.7
Rented	0.3	2.6	0.7
School land	0.3	0.0	0.2
Total	100.0	100.0	100.0

Table 3.2.1 shows land ownership for conducting fish farming by sex. Generally, almost all the farmers (89.9 percent) had owned land for fish farming; 5.6 percent used the extended family land. Only a small proportion (0.7 percent) rented and 0.2 percent used a school land. The proportional of women who owned land was slightly lower than men at 74.5 percent and 92.4 percent, respectively.

3.3 Smallholder Resources and Fish Species Cultured

Figure 3.3.1 shows that aquaculture facilities used by smallholder farmers. Almost all the farmers (99.9 percent) used earthen ponds for their fish farming.

Figure 3.3. 1: Aquaculture Facilities used by Smallholder Farmers

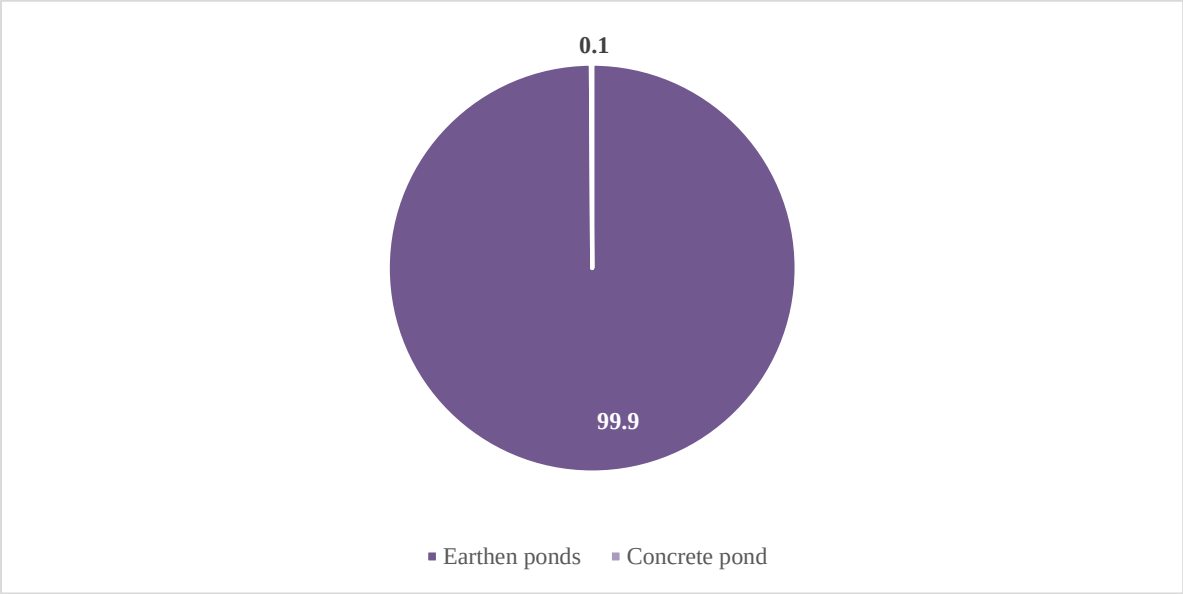
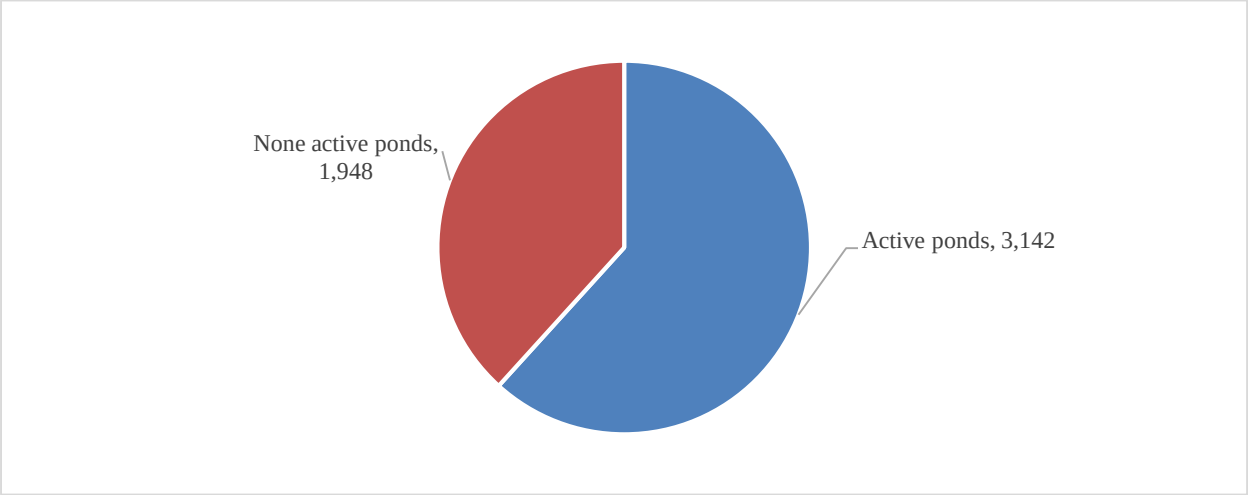


Figure 3.3. 2: Number of Active and None-active Fish Ponds



There was a sum of 5,090 fish ponds in both Northern and Luapula Provinces at the time of the census. Figure 3.3.2 shows the number of active and none active fish ponds. Active ponds were defined as ponds that were stocked with fish while none-active ponds were ponds that had no fish at the time of the census. Figure 3.3.2 indicates that 3,142 fish ponds representing 61.7 percent were active and 1,948 (38.3 percent) were not active at the time of the census. The smallest size of the fish pond was at $4m^2$ (2mx2m) and the largest was $15,000m^2$ (150mx100m) (see annex c for more information of the number sizes of the fish ponds). Most of the farmers (60.1 percent) stocked

1 fingerling per square meter and 35.2 percent stocked 2 to 3 fingerlings per square meter (see figure 3.3.3). the least percentage of farmers (1.1 percent) stocked 6 to 10 fingerlings per square meter.

Figure 3.3. 3: Stocking Density among Smallholder Fish Farmers

Figure 3.3. 4: Sources of Water for Fish Farming

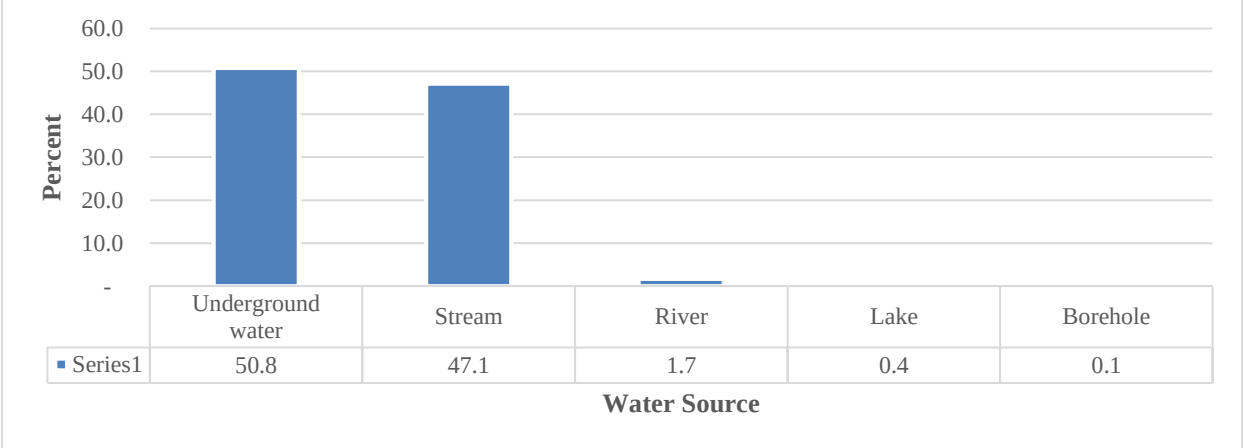


Figure 3.3.4 shows the percentage distribution of sources of water for fish farming among smallholder farmers. Slightly above half of the farmers (50.8 percent) in Northern and Luapula Provinces used underground water (spring water) for their fish farming. Field observations revealed that most of the farmers constructed their fish ponds in the wetlands for easier access of underground water. 47.1 percent of the farmers sourced water from the streams. Less than 1 percent of the farmers sourced water fish farming from the borehole. Figure 3.3.5 shows that 97.5 percent of the farmers have water throughout the year. Further discussions showed that smallholder

farmers had no specific season of fish farming and farmed throughout the year. Figure 3.3.6 further shows that farmers practiced semi-intensive aquaculture systems.

Figure 3.3. 5: Percent Share of Water Availability among Smallholder Farmers

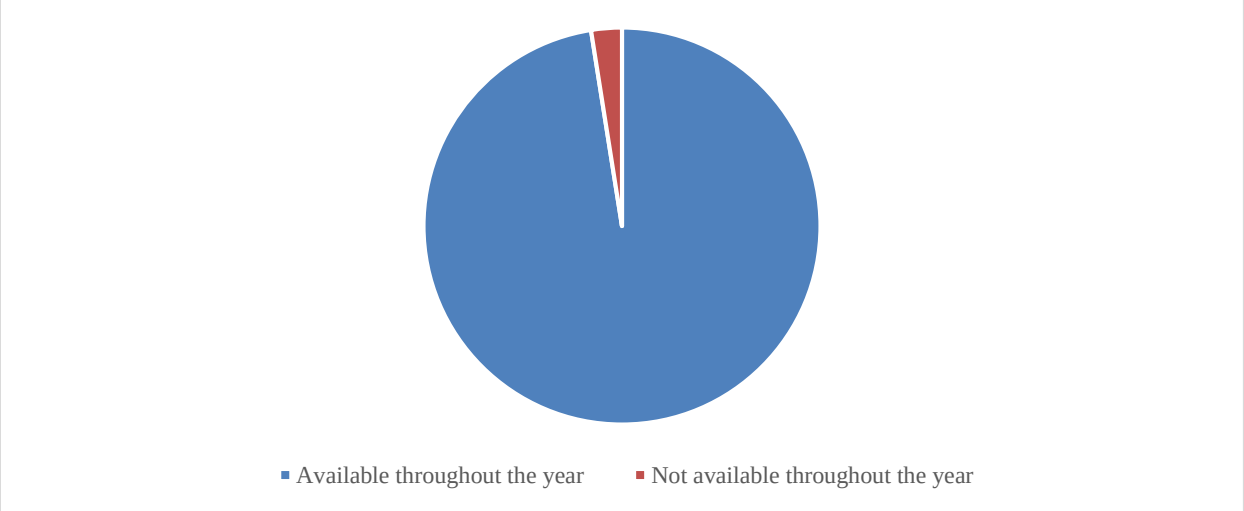
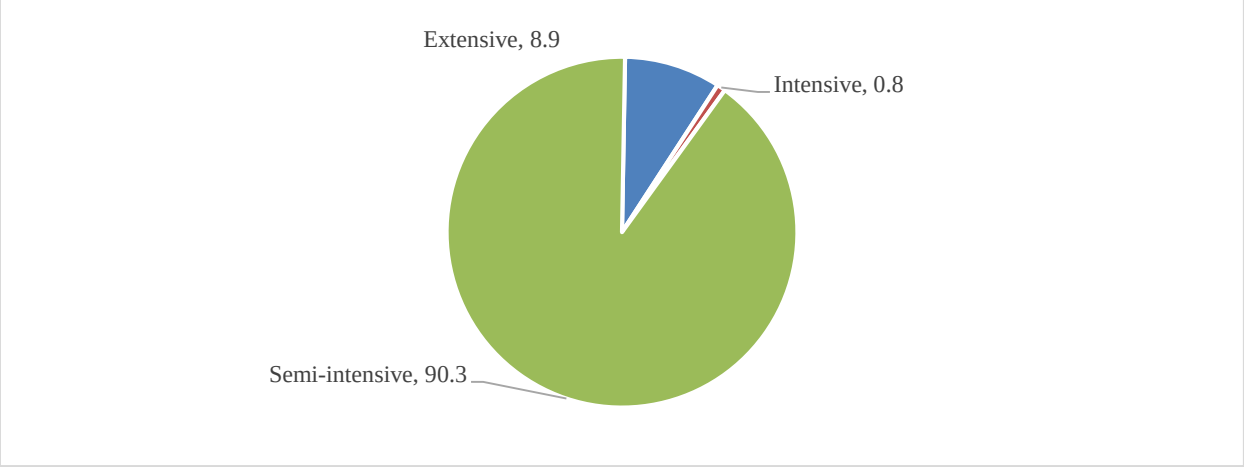


Figure 3.3. 6: Intensity of the Aquaculture System by Gender



One third of the farmers cultured more than one *oreochromis species*. Table 3.3.1 shows the percentage distribution of fish species cultured. The largest percentage of farmers cultured *tilapia rendalli* with 39.5 percent. Farmers who cultured *oreochromis macrochir* and *tilapia rendalli* were second with 23.2 percent, and the third were farmers who cultured *oreochromis macrochir* only. The least were farmers who cultured a combination of *Clarias gariepinus* and *Oreochromis species* with 0.2 percent.

Table 3.3. 1: Fish Species Cultured

Fish Species Cultured	Number	Percent
Tilapia rendalli	664	39.5
Oreochromis macrochir	266	15.8
Oreochromis tanganicae	74	4.4
Oreochromis niloticus	38	2.3
Tilapia sparmani	21	1.3
Oreochromis andersonii	9	0.5
Oreochromis macrochir & Tilapia rendalli	390	23.2
Tilapia polyculture	215	12.8
Clarias gariepinus & Oreochromis species	4	0.2
Total	1,681	100.0

Table 3.3. 2: Tools used by Smallholder Farmers ("na" denotes not applicable)

Tools owned by farmers	Male active farmers %	Female active farmers %	All active farmers %
	n=1,451	n=236	n=1,687
Basic agriculture tools	87.5	90.3	87.9
Fish nets & basic agriculture tools	11.2	8.9	10.9
Diesel Generator, hapa & water tank	0.1	na	0.1
No tools	0.2	na	0.2
Pumps & basic agriculture tools	0.3	na	0.3
Kitchen scale & basic agriculture tools	0.3	na	0.2
Wheelbarrow & basic agriculture tools	0.4	0.9	0.5
Total	100.0	100.0	100.0

The basic agriculture tools here included the following tools hoe, axe, pick, shovel, bucket, and basket. Table 3.3.2 shows the tools owned by smallholder farmers. The largest percentage of farmers only had basic agriculture tools with 87.9 percent among all the farmers.

Table 3.3. 3: Average Cost of pond Construction

Pond size m^2	Average construction cost (ZMW)	Std. Err. (±)
≤100	175.7	14.2
200	214.1	29.1
300	590.4	83.5
400	932.4	119.5
500	838.9	159.3
>500	988.0	77.6

Table 3.3.3 shows the average cost of pond construction (particularly digging only). The average cost for constructing a pond size of ≤ $100m^2$ was at ZMW175.7(±14.2) at the time of the census, and a fish pond size of >$500m^2$ was at ZMW988.0(±77.6). It is important to note that some of the

smallholder farmers used family labor hence did not incur any cost associated with pond construction.

3.4 Gender, Youth and Division of Roles in Fish Farming

Table 3.4.1 shows the percentage distribution of responsibility for making decisions to allocate land to construct fish ponds by sex. Overall, most of the farmers (46.1 percent) said that the male household head was responsible for making decisions to allocate land. The second were farmers who made the decisions jointly with the husband and wife with 30.7 percent, and a male household member with 14.4 percent. Female household head and a female household member accounted for 3.0 percent and 1.2 percent of the proportion of the decision makers, respectively. The least were the decisions made by the employee with 0.1 percent. Furthermore, table 3.4.1 shows that half (50.0 percent) of the female farmers said that decisions to allocate land was done jointly by the husband and wife. In contrast, slightly above half (51.5 percent) of the male farmers stressed that decisions to allocate land for pond construction were made by the male household head.

Table 3.4. 1: Percentage Distribution of Responsibility for Making Decisions to Allocate Land to Construct Fish Ponds by Sex

Responsibility for making decisions to allocate land for pond construction	**Male fish farmers %**	**Female fish farmer %**	**All fish farmers %**
	n=2,013	**n= 328**	**n= 2,341**
Male household head	51.5	12.8	46.1
Joint decision	27.5	50.0	30.7
Male household member	15.9	5.8	14.4
Female household head	0.4	19.5	3.0
Female household member	0.3	7.0	1.2
Employee	0.1	0.3	0.1
Not sure	4.4	4.6	4.4
Total	100.0	100.0	100.0

Figure 3.4.1 shows the percentage distribution of responsibility for making decisions to acquire fingerlings by sex. Of all the farmers, 44.6 percent indicated that they made the decisions to acquire fingerlings jointly with their spouse, 33.0 percent said that decisions were made by the male household head, and 16.8 percent mentioned that decisions were made by the female household head. The proportional of female farmers who said that decisions to acquire fingerlings were jointly done by spouses was slightly higher compared to their male counterparts with 58.1 percent and 42.4 percent, respectively.

Figure 3.4. 1: Percentage Distribution of Responsibility for Making Decisions to Acquire Fingerlings by Sex

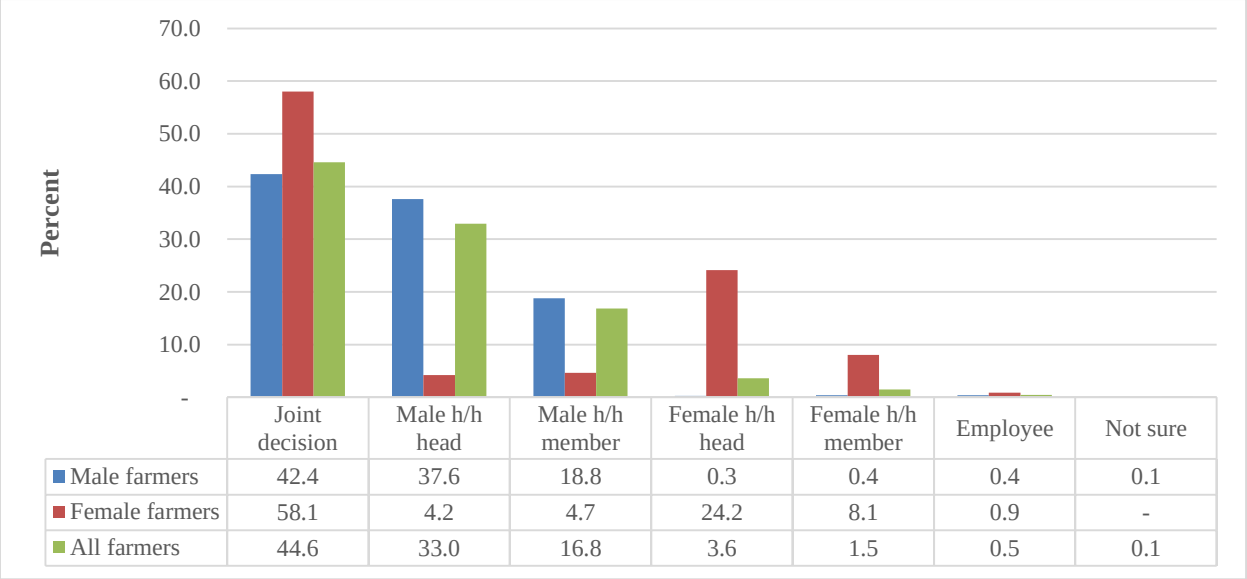


Table 3.4. 2: Percentage Distribution of Responsibility for Making Decisions to Acquire Fertilizers by Sex

Responsibility for fertilizing the ponds	Male active farmers %	Female active farmers %	All active farmers %
	n=1,451	n=236	n=1,687
Joint decisions	32.5	30.1	32.1
Male household head	23.0	1.7	20.0
Female household head	11.9	44.1	16.4
Youth	3.5	3.4	3.5
Employee	0.8	0.9	0.8
Children	0.4	na	0.4
Do not fertilize the ponds	28.0	19.9	26.9
Total	100.0	100.0	100.0

"na" denotes not applicable

Table 3.4.2 percentage distribution of responsibility for making decisions to acquire fertilizers by sex. Of all the farmers, 32.1 percent of the decisions to acquire fertilizers were done jointly by husband and wife. 26.9 percent indicated that they did not fertilize their fish ponds hence did not engage in the discussions around acquiring fertilizers. The least proportional of the decision makers were children with 0.4 percent. Further discussions with the parents' children revealed that the farmers were using farm materials such as leaves to fertilize their ponds and children played a vital in deciding when to put the leaves in the fish ponds. A similar trend is depicted in figure 3.4.2 with 65.2 percent of the female farmers stating that construction of fish ponds done by both husband and wife. Analysis of the results by sex reveals that married farmers work jointly with their spouses to undertake various farming activities. However, men seem to be dominating responsibilities for undertaking the fish farming activities.

Figure 3.4. 2: Percentage Distribution of Responsibility for Constructing Fish Ponds

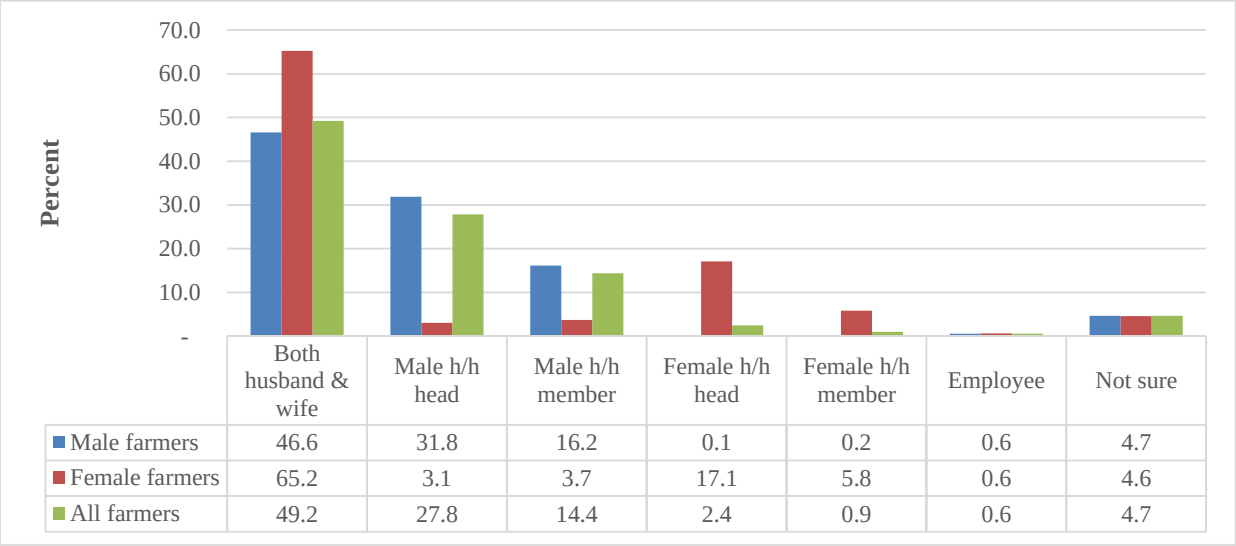
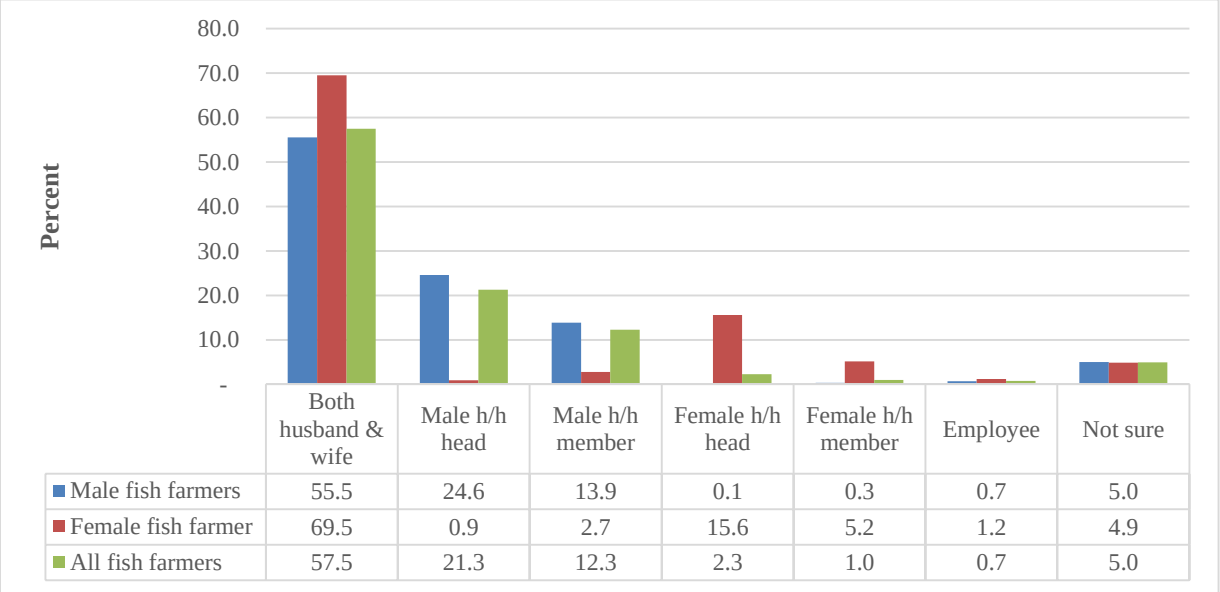


Table 3.4. 3: Percentage Distribution of Responsibility for Preparing Fish Ponds by Sex

Responsibility for preparation of fish ponds	Male fish farmers %	Female fish farmer %	All fish farmers %
	n=2,013	n=328	n=2,341
Both husband & wife	50.8	66.8	53.0
Male household head	28.8	2.1	25.0
Male household member	15.0	3.1	13.3
Not sure	4.6	4.6	4.6
Female household head	0.1	16.2	2.4
Female household member	0.2	6.1	1.0
Employee	0.6	1.2	0.7
Total	100.0	100.0	100.0

Table 3.4.3 shows the percentage distribution of responsibility for preparing fish ponds by sex. Overall, 53.0 percent of the farmers said preparation of fish ponds was done by both husband and wife, followed by 25.0 percent carried out by the male household head, and 13.3 percent by a male household member. For female farmers, the largest percentage said that fish ponds were prepared by both spouses with 66.8 percent, and 16.2 percent indicated that preparation of fish ponds was done by the female household head. A graphical illustration of results on responsibilities for maintenance of fish ponds is displayed in figure 3.4.3.

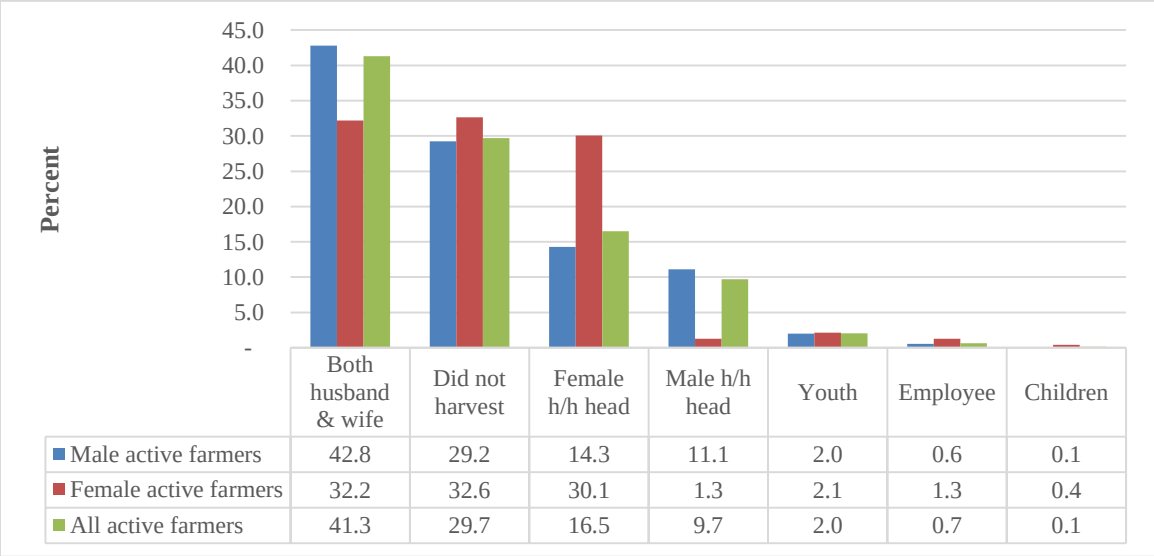
Figure 3.4. 3: Responsibility for Maintaining the Fish Ponds



	Both husband & wife	Male h/h head	Male h/h member	Female h/h head	Female h/h member	Employee	Not sure
Male fish farmers	55.5	24.6	13.9	0.1	0.3	0.7	5.0
Female fish farmer	69.5	0.9	2.7	15.6	5.2	1.2	4.9
All fish farmers	57.5	21.3	12.3	2.3	1.0	0.7	5.0

Figure 3.4.4 shows the percentage distribution of responsibility for harvesting the fish by sex. Overall, 41.3 percent of the farmers said harvesting fish was done by both husband and wife, and 29.7 percent pointed out that they had not harvested fish at the time of the census. The least percentage (0.1 percent) stressed that harvesting fish was done by children. The percentage of men who said that the harvest together with their spouse was slightly higher at 42.8 percent compared to 32.2 percent for female farmers. More women said that they did not harvest than men (32.6 percent to 29.2 percent).

Figure 3.4. 4: Percentage Distribution of Responsibility for Harvesting the Fish by Sex



	Both husband & wife	Did not harvest	Female h/h head	Male h/h head	Youth	Employee	Children
Male active farmers	42.8	29.2	14.3	11.1	2.0	0.6	0.1
Female active farmers	32.2	32.6	30.1	1.3	2.1	1.3	0.4
All active farmers	41.3	29.7	16.5	9.7	2.0	0.7	0.1

Figure 3.4.5 shows the percentage distribution of responsibility for marketing and selling fish. Of the all the farmers, the largest proportion (43.7 percent) had never sold fish at the time of the census. The

percentage of farmers who had never sold was higher among female farmers at 46.2 percent compared to 43.3 percent among male farmers. Female farmers had the biggest proportional of farmers responsible for fish marketing and selling at 29.2 percent.

Figure 3.4. 5: Percentage Distribution of Responsibility for Marketing and Selling Fish

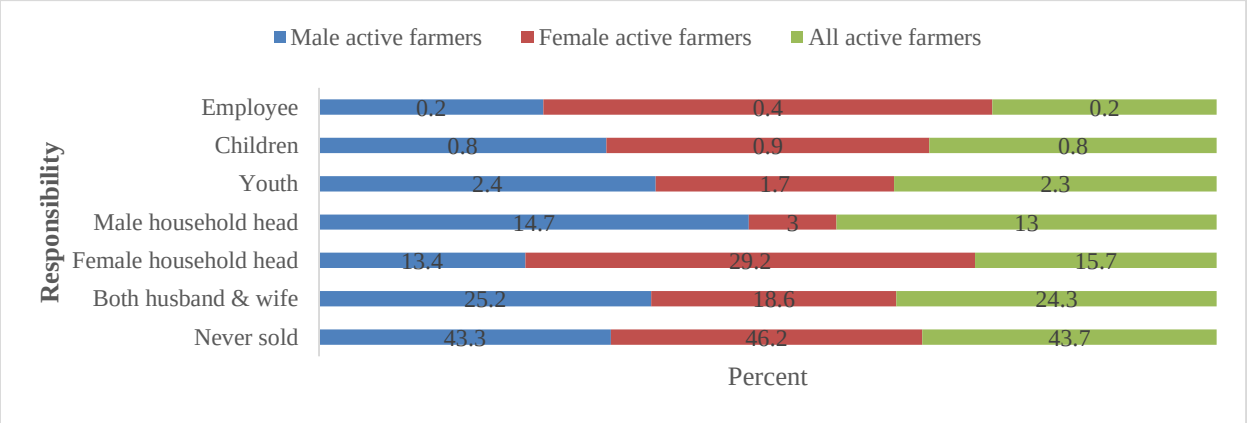
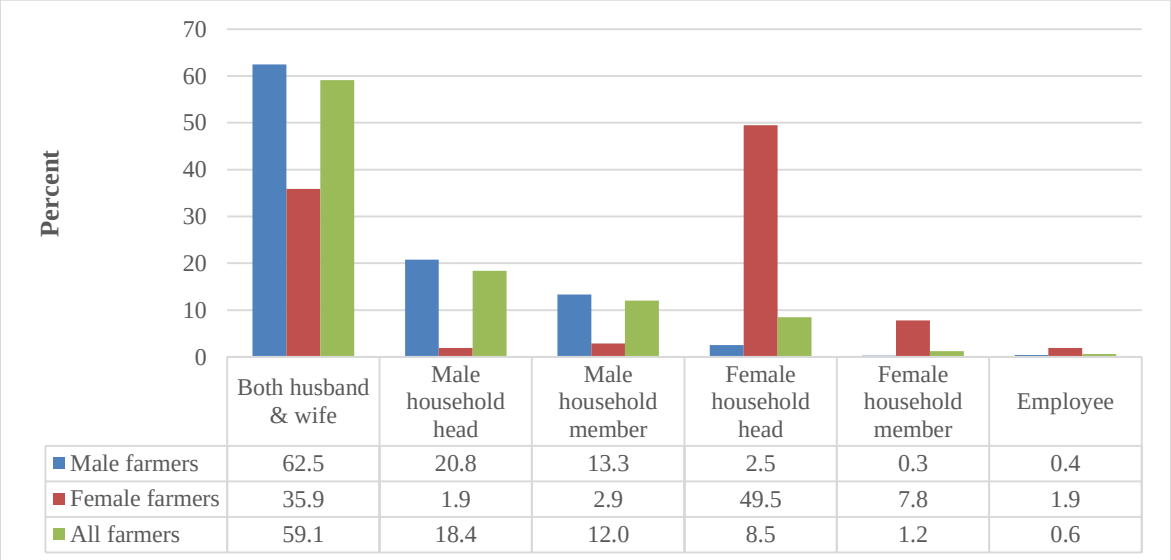


Figure 3.4.6 shows the percentage distribution of responsibility for decision making on use of income generated from fish by sex. Of all the farmers, 59.1 percent indicated that decision making on use of income generated from fish farming was jointly done by the husband and wife, 18.4 percent said that the male household head was responsible for decision making, and the employee made up the least percentage of decision makers on use of income from fish farming with 0.6 percent. Furthermore, figure 3.4.6 shows that the largest percentage of male farmers said that decisions were made by both husband and wife. In contrast, largest percentage of female farmers indicated that the female household head was responsible for decision making on use of income generated from fish farming.

Figure 3.4. 6: Percentage Distribution of Responsibility for Decision Making on Use of Income Generated from Fish Farming by Sex



	Both husband & wife	Male household head	Male household member	Female household head	Female household member	Employee
Male farmers	62.5	20.8	13.3	2.5	0.3	0.4
Female farmers	35.9	1.9	2.9	49.5	7.8	1.9
All farmers	59.1	18.4	12.0	8.5	1.2	0.6

3.5 Access to Input Markets

The government hatchery, wild resources, NGOs (Peace Corps and others) and few private hatcheries are the primary sources of fingerling for smallholder farmers. There are also secondary sources which involves farmer to farmer and/or recycling fingerlings. Figure 3.5.1 shows the percent share of source of fingerlings. The majority of the smallholder farmers got their fingerlings from their fellow farmers with 36 percent. Thirty-three percent of the smallholder farmers recycled their own fingerlings, and 19 percent sourced their fingerlings from the Government hatchery. The least was local breeder farmer with 2 percent. Figure 3.5.2 shows that almost all the farmers did not use sex-reversed fingerlings at the time of the census

Figure 3.5. 1: Percent Share of Source of Fingerlings

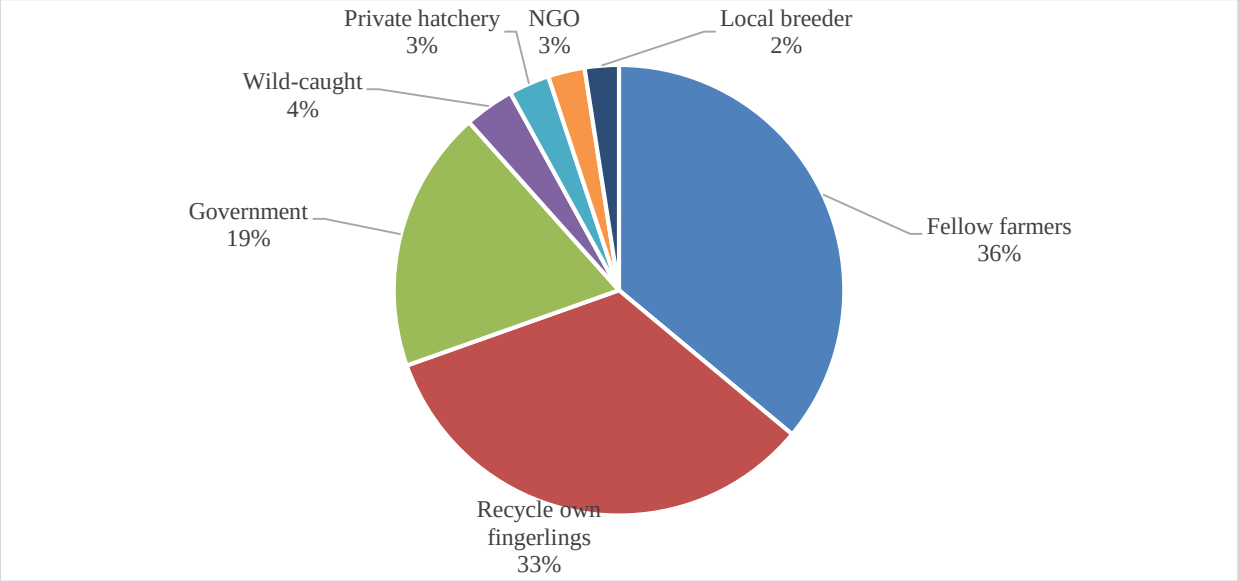


Figure 3.5. 2: Percent Share of Farmers Using Sex-reversed Fingerlings

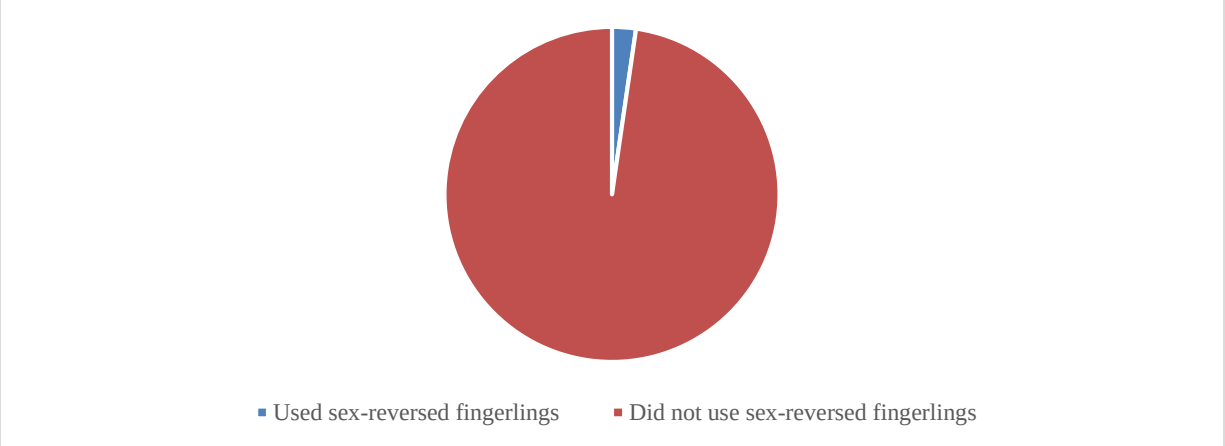
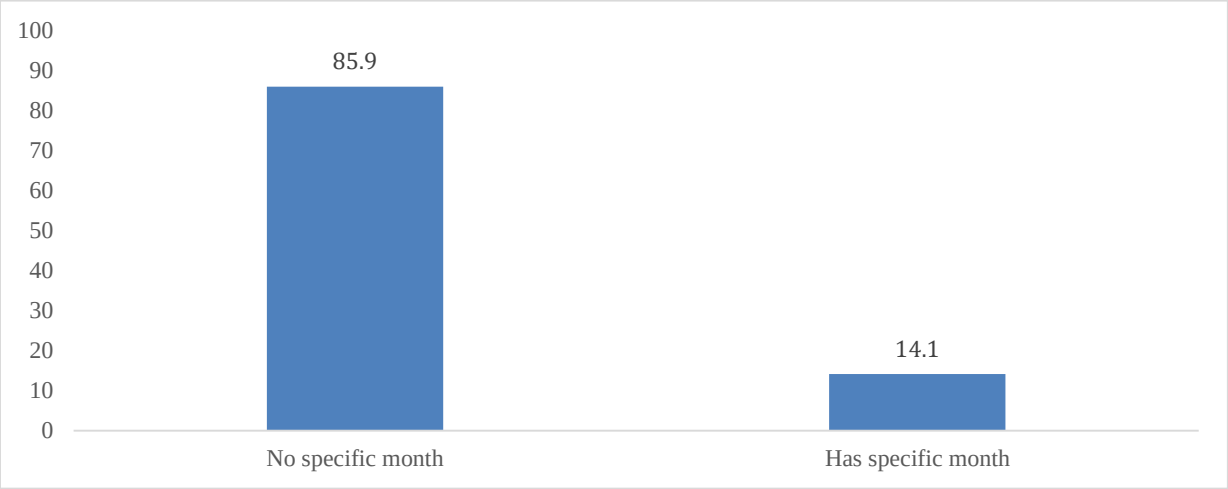


Figure 3.5.3 shows the percentage distribution of months in which farmers stock fingerlings. Most of the farmers did not have a specific month for stocking fingerlings in their ponds with 85.9 percent, and only 14.1 percent indicated that they had a specific month for stocking their fish ponds.

Figure 3.5. 3: Percentage Distribution of Months Farmers Stock Fingerlings



Smallholder farmers use commercial and non-commercial types of feed to feed their fish. Commercial feed was defined as processed feed from feed milling companies while non-commercial feed included use of farm materials such as vegetables, kitchen waste, termites, residue milling from hummer mill, maize bran and home-made feed from soya beans and/or sun flower. Figure 3.5.4 shows the percent share of types of feed used by smallholder farmers. The largest percentage of farmers used non-commercial feed with 81 percent, 16 percent use both commercial and non-commercial feed, and only 3 percent exclusively used commercial feed to feed their fish at the time of the census.

Figure 3.5. 4: Percent Share of Types of Feed Used by Smallholder Farmers

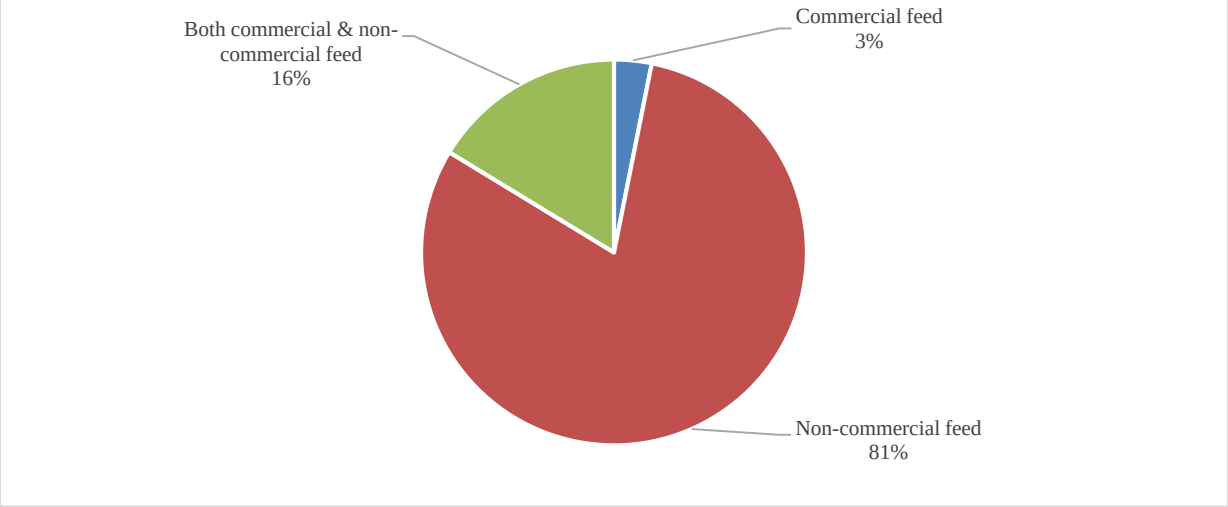


Figure 3.5.5 shows the percentage distribution of sources of fish feed for smallholder farmers. The majority of the farmers used farm materials from their farms to feed fish, and a question on sources of feed revealed that 78.9 percent got feed from their farms. The second source was a combination of both feed shop and own farm with 13.8 percent.

Figure 3.5. 5: Percentage Distribution of Sources of Fish feed

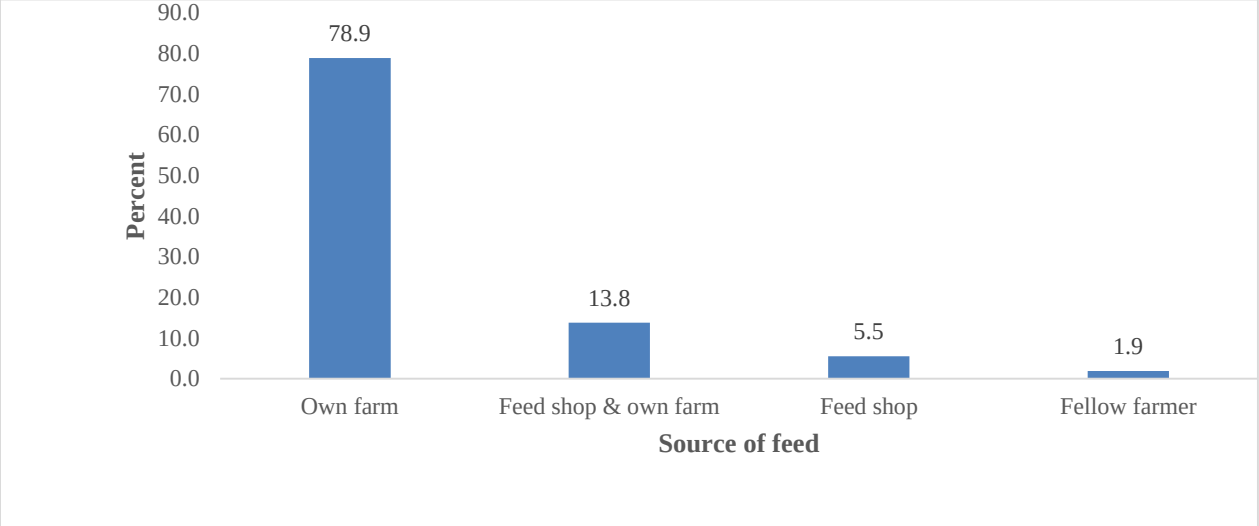
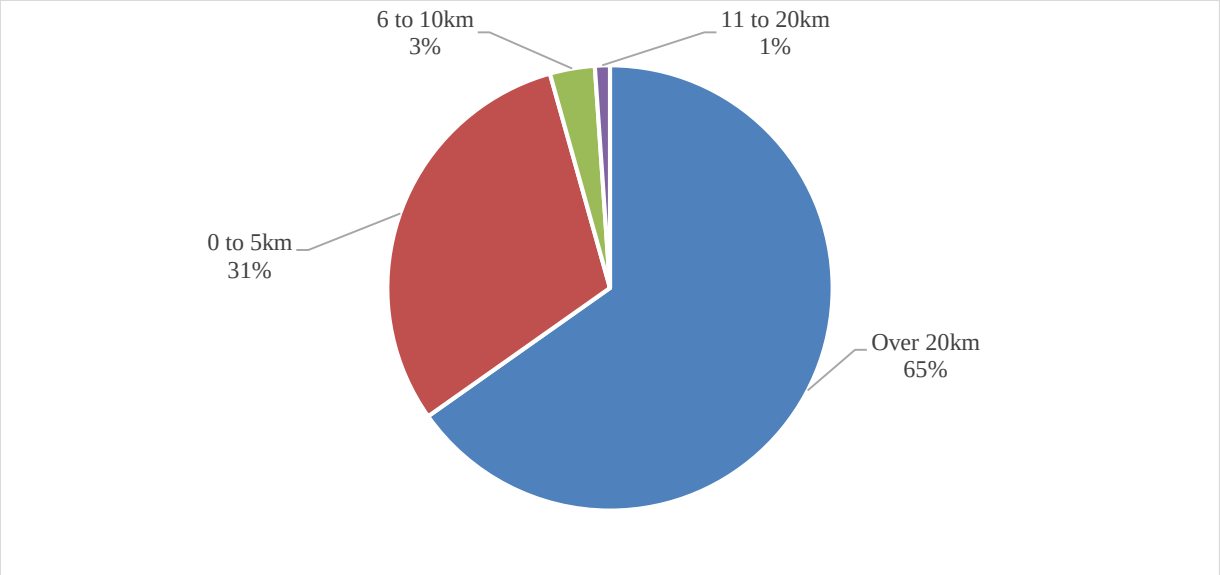


Figure 3.5.6 shows that 65 percent of the farmers who used commercial feed covered over 20 kilometers (km) to access commercial feed, 31 percent covered 0 to 5km, 3 percent moved 6 to 10km and only 1 percent traveled a distance of 11 to 20km to access fish feed at the time of the census.

Figure 3.5. 6: Percent Share of the Distance Covered to Access Commercial Fish Feed



The study revealed that the majority of the farmers used animal manure to fertilize their ponds, figure 3.5.7. Use of animal manure was utilized much more by female farmers than the male farmers. A very small percentage of active farmers used inorganic fertilizers.

Figure 3.5. 7: Percentage Distribution of Type of Fertilizer Used by Farmers

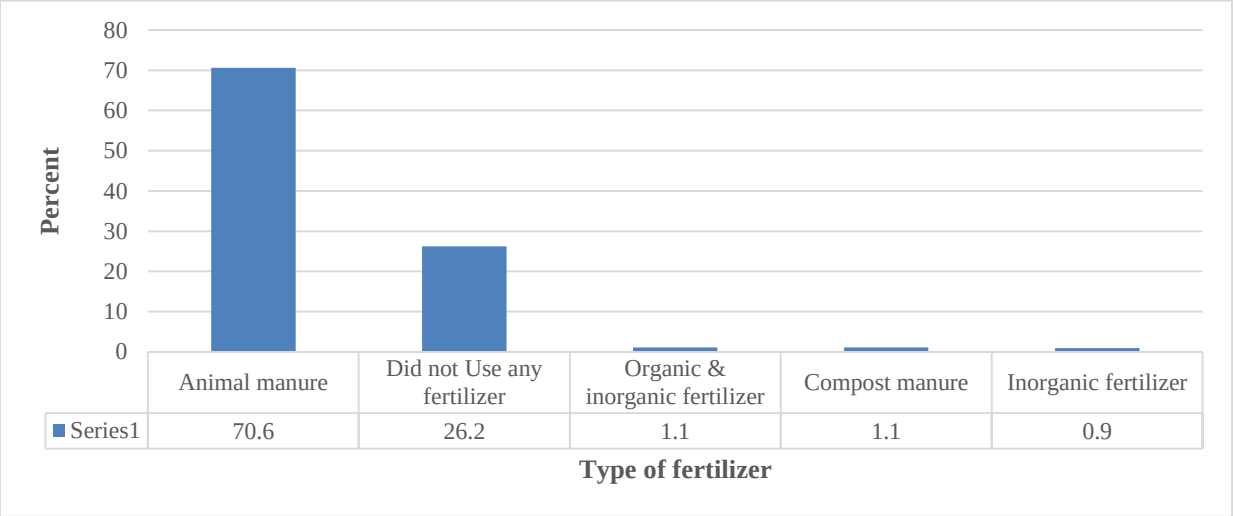


Figure 3.5.7 shows the percentage distribution of types of fertilizers used by farmers. The largest percentage of farmers used animal manure with 70.6 percent and the least used inorganic fertilizers with 0.9 percent.

3.6 Access to extension services

Access to technical information on fish farming was extremely limited. One of the critical contributors to productivity is technical knowledge, yet the fish farmers in Luapula and Northern Province have very little access to information. Of all the active farmers, 78.7 percent stated that they had not met with a fisheries extension service officer in the past 12 months (see table 3.6.1). Only 21.3 percent said that they were visited by a fisheries extension officer in the past 12 months at the time of the census. The percentage differences for who were visited by a fisheries officer between male and female farmers were very small at 20.8 percent and 24.3 percent, respectively.

Table 3.6. 1: Percentage Distribution of Farmers Visited by Extension Officers in the past 12 Months by Sex

Access to Extension	Male active farmers (%)	Female active farmers (%)	All active farmers (%)
	n=1,454	n=235	n=1,689
I have never been visited by a fisheries officer in the past 12 months	79.2	75.7	78.7
I have been visited by a fisheries officer in the past 12 months	20.8	24.3	21.3
Total	100.0	100.0	100.0

Figure 3.6.1 shows the percent share of sources of information. The largest proportion of the farmers sourced information about fish farming from their fellow farmers with 62 percent at the time of the census. The second percentage were farmers who got information from both extension officers and Peace Corps with 26 percent. The least source of information was from private consultants with 2 percent.

Figure 3.6. 1: Percent Share of Sources of Information

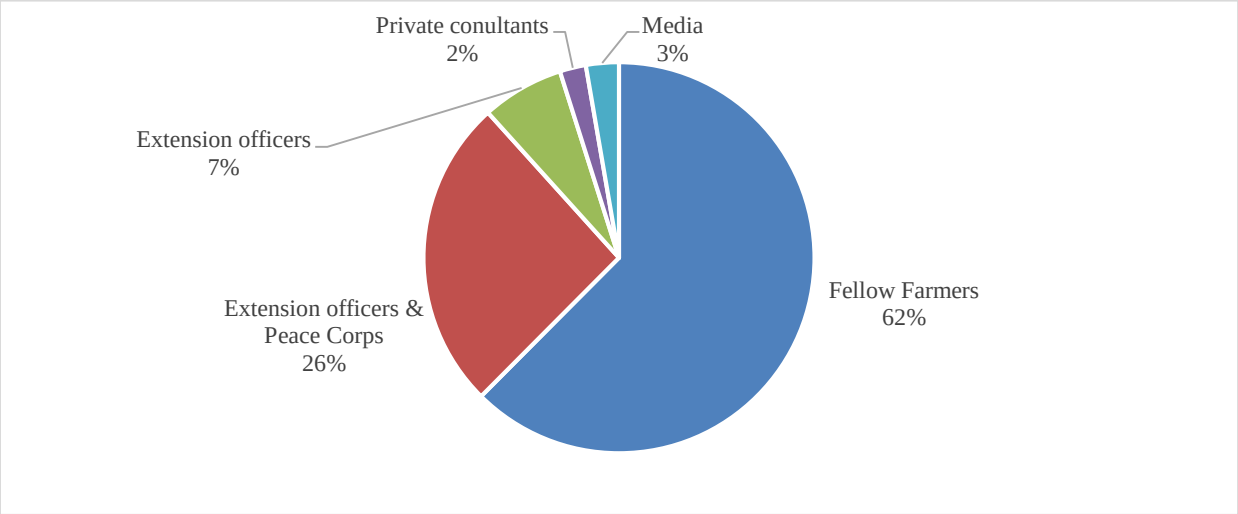


Table 3.6.2 shows the percentage distribution of farmers who received formal training by sex. The largest percentage of the farmers had never received a formal training with 72.7 percent. Only 27.3 percent said that they had received a training at the time of the census.

Table 3.6. 2: Percentage Distribution of Farmers Who Received Formal Trainings sex

Access to Formal Training	**Male active farmers (%)**	**Female active farmers (%)**	**All active farmers (%)**
	n=1,454	**n=235**	**n=1,689**
Did not receive formal training	73.8	66.0	72.7
Received formal training	26.2	34.0	27.3
Total	100.0	100.0	100.0

3.7 Access to Output Markets

Table 3.7.1 shows the percentage distribution of smallholder farmers' harvesting strategies by sex. Most of the smallholder farmers (81.9 percent) preferred to do a partial harvest, 9.5 percent had never harvested and 8.6 percent indicated that they always had a complete harvest of their fish at the time of the census. This made it difficult to estimate the quantity of fish the farmers harvested. However, the results showed that smallholder farmers who carried a complete harvest produced an average of 35.0 (±3.7) Kgs of fish in each production cycle.

Table 3.7. 1: Percentage Distribution of Smallholder Harvesting Strategies by Sex

Harvesting Strategies	**Male active farmers (%)**	**Female active farmers (%)**	**All active farmers (%)**
	n=1454	n=235	n=1,689
Partial Harvest	81.5	84.3	81.9
Never harvested	9.8	7.2	9.5
Complete	8.7	8.5	8.6
Total	100.0	100.0	100.0

Figure 3.7.1 shows the percentage distribution of farmed fish markets by sex. Overall, 49.5 percent sold their fish to neighbors at farmers' farm, 42.5 percent had not sold fish at the time of the census, and the least, 0.3 percent sold their fish at church. The average price of fish was at ZMW20.4 (±0.2) per Kg with the lowest price at ZMW10 per Kg and the highest price at ZMW40 per Kg.

Figure 3.7. 1: Percentage Distribution of Farmed Fish Markets

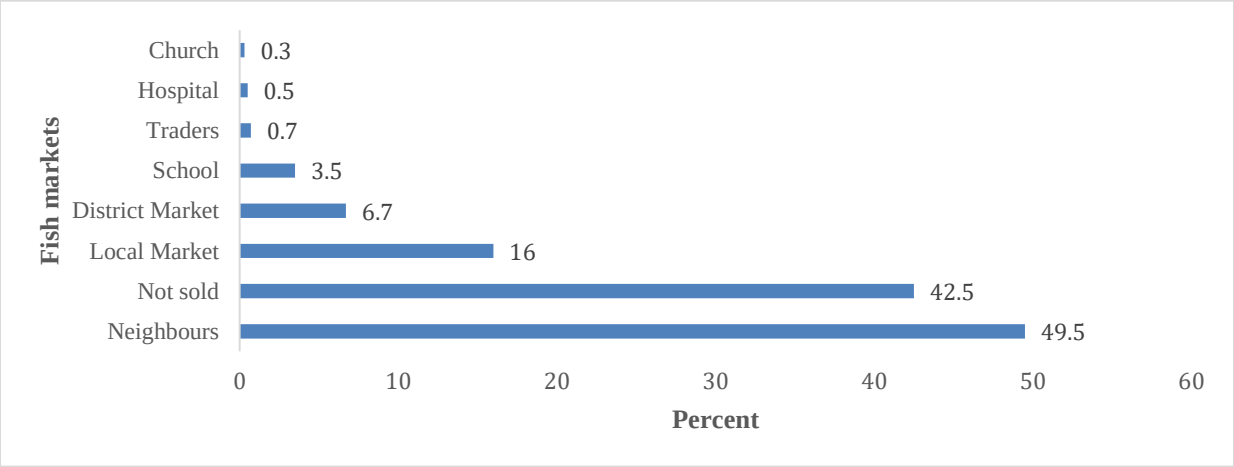


Table 3.7. 2: Average Income Made by Farmers Per Growing Cycle by Sex

Sex	Average income (ZMW)	Std. Err.(±)	Min	Max
All farmers	1,263.3	101.8	5.0	36,000.0
Male farmers	1,273.6	109.3	5.0	36,000.0
Female farmers	1,194.6	281.4	6.0	27,300.0

Table 3.7.2 shows the average income made by farmers per growing cycle by sex. Of all the farmers, they earned an average income of ZMW1,263.3 (±101.8) per growing cycle. The lowest amount of income earned was ZMW5 and the maximum income earned was at ZMW36,000.0 at the time of the census.

Figure 3.7. 2: Percent Share of Length of Production Cycle

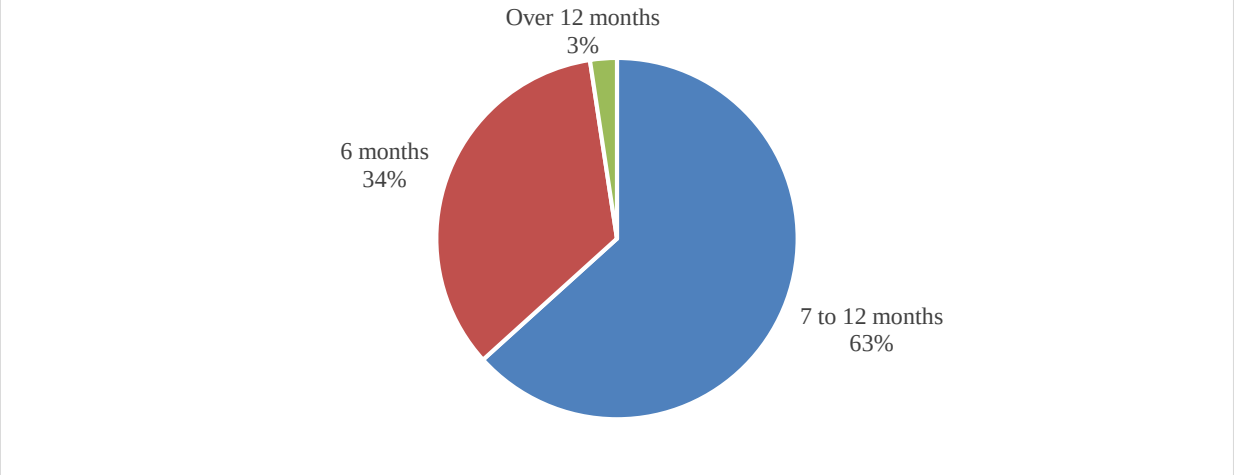
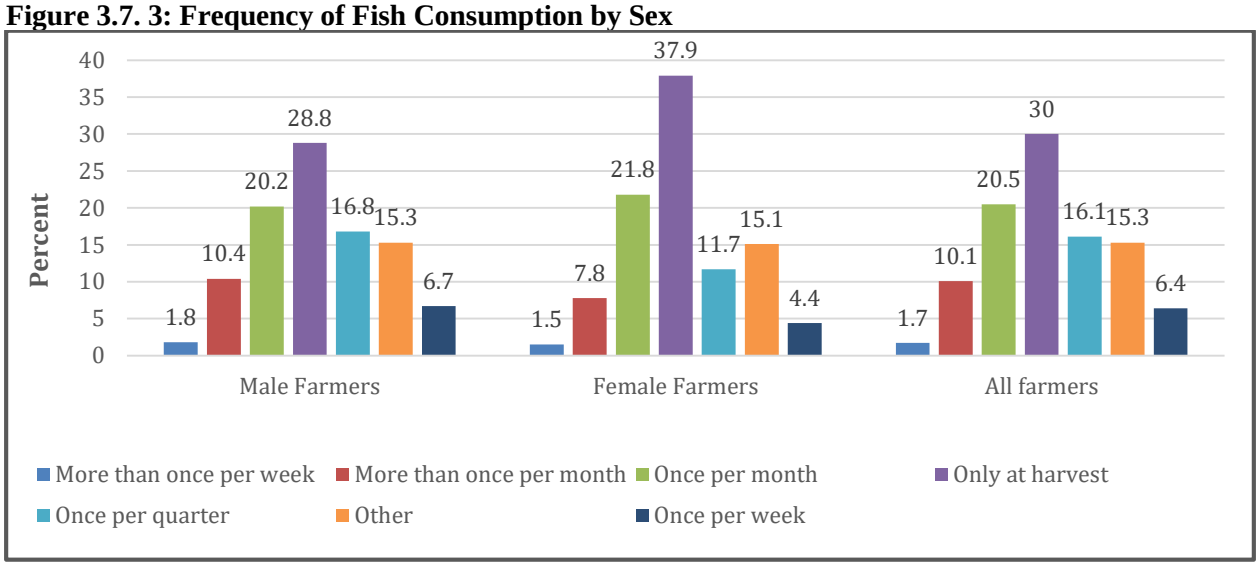


Figure 3.7.2 shows the percent share of length of production cycle. Most of the smallholder farmers (63 percent) of smallholder farmers had a production cycle of 7 to 12 months, followed by farmers with production cycle of 6 months with 34 percent, and 3 percent had a production cycle for over 12 months.

As indicated in the previous sections, there are various reasons farmers venture into fish farming and some of them get into aquaculture so that they can have fish for consumption. Farmers were asked to indicate the frequency of fish consumption from their farms and the results are displayed in figure 3.7.3. Overall, the largest percentage of farmers consumed fish only at harvest with 30 percent, followed by farmers who ate farmed fish once per month with 20.5 percent, and the least stressed that they ate fish from their farm more than once per week with 1.7 percent. The results further show that the proportion of frequency of fish consumption among women was slightly higher than among men.

Figure 3.7. 3: Frequency of Fish Consumption by Sex



3.8 Production Constraints and Opportunities

Table 3.8.1 shows the percentage distribution of challenges faced by farmers by sex. Of all the farmers, the largest percentage of farmers were constrained by no access to fingerlings with 48.8 percent. The second was no access to feed with 36.4 percent and the least was poor soil quality with 0.1 percent. The challenges faced by male and female farmers were almost the same with minor percent differences. Despite of these challenges faced by the farmers, 86.4 percent of the smallholder farmers ascertained that they had a financial capacity to buy commercial feed (see table 3.8.2).

Table 3.8. 1: Challenges faced by Farmers by Sex

Challenges	**Male active farmers (%)**	**Female active farmers (%)**	**All active farmers (%)**
	n=1,451	**n=236**	**n=1,687**
No access to fingerlings	51.0	35.2	48.8
No access to feed	35.0	44.9	36.4
Feed too expensive	4.3	5.5	4.5
No training	3.8	2.5	3.6
Fingerlings too expensive	2.9	4.2	3.1
Predation	1.5	2.5	1.7
Limited finances	0.2	1.7	0.4
Stunted growth	0.1	2.1	0.4
Water shortage	0.4	na	0.4
Human theft	0.3	na	0.2
No access to nets	0.2	0.4	0.2
Labour & transport	0.1	0.9	0.2
Poor soil quality	0.1	na	0.1
Total	100.0	100.0	100.0

"na" denotes not applicable

Table 3.8. 2: Financial Capacity to Purchase Commercial Feed

Financial Capacity	Male active farmers (%)	Female active farmers (%)	All active farmers (%)
	#1454	#235	#1,689
Have the financial capacity	86.9	83.0	86.4
Do not have financial Capacity	13.1	17.0	13.6
Total	100.0	100.0	100.0

4.0 Conclusion and Recommendations

4.1 Conclusion

There are a lot of people venturing into smallholder aquaculture in Northern and Luapula Provinces with an average of two fish ponds at the back of their yard in almost every village you visit. The farmers are culturing various tilapia and *oreochromis* species, and in most cases practice a combination of species in one fish pond. The smallholder farmers know that aquaculture can help them earn income and a source of fish for consumption though most of them seem not to understand that culturing fish requires greater commitments in terms investment in inputs and time to continuously monitor the growth of the fish as well as the markets and costs associated with farming. As a result, smallholders are just producing small quantities mostly for consumption and selling within the neighborhood. However, there are many reasons surrounding low productivity of the smallholder aquaculture. One of them is inadequate infrastructure, particularly inputs and output markets to support the aquaculture sub sector. There is a very limited access to extension services as a results farmers depend on their fellow farmers for supply of farming inputs such as information about fish farming, fingerlings and feed. The smallholder farmers have resorted to recycling fingerlings and feeding their fish with farm materials such as vegetables, termites and waste materials from the kitchen. This has significantly affected their production, productivity and profitability.

4.2 Recommendations

The previous sections have demonstrated that smallholder farmers have limited access to aquaculture inputs and output markets as well as low participation of women and youths. To address these problems, there is need to invest in the following:

i. **Training.** There is need for vigorous training of the smallholder farmers to help them understand the aquaculture fundamentals if they are to excel in this business/livelihood activity. The training should be aimed to help the farmers understand the (i) effects of mixing fish species in one fish ponds; (ii) importance and best practices of fish feeding; (iii) effects of recycling fingerlings; (iv) temperature, water quality and pond construction, and many other better management practices for tilapia and catfish fish culture with reference to the climatic conditions of the northern region.

ii. **Fingerling**s. there is need to invest in high quality seed/fingerlings production in each district and/or cluster/communities where there is a reasonably higher number of farmers. Currently, the demand for fingerlings is very high. However, investments in fingerlings production should be carefully planned to ensure that it does not lead to over-supply of fingerlings. In addition, seed/fingerlings producers should be certified as a way of promoting quality fingerlings to smallholder farmers. This can be done through public private partnership (PPP) with the private sector that have already been producing fingerlings.

iii. **Feed**. There is need to invest in feed so that it can be accessible to smallholder farmers. Zambia has two international feed milling companies and many other companies located in Lusaka and Southern Provinces. This can be scaled out to the northern region through partnership with these companies as a way of helping them set up feed outlets in the northern region.

iv. **Output markets**. Currently, the fish that is produced by smallholder farmers is sold locally within the neighborhood. This is because the amounts fish production is still very low but in an event that production increases, there will be need for markets as the local market may not consume all the fish. Thus there is need to link smallholder farmers to bulk buyers of fish such as Capital Fisheries

or Yalelo so that the smallholders can have a readily available markets and at the same time the private companies have a locally available supply of fish. Capital Fisheries is currently importing fish from Namibia and China hence local source might be an option for them together with other players in the output markets.

v. **Women and youth participation**. The smallholder sector is marred with men and adult population in the ages 35 to 64 years.

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Annex 1: Descriptive Tables of Smallholder Farmers by Camp and District

NORTHERN PROVINCE

1. Luwingu

Camp name	Number	Percent
Nsombo	86	20.4
Mufili	55	13.1
Tungati	53	12.6
Luwingu main	51	12.1
Kapisha	21	5.0
Katuta	19	4.5
Chungu	18	4.3
Shimumbi	18	4.3
Chifwile	16	3.8
Mampulanga	14	3.3
Muchelaka	14	3.3
Luena	13	3.1
Mfungwe	11	2.6
Malekani	8	1.9
Lundu	6	1.4
Misambula	6	1.4
Mutondo	4	1.0
Chibaye	3	0.7
Chitunkubwe	2	0.5
Chipemba	1	0.2
Katuta	1	0.2
Rosa	1	0.2
Total	421	100.0

2. Mbala

Camp name	Number	Percent
Kaka	55	14.7
Masamba	46	12.3
Kakungu	42	11.2
Mwamba	37	9.9
Kawimbe	27	7.2
Mambwe mission	24	6.4
Masamba east	21	5.6
Nondo	20	5.4
Lunzua	15	4.0
Sikalembe	14	3.7
Mutwizi	11	2.9
Senga	10	2.7
Lucheche	8	2.1
Maule	7	1.9
Nsokolo	7	1.9
Kamuzwazi	5	1.3
Kasesha west	5	1.3
Chindo	3	0.8
Kasesha	3	0.8
Chinakila	2	0.5
Kapatu	2	0.5
Chitimbwa	1	0.3
Kaka	1	0.3
Kalongola	1	0.3
Kangu	1	0.3
Kawimbe	1	0.3
Lunse lwamfumu	1	0.3
Masamba east	1	0.3
Mukungwa	1	0.3
Mwembezi	1	0.3
Tanzuka	1	0.3
Total	374	100.0

3. Mpulungu

Camp name	Number	Percent
Kabamba	43	26.9
Chitimbwa	40	25.0
Kalongola	24	15.0
Mpulungu central	13	8.1
Iyendwe	12	7.5
Chinakila	9	5.6
Vyamba	5	3.1
Kaizya	4	2.5
Kabamba	3	1.9
Kalonda	2	1.3
Mpulungu central	2	1.3
Kapondwe	1	0.6
Lunzua	1	0.6
Mbaso	1	0.6
Total	160	100.0

4. Mporokoso

Camp name	Number	Percent
Chalabesa	46	18.9
Chisha mwamba	28	11.5
Chiwala	61	25.1
Kalabwe	24	9.9
Kalabwe	1	0.4
Kambobe	11	4.5
Kapanda	3	1.2
Kapumo	25	10.3
Katutwa	15	6.2
Matamba	1	0.4
Matanda	3	1.2
Muchelaka	1	0.4
Mulama	2	0.8
Mutotoshi	8	3.3
Mwange	5	2.1
Mwange	4	1.7
Njala mimba	5	2.1
Total	243	100.0

5. Mungwi

Camp name	Number	Percent
Chimba	29	13.0
Nseluka	23	10.3
Rosa	19	8.5
Chonya	15	6.7
Kafusha	14	6.3
Maliko	11	4.9
Malole	10	4.5
Chamfubu	9	4.0
Itinti	8	3.6
Makasa	8	3.6
Mungwi east	8	3.6
Nfishe	8	3.6
Kaseke	6	2.7
Kayambi	6	2.7
Ngulula	6	2.7
Kamfusha	4	1.8
Mulala	4	1.8
Chafubu	3	1.3
Chipapa	3	1.3

5. Mungwi…Cont'd

Camp name	Number	Percent
Kalupa	3	1.3
Kamena	3	1.3
Kampanda	3	1.3
Nsombo	3	1.3
Chandaweyaya	2	0.9
Makasa	1	0.5
Camp	1	0.5
Changala	1	0.5
Chikwa	1	0.5
Chilongwa	1	0.5
Chimpili	1	0.5
Chitanga	1	0.5
Ilondola	1	0.5
Kasoma	1	0.5
Katongo	1	0.5
Mambwe mission	1	0.5
Mibulumo	1	0.5
Mungwi central	1	0.5
Mungwi west	1	0.5
Mupeta	1	0.5
Muyala	1	0.5
Total	224	100.0

LUAPULA PROVINCE

1. Samfya

Camp name	Number	Percent
Kasaba	31	15.9
Mano	28	14.4
Katanshya	23	11.8
Lubwe one	16	8.2
Mungulube	10	5.1
Samfya central	10	5.1
Chibuye	9	4.6
Mwewa	8	4.1
Kalasamokoso	7	3.6
Munimbwe	7	3.6
Mulakwa	6	3.1
Shimalingu	6	3.1
Chitundwa	4	2.1
Njipi	4	2.1
Samfya central	4	2.1
Chitundwa	3	1.5
Lubwe two	3	1.5
Miponda	3	1.5
Fibalala	2	1.0
Kasanka	2	1.0
Chamalawa	1	0.5
Chinsanka	1	0.5
Makasa	1	0.5
Mbilimamwenge	1	0.5
Mulisha	1	0.5
Mungulube	1	0.5
Muponda	1	0.5
Sikamusili	1	0.5
Wapamesa	1	0.5
Total	195	100

2. Kawambwa

Camp name	Number	Percent
Chibote	69	19.3
Lusambo	38	10.6
Musungu	38	10.6
Shinonde	29	8.1
Ntembo	23	6.4
Chitondo	16	4.5
Chitondo	16	4.5
Shikalaba	14	3.9
Chimpili	12	3.4
Munkanta	11	3.1
Ntenke	11	3.1
Kala	8	2.2
Kanengo	8	2.2
Wapamesa	8	2.2
Ntembo	7	2.0
Chibote	6	1.7
Chisheta	5	1.4
Folotiya	5	1.4
Chisheta	4	1.1
Kabende	4	1.1
Lengwe	4	1.1
Ntenke	4	1.1
Chimpili	3	0.8
Folotiya	3	0.8
Muyembe	3	0.8
Kalaba	2	0.6
Musungu	2	0.6
Shikalabwe	2	0.6
Kanengo	1	0.3
Luena	1	0.3
Shikalaba	1	0.3
Total	358	100

3. Mansa

Camp name	Number	Percent
Mabumba	84	31.5
Chisunka	25	9.4
Matanda	23	8.6
Mulonga	21	7.9
Chimfuli	18	6.7
Kalaba	12	4.5
Mutiti	11	4.1
Mabumba	9	3.4
Mbaso	9	3.4
Kabende	8	3.0
Kapyata	8	3.0
Kale	6	2.3
Chisunka	5	1.9
Mibenge	3	1.1
Fimpulu	2	0.8
Kaole	2	0.8
Lupenda	2	0.8
Mansa central	2	0.8
Resettlement scheme	2	0.8
Chimfuli	1	0.4
Chinsanka	1	0.4
Chisembe	1	0.4
Fiyongoli	1	0.4
Lukangaba	1	0.4
Mansa	1	0.4
Mansa central	1	0.4
Mansa resentlement scheme	1	0.4
Matanda	1	0.4
Mulonga	1	0.4
Musule	1	0.4
Mutamba	1	0.4
Mutiti	1	0.4
Mwanachama	1	0.4
Resettlement scheme	1	0.4
Total	267	100

4. Chipili

Camp name	Number	Percent
Lupososhi	13	13.3
Mwenda	12	12.2
Kanshimba	9	9.2
Mupeta	9	9.2
Kamami	8	8.2
Kalundu	7	7.1
Mukanga	7	7.1
Kashimba	6	6.1
Mutipula	6	6.1
Luminu	5	5.1
Musonda b	4	4.1
Chikaya	3	3.1
Lupososhi	3	3.1
Mwenda	2	2.0
Chipili	1	1.0
Lumini	1	1.0
Mukoshi	1	1.0
Mushimba	1	1.0
Total	98	100

Annex 2: Census Questionnaire

Informed consent for smallholder fish farmer population census questionnaire for the AQTEVET project

Informed consent: *Before beginning the interview, it is necessary to introduce the respondent to the census/survey and obtain their consent to participate. Make it clear to them that their participation in the survey is voluntary. Please read the following statement in the language of interview:*

Thank you for the opportunity to speak with you. We are a research team form Musika, WorldFish Center and the Department of Fisheries. Musika is a Zambian non-profit company with a mandate to stimulate and support private investment in the Zambian agricultural markets with a specific focus on the lower end of these markets. WorldFish is an international, non-profit, fisheries and aquaculture research organization. We are conducting a fish farmer population census in the district. If you would like to participate, we will ask you questions on topics such as your family background, fish farming background, general information on fish farming activities, gender, youth and division of roles in fish farming, access to aquaculture inputs, output markets and other services, production constraints and opportunities. These questions in total will take approximately 30 minutes to complete and your participation is entirely voluntary. If you agree to participate, you can choose to stop at any time or to skip any questions you do not want to answer. Your answers will be completely confidential.

We will also interview other fish farmers in your village and in the entire district. This information will help us inform the development of interventions that could be helpful to the people in this area and the district as a whole. Do you have any questions about the study or what I have said? If in the future you have any questions regarding the study or interview, or concerns or complaints, we welcome you to contact your district fisheries officer, Musika or WorldFish directly. We will leave this introductory information to you so that you can have a record of it.

Please ask the participants if they consent to the participation in the study (check one box):

Participant:	☐	**YES**	☐	**NO**

I _____, the enumerator responsible for the interview taking place on _____, 2018 certify that I have read the above statement to the participant and they have consented to the interview. I pledge to conduct this interview as indicated on instructions and inform my supervisor of any problems encountered during the interview process.

If the participant does not give consent to all of the data collection, stop the interview and inform your team leader. Team leaders will discuss the reason for this refusal and decide whether a partial data collection is possible for this participant.

Smallholder fish farmer population census questionnaire for the AQTEVET project

Name of enumerator: _____

Date: _____

Section A: Identification and demographics

Fish Farmer Identification	
A01. Is the respondent the farmer?	Yes ☐ No ☐
A02. Name of farmer : _____	
A02i. Phone number**:**_____	
A03. Name of secondary respondent: (*Skip if respondent is farmer*)_____	
A04. What is the secondary respondent's relationship to the farmer? (*Skip if respondent is farmer*) Spouse (1) Own child (2) Step child (3) Parent (4) Brother/sister (5) Nephew/niece (6) Son/daughter-in-law (7) Brother/sister-in-law (8) Parent-in-law (9) Grandchild (10) Other relative (11) Unrelated (12) ☐	
A05. Sex of farmer: ☐ Male ☐ Female	
A06. Sex of secondary respondent: (*Skip if respondent is farmer)* Female ☐ Male ☐	
A07. How old are you? *(If given date of birth calculate and Indicate years*) ☐☐	
A08. How old are you? **(**Age of respondent; skip if respondent is farmer) ☐☐	
A09. Farmer's highest level of education attained: None ☐ Primary ☐ Secondary ☐ Tertiary ☐	
A10. Marital status of farmer: Married (1) Single (2) Widowed (3) Divorced (4) Separated (5) Cohabiting (6) ☐	
A11. What is the total number of people living in your household? ☐☐	
A12: Name of village/camp_____ District _____ Province _____	
A13: GPS coordinates of farmer's main house: Latitude_____ Longitude: _____	

Section B: Fish farming back ground

B1a: Are you an active fish farmer? ☐ Yes ☐ No	
B1b. If No, give main reason why 1) water shortage 2) thefty by humans 3) predation 4) flooding 5) limited finance 6) lack of seed 7) other	
B1c. How long have you been engaged in fish farming? (*Indicate years*) ☐☐	
B2. What was the primary reason for starting fish farming? Home consumption (1) Source of income (2) 3) Others:_____ ☐	

B3. Do you own or rent the land you use for fish farming?
Self-owned (1) Spouse owns (2) Rented (2) Extended family land (3) Others:_____ ☐

Section C: General information on fish farming activities

C1. a) What is your aquaculture system? Earthen ponds ☐ Others: (specify)_____

b) How many fish do you stock per m^2? Specify: _____

C2. a) How many fish ponds do you own? ☐☐

b) How many of these ponds are fully active? ☐☐

c) What are the sizes of the active ponds in m^2? (e.g., 20m x 30m = 600m^2) _____ _____ _____
_____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____

d) What are the sizes of the ponds that are not active? (m^2)

_____ _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____

C3. What is the main water source for your fish farming activities? River ☐ Stream ☐ Lake ☐ Spring/underground ☐ Borehole Others: _____ ☐

C4. Is water available all year-round for fish farming activities? Yes ☐ No ☐

C5. Is your fish farming activity all year-round or seasonal? All year-round ☐ Seasonal ☐

If seasonal, give reasons why:

a)

b)

c)

C6. What is the intensity of your aquaculture system? Extensive (1) ☐ Semi-intensive (2) ☐ Intensive (3) ☐

C7. Which species of fish do you culture? *Oreochromis macrochir* (Pale/inkamba) ☐

Oreochromis tanganicae ☐ *Oreochromis andersonii (Injinji)* ☐ *Oreochromis niloticus* ☐

Captodon (Tilapia) rendalli (Impende) ☐ *Tilapia sparmanii* (Imfindu/Inkun ☐ Others: _____

Note:(*Oreochromis tanganicae* and *Oreochromis niloticus do not have common local names*)

Section D: Gender, youth and division of roles in fish farming

D1. Who in the household is mainly responsible for making the decision to allocate land to construct fish ponds?

Female household member ☐ Male household member ☐ Both ☐

D 2. Who in the household is mainly responsible for the following activities:

a) Pond construction? Female household member (1) Male household member (2) Both (3) ☐

b) Pond preparation? Female household member (1) Male household member (2) Both (3) ☐

c) Pond maintenance? Female household member (1) Male household member (2) Both (3) ☐

D3. Who in the household is mainly responsible for acquiring the following inputs:

a) Fingerlings (fish seed)? Female household member (1) Male household member (2) Both (3) ☐

b) Fish feed? Female household member (1) Male household member (2) Both (3) ☐

c) Fertilizers? Female household member (1) Male household member (2) Both (3) ☐

D4.a) Who in the household is mainly responsible for feeding fish?

Female ☐ Male ☐ Children ☐ All ☐ Others: _____

b) How much time does it take to do the above activity? _____

c) Who in the household is mainly responsible fertilizing fish pond?

Female Male Children All

d) How much time does it take to do the following activity? _____

D5. a) Who in the household is mainly responsible for harvesting fish?

Female ☐ Male ☐ Children ☐ All ☐ Others: _____

b) How much time does it take to do the above activity? _____

D6. a) Who in the household is mainly responsible for marketing and selling fish?

Female ☐ Male ☐ Children ☐ All ☐ Others: _____

b) How much time does it take to do the above activity? _____

D7. a) Who in the household manages the income generated through fish farming?

Female household member ☐ Male household members ☐ Others: _____

D8. What are the kinds of fish farming tools do you own? Nets ☐ Scale ☐ Hapas ☐

Pumps ☐ Buckets ☐ Others:_____ _____

D9. Who owns the above fish farming tools in your household? Female ☐ Male ☐ Both ☐

Section E: Access to input and output markets

Access to inputs
E1. What is the source of your fish seed (fingerlings)? Wild-caught ☐ Government ☐ Private hatchery ☐ Fellow farmers ☐ Recycle own fingerlings ☐ Others: _____ ***(If from private hatchery or government go to question 2 if not skip and go to question 3)***
E2. Do you use sex-reversed fingerlings? Yes ☐ No ☐ If yes indicate why: _____
E3. In which month (s) do you usually stock your fingerlings? Specify_____ No specific month ☐ If they specify the month(s), ask why: _____
E4. What do you feed your fish? Commercial feed ☐ Home-made feed ☐ Maize bran ☐ Rice bran ☐ Vegetables/kitchen wastes/plant leaves ☐ Others:_____
E5. What is the source of your fish feed? Feed shop ☐ own farm ☐ Fellow farmers ☐ Other:_____ If from feed shop, how far is it? _____km
E6. What do you use to fertilize your pond? Animal manure ☐ Inorganic fertilizer ☐ Compost manure ☐
E7. What is the source of your fertilizer? Own farm ☐ Fellow farmers ☐ Buy from shop ☐ If you buy from shop, how far is it? _____km
E8. How much money (ZMW) do you invest in the following fish farming activities per year? **a)** Pond construction K_____ **b)** Purchase of fingerlings K_____ **c)** Purchase of fish feed K_____ **d)** Purchase of fertilizers K_____
Access to extension services
E9. Have you ever met with a fisheries extension service officer in the past 12 months? (*could be government or others*) Yes ☐ No ☐ *(if no, go to Q11)*
E10. How many times did you meet with a fisheries extension service office in the past 12 months? Number of visits: ☐☐

E11. How do you access information regarding fish farming? Government extension officers ☐

Fellow Farmers ☐ Media ☐ Agricultural shows ☐ Private sellers ☐

Other:_____

E12. Do you receive formal trainings on fish farming activities? Yes ☐ No ☐ (*If no skip E13*)

E13. Who provides the training? Specify: _____

Access to output markets

E14. How much fish do you produce in one production cycle? Specify _____kg/pond/cycle;

_____kg for all ponds; _____10L buckets/for all ponds

E15. How long is your growing cycle? _____Months

E16. What is your main harvest strategy? Partial harvest ☐ Complete harvest ☐ **Give reason why:**

a) Partial harvest_____

b) Complete harvest _____

E17.a) Where do you sell your fish? Neighbours ☐ Traders ☐ Local market ☐

District market (Boma) ☐ Others: _____

b) Who are the major buyers of your fish after harvest? Specify: _____

E18. How much do you sell your fish per kg? Specify: **a)** K_____ /k

b) K_____ for_____ pieces of fish ***(e.g. K10 for 5 pieces of fish)***

c) What is the approximate distance to your point of sell above? (*Refer to QE17*)

E19.a) How else do you use your fish? Barter item ☐ Exchange for labour ☐

Home consumption ☐ Others: _____

b) If home consumption, how often do you eat fish from your ponds and how much do you consume?

Several times per week ☐ Amount _____kg

Once per week ☐ Amount _____ kg

Several times per month ☐ Amount _____kg

Once per month ☐ Amount _____kg

Other: Specify _____ Amount_____

E20. How much income do you generate per growing cycle? K_____

E21.a) How much income do you generate from other activities per year? K_____

b) What do you use the income generated from fish farming for?

1. _____
2. _____
3. _____
4. _____
5. _____

Section F. Production constraints and opportunities

Challenges regarding fish farming	
F1. What are the five (5) major challenges you are facing in fish farming?	☐ Water shortage
☐ No access to fingerlings because not available	☐ Soil quality
☐ No access to fingerlings because too expensive	☐ Human theft
☐ No access to feed because not available	☐ Limited finances
☐ No access to feed because too expensive	☐ Land ownership
☐ No training	☐ Limited market access due to: _____ _____
☐ Predation	
☐ Labour and transport	☐ Others: _____ _____

F2. Do you have the financial capacity to purchase commercial feed and good quality fingerlings if they were to be made readily available?

Yes ☐ No ☐

(*Discuss more with farmer and take notes*)

F3. How do you perceive fish farming compared to other farming activities?

Side-line activity ☐ Business activity ☐

(*Discuss more with farmer and take notes*)

F4. What are your fish farming aspirations or future plans? (**List down**)

F5. a) Would you like to be a lead farmer and assist with extension/training of other farmers? Yes ☐ No ☐

b) If yes, why would you like to be a lead farmer? _____

F6. a) Would you like to be an intermediary who could be linked to a private seed producer? Yes ☐ No ☐

b) If yes, **w**hat makes you think you are the right person to offer this service?

Ask if they have time, financial resources, etc.

Annex 3: Annex B. List of Key Persons involved in the Analysis and Report writing

A. Main Authors & Census Coordinators

Name	Position	Organization
Mr. Keagan Kakwasha	Monitoring & Evaluation Coordinator	WorldFish
Mr. Timothy Sichilima	Research Manager	Musika
Mr. Michael Sebele	Research Assistant	Musika
Dr. Libakeni Nabibwa	Manager, Aquaculture Markets	Musika
Dr. Mary Lundeba	Aquaculture Scientist	WorldFish
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Data Analysts

Name	Position	Organization
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Data Collection team

Name	Position	Organization
Dr. Mary Lundeba	Aquaculture Scientist	WorldFish
Ms. Mercy Sichone	Research Assistant	WorldFish
Mr. Henry Kanyembo	Research Assistant (GIS)	WorldFish
Mr. Chris Chikani	Driver	WorldFish
Mr. Keagan Kakwasha	Monitoring & Evaluation Coordinator	WorldFish
Dr. Libakeni Nabibwa	Manager, Aquaculture Markets	Musika

Annex 4: Size of Active and Non-Active Fish Ponds at the time of the census

Size of active ponds (m^2)	Number	Percent
5,000	1	0.03
4,800	1	0.03
4,700	1	0.03
3,200	1	0.03
2,700	1	0.03
2,500	6	0.19
2,400	1	0.03
2,000	1	0.03
1,800	2	0.06
1,750	1	0.03
1,600	3	0.1
1,500	9	0.29
1,470	2	0.06
1,440	1	0.03
1,375	1	0.03
1,350	1	0.03
1,344	9	0.29
1,250	26	0.83
1,200	9	0.29
1,000	6	0.19
900	6	0.19
882	1	0.03
875	1	0.03
850	1	0.03
840	2	0.06
820	1	0.03
800	14	0.45
750	33	1.05

Size of non-active ponds (m^2)	Number	Percent
15,000	1	0.05
9,000	1	0.05
6,750	1	0.05
3,000	1	0.05
2,500	7	0.36
2,400	1	0.05
1,500	12	0.62
1,260	1	0.05
1,250	23	1.18
1,225	1	0.05
1,200	2	0.1
1,120	1	0.05
1,000	9	0.46
960	1	0.05
900	4	0.21
875	1	0.05
840	1	0.05
800	1	0.05
750	19	0.98
738	2	0.1
725	1	0.05
700	2	0.1
650	1	0.05
640	1	0.05
625	19	0.98
600	21	1.08
540	3	0.15
525	4	0.21

Size of active ponds (m2)	Number	Percent
735	3	0.1
720	1	0.03
705	4	0.13
700	1	0.03
676	1	0.03
652	1	0.03
650	3	0.1
625	43	1.37
621	1	0.03
620	1	0.03
600	44	1.4
580	1	0.03
576	1	0.03
575	3	0.1
570	1	0.03
550	5	0.16
540	1	0.03
529	1	0.03
525	16	0.51
504	1	0.03
500	71	2.26
490	1	0.03
484	1	0.03
480	2	0.06
475	1	0.03
450	31	0.99
440	1	0.03
430	5	0.16
425	6	0.19
420	18	0.57

Size of non-active ponds (m2)	Number	Percent
500	77	3.95
480	1	0.05
450	15	0.77
432	1	0.05
420	5	0.26
400	49	2.52
391	1	0.05
378	1	0.05
375	25	1.28
360	7	0.36
356	2	0.1
350	8	0.41
325	7	0.36
324	6	0.31
323	1	0.05
320	10	0.51
319	1	0.05
300	170	8.73
290	1	0.05
288	1	0.05
280	2	0.1
270	5	0.26
260	3	0.15
255	1	0.05
250	38	1.95
240	5	0.26
238	1	0.05
230	2	0.1
225	35	1.8
220	5	0.26

Size of active ponds (m2)	Number	Percent
400	99	3.15
396	2	0.06
380	3	0.1
378	1	0.03
375	45	1.43
374	2	0.06
370	2	0.06
368	1	0.03
360	24	0.76
357	1	0.03
352	1	0.03
350	14	0.45
345	1	0.03
340	7	0.22
336	3	0.1
335	2	0.06
330	2	0.06
325	10	0.32
324	3	0.1
322	1	0.03
320	10	0.32
319	1	0.03
313	1	0.03
310	1	0.03
308	1	0.03
306	1	0.03
300	282	8.98
294	1	0.03
290	1	0.03

Size of non-active ponds (m2)	Number	Percent
216	10	0.51
210	2	0.1
200	109	5.6
195	1	0.05
180	23	1.18
176	1	0.05
173	1	0.05
170	3	0.15
160	7	0.36
155	1	0.05
150	393	20.17
144	16	0.82
140	13	0.67
139	1	0.05
135	1	0.05
132	2	0.1
130	8	0.41
128	1	0.05
126	1	0.05
125	1	0.05
120	60	3.08
119	1	0.05
117	1	0.05
112	1	0.05
110	5	0.26
108	4	0.21
106	2	0.1
105	7	0.36
104	3	0.15

Size of active ponds (m2)	Number	Percent
289	5	0.16
288	1	0.03
286	2	0.06
285	1	0.03
280	2	0.06
272	1	0.03
270	13	0.41
266	3	0.1
264	1	0.03
260	4	0.13
256	12	0.38
255	2	0.06
252	2	0.06
250	78	2.48
240	20	0.64
238	1	0.03
234	1	0.03
231	1	0.03
230	2	0.06
225	46	1.46
224	1	0.03
220	5	0.16
216	10	0.32
210	3	0.1
208	1	0.03
204	4	0.13
200	202	6.43
198	2	0.06
196	1	0.03
195	1	0.03

Size of non-active ponds (m2)	Number	Percent
100	284	14.58
98	1	0.05
96	22	1.13
90	13	0.67
80	54	2.77
78	1	0.05
77	1	0.05
75	14	0.72
72	6	0.31
70	18	0.92
66	1	0.05
65	1	0.05
64	1	0.05
60	38	1.95
56	4	0.21
54	1	0.05
50	94	4.83
49	2	0.1
48	3	0.15
45	2	0.1
42	3	0.15
40	18	0.92
36	3	0.15
35	2	0.1
32	1	0.05
30	7	0.36
28	1	0.05
25	17	0.87
24	6	0.31
21	1	0.05

Size of active ponds (m2)	Number	Percent
192	4	0.13
190	3	0.1
188	1	0.03
180	69	2.2
175	1	0.03
172	1	0.03
171	2	0.06
170	3	0.1
169	1	0.03
168	3	0.1
166	1	0.03
165	1	0.03
162	2	0.06
160	13	0.41
156	3	0.1
155	2	0.06
150	467	14.86
144	22	0.7
140	15	0.48
136	1	0.03
135	8	0.25
130	15	0.48
128	6	0.19
126	1	0.03
125	3	0.1
122	1	0.03
121	2	0.06
120	95	3.02
119	1	0.03
117	5	0.16

Size of non-active ponds (m2)	Number	Percent
20	5	0.26
16	5	0.26
15	3	0.15
12	3	0.15
10	1	0.05
6	3	0.15
4	1	0.05
Total	1,948	100

Size of active ponds (m2)	Number	Percent
112	6	0.19
110	16	0.51
108	3	0.1
106	1	0.03
105	10	0.32
104	2	0.06
100	390	12.41
99	4	0.13
96	21	0.67
95	1	0.03
91	2	0.06
90	20	0.64
88	1	0.03
85	2	0.06
84	4	0.13
82	2	0.06
80	94	2.99
78	1	0.03
77	1	0.03
76	2	0.06
75	18	0.57
72	21	0.67
70	27	0.86
69	1	0.03
66	1	0.03
65	1	0.03
64	14	0.45
63	2	0.06
60	47	1.5
56	2	0.06

Size of active ponds (m2)	Number	Percent
55	1	0.03
54	2	0.06
52	2	0.06
50	146	4.65
49	3	0.1
48	5	0.16
46	1	0.03
45	30	0.95
42	4	0.13
40	19	0.6
37	1	0.03
36	8	0.25
35	4	0.13
32	2	0.06
30	15	0.48
28	4	0.13
27	1	0.03
25	27	0.86
24	4	0.13
23	2	0.06
21	1	0.03
20	6	0.19
18	2	0.06
16	3	0.1
15	4	0.13
12	3	0.1
10	4	0.13
9	5	0.16
4	1	0.03
Total	3,142	100