A COMPARATIVE ANALYSIS OF THE COMPETITIVENESS OF TILAPIA AND CATFISH ENTERPRISES IN MBALE SUB REGION EASTERN UGANDA

BY

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DECLARATION

I Halasi Gidongo Zech, hereby declare that this is my original work and has never been presented for a degree in this or any other university or institution of higher learning. Unless otherwise stated, the work contained here is my own

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This thesis has been submitted to the Directorate of Research and Graduate Training upon our guidance and advice as University Supervisors.

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DEDICATION

To Ass. Prof. Theodora Hyuha without whose guidance and encouragement as a supervisor, I would have left the course due to a hectic and engaging situation at my workplace.

To my wife, parents and nice children Fahad, Amuza, Acram and Husna who dearly missed me during the study.

To God be the glory.

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ABSTRACT

Uganda's capture fisheries are dwindling in supplies. With a population growth rate of 3.2%, an expected annual consumption of 580,234 tonnes with supplies limited to only 330,000 tonnes, creates a consumption gap of above 240,000 tonnes per annum. As such there is need to boost aquaculture supply sources to bridge the gap. The government of Uganda has indicated that no sufficient fish farming research has been done to guide in planning for this sector. Therefore a study on fish farming in Mbale sub-region (Sironko, Mbale and Manafwa districts out of the 5 districts) was carried out with the main aim of establishing the economics of fish (tilapia and catfish) farming. From the fish farmer lists established per district, 40 farmers were selected randomly. In total, 120 households were visited and interviewed. Descriptive statistics, unit cost ratio and simple multiple regression analysis were done to answer the main objective. The results showed that Catfish enterprise had high yields (752,013.00kg/ha/year) but with low price (3045.83Ush/kg) as compared to the tilapia fish enterprise which realised lower yields (2856.15kg/ha/year) but was more expensively sold (4004.16Ush/kg). Catfish competitiveness (UCR=0.89) was higher than tilapia (UCR=0.94) but not significantly different. These values which are nearer 1 indicate less competiveness/profitability than when these figures would be smaller and nearer the 0 value. The regression analysis revealed a number of factors that were significant and positively influencing the competitiveness of both tilapia and catfish as years of experience, level of education, number of extension visits, pond size and membership to farmer groups. Type of feed was only significant for catfish farming. Distance to fresh fish market negatively and significantly affected both tilapia and catfish competitiveness. It thus negatively affected profitability of fish farming. Provision of better performing fish breeds, increased extension service delivery, easy access to quality feed, improved access to markets, farmers'

operation as farmer groups could increase fish farming competitiveness as an enterprise in Sironko, Mbale and Manafwa districts.

LIST OF ACRONYMS

CTFs	Cat Fish Farmers
CTFe	Cat Fish Farmer enterprises
DFR	Department of Fisheries Resources
FAO	Food and Agricultural Organisation
IUFFF	Investing in Uganda's Fish and Fish Farming Industry
MT	Metric Tonnes
NAADS	National Agricultural Advisory Services
NaFIRRI	National Fisheries Resources Research Institute
NDP	National Development Plan
NIPAP	National Investment Policy for Aquaculture Parks
PHC	Population and Housing Census
TSWFA	The State of World Fisheries and Aquaculture
TLFs	Tilapia Fish Farmers
TLFe	Tilapia Fish Farmer enterprises
UBOS	Uganda Bureau Of Statistics
VIF	Variance Inflation Factor
UtCR	Unit Cost Ratio

CHAPTER ONE

INTRODUCTION

1.1 Back ground

Globally, aquaculture has been growing faster than any other food production sector (Rouhani and Britz, 2004). The importance of aquaculture in the world cannot be underestimated given that most of this output is consumed by humans. As indicated in Table 1, as the world population increased from 6.4 in 2004 to 6.8 billion in 2009 (6.25% increase), the overall fisheries and aquaculture output increased by 8.04% that is from 134.3 in 2004 to 145.1 million tonnes in 2009.

Table 1: World Aquaculture and Fisheries Production and Utilization from 2004 to 2009

Year	World Population (Billions)	World Total Production Million tones (MT)			World utilization (MT)		World Per capita supply (kg)	Africa Total Aquaculture Production. (000's)	Uganda Total Aquaculture Production (000's)
		Capture &aquaculture	Capture	Aquaculture	Human	Non Food uses			
2004	6.4	134.3	92.4	41.9	104.4	29.8	16.2	624.63	5.54
2005	6.5	136.4	92.1	44.3	107.3	29.1	16.5	713.93	10.82
2006	6.6	137.1	89.7	47.4	110.7	26.3	16.8	830.46	32.39
2007	6.7	139.8	89.9	49.9	112.7	27.1	16.9	903.18	55.11
2008	6.8	142.3	89.7	52.5	115.5	27.2	17.1	1046.90	52.25
2009	6.8	145.1	90.0	55.1	117.8	27.3	17.2	1087.98	76.65

Source: The state of world fisheries and aquaculture (TSWFA), 2010 & FAO, 2011. Data excludes aquatic plants)

It is however important to note that capture fisheries output supply decreased from 92.4 million tonnes in 2004 to 90.0 million tonnes in 2009 with a growth rate of (-0.52%) whereas aquaculture grew by 5.25%. Thus the marginal input was supported by growth in aquaculture (Table 1).

World utilization (human and non-food uses) for both capture and aquaculture has been also been fluctuating (Table 1). In 2004, 132.4 metric tonnes (MT) were utilized rising to 145.1 metric tonnes in 2009. (FAO, 2011). The above observation indicates that human consumption was exerting pressure on fish supplies at the expense of other non food uses like animal feeds. Though fish production and consumption patterns appear positive, rural areas with vast fish production potential still live in poverty. As such there is need for policy incentives to promote fish farming (Rouhani *et al*., 2004).

In Africa, there is need to increase production intensities, efficiencies and develop management technologies that target local niche markets for indigenous fish species where the fisheries sector has remained low, yet with vast potential (Dugan, 2003). In East Africa, the gap between supply and demand has widened. This has resulted into axial fish skeletons (*mgongo wazi*) commonly eaten by local people becoming scarce among others. The flesh from this fish is packed and exported. (Rutaisire et al., 2009). As seen in table 1, the African continent and more specifically Uganda as a country still has potential to increase aquaculture production. In 2004, Uganda supplied 5,539 tones increasing to 76,654 tonnes in 2009 which is less than 1% of the total African production. Uganda as a country has been experiencing a consistent fish supply gap of above 229,000 tonnes annually (excluding aquaculture) in respect to the recommended per capita consumption of 17 kg by FAO. (NIPAP, 2012) as indicated in Table 2. Currently Uganda per capita fish consumption stands at 8 kilograms

The Government of Uganda through the National Fisheries Resources Research Institute (NaFIRRI), aquaculture unit and donor agencies has planned to inspect and license all aquaculture activities, support live fish marketing group around Kampala and conduct exhibition of agricultural shows among others(NIPAP, 2012).

Table 1: Uganda's capture fish production, consumption and supply gap quantities in tones from 2009 to 2012.

Year	mid-year population projections	Fish consumed domestically	Expected consumption (FAO standards)	Fish Consumption gap (FAO standards)
2009/10	31.78	280,000	540,538	260,538
2010/11	32.94	330,000	559,977	229,977
2011/12	34.13	350,000	580,234	230,234

Aquaculture data excluded. Estimated domestic consumption established from per capita fish consumption of 17 kg as recommended by FAO. Fish supply gap calculated by researcher. , (Source; UBOS, 2012, MAAIF Statistical Abstract, 2011, NIPAP, 2012).

According to DFR, (2011) aquaculture production has steadily risen from 285 MT in 1999 to 100,000 MT in 2010/2011 with a countrywide pond total of 2500 ponds. In 2011, there were 2,000 emerging commercial fish farmers with over 5,000 ponds (DFR, 2011). As Table 3 indicates, the number of households with ponds in the Eastern region of Uganda were 1,270 out of 7,152 households with ponds nationally. This was equivalent to 17.76% of the whole country.

This region had the lowest number of ponds numbering 3,886 compared to other regions of Uganda such as Central region which had a maximum of 12,746 ponds. In the same year, Sironko and Mbale districts together with Uganda as a nation had only 103, 480 and 26,795 ponds stocked retrospectively (PHC, 2002). This contributed to only 0.003% and 0.016% of the national average.

Table 3: Fish pond ownership by farming households in 2002 by regions in Uganda

Region of Uganda	Number of Households with ponds	Total No. of Ponds	Number of ponds stocked with			Number of ponds unstocked
			Clarias	Tilapia	Mixed / species	
Uganda	7152	29999	4771	10556	11468	3204
Central region	1954	12746	2794	3734	5406	812
Western region	2311	7198	839	3034	2551	1014
Northern region	1617	6169	786	2219	2106	818
Eastern region	1270	3886	352	1569	5113	560
Mbale district	177	568	40	236	204	88
Sironko district	54	132	2	65	36	29

(Source; Population and Housing Census (PHC), 2002)

Thus aquaculture activities in Mbale, and Sironko districts are at the minimum requiring drastic interventions to raise. With a high potential in terms of permanent rivers flowing through generally flat areas, farmers in Mbale sub region can indulge in aquaculture farming but more sensibly from an informed point of view.

1.2 Tilapia and Catfish Competitiveness / Farming in Uganda

In Uganda, Fish was introduced in 1953 as a nontraditional activity. It was established at Kanjansi as a training Centre for farmers and staff. Fish farming was introduced for to cater for household nutrition and not commercial purposes. Government was to provide fry. By 1967 about 11,000 ponds covering 410 ha had an annual production of 800-900 tones. In 1970 war collapsed everything. Currently government effort is geared towards commercial fish farming to earn foreign exchange. The Ugandan government cannot rely on its own but recognizes the role of different stakeholders is encouraging private sector to get involved. Catfish farming in Uganda is facing competitors who are involved in: offering consistent products in time and space, no erratic increases in price and products sold with little differentiation. (NARO, 2000).

From 2001 to 2009 per capita fish demand was 15kg while supply was staggeringly below that. Both price trends of tilapia and catfish were on the increase from 2001 to 2009. (Ssebisubi 2010)

With regard to fish farming, the fish will always require good environment to live well in the pond. Its waters must be free of toxic chemical, disease and other fish enemies. The pond should be located not in the way of a river supply but a distance from it, such that water is only drawn in when required. The shallow ends of the pond should be 0.5 meters while the deeper ends 1.0 to 1,.7 meters. Dyke height should be 30 to 50 cm above pond water level. Small commercial ponds are from 500 -1000square meters while 20,000 square meters are recommended for commercial fish production. The large the pond, the more commercial it is. Optimum pond size is 4000 square meters. The pond sides should be sloppy and based on clay/loam soil that can retain water best.

You need reliable water throughout the fish cycle. Security is key while locating ponds. The pond inlet should be higher than pond outlet to facilitate drainage. Specifically for tilapia ,the Nile tilapia commonly called "Ngege" has its scientific name as oreochromis niloticus. Other types are tilapia zilli and oreochromis leucosticus.It feeds on algae. Nile tilapia kept in ponds has always learnt to eat artificial foods and feeds. It can eat cooked food and food left covers. This species matures at 8-10 months averaging 300 to 500grams. In poor farmers' ponds, tilapia should do better than catfish. Optimum temperatures are 26 -28 degrees centigrade. Tilapia is preffered nationally, regionally and internationally.

On the other hand African catfish is locally called "Mmale". Its scientific name is clarias gariepinus. It breathes through normal gills and lunglike structures that enable it to breath dry. As such it can be stocked up to 10 fish per square meter. Catfish is described as omnivore and a scavenger. It feeds on decaying plants (dextritus) and animal parts at the bottom of ponds. It is carnivores on other animals and its young. It matures at 500 grams. It produces when water levels change but many fry die. Averagely grows to 500 to 1000 grams in 8 months. Its feed should be rich in protein. Optimum temperatures are 26 to 29 degrees centigrade. Catfish tolerate lower temperatures than tilapia. Catfish is preferred in the East, North(Tororo,Teso and Sama),Buganda region and Kenya.(NAADS,2005)

1.3 Importance of Aquaculture in Uganda

By 2004, fish species widely kept in Uganda were catfish, tilapia and mirror carps (FAO, 2012). Yield levels per cubic meter of water were at 0.2kg for ponds, 100kg for tanks and 50kg for cages. Increased aquaculture output serves to provide affordable source of protein (Rutaisire et al., 2009). The quality of Ugandan fish is very high as it contains (Omega -3 fatty acids) which can be a target by high income earners with health concerns (IUFFF, 2010). Cholesterol levels in the body can be reduced with intake of fish (Moses, 1999). Uganda earns foreign exchange from fish in various ways. This includes: Exportation of young and mature fish from commercial hatchery operators to Rwanda, Tanzania and Democratic Republic of Congo for grow out and consumption. Farmed fish is also exported to Kenya and Tanzania as bait fish for Nile perch in Lake Victoria (FAO, 2012).

Currently as employment is decreasing in capture fisheries, there is a possibility that opportunities may be created in aquaculture subsector. (TSWFA, 2010). The process of smoking, salting or sun drying creates employment for people. Fish hatcheries operating in the county generate employment (MAAIF, 2011). Aquaculture creates employment for staff along the entire supply and marketing chain (FAO, 2012) Total population employed in aquaculture is approximately 2.1 million. Small scale farmers will always rely on traders and intermediary agents to deliver goods to the market (Jagger and Pender, 2001). Though aquaculture is facing many limitations like market imperfections, it is still being promoted to provide food security and employment (Hyuha et al.2011). Aquaculture is regarded as a better form of employment compared with other non-environmentally friendly practices like deforestation, which may be promoted by making brick among others. (Rutaisire et al., 2009). A study conducted in Kabale district, found the local population considering fish farming as the only activity which is environmentally friendly, sustainable and economically profitable. (Kirya, 2011). There is evidence that aquaculture has the potential to provide gainful employment as such it should be promoted to contribute significantly towards poverty reduction (Karim et al., 2008).

Due to increasing fish price, government intervention for increasing fish production, stagnating capture fish supplies, aquaculture has attracted various entrepreneur farmers who want to exploit the business opportunity at hand (FAO,2012). Demand by fish farmers for fish meal, oil residues, brewery waste, maize bran and chicken offals during the fish production process, promotes fish–industrial linkages (Rutaisire et al., 2009) and hence Uganda’s industrialization. Currently, few firms and companies are in the process of developing infrastructure or at the beginning of the production process. Funding is by foreign investors directly or local firms in partnership with foreign companies (FAO, 2012). Uganda benefits from fingerling and fry production sales which though small, can benefit the community through the multiplier effect. Such aquacultural business may eventually facilitate improvement of services such as electricity, water availability and transport sector amongst farming communities (Vanderluugt, 2010). Aquaculture also presents a potential market for fish species which have been previously not traded on international market such as catfish (IUFFF, 2010). However, there exists limited information on economic analysis of fish farming in Eastern Uganda. The study therefore focuses specifically on comparing competitiveness of tilapia and catfish in an existing farming system in Mbale sub region, Eastern Uganda. There are many advantages accruing from fish farming of which Mbale people should benefit from.

1.4 Problem Statement

Globally, fish is important for its food security, income generation, employment and foreign currency earnings (TSWFA, 2010). In Sub Saharan Africa, little information is available on exact production and consumption patterns (FAO, 2006). In Uganda, the annual production is estimated at about 550,000 tonnes with aquaculture contributing 90,000 tones (16.4%). Out of this annual production, 220,000 tonnes is exported leaving 330,000 tonnes for local consumption (NIPAP, 2012). This translates into a per capita fish consumption of 8 kg which is below the FAO recommendation of 17kg per head. To achieve FAO's recommendation, the country would have to produce 580,234 tonnes annually. There is therefore a consumption gap of 240,250 tonnes , resulting from the difference between the expected FAO recommended country total consumption (580,234tonns) and what is currently consumed (330,000 tonnes) countrywide.
Of recent extension staff in Eastern Uganda have been promoting catfish with the motive of replacing tilapia fish farming. The staff take tilapia to be less profitable as opposed to catfish production. However the local population is used to tilapia given that it has been supplied by lake capture fisheries for a long time. The two fish differ in feeding habits with tilapia being vegetarian and catfish requiring high protein feeds. There is need to compare the two fish species to fully understand their potentials in this farming system.

Furthermore, the shortage in fish supply has had a negative effect on the 17 fish processors, who are currently operating at 30% of their annual capacity (DFR, 2011). In order for these companies to raise their operational capacity, the supply needs to be increased. However, given the fact that the traditional source such as lake Victoria, that is capture fish, has been depleted, aquaculture therefore is the viable alternative. This is equally reinforced by the fact that there is increasing demand for fish from the growing population (UBOS, 2012).

Studies on fish farming in Uganda have focused mainly on profitability of individual fish species the most recent being Hyuha et al. (2011) and Mwesigwa (2008) in Central Uganda. However, there is no recent study in Uganda that has been carried out comparing competitiveness of tilapia and catfish fish species using unit cost ratio in an existing farming system and most specifically in Mbale sub region. McFetridge (1995), indicates that, a competitive firm is one that has average costs less than the market price of its product offering. The opportunity cost (value of goods and services) a firm is using should be less than the value of goods and services offered by the firm. This study seeks to compare competiveness of tilapia and catfish fish farming in Mbale sub region to Eastern Mbale whose findings will guide farmers in the allocation of their scarce resources in fish farming. This will eventually increase fish production and address the fish supply gap in the domestic market. This will in turn reduce on the fish supply pressure from capture fisheries and thus Uganda as a country will earn more foreign exchange through availing more fish (capture and aquaculture) to fish processors for export.

1.5 Objectives of the study

The aim of this study was to analyse competitiveness of tilapia and catfish farming in Mbale sub region. Specifically, the study sought to address the following objectives:

1. To compare characteristics of tilapia and catfish farmers in the Sironko, Mbale and Manafwa districts.

2. To compare competitiveness of tilapia and catfish enterprises in Sironko, Mbale and Manafwa districts.

3. To comparatively determine factors that influence competitiveness of tilapia and catfish enterprises at household level in the study area.

1.6 Hypotheses

1. Characteristics of tilapia and catfish farmers are significantly different
2. Catfish farming as an enterprise is more competitive than tilapia farming in the study area.
3. Years of experience, household size, level of education, number of extension visits, pond size, credit access, feed type and membership to farmer groups, have a positive influence on competitiveness of tilapia and catfish farming in the study area.

1.6 Significance of the study

The findings will be useful in helping farmers make informed decisions and rationally organise their resources in fish farming. Extension workers will find this study findings useful in their advisory role of helping farmers to make informed decisions on investment in the fish enterprise. Knowledge established on competitiveness of fish farming in the study area, will guide non-government organizations, community based organizations and local leaders in advocating for appropriate policy options and choice of interventions to implement aimed at increasing incomes for the communities they serve. The Government of Uganda through the National Development Plan (NDP) (2010), would like to promote the fish farming sub sector subject to assurance that investing heavily in small scale fish farming would be viable. This competitive study on fish farming within the ecosystems in Uganda will serve as a useful tool to support Government's interest of planning for the fish farming sub sector

1.7 Scope of the study and assumptions taken.

This competitiveness study was carried out from late 2010 to early 2011. This study mainly focused on characterising and specifically comparing the competitiveness of Tilapia and Catfish enterprises in the farming system. The study also determined factors that influence competitiveness of both tilapia and catfish farming in the farming system. Other types of fish like less farmed mirror cap and mix of tilapia / catfish were not analysed. Crop and animal enterprises within the same farming system like maize, sugarcane, beans, coffee, poultry and cattle were not compared with the two species of fish in this study. This study relied on primary and secondary data. Other studies that can supplement this study given the differences and peculiarities of specific areas are recommended. However assumption taken was that water temperature and quality (chemical) was homogenous throughout the study area.

1.8 Structure of the thesis

This study is organized in five chapters. Introductions to the study is given in chapter one. Literature on related studies is presented in section two. This chapter mostly dwelt with concepts, measurement of competitiveness and related studies done earlier on competitiveness.

The third chapter has methodology used to capture and analyse data. Analysed results are presented in chapter four. The last chapter presents summary, conclusions, recommendations and areas for further study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Concept of competitiveness

Competitiveness is a widely used term in economics Boone (2000). The competitiveness concept looks at enterprises at a more global and holistic point of view. According to McFetridge (1995), competitiveness means different things to different people. It is better to consider it at 3 levels of aggregation that is firm, industry/groups of industries and national level. Each level has different indicators or measurements of competitiveness. Variations are embedded in what they imply about the present and the wellbeing in future. Some concept may apply at one level and not apply at the other level. According to Garell (2012), it is boundless within an enterprise to ensure free flow of knowledge within cooperation.

A person, enterprise that is competitive tries to develop a competitive advantage in an area where it can out compete others. This leads to specialization which plays an important role in competitiveness. Succeeding in competitiveness implies fully exploiting all resources and competencies at your disposal as such getting the best out of an individual, firm, Horia and Pater (2006) defined competitiveness as the capacity and skill of an entity to win in a competition in its external environments in a confrontational and / or coordinated manner in a period of time.

Munirova (Online accessed on 5th May2013), indicates that enterprise competitiveness is the ability to sell and supply goods and services at the local or world markets and to gain profit from these operations on a sustainable basis. Ability points to enterprise capability to succeed in the competition with other subjects while sustainable profitability is ability to optimally utilise resources.

According to Petrovic et al.(2008) enterprise level competitiveness is defined as the ability of an enterprise to innovate, create, produce and sell the goods and services on internal and foreign markets, maintain or enlarge its market share. The enterprise should be having the essential characteristic of surviving successfully and growing on the market

McFetridge (1995), puts that, in a profit maximising equilibrium in a homogenous product, the lower the firms incremental cost relative to those of its competitors, the larger the market share. Dagang et al. (2001) and Gloy et al. (2002) put it that a firm therefore should compete by achieving a rate of return which is satisfactory. Fish farming should be practiced as farming as a business, however for fish farming in Mbale sub region to be carried out commercially, basic empirical data needs to be in place to ease stakeholder decision making.

2.2 Measurement of Competitiveness

There are many indicators that can be used in measuring competitiveness. Garell (2012) indicates that the International Institute for Management Training (IMD) World competitiveness year book uses 2500 indicators to measure competitiveness. Blunck (2006) notes that measures of competiveness in the traded sector include profitability; the firms export quotient (exports or foreign sales divided by output) and regional or global market share. Profitability/performance in the international market place provides a direct measure of a firm's Profitability/performance.

McFetridge (1995) asserts that the anticipated future profitability of a firm depends on relative productivity, input costs and the relative attractiveness of its products offering overtime. Competitiveness can be a function of its current spending, its patenting activity and any other firm strategies used. A firm which is not profitable is not competitive. At a firm level profitability, cost, productivity and market share are all indicators of competiveness. It is sustained ability of a firm to operate profitably in an open market.

Researchers have used differing choices for appropriate profitability measures. Some have used cash measures of income such as net income, gross margin analysis, net present worth and returns to labour and management. Dagang et al., (2009); Gloy, (2002) used farm's rate of return on farm assets. They argue that, firm competitiveness can also be determined by many interdependent and interlinked factors themselves. These can be farm production potential, capital availability, knowledge, market availability, infrastructure, government policy, skills and ability of people farming the land (FAO, 1999). Wolff et al. (2007) further argues that at micro level, on the input side, competitiveness indicators include stock turn over, physical, human and financial capital. On the output side, it encompasses patents, profitability, firm growth, relative national productivity and market share.

McFetridge (1995) argued that profitability is better used as a long term measure of competitiveness though it can be sufficient as a current measure. Market share can be used for firms maximizing profits and not sacrificing profits for market share. Unit labour costs though becoming infrequent can be used to represent average cost, if labour cost comprises a larger percentage of the total cost. Labour cost productivity may represent total factor productivity if labour is a major input but this is seldom used.

Boone, (2000) proposed a competitiveness measure which he developed in 2004 called relative profits differences. Central to this was that competition rewards efficiency. Increase in competition will decrease output higher for less efficient firms than for efficient firms. Also according to Devine et al.,(2011), increase in competition will always affect profits of less efficient firms more than the more efficient firms

Further still, Boone (2000) affirms that in the 18^{th} Century competitiveness was evaluated on economic efficiency, but by 2008 firm's market power or extent of monopoly was used to measure competitiveness. On the other hand, Behyat and Osty, (2013) says maximising long term profitability of a firms is of utmost importance to competitiveness and farmers wellbeing. However Feller et al. (2006) indicates that the key factor to a firm's competitiveness is to supply what the customers want and the firm must survive competition. This calls for identifying needs and what determines customers' product preference. According to Ssebisubi, (2010) in fish farming profit margins depend on market, survival rates, feed conversion and total yield
Oral (1993) notes that by extending the Richadian comparative advantage to factors of production and multiple goods, the adjusted form obtained is easy to use as an indicator of competitiveness. In this study unit cost ratio which is a derivation from Richadian, comparative advantage was used. Siggel (2006) indicates that, by using price, Unit Cost Ratio(UtCR) overcomes problems of comparing competitors who have differences in product quality and mix.

2.3 Empirical Studies on Competitiveness

The profitability studies reviewed include; Adewum et al. (2005) who examined the profitability potential of fish farming amongst 60 farmers in Ogun state, Nigeria. Using costs and returns, they found it to be profitable fetching approximately Naira 761,400.58 for an average pond size of 310.47square metres.

Emokaro and Ekunwe (2009) studied efficiency of resource use and elasticity of production amongst 60 catfish farmers in Kaduna, Nigeria. Using a stochastic frontier production function of resource use and elasticity, they found farmers not optimally utilizing their production inputs and rates of return to scale indicated stage two of the production process. Results indicated existence of intervention points for relevant stakeholders in catfish business. Abdalla, (2009) studied aquaculture potential of sea bass (*Dicentrarchus labrax*) in Brackish water fish farms in Egypt. Production reached 1900kg/feddan, indicating importance of sea bass culture and that incomes obtained were high. Though returns were relatively high, Sea bass culture had not developed in Egypt due to absence of capital investments in major seasons. Raufu *et al*. (2009) used budgetary analysis to study determinants of yield performance amongst 80 small scale fish farmers in Lagos state, Nigeria. They estimated a farmer's net farm income as N8, 985,904 per annum with a benefit cost ratio of 3.43 and a gross margin ratio of 1.41. Gamal *et al*., (2008) carried out an economic analysis of fish farming amongst 15 farms in Behera, Egypt. Using break even analysis, they established an average production cost of LE 6.5 /kg and a sales price of 7.5/kg. The rate of return was 19% on operational costs in the production season.

Emokaro *et al*. (2010) carried out a profitability and viability study of catfish production in Nigeria. Using cost and return analysis, they got $5,723 and $2,576 as average annual gross revenue and net profit respectively. A profit margin of $51.46 and benefit cost ratio of 1.82 indicated the enterprise to be viable. Kaliba et al. (2006) studied economic analysis of Nile tilapia (*Oreochromis niloticus*) production in an experiment on a farm in Tanzania. He found that with a simulation model for individual fish growth and population dynamics of fish taken into account coupled with no predation, results were not economically sustainable for a culture of mixed sex tilapia. He however established that returns were high enough for improved production systems of tilapia to justify credit access and repayment. Mbugua (2007) researched on a comparative economic evaluation of farming three important aquaculture species in Kenya using 3 national aquaculture centers. He based the study on research extension recommendations for aquaculture production practices in Kenya. He used net present value, internal rate of return and payback period to determine their viability levels. He found a net present value of 14.4, 9.5, 9.3 and 3.4 million Kenya shillings per hectare for bait fish culture, tilapia-catfish polyculture, trout culture and tilapia monoculture respectively. He also got an internal rate of return of 87%, 54%, 16% and 22% for bait fish culture, tilapia-catfish polyculture, trout culture and tilapia monoculture respectively. The payback period was 4.5 years for baitfish and 5.7years for tilapia-catfish polyculture. Trout and tilapia monoculture had 5.3 and 7.5 years for payback period respectively.

Lindawati and Tajerin (2009) studied the economic efficiency amongst 40 pond units of Cyprinus Carpio grow out cultured in running water pond in situ dam valley Ciampea district in Bogor regency. Efficiency analysis showed that production of Cyprinus grow out had not reached its efficient level. This was because input usage was below its optimum level. As such the maximum profit was not gained. There was need to reduce fish seed usage while increasing fish feeds and labour use to obtain optimum condition.

Kaliba et al. (2007) studied economic profitability of Nile tilapia *(Oreochromisn niloticus*) production amongst 138 respondents in Kenya. Input-output was used during model simulation on profitability of 200 and 634 square meter ponds. Mixed tilapia without predation had gross revenue of 2701 and 3092 Kenya shillings for a 200 and 634 square meter pond sizes respectively. Mixed tilapia with catfish predation had 3412 and 10519 Kenya shillings for a 200 and 634 square meter pond sizes respectively. Lastly hand sexed all male tilapia had 6645 and 17182 Kenya shillings for a 200 and 634 square meter pond sizes respectively. Abbas and Ukoje (2009) conducted a rural water utilisation amongst 50 respondents on factors affecting aquaculture in Owo local government area of Ondo state, Nigeria. Using gross margin analysis , they found out that aquaculture was profitable at a level of N 1,395,526.

Williams et al. (2012) studied economic analysis of catfish production in Llelfe, Osun state, Nigeria. Using budgetary analysis, they found catfish farming profitable with a net profit per year of N 35,078.384. The benefit cost ratio was 2.3. Asamoah et al. (2012) studied an economic analysis of pond aquaculture in Southern Ghana. They used 74 fish farmers and employed Cobb Douglas production function and established that aquaculture was exhibiting increasing returns to scale over the period of study. An increase in inputs would more than proportionally increase the output. Estimates of the marginal physical productivity of the inputs indicated stocking rate should be increased while decreasing feed and labour use in order to increase production. Kassali et al. (2011) studied economics of fish production and marketing in the urban areas of Tillabery and Niama in Niger republic amongst 30 pond owners and 40 fishermen. Using budgeting, they found both aquaculture and inland fish production profitable with a rate of return of 61% and 320% respectively. However aquaculture required more capital intensive investment than inland fishing. Reduction in input cost especially the capital input would encourage more participation in fish farming. This would relieve fish supply pressure on inland fishing.

Adebayo and Adesoji (2008) did a comparative assessment of the profit margin of catfish reared in concrete tanks and earthen pond at a research station in Ondo State, Nigeria. He found that the earthen growth margin of N 73.000 was higher due to its lower management costs than 52.500 Naira for concrete tanks. However, this indicated they were all profitable enterprises. Amos (2007) studied resource use in tilapia production among 14 small scale farmers in the Savanna zone of Northern Nigeria. Using farm business analysis, he computed a net income of 140.000 Naira earned per hectare. He also found that for every kilogram of feed, farmers realized 5.5 kg of fish for tilapia-catfish. Awoyemi (2011) analysed profitability of fish farming among 62 women fish farmers in Osun state Nigeria. Using budgetary technique, he established that farmers incurred a total average cost of N37148.35 per annum but earned a gross revenue of N 791242.52. They as such realized a gross margin of N574314 and a profit of N419756.17. Return on investment was 0.58. The study concluded that fish was rewarding and profitable.

However other related studies apart from aquaculture are; Athieno et al. (2008) studied competitiveness of crossbred and indigenous chickens among 120 farmers in eastern Uganda. Using Unit Cost ratio (UCR) , they found chicken farming to be profitable. Cross bred chicken had higher profit margins but indigenous chicken were also profitable due to their low costs of production.

Bielik and Rajcaniova (2004) analysed competitiveness of agricultural enterprises in Slovakia amongst 110 agricultural enterprises divided according to their soil and natural conditions, legal forms and various sizes using resource cost ratio. They established that the common feature was that all the competitive enterprises were associated with one enterprise that was solely plant production and possibly a mix of plant and meat. There was no sole meat enterprise that was competitive. Business companies were more competitive than cooperatives. Groups of enterprises in better soils and natural conditions were more competitive.

Wijnands et al. (2007) compared competitiveness of the food industry between Uerope,Canada and United States of America at enterprise and industry level. They used 5 indicators to measure competitiveness. These were growth of real value added of a specific industry, growth Balassa index, growth of the export share on the world market, growth of the real labour productivity and growth of real value added. They established that competitiveness of the European food was weak and United States and Canada had a stronger position. The possible reasons were small scale enterprises, restricted quota system, availability of raw materials and lower growth of the population which determines quantity demanded.

Most of these studies have been carried out using mainly gross margin, rate of returns and net present value. This study intends to use unit cost ratio. By using opportunity cost of capital, unit cost ratio indicates long term competitiveness.

2.4 Empirical Studies on Determinants of Competitiveness of fish enterprises.

A number of authors have studied factors influencing competitiveness including

Gamal *et al*. (2008) studied factors influencing productivity of fish farming amongst 15 farmers in Behera governorate of Egypt. They used a correlation matrix which indicated a high positive relationship between quantities of fish seeds, income level being generated by farmers, feed costs and cost of transportation. Strong factor influencing productivity of fish farming was quantity of fish seeds. Olawumi et al.(2010) did an economic analysis of homestead fish production in Ogun state Nigeria. He studied 72 fish farmers using budgetary and regression models and found labour in feeding, harvesting, pond size, quantity of fish seeds stocked and use of poultry waste feeds as major determinants of revenue to homestead fish production.

Adewumi et al. (2005) while examining the profitability potential of fish farming amongst 60 farmers in Ogun state Nigeria used multiple regression analysis and found stocking levels of fingerlings, use of lime, pond size and labour being significant. Banjo et al. (2009) did socio-economic analysis of improving clarias productivity towards achieving food security in Nigeria. They used two stage least square regression, analysis of variance and chi square and found out that stocking capacity and rate of water change were the significant factors at 5% and 10% levels. Organic fertilizers were less effective compared to inorganic fertilizers

Asamoah et al. (2012) studied aquaculture economics in southern Ghana amongst 74 pond farmers. They used Cobb-Douglas production function and found stocking rate (fingerling/M^2), labour in man days and fertilizer applied (kg/M^2) being significant for small scale fish farmers. Medium scale fish farmers had quantity of feed, stocking rate and experience in years being significant. Large scale farmers had a stocking rate as the only significant variable. Uguoma et al. (2010) studied performance of 100 small scale fish farmer operators in resource use in Imo state, Nigeria. Using the stochastic translog frontier production function model, they found fertilizer, fingerlings, labour, water, feed and capital significant. Ugwumba (2011) analysed of catfish farming system and its impact on net farm income in Anambra state, Nigeria. He found farmer's age, farm area, cost of feed, pond type and stock size exerting significant effects on net farm income amongst 204 farmers.

Matiya et al. (2003) studied factors influencing prices of fish amongst 223 respondents in 13 markets visited, in Central region of Malawi. Using multiple regression analysis they found that species type, form of preservation and market type influenced the price of fish more than other variables. This suggested that fish trading in urban areas, size and species type and form of preservation played an influential role in determining prices. Ibekwe (2007) studied determinants of small scale fish farming in Owerri agricultural zone of Imo state, Nigeria amongst 30 respondents. Using regression, he found level of education, expenditure on feed inputs, size of pond and expenditure on water significant at 5% level and positively correlated with fish output.

Oladejo (2010) analysed small scale catfish farming amongst 60 farmers in Ido local government area of Oyo state, Nigeria. Using regression analysis, he established the relationship between cost of production and returns. He found out that rent on land, cost of fingerling, pond construction cost, feed cost, transportation costs and salary and wages significantly affecting revenue of respondents. .

Other related empirical studies apart from those in fish farming are; Athieno et al. (2008) conducted a study amongst 120 farmers in Eastern Uganda and using, regression analysis they found that proportion of birds weaned to total folk, number of chickens reared, rearing experience of chicken farmers and type of feeding significantly influenced competitiveness of chicken. DuToit et al. (2010) studied factors influencing the long term competitiveness of 11 commercial milk producers: Evidence from panel data in East Griqualand, South Africa. Using ridge regression analysis with unit cost ratio as a dependent variable, they found that dairy herd size, level of farm debt, annual production per cow, technology and policy changes overtime and the ratio of trading income to total milk income influenced the long term competitiveness.

Adeoye et al. (2011) studied economic analysis of watermelon based production system amongst 90 respondents in Oyo state, Nigeria. Using stochastic frontier production function they found that production level was significantly influenced by labour input while education level significantly contributed towards increasing farmer's efficiency. Muhammad (2012) studied the impact of socio-economic factors on small business success amongst 60 businessmen in Georgrafia, Malaysia. Regression analysis, revealed a positive and significant impact by these factors; investment, entrepreneurial experience, business profile and culture. Yaghoub et al.

(2011) carried out an investigation on factors affecting efficiency and effectiveness of agricultural facilities from the view point of farmers and credit experts amongst 416 farmers in 2009, Iran. Using one variable linear regression and multivariate linear regressions they found the following situation; the process of agricultural training, low age and high education of farmers was having a positive significant relationship with effectiveness of their earning facilities on the fields of profit, increasing productions employment and satisfaction with farming.

Masuku (2011) studied determinants of small holder cane growers amongst 124 farmers in Swaziland. Using multiple regression analysis, he found that performance of farmers was significantly affected by farmer experience, yield per ha and sucrose content. Baseke (2009) studied profitability of pineapple production amongst 65 small scale and 127 large scale pineapple farmers in Kayunga district Central Uganda. Using regression analysis he concluded that farmer's experience, having off farm income, membership to organizations, and access to agricultural extension services, family labour endowment and possession of land title were having a positive influence on pineapple profitability while household dependency ratio and use of hired labour had a negative effect on pineapple profitability in Kayunga district. In this study, factors thought to affect competitiveness/profitability will be studied closely. In the next chapter procedures used to collect data for analysis are given

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CHAPTER THREE

METHODOLOGY

3.1 Description of the study area

This study was conducted in Sironko, Mbale and Manafwa districts located in Mbale sub region (former original Mbale district) in Eastern Uganda. Sironko district comprises 21 Sub Counties, with a projected population of 239,600 and a total area of 1093.9 km^2. Mbale district with a total of 12 Sub Counties and a population of 441,300 has a total area of 1372.8 km^2. Manafwa district comprises 8 Sub Counties with a projected population of 367,500 (UBOS, 2012).

This area was purposely selected due to its high population which is projected to be increasing at a high rate. The area had no lakes or big water bodies hence not favoured by capture fisheries but had many all-weather streams/rivers. Generally highland areas have not been taken seriously for aquaculture production yet many rivers originate from these mountainous areas occasionally with some flat areas suitable for fish farming hence the need to evaluate this potential. For households who own land with easy access to river flowing water sources, keeping fish can be one of the enterprises among others that can be feasibly engaged in. This will enable production of high class protein highly needed by the stakeholders In order for households to access high class animal protein to meet their nutritional needs, this area needs to engage in fish farming as one of its alternatives.

3.2 Sample selection

A sample of respondents was obtained using purposive and simple random procedures. Out of the five districts comprising Mbale sub region, three districts of Sironko, Mbale and Manafwa were randomly selected. The District Fisheries Officers for the three districts were contacted to obtain a list of fish farmers. The fish farmers were then preliminarily visited to update the list after which a sampling frame was constructed. The criteria used to select respondents were; farmers who had completed at least one cycle of fish farming and farmers with functional fish ponds at the time of study. Out of the three districts, 40 respondents were randomly selected per district making a total of 120 households who were interviewed. Where a farmer was not available at the time the household was visited, another one from the nearest household farming fish was substituted.

3.3 Method of data collection

This study employed both qualitative and quantitative methods in collecting the required data. The questionnaire was first pretested on 25 farms. The responses obtained were used to adjust some questions in the questionnaire. Primary data was collected from fish farmers using a structured questionnaire that was administered. To obtain general information about fish farming, secondary data were obtained from related literature.

3.4 Data type collected and its analysis

The data collected included; cost of hired labour equivalent to that used on the farm from production up to primary marketing, input levels and their prices for fish farmers and output levels and their farm gate price values for fish farmers. Other forms of data collected were socio-demographic characteristics of fish farmers which included; sex, farm size, household size, distance to nearest fresh fish market, pond size, experience, age of farmers, education level and marital status among others. In addition, constraints affecting fish farming were collected.

Data gathered were edited for completeness, consistency, accuracy and uniformity and entered into the computer on spread sheet. The data was analyzed using univariate and multivariate methods. Multicollinearity and heteroscedasticity data tests were carried out. According to Hoyt et al.,(2006) ensuring nonexistence of multicollinearity avoids variables correlating with the predictor in the model. Germa and Mara (2000) indicates that checking against existence of heteroscedasticity in model avoid difficulties that would be encountered in separating effects of individual variable due variable overlap. For multicollinearity, data was tested using variance inflation factors (VIF) and tolerance ($1/VIF$) method. Unlike correlation matrix which works with a maximum of two variables, VIF was used because it works with more than two variables and gives conclusive results (Pindey & Rubinfeld, 1981). A threshold value of 10 is normally taken as highly positive indicating presence of multicollinearity (Greene, 1997). Also according to (Judge et al.1988) values of 5.0 were also to indicate serious multicollinearity. From data analysis, VIF was established at 1.22 (appendix V). This was below the value of 5 and 10, indicating nonexistence of multicollinearity. Tests for heteroscedasticity involving carrying out a homoscedasticity test was done using Breusch- pagan test (Constant error variance) of the residual. P values greater than 0.1, indicated weak evidence while those less than 0.1, were strong evidence. From data analysis, values obtained were all above 0.63 for $1/VIF$. This indicated that heteroscedasticity was insignificant at 1 % (appendix V) and as well implied nonexistence of heteroscedasticity.

3.4.1 Characterizing tilapia and catfish farmers in the study area

In characterizing the fish farmers mainly considering the following features were used; Farmer’s experience (years farmer has been keeping fish on farm), House hold size (number of family members), Education level (Number of years spent in school), Access to credit (1=Yes 0=other), sex of household head (1=Male 0=Female), keeping records (1=Yes 0=other), use of lime (1=Yes 0 = other), Sampled (1=Yes 0 = other), land holding per household (hectares held per household), number of ponds per household and source of fry. For continuous variables descriptive statistics like means, standard deviation and percentages were used. T-tests as well as chi square (for categorical variables) tests were carried out to get the difference in means generated by SPSS.

3.4.2 Determining the competitiveness of fish farming in the existing farming system

In order to achieve objective two which was to determine competitiveness of fish farming in the existing farming system, Unit cost ratios were computed in the following manner;

Following Siggel and Ssemogerere (2000) and adapted from Athieno (2008), unit cost ratio for a farm house hold or domestic producer was used after being computed as follows:

$$UtCR_i = \frac{C_i}{VOP_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (1)$$

Where;

$UtCR_i$ = Unit cost ratio of ith fish farmer enterprise.

TC_i = Total cost of the ith fish farm enterprise. (Total cost included variable costs like costs of cabbage leaf remains and other cost items. This was established as cost one would be willing to supply these horticultural crop leaves to the fish in the pond from his farm or horticultural crop leaf remains collected from the market for the whole fish cycle).

VOP_i = Value of output of the ith fish enterprise.

Total costs were computed as follows.

$C_i = \sum X_j P_j + K$ ……………………………………………………………………...(2)

Where;

X_j = the quantity of the j[th] resource used in the i[th] fish enterprise.

p_j = the price per unit of the j[th] resource used in the i[th] fish enterprise.

K = opportunity cost of capital.

i = enterprise index representing tilapia or catfish.

$VOP_i = \sum Q_i P_i$ …………………………………………………….………………(3)

Where;

Q_i = output quantity from the i[th] fish enterprise (numerical).

p_y = Price of the unit output (kg of fish).

Enterprise with average unit cost ratio of less than 1(one) was considered competitive and that with more than 1 (one) considered noncompetitive.

In determining the opportunity cost of capital, the following procedure was used; The total fixed asset value belonging to the fish enterprise (one specific pond which the farmer felt he had most up to date production related data) was established for each individual farmer. Opportunity cost of capital was then calculated using total fixed asset value established for a specific pond multiplied by the Bank of Uganda annual interest rate for that specific year obtained from literature as follows;

$K = Va + r$ ………………………………………………………………………… (4)

Where;

K = Opportunity cost of capital

Va = Total asset value invested in a specific pond in question used to compute competitiveness by an individual fish farmer. Total asset value was obtained by summing up the cost of portion of land occupied by the pond, pond excavation costs and cost of implements used in pond construction which could last for more than one year like hoes, spades, pangas and axes among others.

r = Annual interest rate charged by Bank of Uganda for that specific year (Financial year 2010/2011).

3.4.3 Justification for use of Unit Cost Ratio

Based on literature reviewed, unit cost ratio was taken to be the appropriate method to determine competitiveness of fish farming in Sironko, Mbale and Manafwa districts. According to Siggel (2006), and as specified by Athieno(2008), UtCR overcomes problems of comparing competitors due to differences in product quality and mix as quality differences of this nature are price reflected. This study as such used unit cost ratio (UtCR) which is total cost (C) divided by value of output (VOP).

3.4.4 Determining factors influencing competitiveness of fish farming

To achieve objective three of determining factors influencing competitiveness of fish farming, econometric analysis, using Ordinary Least Squares (OLS) estimation procedures, were used. The competitive index (total cost divided by value of output) was regressed against a number of factors hypothesized to influence competitiveness.

The linear regression model was specified as;

$$CI_{ki} = \alpha_0 + \alpha_1 Y_{1i} + \alpha_2 Y_{2i} + \dots\dots\dots\dots + \alpha_n Y_{ni} + \mu_i \quad \dots\dots\dots\dots(5)$$

Skewness tests were carried out on individual variables where experience, household size, pond size, and unit cost ratio were found to be skewed and these were linealised in a log linear multiple regression model as specified below:

$$InCI_{ki} = \alpha_0 + In\alpha_1 EXP + In\alpha_2 HHZ + \alpha_3 EDUC + \alpha_4 EXT + In\alpha_5 PDZ + \alpha_6 DIST + \alpha_7 FEED + \alpha_8 MORG + \alpha_9 CRD + \mu_I \quad \ldots(8)$$

CI_{ki} = Competitive index (unit cost ratio = $\frac{C_i}{VOP_i}$) For the ith observation which has an inverse relationship with unit cost ratio.

Where;

α_0	=	Intercept
μ_1	=	stochastic disturbance term
$\alpha_1 - \alpha_6$	=	coefficients to be estimated.
EXP	=	Farmer's experience (years farmer has been keeping fish on farm).
HHZ	=	House hold size (numbers of family members).
$EDUC$	=	Education level (Number of years spent in school).
EXT	=	Access to extension services (number of visits by extension personnel per fish farmer for one cycle)
PDZ	=	Pond size. (ha).
$DIST$	=	Distance to fresh fish market (km).
$FEED$	=	Dummy for type of Feed (1= commercially formulated 0=other).
$MORG$	=	Dummy for membership to organization (1=member 0=other).
CRD	=	Dummy for access to credit (1=Yes 0=other).

3.4.5 Explanatory variables and Apriori expectations

In determining the factors affecting competitiveness of fish farming the coefficients of variables listed above were estimated . Table 4 below indicates the a priori expected signs of their coefficients. However, it is important to remember that the competitive index (unit cost ratio) = is inversely related to profitability. When a variable is hypothesized to take on a negative sign, it implies the variable positively influences profitability of an enterprise hence more competitive. Variables included were selected on basis of theory and empirical evidence reviewed in chapter 2.

Table 4: Variables and their Apriori expectations

Label	**Description**	**Expected sign**
EXP	Farmer's experience (years farmer has been keeping fish on farm).	Negative
HHZ	House hold size (numbers of family members).	Negative
EDUC	Education level (Number of years spent in school).	Negative
EXTY	Access to extension services (number of visits by extension personnel per fish farmer for one cycle).	Negative
PDZ	Pond size. (ha).	Negative /Positive
DIST	Distance to fresh fish market (km).	Positive
FEED	Type of Feed (1= commercially formulated 0=otherwise).	Negative
MORG	Membership to organization (1=member 0=otherwise).	Negative
CRD	Access to credit (1=Yes 0=other).	Negative

Experience (EXP) was hypothesized to carry a negative sign. It is assumed that the more the years of experience, the more proficient a farmer becomes in allocating his farm resource. Household size (HHZ) was expected to have a negative sign. As noted by De Janvry et al. (1991) household endowed with family labour which is productive was likely to take on labour intensive tasks like manure application . This improves soil fertility leading to increased yield which transforms into high profitability. A study by Fapohunda (2005) on profitability of homestead fish amongst 55 farmers, found household size positively influencing revenue from the fish enterprise.

Education $(EDUC)$ was hypothesized to be negative. Education accelerates adoption of new inputs and farming practices. Olagunju et al. (2007), found educated fish farmers in Oyo state Nigeria, very receptive to new innovations in the fish production process. Access to extension services (EXT) was expected to take a negative sign. Hyuha et al. (2007) found access to extension facilitating technology adoption which in turn had a positive influence on profit efficiency amongst rice farmers in Eastern and Northern Uganda.

Pond size (PDZ) was expected to take on a negative / positive sign. Mwesigwa (2008) found that increase in pond size without use of proper stocking levels and better performing fingerings could not result in increased profitability amongst commercial fish farmers in Central Uganda

Distance to fresh fish market $(DIST)$ was expected to have a positive influence on profitability of fish farming. Jagger and Pender (2001), while studying markets and production issues for aquaculture in East Africa most specifically found that small pond fish producers deep in remote rural areas locations were most likely to be limited to subsistence production and very localized marketing opportunities.

Type of feed $(FEED)$ was hypothesized to have a negative sign hence influencing profitability positively. Feeding on commercially formulated feeds improved fish performance leading to higher yields. The high yield enables a farmer to earn high incomes hence high profits. This contrasts with feeding fish on local feeds at times of unknown nutrient quality leading to poor yields.

Membership to farmer organization $(MORG)$ was hypothesized to have negative sign as farmers who belong to organizations usually increase their bargaining power by purchasing inputs in bulk at less unit costs, contribute to buy very expensive durable fixed assets and sell together in bulk at high prices. Kidoido (2001) found farmers involvement significant in finger millet yields and profitability in Eastern Uganda. This was because farmers who were in groups had labour more available and as well had easy information access. Access to credit (CRD) received was hypothesized to carry a negative sign. Access to sufficient amounts of credit was likely to enable farmers excavate fish ponds and purchase feeds timely. Abdulai and Huffman (2000) found that credit increased profit levels amongst rice farmers in Northern Ghana. The hypothesis that: Years of experience, level of education, number of extension visits, pond size, level of education, feed type and membership to farmer groups, have a positive influence on competitiveness of fish farming, is supported by this research.

CHAPTER FOUR

RESULTS AND DISCUSSION

The first part of this chapter presents information on selected socio-economic characteristics of fish farmers in Mbale sub region thought to affect production of tilapia and catfish enterprises followed by their competitiveness. Lastly regression results and discussion of study findings on factors affecting fish competitiveness is presented.

4.1 Characteristics of tilapia and catfish farmers compared in Mbale sub region

The characteristics of tilapia and catfish farmers compared in Mbale sub region are summarized in (Table 5). The means of tilapia and catfish farmers were tested to establish if they were significantly different. Simple frequencies are also presented. Farmers for both enterprises were found to have had a considerable working experience of 8.80 years for Tilapia farmers (TLFs) and 7.55 years for Catfish farmers (CTFs) and were also older (51.90 years for TLFs and 51.57 years for CTFs). Middle age, old people and retired civil servants who had accumulated some asset base over years, were found engaging in fish farming.

There was no significant difference in years of education between the two farmer categories with TLFs averaging 10.05 years compared to 10.08 years for CTFs. However this high level of education implied that fish farmers had attained secondary education and were able to read and understand basic literature and to implement technologies. The household size of TLFs (10.10 persons) was not significantly different from that of CTFs (11.55 persons). This average is well above the national average of 5.6 persons(UBOS,2010), Implying fish farmers in Mbale sub region could be having a high source of family labour to help do important tasks like pond construction and general pond maintenance.

The findings of this study show that 26.7% of TLFs and 31.7% of CTFs accessed credit to carry out fish farming. Fish farming is considered risky for funding by credit institutions.

Table 5 : Selected Socioeconomic Characteristics of tilapia and catfish Farmers

Characteristics	Tilapia(n=60)		Catfish(n=60)		t-value	p-value
	Mean	SD	Mean	SD		
Experience (years)	8.80	6.53	7.55	6.79	1.03	0.31
Age household head (yrs)	51.90	13.11	51.57	14.41	0.13	0.90
Level of education(years)	10.05	4.46	10.08	5.60	0.038	0.97
House hold size(persons)	10.10	4.83	11.55	5.60	1.52	0.13
	Tilapia Farmers		**Catfish Farmers**			**Chi square value**
Credit access (%)	26.70		31.70			0.55
Fertilizer use	88.3		85.0			0.288
Lime use (%)	15.00		16.70			0.80
Sex of household head (%)	98.30		95.00			0.31
Practiced sampling (%)	58.30		65.00			0.45
Kept records %	41.70		51.70			0.27

(Source: Survey data 2010/ 2011)

The usage of lime by farmers was discouraging. Lime kills all living organisms in a rehabilitated pond before a new set of fish fry are brought in. A percentage of 16% for TLFs and 17% for CTFs were reported to have utilized it. This level of use was low and could result in catfish and other organisms from previous season passing on to the next fish cycle and hence cannibalizing the newly stocked fry/fingerlings. This is not surprising as reported elsewhere for use in other agricultural enterprises. Though not all lime imported is utilized for aquaculture production, according to MAAIF (2010), only 0.5 and 2 metric tons of lime out of 46 and 108 metric tons of the total fertilizer imports for Uganda were imported for the year 2006 and 2007 respectively.

Overall the majority of the fish farmers were males (98.5% and 95%) for TLFs and for CTFs respectively. There was no significant difference between the two enterprises. The high number of males can be due to the fact that pond establishment needs more manual labour and most women don’t own the land resource which is vital in fish farming. Findings reveal that 58.3% of tilapia farmers practiced sampling. This was practiced in 65.00% of catfish farmer enterprises. The percentage difference between TLFs and CTFs was not significant. It is noted with concern that more than 40% of the farmers do not practice sampling which is vital in monitoring the wellbeing of fish. Through this, farmers can establish the number of fish present, their growth rate and will be able to take corrective measures.

There was no significant difference between TLFs and CTFs in percentage of farmers keeping records (41.7% for TLFs and 51.7% for CTFs).

4.1.1 Selected fish production structure aspects for comparing tilapia and catfish farmers

Analysis of some fish production structure aspects like total pond area and fish cycle length among others are presented in this section. Table 6 shows that TLFs had 2.74 ha and CTFs 3.02ha of land, which was not significantly different.

TLFs had a total pond area of 0.08 ha which was significantly different from 0.12 ha used by CTFs. However not all this pond area was always put under production per season. Average number of tilapia ponds owned was 1.77 while catfish average was 2.03 ponds with the difference not being significant (Table 6).

The average pond size used was significantly different with TLFs having 0.05 ha and CTFs 0.07 ha. This difference can be attributed to the fact that Catfish is recently being adopted and with staff advocating for increased pond sizes to benefit from economies of scale, there appears to be a gradual change.

Table 6: Some economic aspects of fish production structure for comparing tilapia and catfish farmer enterprises

Characteristic	Tilapia		Catfish			
	Mean	**SD**	**Mean**	**SD**	**T**	**p**
Total pond area(Ha)	0.08	0.098	0.12	0.152	1.682	0.095
Average pond size(Ha)	0.05	0.046	0.07	0.051	2.33	0.021
Ponds number	1.77	1.61	2.03	1.850	0.842	0.40
Fish-cycle length(months)	12.45	1.76	11.33	1.68	1.96	0.05
Farmers with one pond (%)	39.00		55.00			
Source of seed outside district (%)	20.10		87.40			

(Source: Survey data 2010/ 2011)

The tilapia fish cycle length was 12.45 months significantly different from 11.33 months for CTFs**.** This fish cycle is above the "*recommended 6 months"* being advocated for by extension staff in the three districts. The longer fish cycle period is likely to have increased production costs hence lowering profits. The significant difference can be partly explained by the fact that some farmers harvested peace meal as more tilapia is constantly produced in the pond. Hyuha et al. (2011) found farmers keeping fish for up to 11.33 months while Adebayo and Adesoji (2008) carried out an experiment for 8 months and found both tilapia and catfish profitable. This study found that thirty nine and fifty five percent had only one pond for tilapia and catfish farmers respectively. This may have made viability of raising catfish hard. This contrasts results by Hyuha et al. (2011) who found that farmers in Central Buganda had mostly 1 to 2 ponds measuring 500 square meters. Adewuyi et al. (2010) found 86.67% of the fish farmers in Cross river state Nigeria owning 0.1 to 2 hectares pond sizes while 18.37% had 3 to 4 hectares. The hypothesis that characteristics of tilapia and catfish farmers are significantly different is not supported by this research.

4.1.2 Fish production cost structure for tilapia and catfish enterprises.

This study analysed of fish production costs which are presented in Table 7. Costs involved in the production of fish included feeds, seed, labour, fertilizers, hiring of nets and fixed capital. Fixed capital costs considered in this study was in form of opportunity cost of capital, computed as shown in section 3.6.2. These included among others hoes, pangas, wheel barrows, metallic basins, spades and axes. This conforms to what Nandlal and Pickering (2004) indicated as tools for a hand constructed pond which were a spade, hoe, mud scoop, mud spade, fork, wheel barrow and wooden mallet. Adewuyi et al. (2010) in his study on profitability of fish farming in Nigeria, established fixed costs as comprising pond structure, pump, vehicle and aerators. Hishamunda et al. (1998) identified some costs as comprising labour, pond construction and watching ponds amongst small scale fish farmers in Rwanda.

Results revealed that average purchase price per seed (young fish) for tilapia (UShs 50.22) was significantly lower than for catfish (UShs 97.60)(Table 7). This was because tilapia seed production was easier to undertake locally and less demanding in skill and time than catfish seed production.In addition the source of catfish was at least 20 km away by progressive farmers and research stations and hence transport charges increased the per unit cost of catfish seed..

Carballo et al. (2008) found catfish though able to produce under normal pond conditions with raised water levels, had high death rates of fry realised due to catfish having no natural practical care for the young. As such common practice used was controlled fry production through induced spawning. This involved costs of setting up an incubator and incurring incubation costs which makes them more expensive.

Table 7: Fish pond production costs (Ushs) amongst tilapia and catfish farmer enterprises in the study area.

Production cost (UShs) for one hectare per year for each type of fish	Tilapia		Catfish		t values	p values
	Mean 000's	SD 000's	Mean 000's	SD 000's		
Lime cost	80.80	30.84	76.13	35.52	0.235	0.222
Unit fry/fingerling cost	50.22	33.20	97.60	49.63	103.00	0.000
Fish seed cost	776.67	436.63	1,435.63	687.18	6.269	0.000
Feeds costs	3,977.21	2,166.48	4,657.77	2,133.31	0.118	0.086
Fertilizer costs	329.68	272.70	157.48	104.66	4.282	0.000
Labour cost	2,285.47	1,345.17	1,599.14	982.59	3.191	0.002
Net hiring cost	194.42	119.58	154.65	83.25	0.630	0.126
Total variable cost	7,431.89	3,380.76	7,924.27	3,069.32	0.835	0.405
Opportunity cost of Capital	2,810.05	1,072.39	2,612.64	1,343.83	0.889	0.376
Total production costs	10,241.95	3,975.57	10,536.91	3,889.36	0.411	0.682
Contribution; Feed cost to total cost (%)	37.73		43.50			
Contribution; Total variable cost to total cost (%)	67.52		76.37			

(Source: Survey data 2010/ 2011)

On the other hand, tilapia becomes sexually mature at 30gm (10cm). It naturally produces more leading to overproduction in the pond. One tilapia on the average provides a constant supply of 100 fry per square meter per month

Seed cost for TLFe of Ushs 776,667.75 per year per ha was significantly lower than that of CTFe (Ushs 1,435,625.80 per year per hectare). This is justified by preceding discussion. Hyuha et al. (2011) established seed cost in Central Uganda at Ushs 514,324 for an average pond size of 520 M^2 while Pham (2010) established a total seed cost of 2.180,000 Vietnam dongs per hectare in both Cai Nuoc and Dam Doi districts of Vietnam. Adinya and Ikpi (2008) established fingerling cost at 186,900 Naira per hectare. Adewuyi et al. (2010) also found a fingerling cost of 48898.57 Naira for a 355M^2 pond size contributing 12.4% of the total production costs. NAADS

(2005) notes that for catfish, artificial inducement requires another catfish killed to obtain the pituitary gland to be used. Killing of another male catfish to produce a set of fry increased the per unit seed production costs. Carballo et al. (2008) found that tilapia naturally spawns under any type of water between 20 to 30 degrees centigrade hence cheaper to produce its seeds.

Tilapia feed costs of Ushs 3,977,210.53, were significantly less than catfish seed costs of Ushs 4,657,482.56 per hectare per year. This translates into Ushs398 and 466 per 1 square metre per year for TLFs and CTFs. Feed cost contributed a percentage of 37.73% to the total cost for TLFs. Analysis for catfish enterprise revealed a 43.50% contribution of feed cost to the total cost. This implies that feed costs greatly affect the total production costs which in turn affects unit cost ratio hence the overall fish competitiveness. Hyuha et al. (2011) found feed costs at Ushs 428,264 for an average pond size of 520 M^2.This translates into Ushs824 per square metre which was a higher figure than findings of this study. Olawumi et al. (2010) who studied fish farming in Nigeria found feed costs for a 170.92M^2 pond size amounting to 8103.33 and 2480 Naira which accounted for 75.74% and 10.11% of the total costs for sole heteroclarias and tilapia- heteroclarias mix respectively. Furthermore Adewuyi et al. (2010) analysed profitability of fish farming in Ogun state Nigeria and found feed cost totaling 46450.77 Naira contributing 11.7% of the total cost of production for a 355 M^2 pond size.. The findings can be partly because catfish needs protein feeds which are costly. Catfish was fed on feeds like leftovers from hotels and homes. However tilapia was mostly fed on cabbage, dodo and cocoyam leaves by farmers which were relatively cheaper. NAADS (2005), states that for better performance, catfish needs artificial feeds, which are costly. Carballo et al. (2008) indicates that tilapia is herbivore while catfish is not and therefore expensive to raise given its high protein needs.

Fertilizer costs were significantly higher for TLFe (Ushs 329,676.66) than for CTFe (Ushs 157,482.56). Farmers were always advised to add more fertilizer in tilapia fish ponds given their high degree of dependency on natural pond food as compared to catfish. Carballo et al. (2008) argues that adult tilapia fish can be raised on food produced in pond if manure is added. With fertilization, tilapia can feed and survive on natural pond food (Nandlal and Pickering, 2004). Supplementation is only required if a farmer wants better yields and hence increase profit. Rutaisire et al. (2009) states that manure added to fish pond enables production of plankton which is fish feed. Tilapia feeds on algae produced from manure as well as added vegetables. As such these individual costs resulted in total variable costs which were significantly higher for catfish (Ushs 7,924,271.43) than for tilapia (Ushs 7,431,892.19) and contributed 67.52% and 76.37 % for tilapia and catfish to production costs respectively. Adewuyi et al. (2010) found that total variable costs contributed 45% to the total production cost of fish production in Ogun state Nigeria. Further still as indicated in (table 4.3) the analysis shows that opportunity cost of capital, hiring nets costs, total cost of production costs of TLFs and CTFs were not significantly different.

4.1.3 Fish sales by farmers in the fish farming enterprise

Table 8 presents these results. Mature fish was sold basing on size but always approximated to weight in kilograms. Tilapia was sold at a significantly higher price (Ushs 4,004.16/kg) than catfish (Ushs 3,045.83) per kg (Table 4.4). This can be partly explained by the fact that people in Mbale sub region are more used to tilapia than catfish which has been supplied from capture fisheries for over a long time. Catfish is rarely supplied by capture fisheries which is normally from big water bodies like lake Victoria and river Nile.. Around Mbale town, catfish is very common in sewage waters and those regarded as low class people are always seen harvesting them for home use from these waters. This may have affected the consumption of catfish hence the observed lower prices despite extension staff advocacy. These results are equally in conformity with NAADS (2005) which found out that tilapia was usually sold at a higher price (Ushs 3000) than catfish (Ushs 2500) in East and Northern Uganda. According to DFR, (2011) field reports indicated that for the year 2010 a selling price of 4000 and 6000 Ushs for tilapia and catfish respectively was observed. The low price of catfish can be attributed to lack of export market. USAID (2009) reports that catfish export market has not been developed given that its production was still low.

Table 8: Costs involved and Gross margin analysis per hectare / per year by tilapia and catfish farmer enterprises

Costs/returns	Tilapia		Catfish			
	Mean 000's	SD 000's	Mean 000's	SD 000's	T	P
Total production costs(UShs)	10,241.95	3,975.57	10,536.91	3,889.36	0.41	0.682
Quantity harvested (kg)	2.86	0.80	3.95	0.75	7.76	0.000
Selling price per Kg(UShs/kg)	4.00	0.22	3.05	0.55	12.57	0.000
Unit production cost(UShs/kg)	3.66	1.28	2.70	0.91	4.76	0.000
Value of output (UShs)	11,428.32	3,560.25	12,047.22	2,494.45	1.103	0.273
Gross Margin(UShs)	3,996.42	3,698.62	4,122.95	3,363.78	0.20	0.845

(Source: Survey data 2010/ 2011)

The results show that tilapia harvests (2,856.15kg) were significantly less than that of catfish (3,954.99Kg) per ha per year. This could be due to the fact that catfish grew to bigger sizes as compared to tilapia. The same cause could have led to less harvest. NAADS (2005) achieved a weight of 800 to 1000 gm and 300 to 500 gm within 8 months for catfish and Nile tilapia respectively. Blow and Leonard (2007) observed that since there were no new introductions of tilapia breeds in Zimbabwe, it resulted in reduction of growth vigour thereby lowering overall performance. Nandlal and Pickering (2004) explained that due to overproduction, tilapia will always reach pond carrying capacity before maturity. This results in no growth registration from additional feeding. Rutaisire et al. (2009) notes that tilapia carrying capacity was 1kg per cubic meter. Arrigon (1998) argues that with no action, a pond stocked with 100 small tilapia fish will after a few months not produce 100 large fish but 500 to 1000 small tilapia fish. In this study farmers reported tilapia producing a lot of fry resulting into many stunted fish in the pond.

4.1.4 Total production costs, total value of output and profits of tilapia and catfish farmer enterprises

Total production costs and value of output were obtained and utilized in analyzing competitiveness of TLFe and CTFe as indicated in table 8. Unit cost of production was significantly higher for tilapia than catfish. That is one kg of tilapia was produced at (Ushs 3,660) as compared to (Ushs 2,700) for catfish as presented in table 4.4**.** This could have been as a result of the high yields of catfish (3,954.99kg) in comparison to 2,856 kg of TLFs. Both enterprises exhibited higher value of output in comparison to total cost invested in. This implied that tilapia and catfish enterprises were both profitable. Gross margin realised annually per hectare were as such higher for catfish (Ushs 4,122,946.41) than tilapia (Ushs 3,996,424.64) though not significantly different.

4.1.5 Constraints as perceived by the tilapia and catfish farmers

Constraints faced in fish farming enterprise as identified by farmers and analysed by multiple response are given in (table 9). Each fish farmer was asked to mention four major constraints facing his/her fish farming enterprise.

Table 9: Constraints in Aquaculture as Perceived by tilapia and catfish farmers in the study areas

	Tilapia (n=60)		Catfish(n=60)	
Constraint	**Percentage**	**Rank**	**Percentage**	**Rank**
Predators	9.9	4	26.1	1
Expensive feeds	25.5	2	23.5	2
Thieves	11.6	3	7.3	5
Poor seed quality	26.8	1	16.6	3
Floods	3.5	7	5.0	6
Inaccessibility to Market	8.3	5	9.2	4
Inadquate capital	8.3	6	4.7	7
Inadquate extension services	2.6	8	0.4	10
Water loss/dirty	1.7	9	3.0	9
Drowning	0.8	10	0.4	11
Landslides and mudslides	0.4	11	0.2	12
Cannibalism			3.9	8

(Source: Survey data 2010/ 2011)

The three major constraints identified by CTFs were predators, expensive feeds and poor seed quality. While for the TLFs were: poor seed quality, expensive feeds and thieves in that order. CTFs mentioned various predators which included snakes, monitor lizards, preying birds and frogs**.** Some farmers reported reduced fish numbers at harvest yet they had many frogs and tortoise seen in their ponds whose effects they were not aware of. Predators ate the fish directly leading to reduction in fish numbers and increased production costs through their control. This resulted in increased fish unit production costs. Rutaisire et al. (2009) named predators to fish farming which included fish eating birds, snakes, otters, frogs, monitor lizards, tadpole and insects. USAID (2009) also states that human beings, frogs, snakes, birds, monitor lizards and otters are among predators to fish farming.

Fish seed supplied appeared to be of unknown and poor quality. USAID (2009) established that seed of unknown age was supplied and chances were it was produced from the slowest growth fish. Unscrupulous traders had noticed this vacuum and some of them sold seed from the wild. Other constraints mentioned were: unavailable seed for catfish, floods, limited market information, limited capital, water loss, access to extension services, less water, children drowning and landslides. Unlike tilapia, CTFs reported cannibalism as another constraint.

Farmer’s actions to control these fish farming constraints included catfish farmers carrying out a number of activities to control predators. These included killing predators by trapping snakes using boiled eggs which were hard for the snake to digest after swallowing, cleared bush around ponds and putting in place nettings. Rutaisire (2009), recommends keeping grass low around ponds, screening of water at inlet, criss-crossing of strings, leaving water levels high enough, use of traps, fencing, liming and using baited traps to control fish pond predators. As regards to expensive feeds, farmers were sourcing for cheap feeds and mixing their own feeds. Rutaisire (2009), says some farmers used brew wastes, kitchen refuse and animal wastes as feeds. As for fish seed, tilapia farmers were trying to look for better tilapia breeds amongst themselves within and in neigbouring districts.

4.2 Competitiveness of Catfish and Tilapia Fish Enterprises

Results show the differences in competitiveness of TLFs and CTFs enterprises (Table 4.6). The differences are shown in terms of unit cost ratio(UtCR) and some selected production costs per value of output. Costs analysed in this section are feed costs, seed costs and total variable costs. Tilapia had a mean unit cost ratio of 0.94 compared to 0.89 of catfish. This implies that the total production costs involved in tilapia and catfish production are less than the total value of outputs realised. This is in line with the results shown earlier on Table 10. On this table, catfish production costs are lower than those of tilapia. The unit cost ratio conforms to these results. This further indicates that tilapia and catfish farming in Sironko, Mbale and Manafa districts is profitable and competitive. It therefore indicates that catfish enterprises though not significantly different from tilapia are more competitive than tilapia enterprises.

Table 10: Unit Cost Ratio and costs per value of output of tilapia and catfish enterprises

	Tilapia (n-60)		Catfish (n=60)			
Unit cost ratio and cost per value of output	**Mean**	**SD**	**Mean**	**SD**	**t-value**	**p-value**
UtCR	0.94	0.684	0.89	0.726	0.382	0.703
Feed cost per value of output	0.361	0.207	0.395	0.181	0,980	0.329
Seed costs per value of output	0.073	0.044	0.121	0.052	114.65	0.000
Total variable costs per value of output	0.674	0.289	0.669	0.243	0.107	0.915

(Source: Survey data 2010/ 2011)

The feed cost per value of output for tilapia (0.36) was lower than for catfish (0.40). The difference however was not significant (Table 4.6). Seed cost per value of output for tilapia (0.073) was significantly lower than that of catfish (0.121). It implies that tilapia fish was more competitive in terms of seed cost per value of output in Mbale sub region. Tilapia seed cost per value of output was 1.66 times lower than that of catfish farmers. The total variable cost per value of output was not significantly different. Though the hypothesis which guided this research was that; CTFs was more competitive than TLFs, the UCR values obtained from this study (0.94 and 0.89 for TLFs and CTFs respectively) indicated CTFs being more competitive but not significantly different from TLFs. The hypothesis is not supported by this research. This is because the difference in unit cost ratio was not significant. Though with significantly higher yields, the low unit selling price of catfish lowered its UtCR bringing it nearer to the one of tilapia fish.

This can partly be explained by the fact that 55% of CTF's own only one pond and less than 17% applied lime in their ponds which makes it hard to control cannibalism while TLFs had fingerling quality issues and overproduction constraints leading to stunting problems as well.

4.3 Factors affecting tilapia and catfish enterprise competitiveness in Mbale sub region

In this section regression results on factors that influence competiveness of tilapia and catfish at household level in Mbale sub region are given and discussed. OLS technique is used to estimate equations given in section 3.6.4. The parameters were obtained using single multiple regression model. Variables included in the model were in line with theoretical and empirical studies given in chapter three. Variables included were; farmer's experience, number in household, education level, number of extension visits, pond size, distance to fresh fish market, feed type, membership to organization and credit access.

The R^2 of 0.64 and 0.60 indicate that all variables included in the model explain the variation observed by more than 60% for TLFs and CTFs farmers. (Table 11).

This indicated that over 60% variability in unit cost ratio is accounted for by the joint effects of the various independent variables. The signs of the coefficients are in line with apriori expectations. The F value of 12.447 and 10.855 for tilapia and catfish farmers respectively was significant at 1% for both models. This shows that there is a significant linear relationship between the unit cost ratio and all the independent variables combined together for tilapia and catfish in Sironko, Mbale and Manafwa districts.

Table 11: Factors affecting competitiveness of tilapia and catfish farming enterprises in the study area

Explanatory variables	**Tilapia**			**Catfish**		
Variables	**Coefficients**	**t-value**	**P –value**	**Coefficients**	**t-value**	**P-value**
Experience(Years)	-0.093	2.382	0.021	-0.099	2.695	0.010
Household size	-0.052	0.918	0.363	-0.020	0.342	0.734
Education(Years)	-0.018	2.039	0.047	-0.015	2.066	0.044
No_times_visited	-0.047	2.842	0.006	-0.038	2.231	0.030
Pond Size (ha)	-0.102	2.205	0.032	-0.098	1.996	0.051
Distance toMkt (Km)	0.043	2.234	0.030	0.049	2.503	0.016
Feed_type	-0.068	0.858	0.395	-0.165	1.877	0.066
Membership to organizations	-0.168	2.444	0.018	-0.122	1.874	0.067
Credit	-0.051	0.715	0.478	-0.070	0.963	0.340
(Constant)	0.438	1.170	0.247	0.422	1.320	0.193
Sample size	60			60		
F value	12.447		0.000	10.855		0.000
R2	0.691			0.661		
Adjusted R	0.636			0.601		

Dependent Variable= UtCR

UtCR,Experience, Householdsize and Pondsize,are linearised.

(Source: Survey data 2010/ 2011)

The results show the following variables to be significant at various levels; farmer’s experience, years of education, number of extension visits, pond size, distance to fresh fish market, type of feed and membership to farmer organization. The estimated coefficients associated with experience, years in education, number of extension visits, pond size, feed type and membership to farmers’ organization carry a negative sign implying that these variables have a negative effect on unit cost ratio for both types of enterprises. Distance to fresh fish market as a variable was positive and significant for both species implying positive influence on UCR.

The above analysis can further be explained that; the number of years of experience a farmer had in practicing both tilapia and catfish farming as a variable had a negative sign and was significant at 5% for both tilapia and catfish. This means increasing number of years of farming fish enables a farmer to gain proficiency in fish farming. Experience as a variable had a positive influence for both tilapia and catfish competitiveness. The model predicts that a unit increase in experience in years decreases unit cost ratio by 0.093 units and 0.099 for tilapia and catfish respectively. This findings conforms to Pham (2010) who found that a 10% increases in farmers experience amongst fish farmers in Damdoi district in Vietnam, led to a 1% increase in technical super efficiency.

The level of education had a negative sign and was statistically significant at 5% level for both species. This indicated that the more years of education, the more competitive fish farming became. The study reveals that a unit increase in numbers of years in education decreases the unit cost ratio of tilapia by (0.018) more than the decrease in catfish (0.015). The more education farmers attain the more they are able to read, understand and apply the knowledge themselves. A comparable study by Pham (2010) is in line with this. He found that a 1% increase in farmer's education resulted into an increase by 76.1% in technical super efficiency of shrimp farmers in Cai,Nuoc and Damdoi districts in Vietnam. They were using mad crab culture for its production. Olawumi et al. (2010) indicated that educated farmers up to tertiary level were expected to be more efficient hence achieve high fish yields.

Further results found that extension staff visits to farmers had a negative sign and significant for both fish species. This means, the more times a fish farmer was visited, the more competitive they became. That is, a unit increase in extension services led to decrease in unit cost ratio by 0.047 and 0.038 for TLFs and CTFs respectively. In these districts access to extension service served to add technical input to farmers. Non-Government Organisations like Uganda Cooperative Alliance and Church based initiatives had put in place staff who were educating farmers on fish farming. This is in line with findings by Balorunduro et al. (2005) who found that the more staff extension visits and demonstrations were made on construction and operation of kilns amongst fish processors, the more they were aware about them and adopted post-harvest handling fish technologies. Ofouku et al. (2008) found that for farmers to be able to appropriately mix feeds like manufacturers do, they needed to utilize recommended technologies. They would then be efficient in fish farming. Adinya and Ikpi (2008) found farmers in need of extension staff to help interpret research technologies to them. Some of the farmers were illiterate. He argues that for development to occur in agriculture, extension services were a necessary prerequisite. USAID (2009) found farmers not able to evaluate fish seed conditions and to make decisions on which fry/fingerling size to buy and stock rate

Pond size as a variable had a negative sign and was significant at 5% for tilapia and 10% for catfish farmers. A unit increase in pond size decreased the UCR value by 0.102 and 0.098 units for tilapia and catfish competitiveness respectively. This means both fish enterprises competitiveness were favoured by increase in pond size given that average pond size was 0.05 ha and 0.07 ha for TLFs and CTFs respectively. Increment in pond size would help farmers move towards achieving economies of scale. This is in line with findings by Pham (2010) who studied technical efficiency of shrimp farming in Vietnam and found that a 1% increase in pond area would result into a 7% and 87% increase in fish production for Cai Nuoc and Dam Doi districts respectively. Adewuyi et al. (2010) also analysed profitability of fish farming in Ogun state Nigeria and found pond size significant at 5 percent. An increase in pond size would result into an increase in fish produced.

Distance to nearest fresh fish market was used as a measure to market access. A unit decrease in the distance to fresh fish market led to a decrease in unit cost ratio by 0.043.and 0.049 for tilapia and CTFs respectively. This implies distance to fresh fish market had a negative impact on fish competitiveness. An easy access that is a shorter distance to the fresh fish market implies a farmer's produce will reach the market in a short time. A study by Jagger and Pender (2001) found that smallholder fish farmers with good market access were likely to command highest prices and net returns. This would be more strengthened if they could afford constant and continuous market supply. Nwebueze A. and Nwabueze.E.(2010) established that aquaculture was the most reliable and regular source of fresh fish in Delta state as compared to lake supplies which were high but seasonal.

Feed type for catfish as a variable had a negative sign and was significant at 5% indicating that the use of commercially formulated feed increases competitiveness of catfish fish farming. In fact use of commercial feeds will decrease UCR value by 0.165 units for CTFs. That for fish to grow and reach market size in a short time, there is a need to use good quality feeds. Ukonji (2013) after experimenting with *Oreochromis niloticus* using three different treatments, found use of commercial feeds being more profitable than algae treatment. Algea combined with commercial feeds treatment was midway in performance. Gertjan and Johannes (1996) argues that catfish has high protein requirement. This can be in form of fish or blood meal. However, they can be replaced to minimize cost with plant oil cakes or meals. NAADS (2005) explained that for better performance, catfish needs high protein feeds. These are in most cases artificial and costly. Thus in case of intervention, fish feed could form an entry point.

The membership to farmer organizations had a negative sign and was significant for both species of fish. This implies that membership to farmer organization decreased UCR by 0.168

and 0.122 for TLF's and CTF's respectively. In other words, belonging to a farmer organization increased fish farming competitiveness for both fish species. Being a member of a farmer organization enabled farmers to join efforts and therefore derive benefit from their synergies. This is because their joint efforts enabled them to easily achieve economies of scale and benefit from their increased bargaining power. Grigoryan et al. (2008) found that for rural farmers in Caucasus state, Armenia, being united in a form of cooperative was the only way they could develop and have opportunity to solve their common problems in a more effective and efficient way. Through this, they could contribute to agricultural development. This also conforms to findings by Ofouku et al. (2008) who established that farmer's membership to a group was significant and positively influenced information usage. He argued that farmers in groups shared experiences and had influence over each other which improved adoption of technologies. Adewumi et al. (2005) also asserts that old organizational frame works such as farmers' cooperatives had been successful in increasing production of fish. The hypothesis that; years of experience, level of education, number of extension visits, pond size, feed type and membership to farmer groups have a positive influence on competitiveness of tilapia and catfish farming in the study area, is supported by this research.

On the other hand number per household, feed type for tilapia and access to credit had negative signs. This means increase in their usage would generally lead to decrease in tilapia and catfish unit cost ratios hence increasing their competitiveness. This means they have a positive impact on fish yields and profitability. However, they were not statistically significant. The next chapter gives summary, conclusions, recommendations and areas of further study.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary of the study and conclusions drawn from empirical findings. Recommendations drawn and further studies that can supplement this research are given.

5.1 Summary of the findings

Given that capture fisheries are on the decline with population growth on the increase, it implies that another source of fish most especially aquaculture must come in to sustain the rising fish demand. Aquaculture contributes to provision of household animal protein, employment, income and foreign currency earnings. Although aquaculture's importance is known, not much is known about its competitiveness in Mbale sub region and most specifically comparison of the two species of tilapia and catfish. This study investigated competitiveness of tilapia fish farming in relation to catfish farming in Sironko, Mbale and Manafwa districts. The specific objectives were: characterising fish farmers in the study area, determining competitiveness of tilapia in comparison to catfish enterprises and determining factors that influence competitiveness of tilapia and catfish farming at household level. Data analysis was by descriptive statistics, unit cost ratio and simple multiple regression model.

Results from the study indicated that tilapia farmers (TLFs) had a higher working experience, (8.80 years) than catfish farmers (CTFs) who had 7.55 years. TLFs were less educated (10.05years) relative to CTFs (10.08 years). Further analysis established that TLFs had a lower household size (10.10 persons) as compared to CTFs (11.55 persons). Both enterprises had a high mean household head age of above 51.00 years. Credit access was minimal with a percentage of 31.7% for CTFs and 26.7% for TLFs.

Fish farming was dominated by males at a level of (98.3%) and (95%) for tilapia and CTFs respectively. TLFs practiced sampling at a level of 58.30% which was less than 65.00% for CTFs. Less TLF's farmers kept records (41.7%) as compared to CTF's (51.7%). Less than 16.7% for both tilapia and CTFs used lime. The average land holding for TLFs was (2.74ha) lower than land holding of 3.02ha for CTFs.

When production costs were analysed, it was found that TLFs farmers had a lower mean total production cost (UShs 10,241,946.25) than CTF's (UShs 10,536,908.98). At the same time tilapia had a lower output value UShs 11,428,316.83) than catfish (UShs 12,047,217.83). These values were not significantly different. As a result, TLFs had a lower gross margin (UShs 3,996,424.64) per year per ha than CTFs (UShs 4,122,946.413) though the difference was not significant. Although tilapia was sold at a higher price (Ushs 4004.17) than catfish (Ushs 3045.83) per kg, farmers involved in the latter realized a higher profit partly due to the high quantities harvested (3954.83kg) compared to the former (2856.15kg). Therefore, though both tilapia and catfish enterprises were profitable, catfish was more profitable compared to tilapia enterprise. The estimated unit cost ratio for tilapia (0.94) was higher than catfish (0.89) though not significantly different. This indicated that both tilapia and catfish were competitive but catfish was more competitive though not significantly different.

Regression results using multiple regression model revealed that there were a number of factors that influenced competitiveness of fish farming in the study area. These were; experience, level of education, number of extension staff visits, pond size and membership to organization which significantly and positively influenced competitiveness. This implied that they positively influenced profitability of both categories of enterprises. Distance to fresh fish market negatively and significantly influenced competitiveness of both tilapia and catfish enterprises. This means the shorter the distance to the market, the more profitable the fish enterprise became. Type of feed significantly and positively affected catfish competitiveness. The major constraint facing CTFs farmers was predators while for TLFs it was poor seed quality. Expensive feeds affected both TLFs and CTFs. Other constraints mentioned were; thieves, floods, limited market information, limited capital, access to extension services, drowning of children, landslides and water loss. Cannibalism was only reported by catfish farmers. Catfish farmers controlled predators by killing predators through trapping snakes with boiled eggs which could kill them when the snake would fail to digest the hard cooked egg. Clearing bush around ponds and putting in place nettings would further stop predator encroachment. TLFs controlled seed quality constraint by looking for better tilapia breeds amongst tilapia farmers within and from neighbouring districts. Some farmers mixed own feeds in an attempt to solve the problem of expensive feeds.

5.2 Conclusion and Recommendations

From the results of this study, we conclude that; The value of unit cost ratios for both tilapia and catfish are 0.89 and 0.94 respectively. These values are close to the unit 1 meaning the enterprises are not as competitive as when their values would have been nearer the 0 value. However both species are competitive thus profitable. Stakeholders are argued to venture in tilapia and catfish enterprises.

Based on the results of this study, there is need to increase the competitiveness of the two enterprises in the study area. As such a number of recommendations can be advanced. First, given the significance of the number of extension visits in fish profitability and competitiveness, there is need to improve staffing in the fisheries sector in the districts. More extension staff trained in aquaculture should be employed by government and deployed at sub county level to bring services nearer to the people. This is to increase on regularity of extension visits made to farmers. Routine monitoring and advisory farm visits will enable extension staff to evaluate the farmer's performance and give timely corrective measures to avoid farmers incurring losses. Extension staff will be able to interpret research recommended technologies to farmers. This is reinforced by Mbale district fisheries officer, who remarked that *"Eighty percent of the farmers who start fish farming without extension advice usually fail given the fact that pond siting and construction is key to fish farming success*". Secondly pond size was found to be significant. Given that the average pond size of 0.05ha and 0.07ha for TLFs and CTFs were small, farmers are advised to widen or construct bigger sized fish ponds. The optimum fish pond size is one acre (4000square metres)

Secondly, the results also found membership to organization significant for both TLFe and CTFe. As such farmers should be encouraged to form groups. In groups, farmers can buy inputs together. Purchases made in large quantities will attract discounts which lower production costs for farmers. Further still, farmers in a group can make small contributions each to pool resources and be able to purchase expensive inputs which may be hard for an individual farmer to achieve. Members in a group can also rotate in turns and carry out hard tasks like construction or rehabilitation of ponds for each group member. It is also easier to carry out market research as a farmers group. Once yields are realized it would be easier to access market once fish is marketed in bulk to the large consumers. When together farmers benefit from synergies of their individual efforts hence increasing their bargaining power through achieving economies of scale. With scheduled and synchronized production a group of fish farmers can maintain a regular and consistent supply of fresh fish to the market. This will improve on the fish farmers' reputation in form of reliability. It would be easy for a farmer group member to access credit from an institution which considers client membership to a group as a form of security.

To address constraint(s), Farmers should be trained on how to raise quality tilapia fry. Quick maturing tilapia breeds would save on time and earn the farmer more income. Farmers should also be advised to purchase fish seed from reputable sources like government research centers among others. Predator control strategies like use of nets, lime use, slashing around fish pond, effective record keeping, use of more than one pond in raising specifically catfish and grading of catfish at least once after one month should be vigorously promoted. This will avoid mistaking cannibalism for predation. Once effective; the number of catfish harvested will be high thereby reducing unit production costs.

Further still, this study found the type of feed significant for CTFe. This was in line with the fact that to be able to achieve high yields there is need to feed fish on better feeds. A well fed fish grows fast and takes a short time in the pond. This reduces the production costs and a farmer is thus able to achieve two cycles per year. At the same time Uganda produces a lot of grains including maize, sorghum, rice and soya bean. If the feasibility studies being carried out by Kajansi on different fish feeds in Uganda bear fruit, then Investors / Government and other concerned stakeholders, should consider setting up feed mills to supply quality feeds to fish farmers.

From the regression results distance to fresh fish market was significant for both TLFe and CTFe. To mitigate this government should construct or encourage local leaders / community to promote marketing of fresh fish in their localities by encouraging private/public partnerships which can invest in cooling facilities.

5.3 Areas for further research

Though this study shade light on economics of fish farming in the study area, the study analysed the competiveness of tilapia and catfish without comparing them with other major crops and animal enterprises in the study area. Land shortage in this sub region being acute, there is need to carry out a profitability study comparing various enterprises in the area including fish farming to guide in rational allocation of farmers' meagre resources most especially land. More specifically, a study involving competitiveness of fish and other enterprises to gauge the best use of scarce resources such as land should be done. The study should be carried out regionally and nationally.

There is need to investigate record keeping and their utilization levels amongst farmers, further still there is need to explore alternate feeds for tilapia and catfish especially for home feed making without compromising quality. Research should be carried out on availability of quick maturing, high yielding fish species with technologies that are viable and efficiently utilize farmer's meagre resources.

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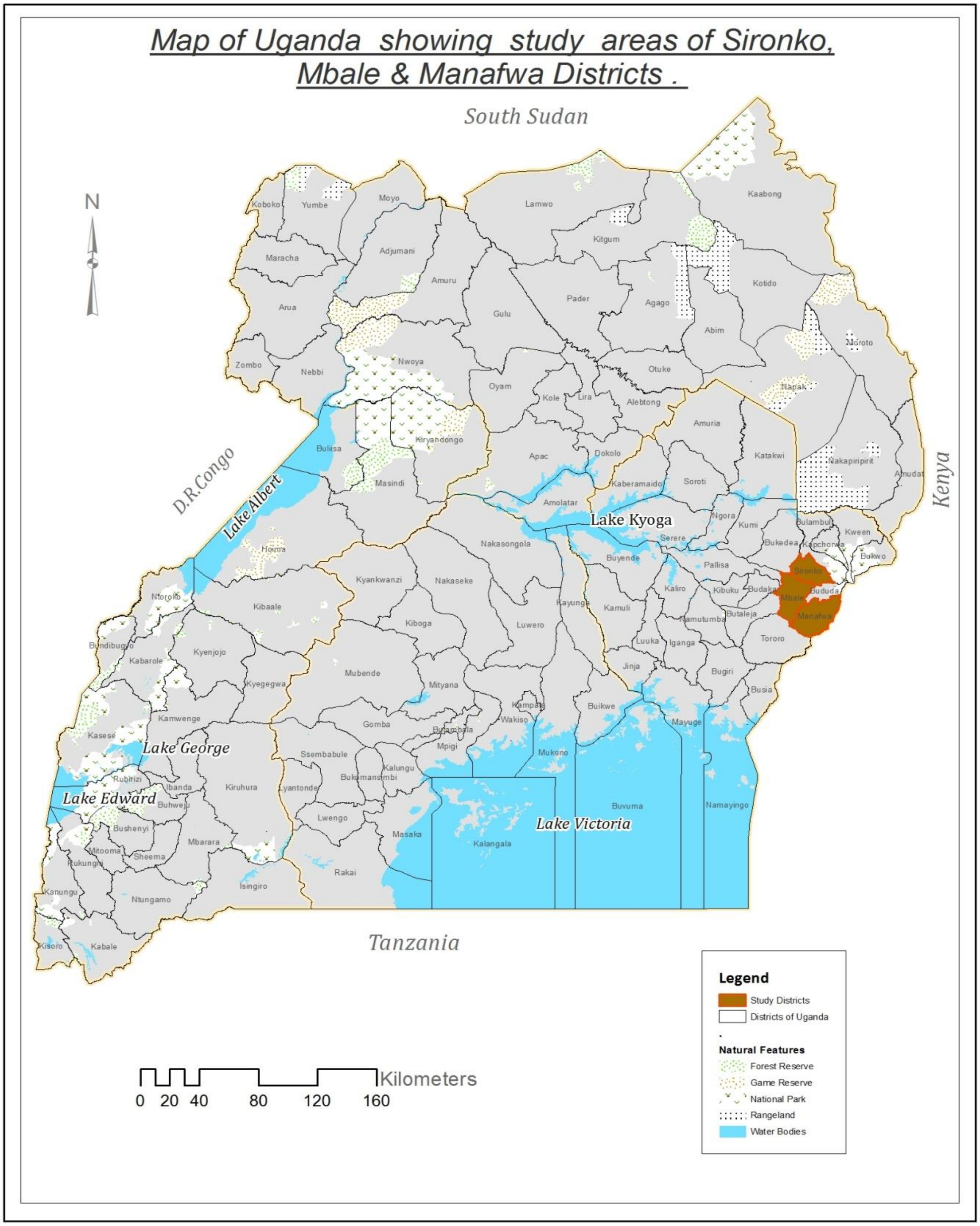
APPENDICES

Appendix I: Map of Uganda Showing Study Areas



Appendix II: Questionnaire on Analysis of Fish Farming in Mbale Sub Region, Eastern Region

SECTION 0: IDENTIFICATION

District 1. Sironko 2. Mbale 3. Manafwa.

County……………………Sub county……………………………Parish…………………………

Name of household head………………………………..village…………………………..

Interviewer………………………………………………date…………………………….

Name of respondent………………………………..His/Her status 1. Owner 2. Manager

3. Chairman to the group 4. Secretary to group 5. Others……………………………..

If any of 2 , 3, 4 and 5 mentioned go to section 1 number 6

SECTION 1: ESTABLISHMENT OF POND

1. Have you ever kept fish? 1. Yes 2. No If No. *politely end the interview*

2. When did you start fish farming? Year………………………….

3. How much cost if any was involved in getting water to your fish farm before starting fish farming?............................Ug Shs.

4. What is the distance from home to your fish farm………………………….km.

SECTION 2: FISH PRODUCTION INFORMATION

5. How much land do you have in total for farming? ……………………acres.

6. How many ponds do you have …………and their area,

Pond No 1…….M^2 Pond No.2 ……M^2, Pond No. 3 …..M^2, Pond No. 4………….M^2, Pond No. 5……..M^2 Pond No.6……M^2, Pond No. 7 …..M^2, Pond No. 8………….M^2, Pond No. 9……..M^2 No. 10……..M^2

7. Which one of the above ponds was most recently harvested No………………..

8. How much would this pond area (pond selected above) cost you if you bought it? ………………………………………….Ushs.

(Bring to the attention of the respondent to avoid confusion. Tell the respondent that you are going to talk about the selected pond which is No……………from this stage on wards)

9. Table 1: Cost involved in construction of selected pond No……(**respondents to give amount they would have been paid for the same activity if they worked for another person or amount they should have paid someone to do the same activity).**

Activity	**Unit cost**	**Total Cost**
Siting		
Construction		
Labour Man days		
Pipe and joints		
Wheel barrow		
Spades		
Hoes		
Pangas		
Others specify		

10. When did you stock that specific pond? Year……………….month………………….

11. Fish species and number it was stocked with: 1. tilapia No………   2. Cat fish No………

3. Others specify …………………………………

12. What was the source of your fry/fingerlings?

1. fellow farmer   2. NARO   3. Wild   4. Commercial

5. Others specify…………………………………………

13. Cost of fingerling or fry bought in the last cycle for this pond No…………………..

14. Did you lime your pond? 1. Yes 2. No

15. If yes, what was the cost of the lime you used?..............................Ug Shs.

16. If you did not use, give reasons why?

1. Not aware   2. Expensive   3. Pond is old

4. Others specify…………………………………………………………

17. Did you use fertilizers? 1. Yes   2. No

18. If yes, what type of fertilizer did you use? 1. Inorganic   2. organic

19. How many times did you put organic manure in your pond in that cycle?.............

20. In what quantities………………………………………..

21. What was the cost of the fertilizer you used?

1. Organic ………………………. 2. Inorganic………………………………

22. What type of feed did you use in that cycle?

1. ugachick 2. homemade 3. left over 4. mixture

5. Others specify…………………………………….

23. Table 2: Cost of the feed

Type of feed	Quantity	Price

24. Table 3: Other costs incurred during the cycle. ……(respondents to give amount they would have been paid for the same activity if they worked for another person or amount they should have paid someone to do the same activity).

Variable cost	Quantity	Cost
Sampling net		
Harvesting net		
Security		
Operational labour (feeding)		

25. Did you ever sample your fish pond before starting to harvest in the last fish cycle

1. Yes 2. No

26. If No, why? 1. I had no net 2. Not aware 3. Others Specify…………..

27. If you sampled, how often did you sample your fish pond in the last fish cycle?

1. Monthly 2. Others specify……………………………………….

28. What did you use to sample fish in the last cycle?

1. hook 2. net 3. perforated basin

4. others specify……………………………………

29. Why did you sample? 1. Establish whether fish is there and growing

2. Determine when to harvest

3. To determine amount to feed basing on fish size & weight

4. Others specify……………………………………………

SECTION 3: HARVEST (ONLY HARVESTS FROM SELECTED POND)

30. Table 4: Harvest in unit cycle

Harvest	Date harvested	Qty small size	Qty average size	Qty big size	Total No. of Kgs harvested	Mode of transport 1,2,3,4	Harvesting labour cost	Transportation costs
1								
2								
3								
4								

If the farmer is still harvesting please note it.

1. bicycle 2. head 3. motorcycle 4. cars 5. others specify…………….

31. Table 5 Marketing of fish

Date harvested	No. of fish sold (kg)	Price/kg of fish	Where did you sell 1, 2, 3, 4	Fish consumed of home (No or kg)	Fish given away (No. or Kg)
1					
2					
3					
4					

1. farm gate 2. fish market 3. hawking 4. others……………………..

32. Distance from the nearest fresh fish market ……………..(kms)

SECTION 4: ACCESS TO SERVICES

33. Did you borrow money for your last cycle? 1. Yes 2. No

34. What was the source? 1. Friends 2. SACCOS 3. Relatives

4. Banks 5. Others (specify)……………………………………………..

35. Table 6: Credit services

Amount of credit	Interest rate	Terms of payment	Collateral needed	Paid loan in time?
				(yes/no)
				(yes/no)

36. Were you visited by fisheries extension officer/NGO during the last cycle?

1. Yes 2. No

37. If yes, how many times per month?...

38. What services did he/she give?

1. Feeding 2. Construction 3. Pond management

4. Others (specify)……………………………………………………………

SECTION 5: RECORD KEEPING

39. Do you keep records on your fish enterprise? 1. Yes 2. No

40. If No, why?

1. takes too much time 2. Illiterate 3. No need

4. Other (specify)…………………………………

41. What did you use your records for?

1. Planning 2. Access to loan 3. Monitoring and evaluation

4. Others (specify)……………………………………………..

42. What problems did you encounter in keeping farm records?

1. Time wasting 2. No knowledge 3. Interpretation of records

SECTION 6: CONSTRAINTS

43. What major constraints did you face in last fish cycle? Mention four of them.

a. ……………………………………………………………………………………………

b. ……………………………………………………………………………………………

c. ……………………………………………………………………………………………

d. ……………………………………………………………………………………………

44. How have you been trying to solve these problems?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

SECTION 7: OTHER MAJOR ENTERPRISES ON FARM

45. Are a member of an organization?   1. Yes   2. No

46. If Yes, what organization?

1. farmer's group   2. Co-operative   3. SACCO

4. Others Specify …………………………………….

SECTION 8: CHARACTERISTICS OF THE HOUSEHOLD (Should have kept fish for at least one cycle within two years time period i.e from 2008)

47. How many are you in the household…………………………………………………..

48. How many are females…………………………………………………………………

49. How many are males?...

Description relationship	Age (years)	Education level (years)	Sex		Marital status 1,2,3,4	Main occupation 1,2,3,4
			M	F		
Household head						
Spouse 1						
Spouse 2						

Marital status 1. Married   2. Separate   3. Single   4. divorced

Main occupation: 1 Farming   2. Business   3. Others specify……………………

50. Any other comments……………………………………………………………………

………………………………………………………………………………………………….

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

Appendix III: Regression Results From Tilapia Fish Farmers Only

TILAPIA FISH TYPE

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.832(a)	.691	.636	.23144

a Predictors: (Constant), Credit34mm, Educ34_numericalmm, Feed34_typemm, QDist_Mkt_Kmmhh, M34__organisationsss, LnHouseholdkab, LnExperiencekab, No34_times_visitedmm, LnPondSizekab

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.001	9	.667	12.447	.000(a)
	Residual	2.678	50	.054		
	Total	8.679	59			

a Predictors: (Constant), Credit34mm, Educ34_numericalmm, Feed34_typemm, QDist_Mkt_Kmmhh, M34__organisationsss, LnHouseholdkab, LnExperiencekab, No34_times_visitedmm, LnPondSizekab
b Dependent Variable: Ln_UCR_NEW

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta	B	Std. Error
1	(Constant)	.438	.374		1.170	.247
	LnExperiencekab	-.093	.039	-.216	-2.382	.021
	LnHouseholdkab	-.052	.057	-.081	-.918	.363
	Educ34_numericalmm	-.018	.009	-.212	-2.039	.047
	No34_times_visitedmm	-.047	.017	-.284	-2.842	.006
	LnPondSizekab	-.102	.046	-.246	-2.205	.032
	QDist_Mkt_Kmmhh	.043	.019	.189	2.234	.030
	Feed34_typemm	-.068	.079	-.073	-.858	.395
	M34__organisationsss	-.168	.069	-.215	-2.444	.018
	Credit34mm	-.051	.072	-.060	-.715	.478

a Dependent Variable: Ln_UCR_NEW

Appendix III: Regression Results From Catfish Fish Farmers Only

CATFISH TYPE

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.813(a)	.661	.601	.24322

a Predictors: (Constant), Credit34mm, LnHouseholdkab, No34_times_visitedmm, Educ34_numericalmm, M34__organisationsss, QDist_Mkt_Kmmhh, Feed34_typemm, LnExperiencekab, LnPondSizekab

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.779	9	.642	10.855	.000(a)
	Residual	2.958	50	.059		
	Total	8.737	59			

a Predictors: (Constant), Credit34mm, LnHouseholdkab, No34_times_visitedmm, Educ34_numericalmm, M34__organisationsss, QDist_Mkt_Kmmhh, Feed34_typemm, LnExperiencekab, LnPondSizekab
b Dependent Variable: Ln_UCR_NEW

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta	B	Std. Error
1	(Constant)	.422	.320		1.320	.193
	LnExperiencekab	-.099	.037	-.258	-2.695	.010
	LnHouseholdkab	-.020	.058	-.030	-.342	.734
	Educ34_numericalmm	-.015	.007	-.195	-2.066	.044
	No34_times_visitedmm	-.038	.017	-.198	-2.231	.030
	LnPondSizekab	-.098	.049	-.216	-1.996	.051
	QDist_Mkt_Kmmhh	.049	.019	.222	2.503	.016
	Feed34_typemm	-.165	.088	-.195	-1.877	.066
	M34__organisationsss	-.122	.065	-.160	-1.874	.067
	Credit34mm	-.070	.072	-.085	-.963	.340

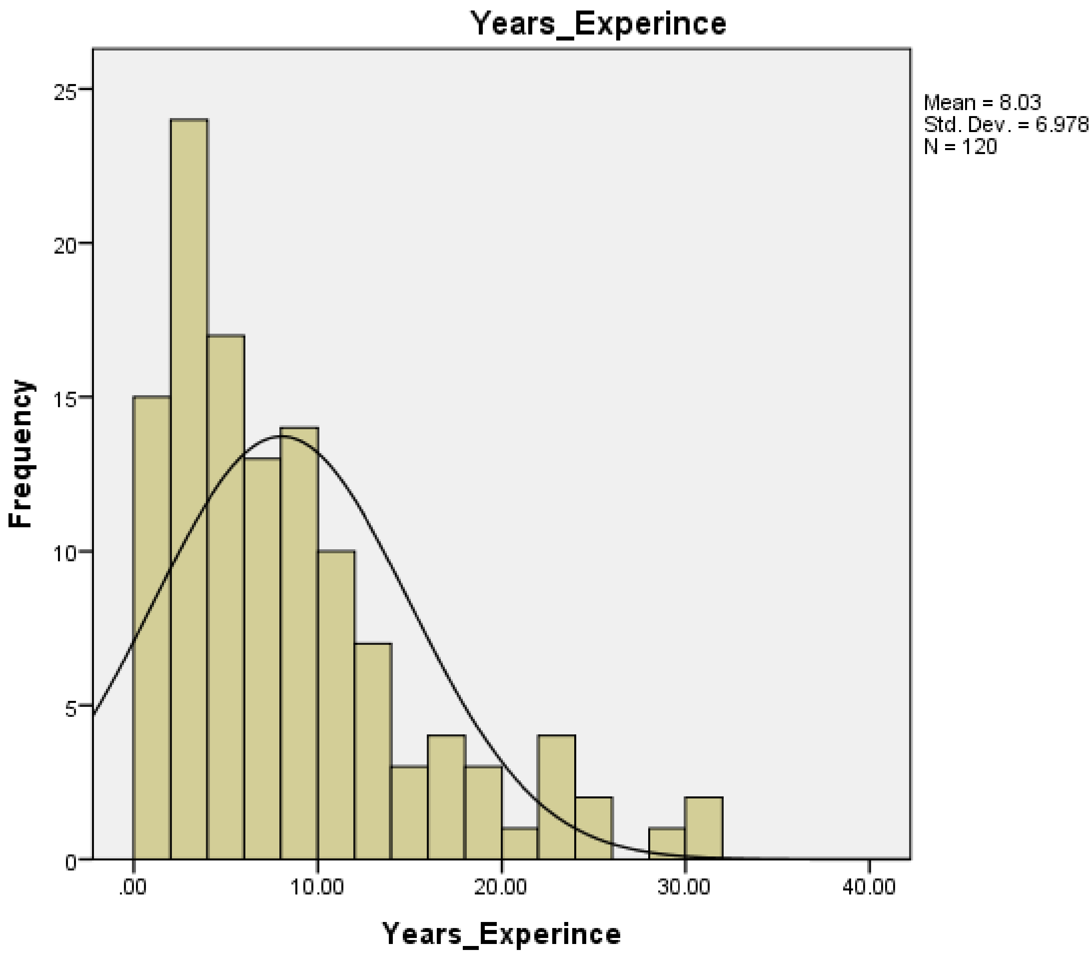
a Dependent Variable: Ln_UCR_NEW

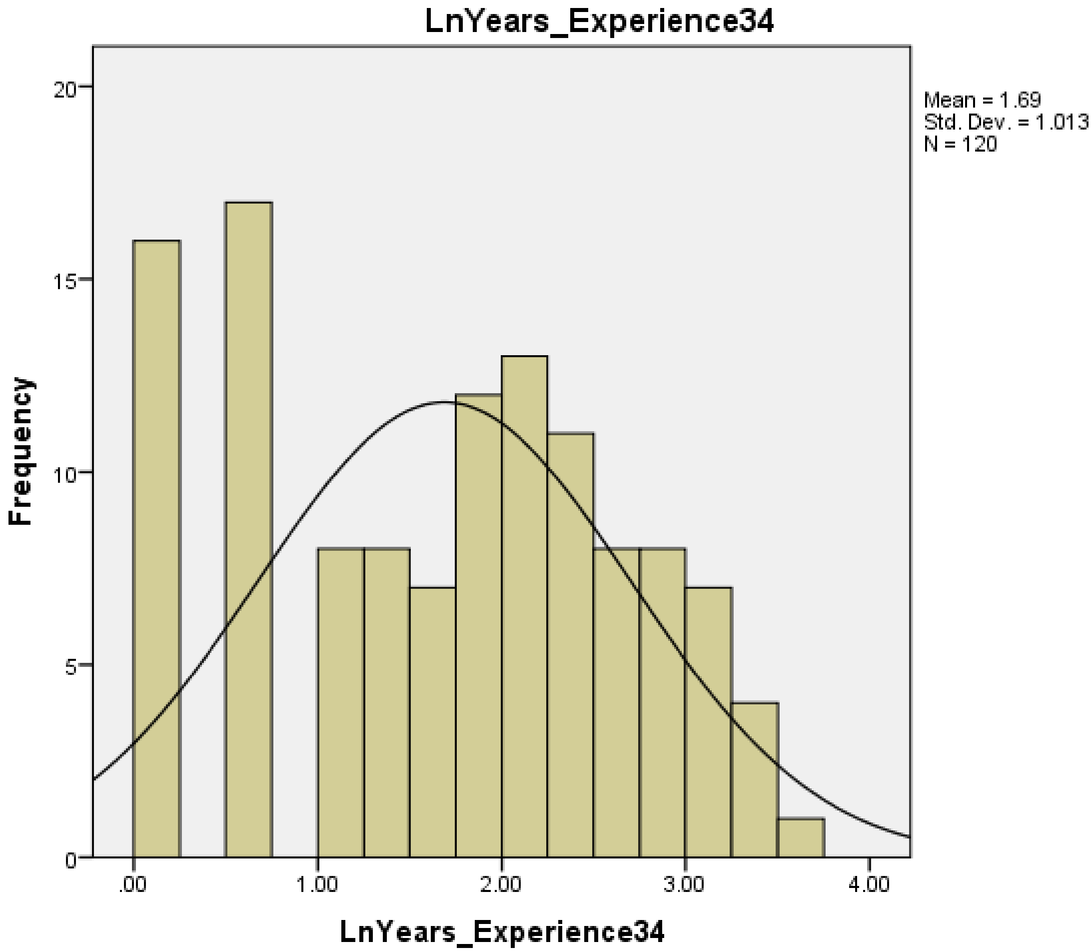
Appendix IV: Regression results and multicollinearity and Heteroscedasticity tests for both tilapia and catfish enterprises

```
  ___  ____  ____  ____  ____ (R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   9.0   Copyright 1984-2005
  Statistics/Data Analysis            StataCorp
                                      4905 Lakeway Drive
                                      College Station, Texas 77845 USA
                                      800-STATA-PC        http://www.stata.com
                                      979-696-4600        stata@stata.com
                                      979-696-4601 (fax)

Single-user Stata for Windows perpetual license:
       Serial number:  199044141
         Licensed to:  halasi
                       DEVIN

Notes:
      1.  (/m# option or -set memory-) 1.00 MB allocated to data

. use "D:\Dr Ekere 13-04-2013 hand in post graduate school ready\uutsrqpnnnoooon
> mlkjhgggboth_lowerupperadjusthyuha_onmmllld.dta"

. regress ln_ucr_new lnexperiencekab lnhouseholdkab educ34_numericalmm
no34_times_visitedmm lnpondsizekab  qdist_mkt_kmmhh feed34_typemm m34__or
> ganisationsss credit34mm

      Source |       SS       df       MS              Number of obs =     120
-------------+------------------------------           F(  9,   110) =   24.92
       Model |  11.7340172     9  1.30377969           Prob > F      =  0.0000
    Residual |  5.75494577   110  .052317689           R-squared     =  0.6709
-------------+------------------------------           Adj R-squared =  0.6440
       Total |   17.488963   119  .146966076           Root MSE      =  .22873

------------------------------------------------------------------------------
  ln_ucr_new |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnexperien~b |  -.0938913   .0244951    -3.83   0.000    -.1424348   -.0453478
lnhousehol~b |  -.0458224   .0366313    -1.25   0.214     -.118417    .0267721
educ34_num~m |  -.0165706   .0049568    -3.34   0.001    -.0263939   -.0067473
no34_times~m |  -.0422548   .0109415    -3.86   0.000    -.0639383   -.0205712
lnpondsize~b |  -.1135208   .0290679    -3.91   0.000    -.1711266    -.055915
qdist_mkt_~h |   .0440982   .0129258     3.41   0.001     .0184822    .0697142
feed34_typ~m |  -.1027507   .0532614    -1.93   0.056    -.2083022    .0028008
m34__organ~s |  -.1439501   .0434513    -3.31   0.001    -.2300603   -.0578399
  credit34mm |   -.060694   .0478183    -1.27   0.207    -.1554586    .0340706
       _cons |   .3907028   .2201771     1.77   0.079    -.0456365    .8270422
------------------------------------------------------------------------------


. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of ln_ucr_new

         chi2(1)      =     0.95
         Prob > chi2  =   0.3305

. regress ln_ucr_new lnexperiencekab lnhouseholdkab educ34_numericalmm
no34_times_visitedmm lnpondsizekab  qdist_mkt_kmmhh feed34_typemm m34__or
> ganisationsss credit34mm

      Source |       SS       df       MS              Number of obs =     120
-------------+------------------------------           F(  9,   110) =   24.92
       Model |  11.7340172     9  1.30377969           Prob > F      =  0.0000
    Residual |  5.75494577   110  .052317689           R-squared     =  0.6709
-------------+------------------------------           Adj R-squared =  0.6440
```

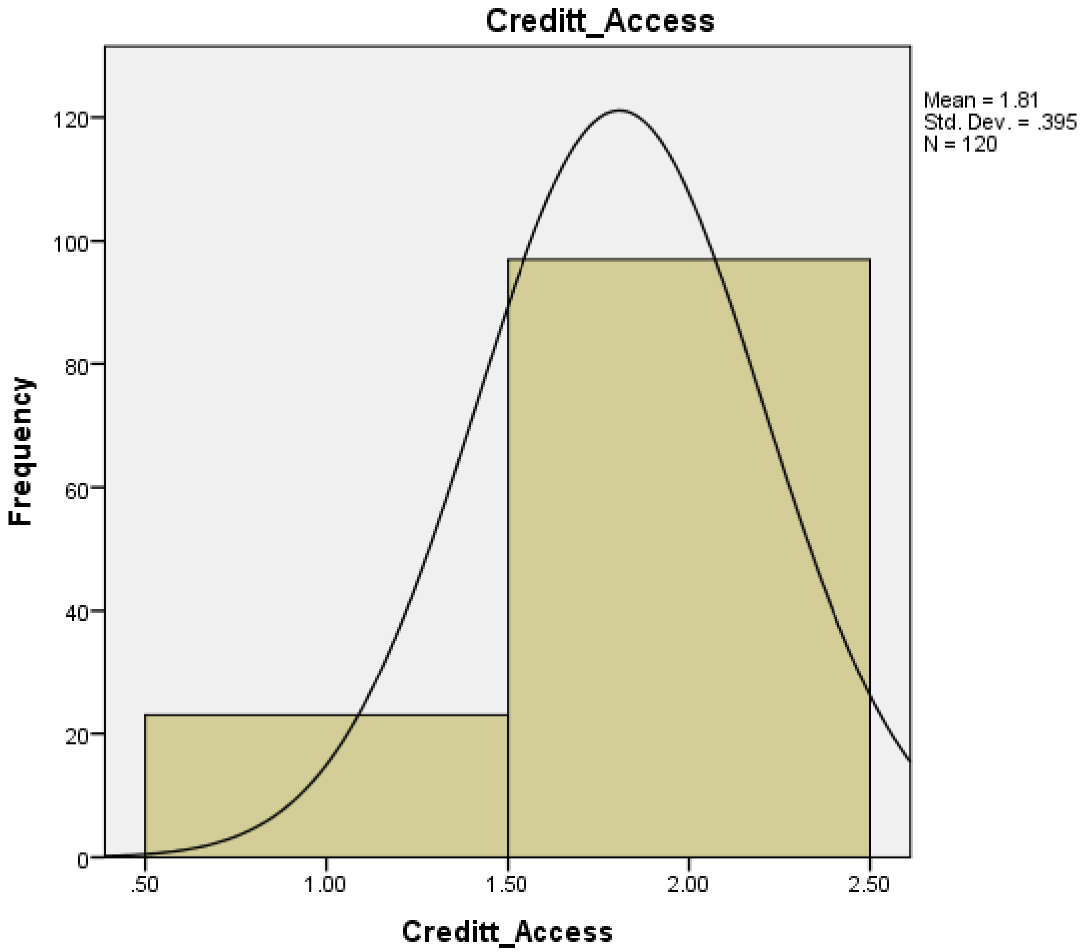
```
       Total |   17.488963   119  .146966076           Root MSE      =  .22873

------------------------------------------------------------------------------
  ln_ucr_new |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnexperien~b |  -.0938913   .0244951    -3.83   0.000    -.1424348   -.0453478
lnhousehol~b |  -.0458224   .0366313    -1.25   0.214     -.118417    .0267721
educ34_num~m |  -.0165706   .0049568    -3.34   0.001    -.0263939   -.0067473
no34_times~m |  -.0422548   .0109415    -3.86   0.000    -.0639383   -.0205712
lnpondsize~b |  -.1135208   .0290679    -3.91   0.000    -.1711266    -.055915
qdist_mkt_~h |   .0440982   .0129258     3.41   0.001     .0184822    .0697142
feed34_typ~m |  -.1027507   .0532614    -1.93   0.056    -.2083022    .0028008
m34__organ~s |  -.1439501   .0434513    -3.31   0.001    -.2300603   -.0578399
  credit34mm |   -.060694   .0478183    -1.27   0.207    -.1554586    .0340706
       _cons |   .3907028   .2201771     1.77   0.079    -.0456365    .8270422
------------------------------------------------------------------------------

. vif

    Variable |       VIF       1/VIF  
-------------+----------------------
lnpondsize~b |      1.59    0.629548
no34_times~m |      1.28    0.779091
educ34_num~m |      1.26    0.790551
lnexperien~b |      1.23    0.810354
feed34_typ~m |      1.22    0.819675
qdist_mkt_~h |      1.11    0.897751
  credit34mm |      1.08    0.922900
m34__organ~s |      1.07    0.933011
lnhousehol~b |      1.05    0.953137
-------------+----------------------
    Mean VIF |      1.21

.
```

Appendix VI; Skewness Tests For Variables Used In Regression Analysis




LnYears_Experience34
Mean = 1.69
Std. Dev. = 1.013
N = 120
Frequency
20
15
10
5
0
.00
1.00
2.00
3.00
4.00
LnYears_Experience34


Feed_type
Mean = 1.73
Std. Dev. = .444
N = 120
Frequency
120
100
80
60
40
20
0
.50
1.00
1.50
2.00
2.50
Feed_type


Creditt_Access
Mean = 1.81
Std. Dev. = .395
N = 120
Frequency
0
20
40
60
80
100
120
.50
1.00
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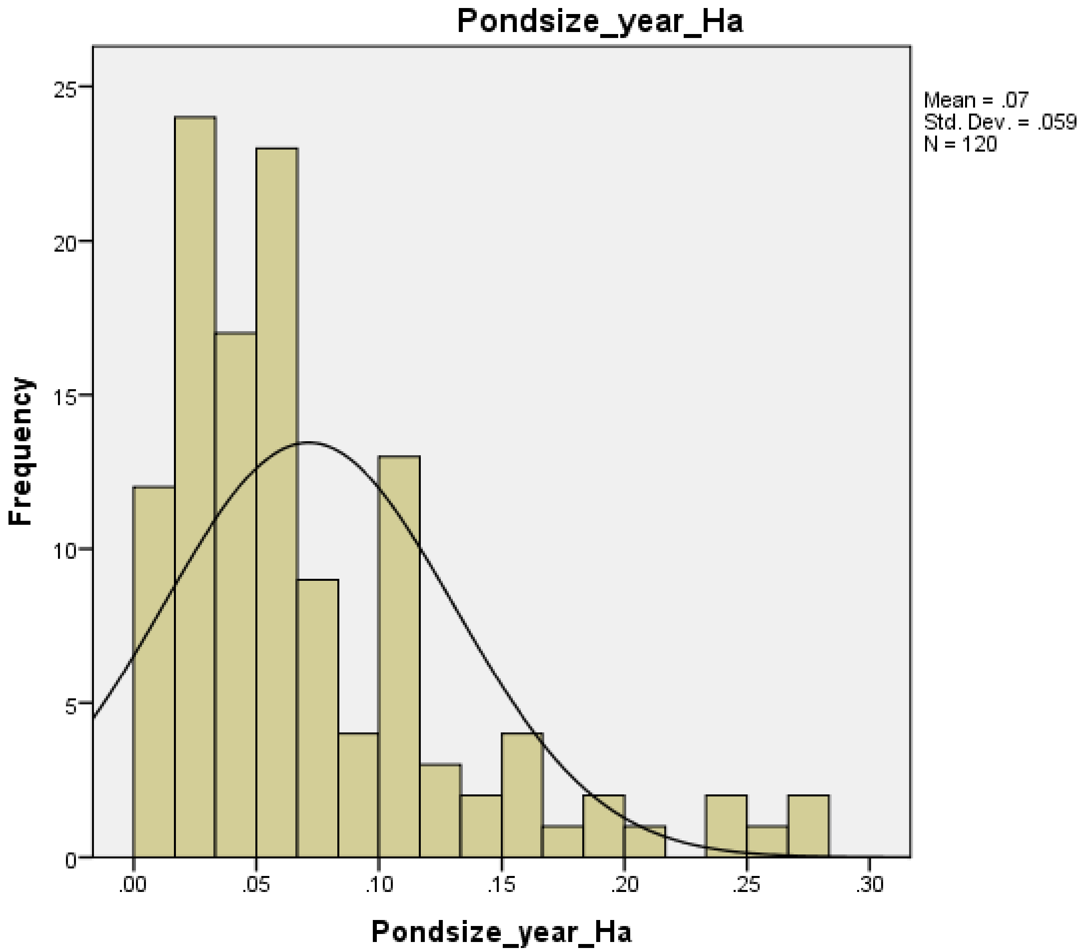
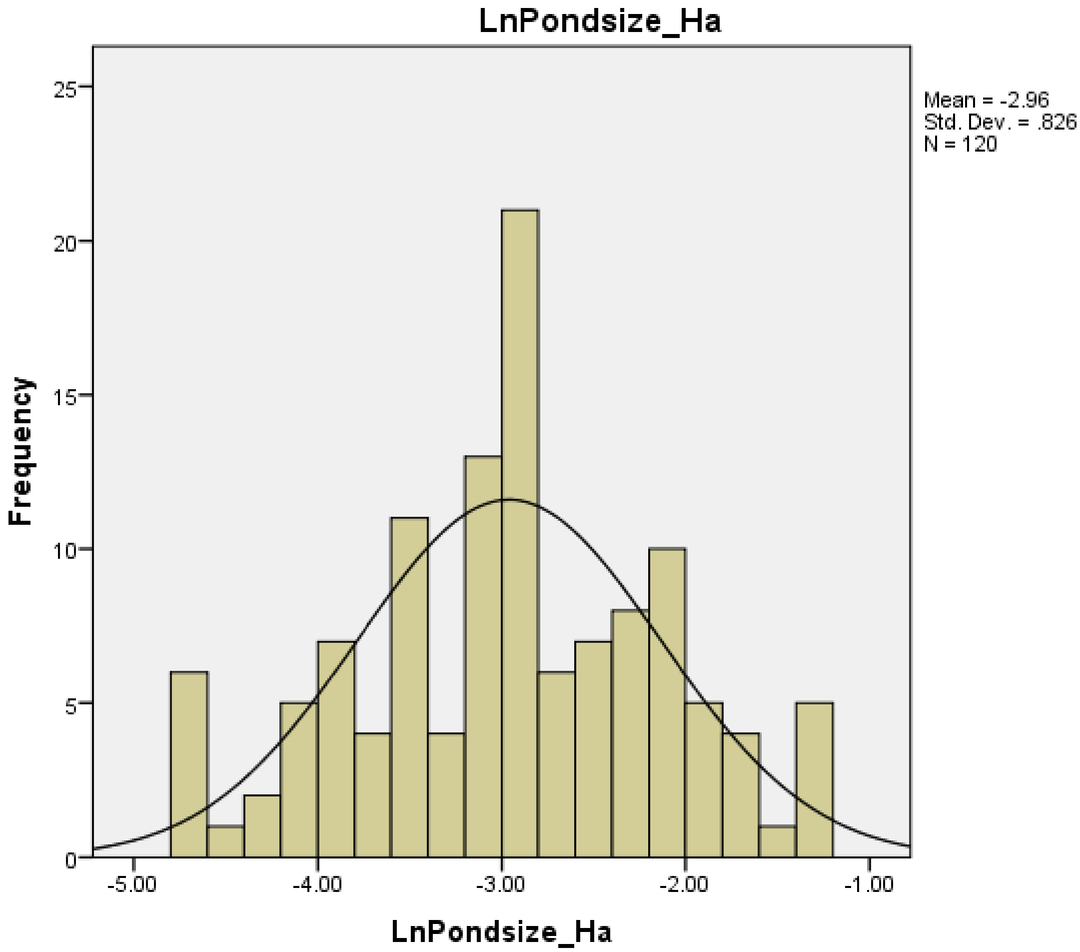
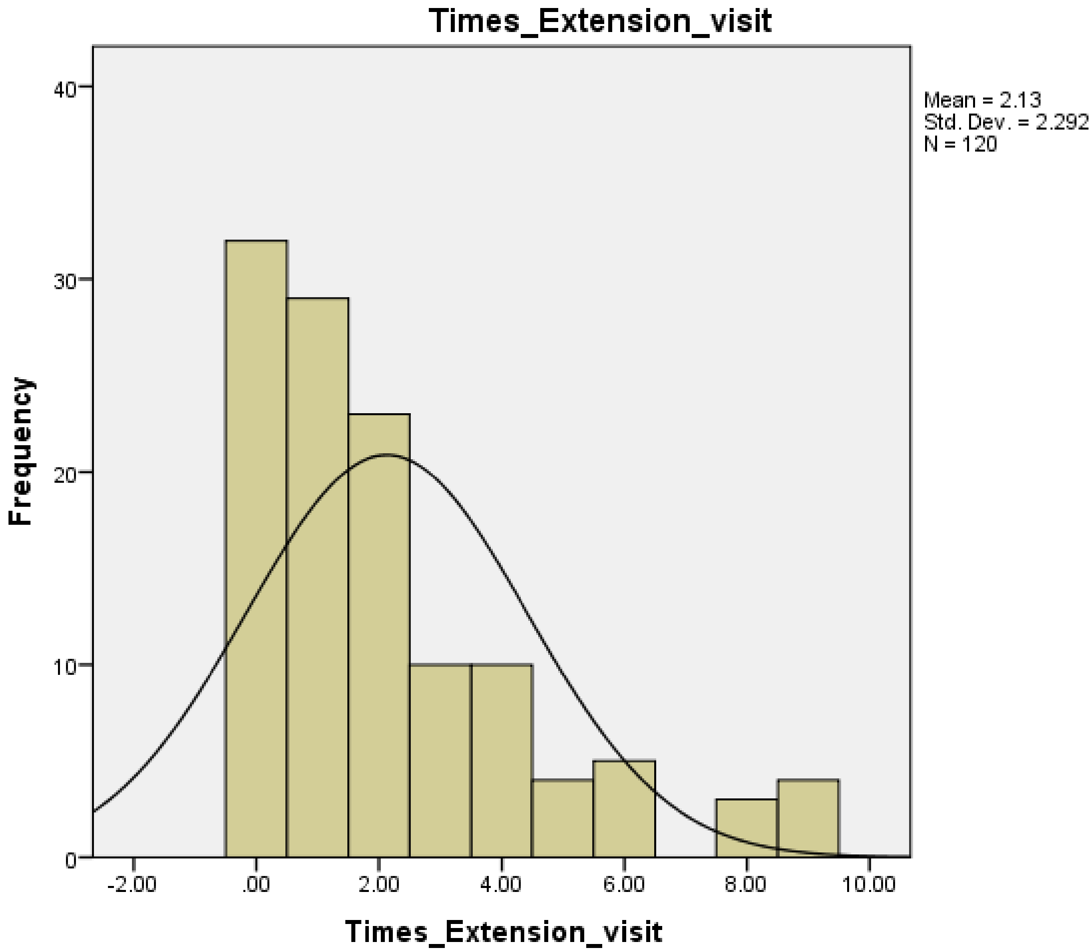
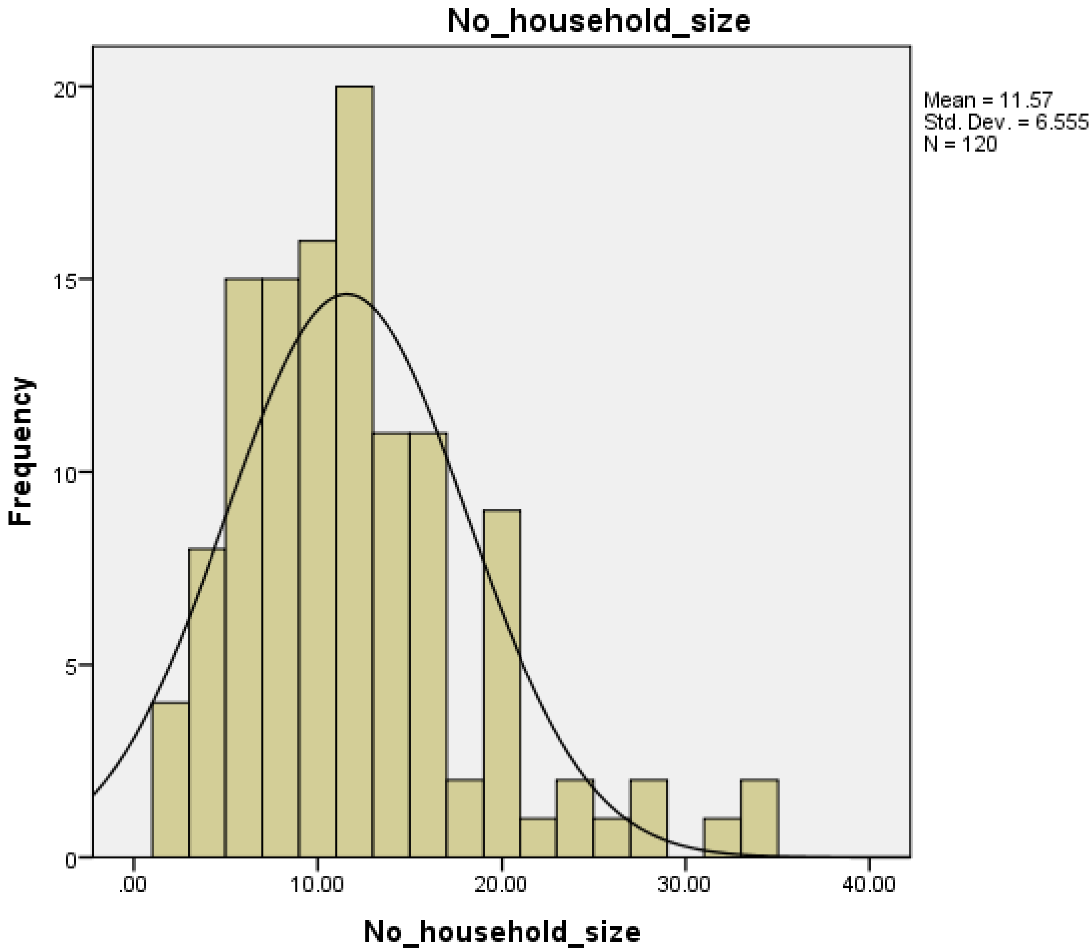
2.00
2.50
Creditt_Access

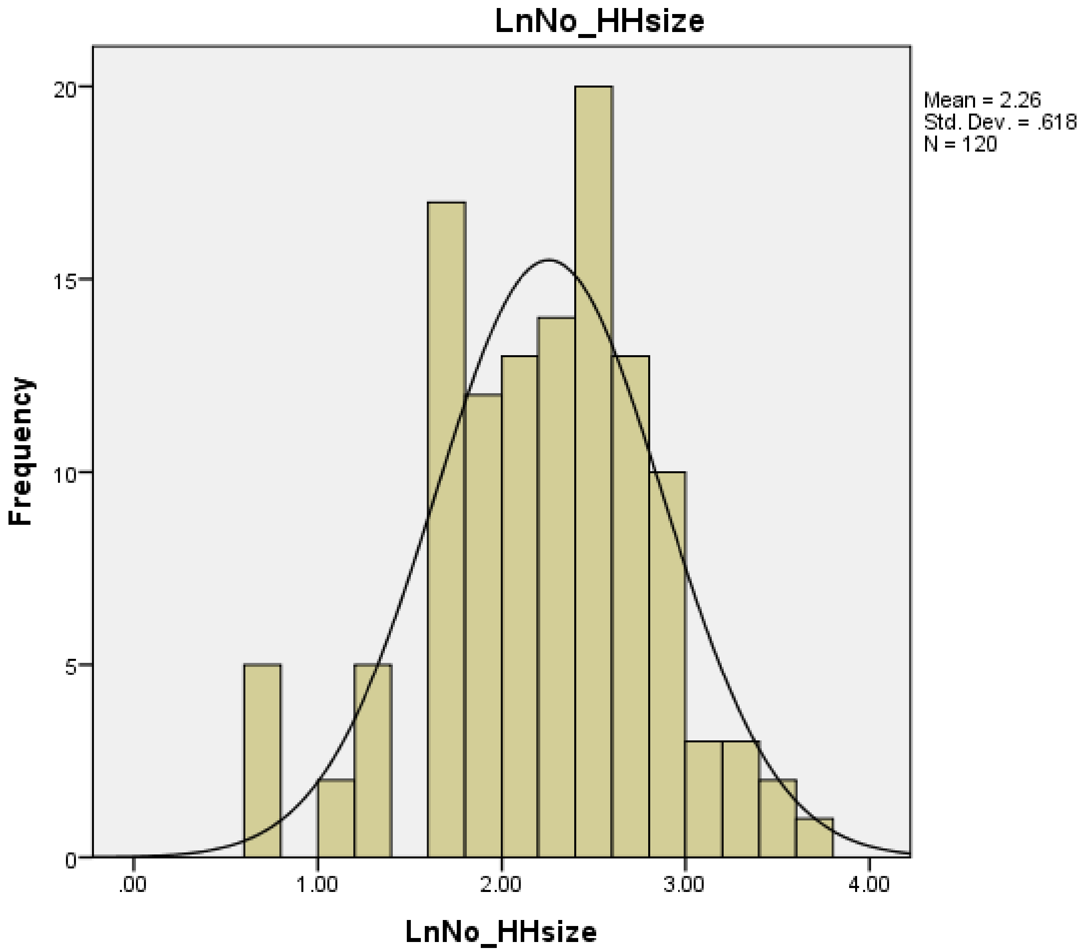

Pondsize_year_Ha
Mean = .07
Std. Dev. = .059
N = 120
Frequency
25
20
15
10
5
0
.00
.05
.10
.15
.20
.25
.30
Pondsize_year_Ha

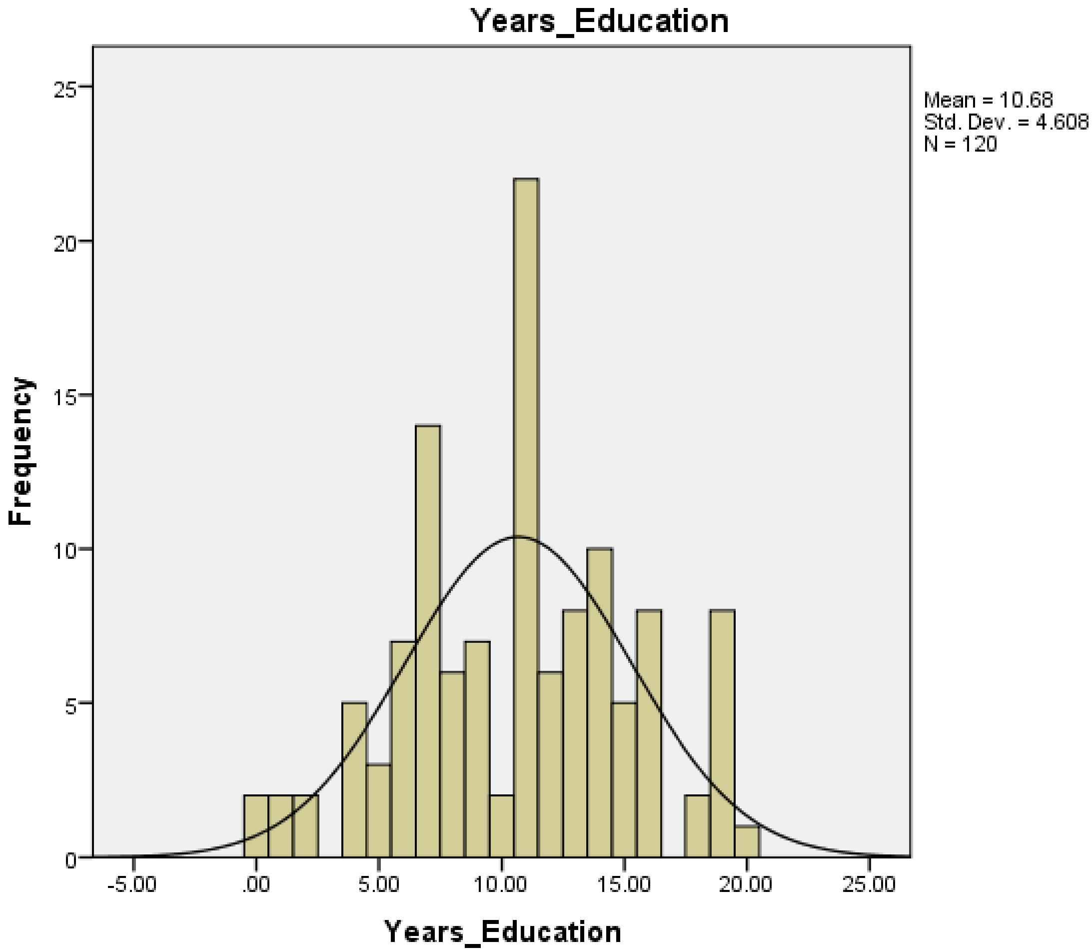

LnPondsize_Ha
Mean = -2.96
Std. Dev. = .826
N = 120
Frequency
25
20
15
10
5
0
-5.00
-4.00
-3.00
-2.00
-1.00
LnPondsize_Ha



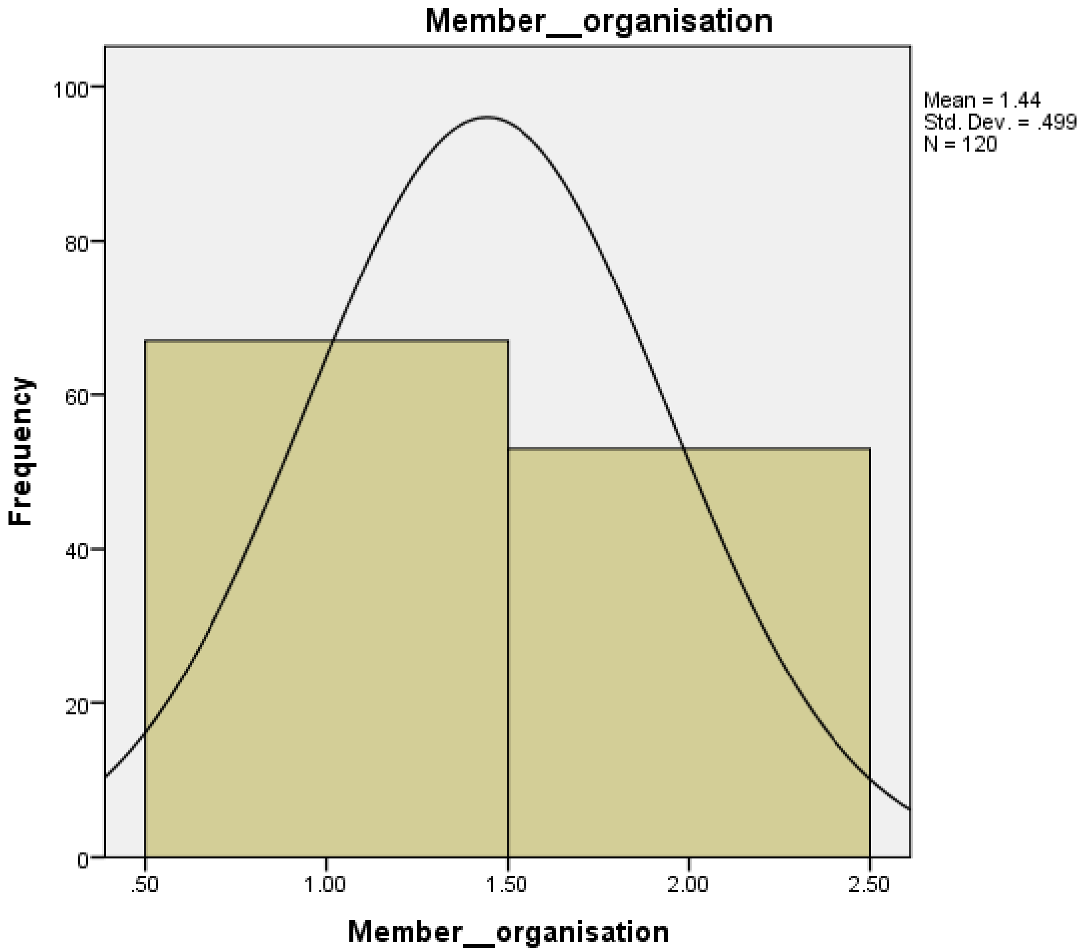
Times_Extension_visit
Mean = 2.13
Std. Dev. = 2.292
N = 120
Frequency
40
30
20
10
0
-2.00
.00
2.00
4.00
6.00
8.00
10.00
Times_Extension_visit


No_household_size
Mean = 11.57
Std. Dev. = 6.555
N = 120
Frequency
20
15
10
5
0
.00
10.00
20.00
30.00
40.00
No_household_size

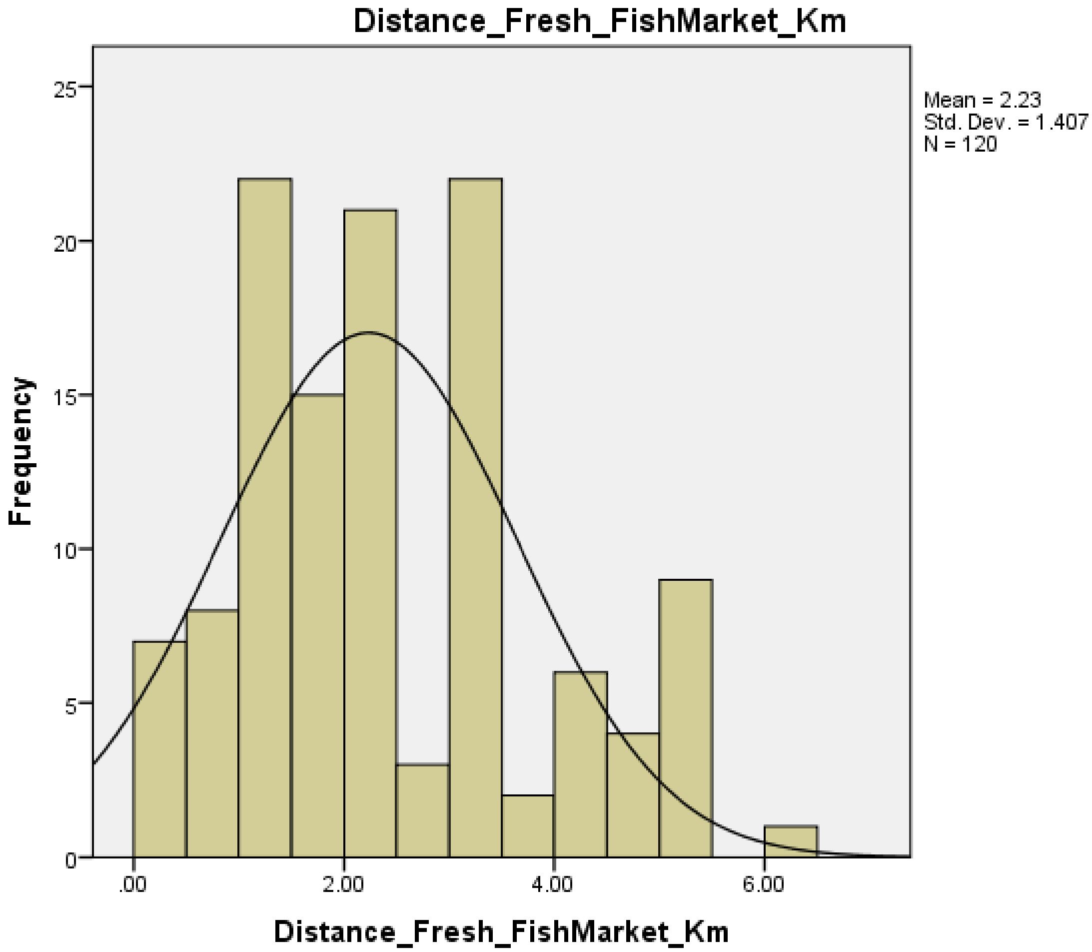

LnNo_HHsize
Mean = 2.26
Std. Dev. = .618
N = 120
Frequency
20
15
10
5
0
.00
1.00
2.00
3.00
4.00
LnNo_HHsize

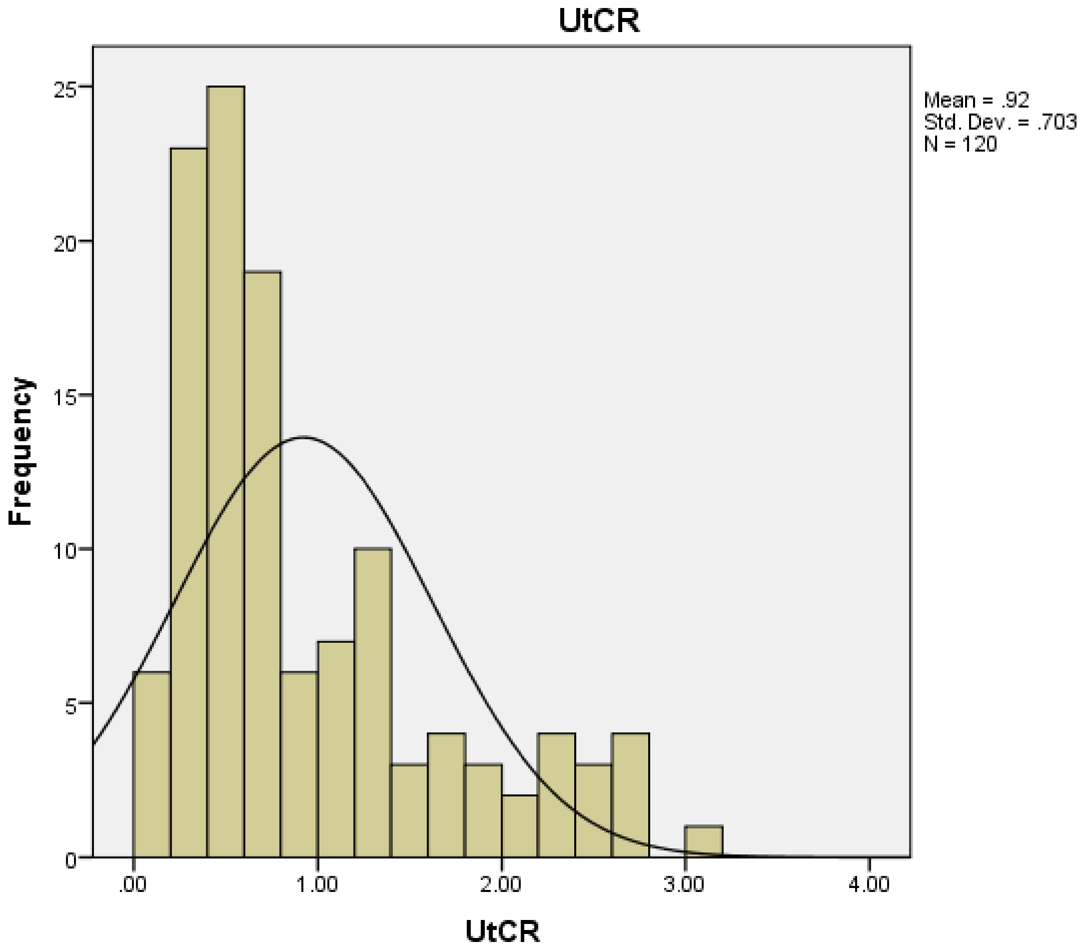


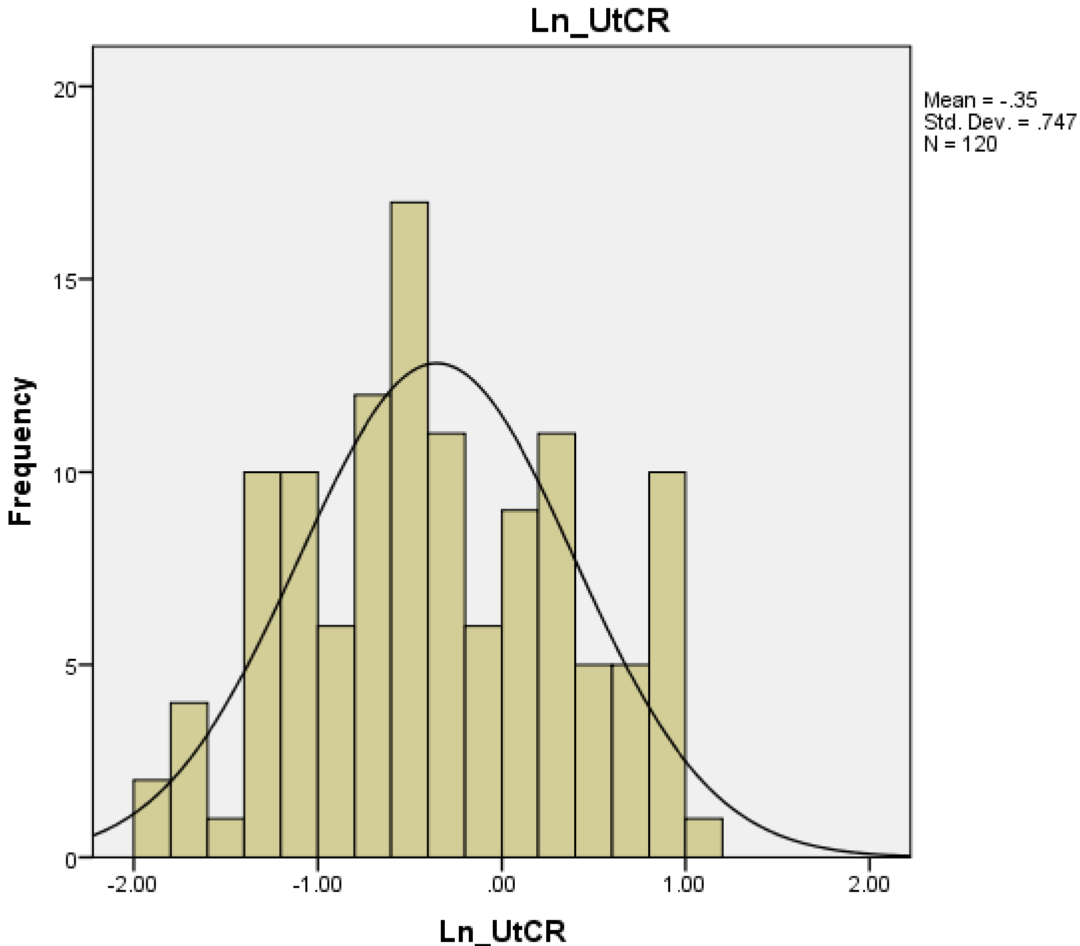
Years_Education
Frequency
25
20
15
10
5
0
-5.00
.00
5.00
10.00
15.00
20.00
25.00
Years_Education
Mean = 10.68
Std. Dev. = 4.608
N = 120


Member__organisation
Mean = 1.44
Std. Dev. = .499
N = 120
Frequency
0
20
40
60
80
100
.50
1.00
1.50
2.00
2.50
Member__organisation

w


Distance_Fresh_FishMarket_Km
Mean = 2.23
Std. Dev. = 1.407
N = 120
Frequency
0
5
10
15
20
25
.00
2.00
4.00
6.00
Distance_Fresh_FishMarket_Km


UtCR
Mean = .92
Std. Dev. = .703
N = 120
Frequency
25
20
15
10
5
0
.00
1.00
2.00
3.00
4.00
UtCR


Ln_UtCR
Mean = -.35
Std. Dev. = .747
N = 120
Frequency
20
15
10
5
0
-2.00
-1.00
.00
1.00
2.00
Ln_UtCR