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DETERMINANTS OF FISHING HARVEST AT LAKE CHAMO, SOUTHERN ETHIOPIA

By

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As members of the Examining Board of the final Master Thesis open defense, we certify that we read and evaluated the thesis prepared by SemiraNuredein and recommend that it be accepted as fulfilling the thesis requirement for the Degree of Master of Science in Development Economics.

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DECLARATION

I, the undersigned, declare that this thesis is my original work and prepared under the guidance of my advisor **WONDIMAGEGNECHEKOL** (**PhD**). All sources of materials used for the thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full's to any other higher learning institution for the purpose of earning any degree.

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St. Mary's University, Addis Ababa July, 2019

ENDORSEMENT

This thesis has been submitted to St. Mary's University, School Of Graduate Studies for examination with my approval as a University advisory.

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Advisor Signature

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ACRONYMS

AD	Agricultural Development
FAO	Food and Agriculture Organization
ILR	International Livestock Research Institute
IPMS	Improving Productivity and Marketing
LFDP	Lake Fish Development Project
MOARD	Ministry Of Agriculture and Rural Development
SNNP	South Nation Nationality of People
VIF	Vector Inflation Factors
WANRMO	Wilde Animal and Natural Resource management Office
WB	World Bank
ERVLB	Ethiopian Rift Valley Lakes Basin (ERVLB)
ACB	Abaya–Chamo drainage sub-basin
MLRM	Multi Linear Regression Model

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Abstract

The general objective of this study was to investigate the determinant of fishing harvest at Lake Chamo. Specifically, this study investigated the factors affecting of skills, education status, open access, illegal fishers, adding nutrients for fish, age, mesh net Size and gender at fishing harvest in Lake Chamo. The estimated sample size is 80 as obtained from Yamane (1967:886).The researcher used simple random sampling technique to select the sample population. This is done in order to give equal chance of being selected to all respondents of Lake Chamo. Moreover, random sampling is best technique of sampling to make the sample reliable representative of the whole respondents as they draw without the subjective judgment of the researcher .Demographic and socio-economic analyses as well the factors affecting fishing harvest in the study area were analyzed in detail in the first part of the result and discussions by using descriptive analysis. The second part of the study emphasized on an in-depth analysis of factors that affect the Fishing harvest through econometric analysis of multiple linear regression models. In general, the result of the model revealed that open access and education level were statistically significant and negatively affect at fishing harvest, where as skill of fishing techniques, adding nutrient for fish and mesh net size were found to have a significant and positive affect at fishing harvest. Lastly the result from this survey revealed that adding nutrients for fish and Continues support for organized fishery cooperatives in terms of finance and training are helpful to improve fishing harvest at Lake Chamo.

Key Words: Fishing Harvest, Lake Chamo

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

Fish provides the main source of animal protein for 20 percent of the world's population. At the same time, some 40 percent of the global fish production is traded internationally. Fish is indeed a global good, caught all around the world and exported for trade almost everywhere (2017 Kebede A, et al). Sustaining fish supplies from capture fisheries will not be able to meet the growing global demand for aquatic food (FAO, 2006).

In developing countries, fish production not only improved a nation's diet but brought income to small farmers and created employment particularly in rural areas. Fish culture has proved successful in improving the standard of living of rural farmers in developing countries, where fish culture had a long tradition (Edwards 2000).

Sub-Saharan Africa, on the other hand, is expected to see a per capita fish production decline of 1 percent per year from 2010 to 2030 but, due to rapid population growth of 2.3 percent in the same period, the region's total fish production will grow by 30 percent overall by FAO (2007).

Ethiopia is a land-locked country which has approximately 7400 Km surface area of major lakes and 7185 Km long river network (Dejen&Mintesnot 2012).The country has a number of international rivers, beautiful lakes political, ecological and economic importance. Sofar, there are 180 different species are endemic to the country (Golubstov&Mina,2003).The total annual fish potential production of the country's major inland water bodies is estimated to be 51,481 metric tons per year on maximum sustainable yield basis (Anteneh 2013). However, only 20-30%of this resource is utilized (Senbete 2008).

Lake Chamo is a component of the Ethiopian Rift Valley Lakes Basin (ERVLB) in the Abaya–Chamo drainage sub-basin (ACB). The ERVLB comprises eight natural lakes and their major tributaries. The ACB comprises Lake Chamo and Lake Abaya, and rivers and streams entering the lakes. The two lakes are connected via surface hydrology. Outflow from Lake Abaya enter Lake

Chamothrough River Kulfo, and an overflow from Lake Chamo through Metenafesha joins Sermale Stream and subsequently the Sagan River (SeleshiBekele, 2006).

Fish resource utilization of Lake Chamo calls for urgent management action for sustainable use and for conservation of fish biodiversity and the environment. On the other hand, the water quality variables were found to indicate that the lake water is generally suitable for its fish species. Thus, it can be concluded that the water quality status of Lake Chamo is not a threat to its fish populations.The fish resource in Lake Chamo is used by co-operative members as well as private fishers. At the co-operative, the fish were simply packed and preserved without any cleaning, grading. The private fishers are accused of being illegal, unorganized and not being liable for any governmental obligations (EARO, 2002).

Fishing takes place both in the littoral and deep water throughout the year. However, according to the regional fishery expert during the lent period the demand for fish increases and as a result fishing intensifies (LFDP 1997).The Chamo lake Fish production potential and Its catch per year is 4500 tons' year and 4359 tone's year respectively.

Currently there is fishery management legislation enforced at the Federal level, proclamation No.315/2003 in 2011. It provides broad guidelines relating to resource conservation, food safety and aquaculture. This document puts considerable emphasis on regulation, permits and the role of the fishery inspector. It is intended that the regional administrations should then use this as the broad framework within which their own proclamations are developed (Janko AM (2014).

Aquaculture research has become a national responsibility since the collapse in 1977 of the East African Community. The Ministry of Regional Development, Science and Technology assure now overall supervision. The Research is directe into production aspect of fish rather than the whole fish value chain. A Need for Research stressed the need for the immediate implementation of the results of past research through extension (Charo et al., 2010).

1.2. Statements of the Problem

The contribution of fishery in some area of Ethiopia such as lake chamo is high in terms of supplying cheap source of protein ,employment ,and covering house hold food security to the fishermen .Moreover, there is high number of people who are engaged in different fishing related activity such as local boat making ,fishnet making ,fish product transporting ,marketing and cooking(mainly female).Recently ,however, due to different reasons the fisheries sub-sector in Lake chamo has faced

several fishing harvest problems .The increase in population ,high demand of fish products, lack of alternative income strategies and high unemployment rate have put serious stress on the fish subsector of lake chamo .Getting little attention by production, the fishers are left confused by many extension officers who visit and give varying information, declining fish stocks in the natural water bodies and conflict between various users of fisheries resources. This condition have been caused by an inadequate level of education, using illegal fishnet by illegal fishers, waste (toxic) material entered by flood, ,and destruction of reproductive (Alemayehu H,2010).

Mulgeta Hizekeal (2008) also investigated the depletion of fish stock on Lake Chamo. His investigation was focus on a number of factors that leads to deplete fish resources on Lake Chamo such as natural and human factors. The natural factors such as the effect of harsh climate that causes the less reproductive of fish, the effect of high rainfall that causes pollution of the Lakes through their tributaries by coming with dirty water and waste product from farming areas and increasing the number of crocodile because of anybody cannot use their productions from Lake chamo.

Whereas human made factors such as increasing the number of illegal fishermen and lack of government controls. The illegal fishermen affects the growth of fish by catching very small fish by using illegal fishing instruments like small mesh size of net that catches very small fish and without replacing them. In addition to this polluting the rivers by washing cars, damping waste material that comes from agricultural and town areas, and using the rivers for irrigation system are highly affects the rise of fish production in the Lake.

There is little research done to find out the fishery harvest problem associated impacts at lake chamo, getting little attention by responsible local government sectors and there is lack of awareness by local community about the impacts of their practice on the lake sector .Therefore, this study endeavors to investigate the determinants of fishing harvest in lake of fulfill the information gap.

1.3. Research Questions;

The study sought to answer the following basic research questions;

- What are the major factors that affect fishing harvest at Lake Chamo?
- Are there possible solutions that alleviate the problem of fishing harvest at Lake Chamo?

1.4. Objectives of the Study

The general objective of this study is to investigate the Determinant of fishing harvest and propose possible solutions for improving the fishing harvest problem in the study area.

1.4.1 Specific Objectives of the Study

The study was guided by the following objectives:

- To identify the factors affect fishing harvest at lake chamo
- To recommend possible solution that can alleviate the problem of fishing harvest at Lake Chamo.

1.5. Hypothesis of the Study

This study has the following Alternative hypotheses about the Determinant of fishing harvest at Lake Chamo;-

Ha1: Skill of has a significant impact on fishing harvest on the lake.

Ha2: illegal fisher has a significant impact on fishing harvest in the lake.

Ha3: Education has significant effect for fishing harvest.

Ha4: open access has significant impact on fishing harvest over time.

Ha5: mesh net size has significant impact on fishing harvest of the study area.

Ha6: Adding Nutrients into the lake has significant impact on fishing harvest

1.6. Significance of the Study

This was a study built up to help identify the factors that affect the fishing harvest at Lake Chamo. The study findings and recommendations are hoped to help the county governments to implement policies that can revitalize fish harvesting and encourage other stockholder's participation on food security initiatives. The study is endeavored to provide information to local community extension in identifying their own strengths and weaknesses and change as argents and come up with appropriate corrective measures and come up with appropriate capacity building programs to improve fish harvesting in Chamo Lake.

The findings are hopped to provide information to cooperatives to efficiently produce high fish yields with minimal inputs there by maximizing profit. In addition the study is also hopped to provide a base for further research on fish harvesting issues. The research is also hoped to be a reference material in the University of St. Mary's University.

1.7. Limitation and scope of the Study

Undertaking research on the determinants of fish production at national level is a complex task since it requires huge finance, time, and sufficient knowledge. These constraints force the study to undertake research Specifically at Lake Chamo. Moreover, the study focused on identifying the Determinants of fish production and their effects in Lake Chamo.

1.8 Organization of the Study

This study is organized in to five chapters the first chapter is about the introduction of the study .Under this background, statement of the problem, the general and specific objectives, hypothesis, significance, scope and limitation and organization of the study are discussed. The second chapter presents theoretical literatures which relates to the researcher's problem. The third chapter discusses about methodology of the study. Under this chapter data sources, method of data collection, sample size and sampling technique, method of data analysis, model specification and theoretical model are explained in this paper. The fourth chapter present and discuss the findings of the study. The last chapter presents the conclusions that are derived from the analysis of the data about the problem in the Lake Chamo. It also presents some policy recommendations based on the findings of the study that are recommended to be taken by the responsible bodies to curb the problem of fish production of fishermen in Lake Chamo.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definitions of Terms

Traditional Fishing

Traditional fishing is any kind of small scale, commercial or subsistence fishing practices using traditional techniques such as rod and tackle, arrows and harpoons throw nets and drag nets with unskilled fishermen (Share Alike, 2014).

Extension Services

The governments are popularized aquaculture in 1960's through the "eat more fish" campaign, but this did not achieve much increasing fish production. One of the major challenges are :-lake of quality fingerlings and insufficient training of extension works to deliver technical knowledge about aquaculture to the fishermen and further aspects of constructing ponds of appropriate size and depth that can ensuring a suitable sources of water that stimulate fish production and profitability(J-M Manyala ,2004).

Small scale Fishery

According to the FAO (2014) glossary defining small scale and artisanal fisheries is a challenge as the terms have been used for decades by fishery politicians and administrators, legal officers, biologists, economists, sociologists, engineers, fishers, non-governmental organizations and the media to represent different points of view and socio-economic dimensions in different national contexts. Trying to combine all the characteristic dimensions of these fisheries, it indicates that artisanal or small scale fisheries are: traditional fisheries involving fishing households (as opposed to commercial companies), using relatively small amount of capital and energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, mainly for local consumption. Artisanal fisheries can be subsistence or commercial fisheries, providing for local consumption or export. They are sometimes referred to as small scale fisheries"(FAO 2014, 20)

2.2 Empirical literature Review

2.2.1 Views of Efficiency on Fish Problem

Efficiency is associated with maximizing the net benefit from the use of the resource. By the current generation, the over commitment of resources fishing: too many boats, fishermen, too much effort. As a result, current fishermen earn a substantially lower rate of return on their efforts. Overfishing reduces the stock, which in turn lowers future profits from fishing .Each boat would receive a profit equal to its share of scarcity rent and in open access resource results in overexploitation. The individual fishermen have an incentive to expand further effort until profits are zero. At profit zero or average revenue equal with average cost the contemporaneous external cost is too much effort level is being expanded to catch too few fish and the cost is substantially higher than it would be in an efficient allocation.

Many fisheries are currently plagued or faced with inefficient MSY and the owner is not encouraged to invest in the resource and undertake measures that will increase the productivity (yield) of fishery. Like adding certain nutrients to water or controlling temperature (aquaculture) can markedly increases the yield of some species therefore, there is higher effort leaves and small stock of fish remains in the Lake or Ocean for example Japan is well known in the aquaculture activity. In fishing activities, the harvest level is where the net benefit to the fishermen is maximized (T. Tietenberg, 2009).

2.2.2 Marketing Constraints of Fish Production

The major marketing constraints faced by the fishermen are physical access to landing point's, collector boat collection points and road side traders, price also insufficiently remunerative to fishers particularly reflecting the high costs of landing to the caught fish and loss of quality because of limited options for conservation and distance from trading points. These will be explored clearly that acts as a braked of fishing activity rapidly increase the effort level of fishing and this also causes for dawn ward the profitability of fishermen of Ethiopia and other developing Countries (Share Alike L,2014).

Currently, in Lake Chamo there are 17 different landing points; access to this landing point is often difficult. Fishing techniques are also very few motorized boats and the predominant boat is the reed (papyrus) tanqwa. It is even difficult to obtain certain materials for nets (lead rope and floats).Gill

nets are the most common, but there is also some use of costs nets and line fishing. Even if, the fishermen also don't live by the Lake side but they will comp for periods of up to one month. The selection of a camping site is based on the availability of collecting boats and the expected catch on the nearby fishing grounds. There are about thirty camping sites, but only twenty are regularly occupied. Out of these twenty only three are accessible by land which is very difficult for fishermen in supplying on the right time to the market this also makes inefficient benefits from the Lake (WARMO, 2014)

2.2.3 Fish Production in Ethiopia

Aquaculture is a food production technology where by fish or other aquatic organisms are grown in managed system that produce greatly harvest than would natural occur. It Ethiopia over 200 species of fish are known to occur in lake hivers. The major lake of fish diversity found in Ethiopia are chemo, Abaya, Hawassa, shalla, LanganoAbijata, ziway,koka,Tana and fincha (FTo,2000).

Development and management of aquatic resources in Ethiopia is largely at the early stage commercial fishing is new practices in Ethiopia lakes and it was started in the 19505.The production in most Ethiopia yield (30-40%) of an average (FAO, 2001). Ethiopia contains more than 1000km2 of land water bodies such as lakes and rivers. These water bodies are home to the varied species of fishes.The major rivers includes abay, awash, baro, Gibe. Omo, Tekezze and wabisheBella.Fishery resources of those rivers are not properly exploited and neither the current production any estimate of potential is known currently. The rift valley lakes (lakeHawassa, chemo, Abaya, Langano and ziway) are major source of fish production in Ethiopia (Hableetalj 2002).

2.2.4 Challenges of Fish Production

Like for most of Africa, Ethiopia is riddled with poverty, economic stagnation and environmentally unsustainable practices, all of which pose serious constraints to fisheries development. However, ample opportunities exist for the sector to help reverse national development challenges by making a significant contribution to poverty alleviation, economic growth, better nutrition and ecological improvement. Dual problems of food security and poverty are major and immediate challenges .for Ethiopia where about 45 percent of the people live below the poverty line, with the level of impoverishment being worse in rural areas where 85percent of the population live (FAD, 2015).

Several studies have shown that the growth of fisheries catches worldwide has slowed down since the 1970s, and indeed reversed since the late 1980s (FAO, 2002; Paul *yet al.* 2002). The decline is

due to several factors; overfishing, ecosystem changes due to destructive fishing practices, discarding of by-catch, and pollution of coastal waters. The reality is, however, quite the opposite. Many nations choose to become competitive in the race for the last fish, through expansion and modernization of fishing fleets that go fishing farther, deeper, and stay longer at sea (Pauly and Maclean, 2003).

According to (FAO 2015) sewage of factories and agriculture are the sources of major pollutants affecting Ethiopian water bodies and their fishes. This poses serious constraints fisheries. The extraction of minerals from Lake Abijata could have negative effect on fish stocks, just as the effluents from the tannery at Koka Reservoir and the textile industries at Awassa and Arba Minch can affect the fisheries. Also, the increasing rate of deforestation could result in increased drying up of water bodies and increase in water turbidity. Further, the dam on River Omo has negatively affected the *anadromous*fish which migrate from Lake Turkana to spawn in the Journal of Economics and Sustainable Development.

According to FAO (2015), Ethiopia's fishery production has been overexploited due to lack of adequate knowledge and skills of the fisher men towards integrated fish product they are not able to maximize their productivity. Because fisheries technology is continuously changing, many skills are needed for use of these techniques by the fisher men in increasing production. For this reason it is necessary to arrange timely training programmers to acquire necessary knowledge and skills in different aspects of improved integrated fish product. A well trained integrated fish farmers able to ensure more fish production. Meenambigai and Seetharaman (2003) asserted that training is the most singular factor affecting individuals' attitude, productivity, improvement, minimization of risks. So, adequate training is essential for the integrated fishermen on integrated fish product. And also due to Inadequate legal and policy frameworks have largely given rise to poor fishery resource exploitation resulting, in some cases, in the overfishing of some important species, such as the Nile perch in Lake Chamo, and tilapia in Lakes Awassa and Ziway.

Though there are fishery laws and regulations currently in place, these legislations are inadequately implemented. These include: declining fish stocks in the natural water bodies, conflict between various users of fisheries resources, cross-border fishing and trade conflict, fish marketing, fish quality and post-harvest issues, lack of a comprehensive fisheries policy and a fisheries master plan, low funding levels for the department and slow capacity building and staff motivation. These coupled

with lack of proper extension services in the rural areas can adversely affect the output of the projects (FAO, 2007).

2.2.5 Opportunities of Fish Production

Attractive fish prices at local market for better profit; the presence of diversified fish species; and inhabitants' traditional knowledge for fisheries and good consumption habit are considered as occasion for the sector escalation. In addition, availability of gotera/kefo a locally made fishing gear which has a hive like structure is the best practice for fish catch. Because fishers let small fishes out to the water body while they are collecting their catches. This system enables fishers to be selective or non- selective which depends on the size and preference of the fishers. Fishers have a good practice in the post-harvest processing, which is either fresh or gutted when there is demand for fish or sun-dried form during surplus of production (FAO 2015).

In addition, the future fishing villages' offers homogeneous and less dispersed pastoral communities which are ideal for social mobilization for poverty alleviation programs. Reservoir fisheries require minimal initial investment and provides quick returns compared to other economic activities. Access to microfinance facilities, which have received strong internal and external support, will therefore promote rapid development of fisheries, especially for the benefit of women and youth.

It does not also require sophisticated skills and knowledge for the entry and coping up with operation at small scale level. The regional pastoral extension program can rigorously conduct an extension service and provide training to the communities not only this while the supply from capture fisheries is lagging behind, the demand for fish is growing in Ethiopia, this offers opportunities for Aquaculture businesses to play a role in improving fish production and expanding the fish markets opportunities much land is suitable for aquaculture in Ethiopia and for most system (earthen pond, concrete pond, cage in lake and more). Absence of social and culture taboo in fish consumption is also another asset for fish production in Ethiopia (Erkie, *et al*., 2016).

The current global concern for integrated watershed management; global and local support for conservation of natural resources; and policy provisions of Environmental Protection Authority of Ethiopia can be taken as opportunity to the eco-development of lake- wetland ecosystem. The highly productive nature of the lake and its potential to harbor mammals, reptiles, and birds in harmony

makes the lake Chamo fortunate to pay attention. The hospitality to maintain and preserve nilotic species that were supposed to be remained at the time of connected river network of Abaya-Chamo-Chewbahir-Turkana- Nile basin calls for strong consideration for conservation.

The lake- wetland resource could be taken as a fertile ground to establish aquaculture and crocodile ranching using finger ponds for commercial fishing. Such approaches would potentially reduce the pressure on natural lake resource, reduce overexploitation, promote sustainable utilization and also can also be used as alternative means to generate income. Besides, the resource from fish processing (fillet) considered as 'waste' could be used as a cheap source of protein to feed people under proper sanitation. It may also be used as feed for poultry and crocodile ranching establishments as win-win principle of eco- sanitation. Such establishments can be used as training centers of the fishery community to create awareness for its eco-development. The regular flow of inputs from upstream of the watershed, the existence of permanent rivers (Kulfo and Sille) and the spring waters emanating from the dense groundwater forest made the lake wetland ecosystem to harbor unique habitats for terrestrial, wetland and aquatic species that have economic and scientific significance.

NechSar National Park and Arba Minch University being in close proximity to this area provides a golden opportunity to monitor Lake Limnology and conduct researches on ecological and catchment treatment options. This would result in sustainable utilization of Chamo lake-wetland ecosystem. It can be concluded that with sustainable utilization of resource a participatory management plan that considers the social values and indigenous knowledge is important for the fish production of the region. Hence, an integrated watershed management, which is sensitive to the lake- wetland catchments, as well as, upstream and downstream linkages needs to be considered.(AlemayehuHailemicael and A. J. Solomon Raju 2010).

2.2.6 Socio-Economic Importance of Fish Production

In Ethiopia Sustainable fisheries management is crucial to food security, poverty alleviation and economic growth. Fisheries are thus acknowledged as an important strategy in the drive for poverty reduction. It helps to promote greater economic development in Ethiopia. In 2010 Ethiopia realized about USD 14,000,000 from its capture fishery while a total of 40,000 livelihoods were positively impacted upon by the fishery sector in the same year (Assefa, 2014).

Fish plays a vital role in domestic trade as well as in import and export market. The Ethiopian cross-border fish trade is currently not properly documented. The country imports significant amounts of fish from neighboring countries though some of these imports end up being exported to Sudan through the porous border with neighboring South Sudan. The per capita fish supply is around 200 g, significantly below the mean 2.6 kg per capita per year for the East African sub region (FAO, 2015). Although most fish traders do not have access to basic cold chains with ice and insulated containers, a few basic fish handling and preservation institutions which are equipped with electricity and freshwater supplies are available in the Ethiopian fisheries. By such a ways many people are engaged in this sector as source income. As a result of the general shortage of basic cold chains, consequently, fish marketers concentrate their trade during religious fasting periods when there is more demand (Ann et al., 2013).

Consumption of fish has several healths, nutritional, environmental and social advantages over other terrestrial animal meat. Even when consumed in small quantities, fish often comprises a nutritionally important part of many people's diets in developing countries. It is a vital source of protein and micronutrients, and improves the quality of protein in largely vegetable and starch-based diets by providing essential amino acids. Fish provides nutrients and micronutrients that are essential to cognitive and physical development, especially in children, and are an important part of a healthy diet. As an affordable animal source of protein in some of the poorest countries, fish is the primary source of nutrition, creating growing demand for this staple. Therefore, fisheries are regarded as an important sector in the effort to increase animal protein consumption and achieve food security for the growing population (FAO, 2014). National fish demand is somewhat seasonal, as religious observances exert strong influence on fish consumption patterns. During Lent, for example, Christians, especially of the Coptic Orthodox Church, who are required to refrain from eating meat, milk and eggs, resort to fish as a substitute? The domestic fish demand is significantly robust during two short periods of the year when the Orthodox Church encourages fish consumption.

These periods are the fasting seasons in February to April, and two weeks in August, totaling about 80 days. Large quantities of fish are consumed at periods of religious fasting in the cities, around major fish production areas such as the Great Rift Valley lakes, and major towns, particularly in Zeway, Arba Minch, Bahir Dar and the capital Addis Ababa (FAO, 2015).

Employment in the fisheries sector has grown more rapidly than both world population and employment in agriculture. A considerable workforce is employed, both directly and indirectly, by Ethiopia's capture fisheries which also help in sustaining local communities. Whereas 4052 persons were employed directly by the sector in 2010, a total of 9148 others benefited from indirect employment offered by the sector. Therefore, sector is a good means to create job opportunities for rural, pre-urban and urban unemployed and under employed people. This is especially so around the Great Rift Valley and areas surrounding the lakes, reservoirs, rivers and other small water bodies with major fishing activities (Alazar, 2016). The rural areas of Ethiopia where substantial fishing takes place benefit from the economic activities of the fishers and their related operations.

In those areas, much more than in the urban and per-urban centers, fisheries are increasingly recognized as an alternative means of addressing the problems of food security and poverty, consistently with the rural development objectives of the sector. There is a national awareness that rural areas and the agricultural sector, which support more than 80 percent of the total population, are the basis for bringing about rapid and equitable economic growth and development in the country (FAO, 2014).

2.2.7Demographic and Fish Production

Education levels of entrepreneurs have been identified as factors that influence the performance and success of enterprises (Rutherford and Oswald, 2000; Man et al., 2002). For example, even though two different studies have shown that the manager‘s level of education is a significant determinant of the growth of enterprises, the strengths of the relationships were not statistically significant, suggesting that the level of education did not actually matter in explaining the growth of small scale enterprises (McPherson, 1996); (Unger et al., 2011). However, other authors have identified education and training as contributors to the growth and success of small enterprises (Simpson et al., 2004; Kolstad and Wiig, 2013).David L. Ortega (2012) Consumers are increasingly aware of the quality and safety of the aquaculture products they consume. As dynamic demand from consumers requires changes in the production and marketing of aquaculture products, suppliers are faced with decisions regarding the adoption or discontinuation of various practices regarding the production and marketing of their aquaculture products.

Midwest aquaculture producers and retailers face difficult supply management and food safety decisions partially due to significant uncertainty regarding American consumers‘WTP for various food product informational attributes.

According to Ofuoku A.U (2008) in his research on educational level of Respondents indicated that majority (68.3%) of the fishermen were in the age bracket of 41-50 years, while 22.5% were on the age bracket of 31-40 years.This implies that most of the fishermen were between the ages of 31-50 years. This indicates that very few young and old people are involved in fish production. This is because fish production requires adequate attention and a lot of sense of responsibility. The young people in the rural communities mostly pursuing tertiary education between the ages of 20-30 years and pay much attention to their studies that they have little or no time for other serious activities, people above the age of 50 were few in fish production because they lack adequate stamina required in the management of fish production. Males (93.3%) dominate fishermen. The male dominance of this rural source of livelihood implies the laborious nature of fish production operations right from pond construction to management which their female counterparts cannot easily undertake.

Harvey (1993) investigated on factors affecting the frequency of purchase of fish and other seafood for at-home and restaurant consumption by Northeaster consumers in his Cluster analysis, he identified six groups of consumers with similar perceptions of the attributes of fish. Demographic and cluster membership variables were employed in logistic regressions to identify the characteristics of frequent at-home use and restaurant purchasers.

At-home purchase was more likely to be frequent among respondents with white collar occupations, older ages, urban/suburban and New England residence, recreational fishing participation, and membership in one of five attitudinal clusters.Restaurant purchase was more likely to be frequent among whites and among those with higher incomes, white collar occupations, and recreational fishing involvement and among members of two clusters with favorable attitudes toward fish; it was less likely to be frequent in households with children age 10.

Medwell journals ((2010) research aims to determine the socio-economic factors that are effective on fish production. Through clarifying these factors, the study attempts to bring proposals towards increasing fish consumption which is vital for adequate nourishment.. It is seen that this group of households has lower and middle income with lower literacy level living in large families and is generally within the middle-age group. On the other hand, a smaller percent of the household 13.05%, substitutes fish only for chicken. Another important finding of the research is that a much larger group of the households, 78% with higher income, higher educational level in the older age group and covered under pension scheme has a higher propensity to buy or consume fish. According to the results of the analysis, the most effective factors on fish consumption can be stated as price

and dietary attributes. Therefore, it is concluded that by setting themarket price of fish in line with different household income levels, dietary habits might change as well.

2.3 Theoretical literature review

Biological Theory of Fisheries Management states that as populationincreases, so fishing effort increases. It increases pressure on the original stock offish. Maintaining effort is therefore necessary where fish stock has been depleting.The theory has been formulated by Milner B. Schaefer, an American biologist, in1954. The Schaefer model had identified the relationship between sustainable Yield and population arid fishing effort. He assumed that fish stock increases atvarious rates, depending on its initial weight, recruitment, individual growth andmortality rates. Catch responds to changes in population and fishing effort(Korakandy, R., 1996).

The theory of Fisheries Management under Common Property System byFrancis T. Christy Jr. and A.D. Scott (1985) analyzes the working conditions ofthe common property system in marine fisheries where there was no restriction onentry. This would lead to reduced profit and fall in sustainable yield and also torising cost, falling revenue and reduced sustainable yield, with the possibility ofloss and even extinction of the industry.Christy and Scott believed that restrictions are essential for efficientutilization of resources. However, R. Korakandy (1996) opines that theserestrictions will be socially unacceptable and fishermen may object to theconversion of common property resources into private property rights. Christyand Scott also considered limiting entry by licensing or restriction on quotasystem, which are considered to have a negative effect on employment andearnings.

2.4 Research Gap

The knowledge gap that is going to be addressed in this study is that despite the fact that the current global concern for integrated watershed management; global and local support for conservation of natural resources; and policy provisions of Environmental Protection Authority of Ethiopia can be taken as opportunity to improve fish production with sustainable utilization of resource a participatory management plan that considers the social values and indigenous knowledge is important for the eco-development of the region. Hence, an integrated watershed management, which is sensitive to the lake- wetland catchments, as well as, upstream and downstream linkages needs to be considered.(AlemayehuHailemicael and A. J. Solomon Raju 2010).

Due to lack of adequate knowledge and skills of the fish products towards integrated fish farming they are not able to maximize their productivity. Because fisheries technology is continuously changing, many skills are needed for use of these techniques by the fishermen in increasing production. For this reason it is necessary to arrange timely training programmers to acquire necessary knowledge and skills in different aspects of improved (FAO,2015).

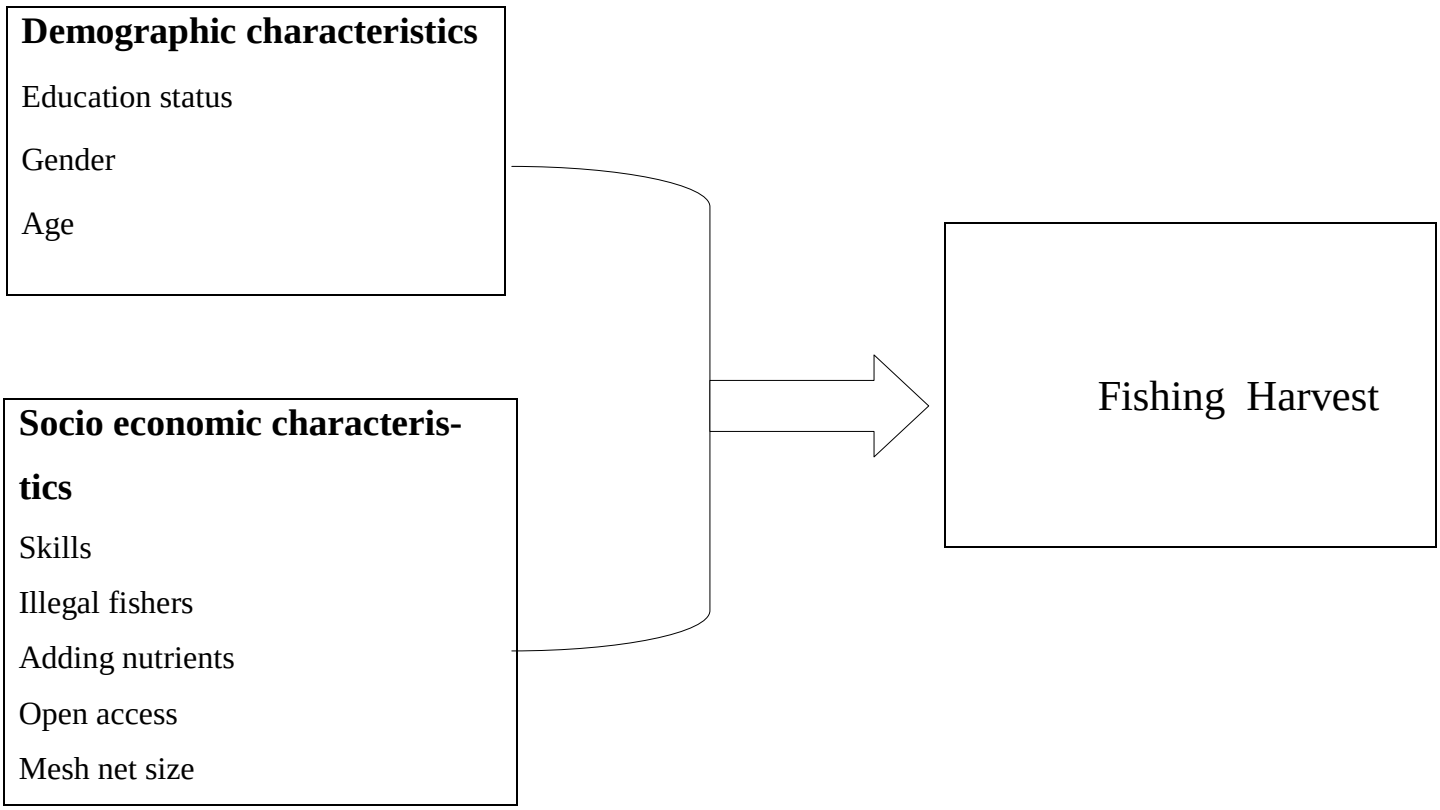
Medwell journals ((2010) research aims to determine the socio-economic factors that are effective on fish production. According to the results of the analysis, the most effective factors on fish production can be stated as price and dietary attributes. Therefore, it is concluded that by setting the market price of fish in line with different household income levels, dietary habits might change as well.

This paper differs from mulugeta H. by time variation and method of analyzed and presentation which was done in 2008 on Lake Chamo this research is done in 2019 by using MLRM model.

2.5 Conceptual framework

Mugenda (2008) defines conceptual framework as a concise description of the phenomenon under study accompanied by a graphical or visual depiction of the major variables of the study. According to Young (2009), conceptual framework is a diagrammatical representation that shows the relationship between dependent variable and independent variables. Following the resource-based perspective, it was hypothesized that skills ,education status, gender, open access, age, adding nutrients for fish, mesh net size, illegal fishers have an effect on the fishing harvest at lake chamo. The variables were developed based on the literature review and the purpose of the study. The figure 2.1 presents the conceptual framework for this study.

Figure 2.1 Conceptual frame work



Source: modified from Ojijo grace auma, 2016

CHAPTR THREE

Research Methodology

3.1 Research design

A research design is a programme that is used to generate answers to research problem. Descriptive survey methods were utilized to address the questions posed for this study. Geneserth(1984),defines descriptive survey as a method of collecting information by administering questionnaires. This method was adequate for the study because it provided both qualitative and quantitative descriptions of a sample of the population.

3.2 Description of the study area

The research is conducted at Lake Chamo wholly situated in SNNP in GamoGofa Zone in Arba Minch town which far from the town about 10km and located 5 40'N: 37 37'E. The altitude is 1282m, the surface area is 350km square and depth 13m max, and 6m mean with a volume is 2.1km cube. It has a much more diversified than other lakes In Ethiopia. Stock assessment studies made by LFDP the estimated maximum potential yield of the lake is about 4500 t per years Before fish resource depleted most of the ArbaMinch people were engaged in fishing activity , preparation of fishery materials like boat, net prepare and processing of fish product trading like opening fish food selling in hotels and so on. But, now due to the decline of fish production resources the people who was engaged on this activates become unemployment (MulgetaH, 2008).

3.3 Data Collection Method

This study used both primary and secondary data sources. The primary data was collected from the randomly selected respondents through distributing structured questionnaires that include open and closed ended questions. The questionnaires contain a serious of questions which asks each sample of fishermen that selected randomly from cooperative at the Lake. While the secondary data were obtained from written documents (Journals, Books and internets).

3.4Samplesize and sampling technique

Simple Random sampling techniques utilized to the respondents. This gives equal chance for each and every respondents to avoid sample bias and ensure that the results be reliable and enough to be generalized. The sampling technique play enormous role for the accuracy and validity of information. Sampling is the procedure of selection a sample of population from the entire population of the organization. Selecting sample is fundamental for research study. Because taking the total population impossible due to time constraint. So the sample techniques will used. Therefore, the researchers have to determine sample which representative for the total population. Yamane (1967:886) provides a simplified formula to calculate sample size of finite population, which used to determine the sample size for this study paper.A95% confidence level was assumed for this formula to determine the sample size. At e= 0.05. The sample size will be determine by the following formula

n=**N/1+N (e)^2**

Where:

n= is sample size

N= is the population size

e= is the level of precision

Therefore, the sample size of this research is 80 fishermen as respondents and the sampling frame isGamoGofa Zone animal and resource management office.

3.5 Data Analysis Method

In these study two types of data analysis, namely descriptive and econometric analysis were used for analyzing the data collected from fishing harvest. Descriptive statistics was used to compute the demographic and socio economic characteristics of the respondents. This involved calculationof (percentages, ratio, frequency, significant intervals and t-test).Descriptive statistics were analyzed and described quantitavely by use of SPSS 20 Version.An econometric analysiswas used to analyze the determinants of fishing harvest in the study area .Multiple linear Regression model was adopted for the analysis econometric issues. Variables, which play significant role to analyze the determinants of fishing harvest in Chamo Lake, were analyzed through this model.

3.6 Model Specification

The study used inferential statistics which allows inferring from the data through analysis the relationship between two or more variables and how several independent variables might explain the variance in a dependent variable. The following inferential statistical methods were used in this study. In multiple linear regression models, the dependent variable is explained by means of a set of independent variables. In this analysis, a multiple linear regression analysis was used to test whether or not the key independent variables were related to the dependent variable. The multiple linear regression analysis was chosen because the dependent variable takes a continuous measure.

For the analysis of this study, the multiple linear regression models that were used to estimate are formulated as follows: Fishing harvest = f (skills , education level, open access, illegality, adding nutrient, net size, age and Gender).The general multiple linear regression models are specified as:

LnFP=B0+B1lnSK+B2lnIL+B3lnED+B4lnOA+B5lnNS+B6lnAN+B7lnAG+B8lnGE+U

Where LnFP= the logarithm of fish production

B0= the intercept term

u=the error term

SK =skill of respondents

ED = education level of respondent

IL = illegal respondents

OA = open access of fishing system

NS = net size

A N= adding nutrients in to the lake as food for fish

AG=Age of the respondents

GE=gender of respondents

3.7Definition of Variables

Dependent variables

Fishing Harvest: This refers to an economic activity involving catching fish for either domestic use or as a source of income. And is dependent variable, which is a continuous category

Independent Variables

Below described explanatory variables were hypothesized to influence the dependent variable fishing harvest:

Gender: This is Dummy variable that takes a value of one if the houses hold head is male and zero otherwise.Sex difference is one of the factors expected to influence fishing harvest .Due to many socio-cultural values and norms, males have freedom of mobility and participation in different meeting and consequently have greater access to information(Techane,2002)..

Education level is a dummy variable and measured using formal schooling of the house hold head was supposed to determine fishing harvest. Education plays an important role in the fishing harvest.

Age: It is a continuous variable and measured in year .This can be seen in two ways: aged households may be believed to be wise in resource use and old aged household cannot possess active labor. Therefore, it is not possible to predict in advance about the likelihood sign of the coefficient of age.

Fishing net: in their most common form size aim at allowing immature fishes to escape capture by gill nets. Mesh net size should be based upon knowledge of the reproductive biology of the stock and the selectivity of the gear considered Cycon(1986 cited in Desalegn Tadese,2005).This method may alleviate the declining fishes in the lake. It takes a dummy values 1 for wide size, 2 medium and 3 for small net size.

Open Access: is the condition where access to the fishing (for the purpose of harvesting fish) is unrestricted: the right to catch is free and open to all. It was measured as dummy variable taking a value 1 for those states open access fishing system and 0 for those who states the fishing system is closed access.

Illegal fisher ::are who are not member of cooperatives but are still in fishing and is dummy variable taking 1 for those not member of cooperative and 0 those member of cooperative.

Skill: skill fishery responsible for harvesting fish and Represents dummy for skill of Respondents: and assumes 1 if the Respondent is gained trained and 0 otherwise.

Adding Nutrients: Represents the dummy for adding nutrient in to the lake and assumes 1 if the fishers add nutrient added in to the Lake and 0 otherwise.

CHAPTER FOUR

RESULT AND DISCUSSION

In this section, the data collected through different data collection methods and tools are discussed and analyzed carefully in order to show and assess determinants of small and medium fish production in the study area. Eighty questionnaires were distributed. All respondents completed and retrieved successfully, representing 100% response rate.

4.1 Descriptive Analyses

In this chapter, the collected data are analyzed and interpreted. The questionnaires which were distributed among the respondents of Lake chamo, to analyzing the determinants of fishing harvest at Lake Chamo. Out of 80 questionnaires distributed among the respondents all are returned. In line with this, all information's that are gathered from the selected respondents are going to analyze through using tabulation method and for the econometric analyzed by using MLRM model.

4.1.1 Socio Economic Characteristics of Respondents

Table 1: Skills of Respondents

Skill of Respondents	No of respondent	Percentage
Trained	71	88.8%
Untrained	9	11.3%
Total	80	100

Source: own survey, 2019

Table 1 shows that out of the total respondents that have trained about fishing techniques before they starting fishing activities were 88.8% and the remaining 11.3% of the respondents were untrained about fishing technique before come to fishing activity in the corporative. In line with this, we can see from the above table, most of the respondents were skilled about fishing techniques when they came to cooperative. So there is training center and professional fishermen that can give fishing technique for the participants of fishing.

Table 2. Illegal of respondents

illegality	Number of respondents	Percentage (%)
Yes	67	83.7%
No	13	16.3
Total	80	100

Source: own survey, 2019

The above table indicates that, out of the total respondent's 83.7% of the respondents illegal, 16.3% of the respondents shows legal .So we can understand from the above information, there were high number of illegal respondents, no limitation of how much to catch, there is less controlling mechanism for the natural resources of the Lakeand poor waste management efforts that would result in eco-degradation and ultimately loss of biodiversity.

Table 3 fishing system

Fishing system	No of respondents	Percentage
Closed access	28	35.0%
Open access	52	65.0%
Total	80	100

Source: own survey, 2019

From table 3 we can see that out of the total respondents 65.0% of the respondent's states that, the fishing system is open access that everyone can be participates in fishing activities and while the remained 35% of the respondents stated that the fishing system in the Lake is closed system. So, we can understand that most of the Respondents were can enter and out from the fishing Activities at every time. Therefore, the open access system it can be one of the main causes for overfishing and decline the fishing harvest atLake Chamo.

In addition to this open access fishing system leads to over exploitation of fish stock over time and all most equal revenue with costs of the respondents that results the net benefit of the Lake is zero.

Table 4 Adding of Nutrients in the Lake

Adding of nutrients	No of respondents	Percentage
Yes	59	73.8%
No	21	26.3%
Total	80	100

Source: own survey, 2019

The above table tells as, out of the total respondents 26.3% of the respondents were explains, there is no any activity of adding nutrients on to the Lake that can help for fish as a source of food but the remained 73.8% of the respondents were shows existences of the activity of adding nutrients on to the Lake this can affect positively for fishing harvest. In general, as we see from the above table the activity of adding nutrients as food for fish on to the Lake is very high this also results to increase the harvest of the fish in the Lake.

4.1.2 Demographic characteristics of Respondents

In order to describe the demographic characteristics of fishing harvest sample Respondents; Age, sex and education level variables were used. Appendix 2B shows the average Age of the sampled fish producer Respondents were 32, the maximum age was 45 and the minimum age of the sample respondents were 19. The community comprised mostly of middle aged harvester averagely.

Table. 5 Educational Statuses of Respondents

Education level of Respondents	No of respondents	Percentage
Less than high school	28	35.0%
High school	24	30.0%
Above high school	28	35.0%
Total	80	100

Source: own survey, 2019

The above table shows that out of the total respondents, 35% of the respondents are less than high school and the remained 35% and 30% are have high school educational levels respectively. So from the above table, we can deduce that most of the respondents are less than high school and above high

school which leads to less level of fishing harvest in the area. Because, when the Education Level of the respondents increase goes to another type of worker better from harvesting fish and focuses most of the time on their study. Respondents with less than high school increase harvest every time then less number of fish stock remains for the next time and that requires higher effort level which leads to decrease the net benefit of fishing harvest from the lake.Because they have inadequate knowledge on the harvest practices.

Table 6 Gender of respondents

Gender	Frequency	Percentage
Male	67	83.8
Female	13	16.3
Total	80	100

Source: own survey, 2019

The women's policy in Ethiopia was primarily aims to institutionalize the political, economic, and social rights of women so that all Ethiopian women and men were benefited. Even though different strategies were developed to tight the gender gap between male and female in political, economic participation, decision making and control over resources there are still challenges especially in rural part of Ethiopia. The ownership and control over resources especially fishing harvest were solely mandated to male, and women can only harvest when her husband died. The same is true in the study area. The descriptive statistics analysis has shown that out of 80 sample respondents 84% of the Respondents were male, while women were only 16%.

4.2. Econometric Analysis

Finding the determinants that contribute to fishing harvest goes beyond the descriptive analysis and requires employing econometrics analysis as it was mentioned in the methodology. It was briefly presented so far, now it is presented in details with analysis and interpretation of the estimates. Before the model was fitted in this section, the validity of the assumption imposed on the model was tested. The validity tells the significance of the determinant variable and the predictive efficiency of the model.

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Table 7 .Types, codes and definition of variables in the model

Types	Codes	Definition
Dummy	GE	1,if household head is male;0 otherwise
Dummy	SK	1,if fishermen trained ; 0 otherwise
Dummy	AN	1,if yes; 0 otherwise
Dummy	IL	1, if yes; 0 otherwise
Dummy	OA	1,if open access:0 otherwise
Continuous	AG	Number of fishermen in year

Source: Owen Survey 2019

4.2.1 Diagnostic Test

Under these section methods of detecting for breakdowns of the classical assumptions was dealt. With experience, one should develop the habit of doing the diagnostics before interpreting the model's significance, explanatory power, and the significance and estimates of the regression coefficients. If the diagnostics show the presence of a problem, it is a must first to correct the problem and then interpret the model. The power of a regression analysis (after all, it is extremely powerful to be able to say that "data shows that X causes Y by this slope factor") is based upon the fulfillment of certain conditions that are specified in what have been dubbed the "classical" assumptions. If a formal diagnostic test usually a hypothesis testing approach that involves the use of testing against distributions like the T, F, or Chi-Square confirms the breakdown of an assumption, then we must attempt to correct for it. An "informal' test typically refers to a graphical test.

A. Multicolinearity Test

However, before fitting the model, it was important to check whether serious problem of multicollinearity and association exists among and between the explanatory variables of the model estimation. We can assess multi co linearity by examining tolerance and the Variance Inflation Factor (VIF) is two co linearity diagnostic factors that can help to identify multicollinearity.

Tolerance is a measure of co linearity reported by most statistical programs such as SPSS; the variable's tolerance is 1-R2. A small tolerance value indicates that the variable under consideration is almost a perfect linear combination of the independent variables already in the equation and that it should not be added to the regression equation.

All variables involved in the linear relationship will have a small tolerance. Some suggest that a tolerance value less than 0.1 should be investigated further. If a low tolerance value is accompanied by

large standard errors and no significance multicollinearity may be an issue. Similarly, The Variance Inflation Factor (VIF) measures the impact of co linearity among the variables in a regression model. The Variance Inflation Factor (VIF) is 1/Tolerance, it is always greater than or equal to 1. There is no formal VIF value for determining presence of multi co linearity. Values of VIF that exceed 10 are often regarded as indicating multi co linearity, but in weaker models values above 2.5 may be a cause for concern. In many statistics programs, the results are shown both as an individual R2 value (distinct from the overall R2 of the model) and a Variance Inflation Factor (VIF). When those R2 and VIF values are high for any of the variables in your model, multicollinearity is probably an issue. When VIF is high there is high multicollinearity and instability of the b and beta coefficients. It is often difficult to sort this out.

Table. 8 Multi-CoLinearityTests

Variables	**VIF**	**1/VIF**
Skill	1.453	.688
Illegality	1.108	.902
Education	2.548	.392
Open Access	1.151	.869
Net Size	2.532	.395
Adding Nutrient	2.096	.477
Age	1.098	.911
Gender	1.119	.894

Source: Owen Survey 2019

The Average VIF=1.64, Therefore there is no Multi-Collinearity problems

Test for Autocorrelation

Durbin Watson test has been conducted to test presence of autocorrelation among variables .according to Durbin Watson significant table ranges in value 0 to 4 .A value near 2 indicates non-

autocolinearity. A value towards 0 indicates positive auto correlation; a value towards 4 indicates negative auto correlation. Therefore the Appendix 2D foe assessment of auto correlation indicates a value of near 2 that suggest there is no autocorrelation problem.

Correlation Analysis

Pearson Bivariate correlation coefficient was used to compute the correlation among the independent variables. According to Sekaran (2008), this relationship is assumed to be linear and the correlation coefficient ranges from -1.0 (perfect negative correlation) to +1.0 (perfect positive relationship). The correlation coefficient was calculated to determine the strength of the relationship among independent variables (Kothari, 2013). From Appendix 2D, shows the low existence of association between the variables. All the Variables were included in the model as well.

Normality Test: - From Appendix DA graphical tool for assessing normality is the normal probability plot (P-P plot), a quantile-quantile plot (Q-Q plot) of the standardized data against the standard normal distribution. Here thecorrelation between the sample data and normal quintiles (a measure of the goodness of fit) measures how well the data are modeled by a normal distribution. As it indicated in the *figure Appendix 2E.*The normal data the points plotted in the Q-Q plot should fall approximately on a straight line, indicating high positive correlation. These plots are easy to interpret and also have the benefit that outliers are easily identified.

Heterscedasticity

If the error terms do not have constant variance, they are said to be heteroskedastic.Heteroscedasticity can arise as a result of the presence of outliers. An outlier is an observation that is much different than the other observations in the sample.As it is indicated *in the Appendix E* the error terms have constant variance. The residual is normally distributed; plot sample quantile for the residual against the theoretical quantile from standard normal distribution are on the 45 degree line, we can conclude that there are no heteroscedasticity problems. The classic picture of a homoskedastic situation, when the vertical spread of the data around predicted line fairly constant. The plot of explanatory variables of the respondents and the residual has no pattern, which implies that there is no heteroscedasticity caused by the explanatory variables. There are also no outliers observed in the sample as it can be seen from P-P and Q-Q plots for individual variables.

Omission of Variable test: - As Appendix 2G shows the fitted values the model has no omitted variables since the test failed to reject the null hypothesis. As a result this model was ready for analysis.

Model Analysis

In order to test the research hypotheses, model analysis was conducted using fishing harvest as the dependent variable, and the Open access ,Illegal fishers ,skill ,education level adding nutrients ,net size, age and gender were as determinants of fishing harvest: as the predicting variables. . From the model summary in table it is clear that the adjusted R2 was 0.829 indicating that a combination of independent variable explained 83% of the variation in the fishing harvest of the lake chamo.

From the appendix D it is clear that the model is significant in predicting how the independent variables determine fishing harvest in Lake Chamo. The model achieves a high degree of fit as reflected by an R2 of 0.847.

Table 9.Result of MLRM Regression Analysis

Model	Coefficients	Beta	SE	t-value	P-value
Constant	7.535		1.463	5.149	.000
Skill	1.350	.148	.510	2.646	.010
Illegality	.517	.066	.382	1.354	.180
Education	-1.916	-.557	.255	-7.507	.000
Open Access	-.583	-.097	.301	-1.939	.057
Net Size	.581	.165	.260	2.233	.029
Adding Nutrients	1.058	.162	.440	2.404	.019
Age	-.012	-.029	.020	-.595	.554
Gender	-.631	-.081	.384	-1.646	.104

Source: Survey result, 2019

Number of Observation 80

R Square . 847

Table 10 represents the regression results on how the dependent variables determine fish production of Lake Chamo. Eight independent variables that are hypothesized to determine fishing harvest in the study area were included in the model. The model output revealed that skill of respondents ($p<0.05$), Educationstatus ($P<0.01$), Size of net, Adding nutrient ($p<0.05$) and Open access were found to be significantly determine fishing harvest. While the remaining Three variables, namely, Illegal respondents, Age of respondents and Gender of respondentswere not statistically significant ($p>0.1$).In light of the above summarized model results, possible explanations for each independent variable are given consecutively as follows:

Skills of Respondents

On regression analysis, there was positive and significant effect of skill of fishermen on fishing harvest at Lake Chamo. This could be interpreted as increase 1.350 tons per year in the fishing harvest scores forevery unit increase in skill, assuming that all other variables in the model are held con-

stant. Hypothesis testing was also carried out using the standard multiple regression analysis and theHa1 was accepted.

Illegal Fishers

The Regression Result shows there were positive and in significant relationship between Fishing harvest and illegal respondents. This could be interpreted as increase of 0.527 tons per year in the Fishing harvest score for every one unit increase in illegalrespondents,assuming that all other variables in the model held constant. The result failed to accept the Ha2.

Education Level of Respondents

The survey result shows a negative relation between Educational status and fishing harvest. This could be interpreted The fishing harvest as decreases by 1.916 tons per year in the education level of the respondents increases from year to year , assuming that all other variables held constant. That mean aseducationallevels of Respondents increases from year to year, are equivalent less likely to harvest fish than decrease education level.Hypothesis testing was also carried out using the standard multiple regression analysis and the results provide support for Ha3.

Mesh Net Size

And also the above regression indicates that mesh net size in relative to standard positive impact on fishing harvest .That means as size of the mesh net wide the fishing harvest will increase by 0.581 tons per year. Mesh net size determine significantly fishing harvestat Lake Chamo. The Hypothesis testing was also carried out using the standard multiple regression analysis and the results provide support Ha5 was accepted.

Open Accessfishing Activity

The survey result shows a negative relation between Open access and fishing harvest. This could be interpreted as the fishing harvest, holding other variables constant, decreases by a factor of0.538 tons per year scores open access increases by one level. Hypothesis testingwas also carried out using the standard multiple regression analysis and the results failed to provide support for Ha4hence the H_{A4} was rejected

Adding Nutrients for fish

Adding nutrient in to the lake as food for fish also have positive impacts as the above table regression indicated. That means as increase of the1.058 tons per year in the fishing harvest scores for every one unit increasein theactivity of adding nutrient to the lake asfood. Adding nutrient in to the lake's as food for fish is also significantl affect the fishing harvest Hypothesis testingwas also carried out using the standard multiple regression analysis and the resultsprovide support the Ha6.

Age of Respondents

The above regressed table indicates thatthe Age of the Respondents had negativelyaffectthe fishing harvest. This could be interpreted as an a decrease of 0.012 tons per year in the fishing harvest scores for every one year increase in age of the respondents, assuming that all other variables in the model are held constant .So the age fishers is indirectly related to their fishing harvest.

Gender of Respondents

Gender of the Respondents has been one of the factors that affect the fishing harvest at negative coefficient. This indicates that if the household head is Female headed the fishing harvest is increased significantly. It is because of Female headed households involves in land preparation, during planting, weeding and threshing on top of households activities like; children caring, cooking food, and cleaning of clothes and other kinds of house management activities. Even though the resource is largely dominated by male women headed households are more productive than male in economic sector. Therefore as the participation of Female in fishing harvest increased.

The beta coefficients are used by some researchers to compare the relative strength of the various predictors within the model. Because the beta coefficients are all measured in standard deviations, instead of the units of the variables, they can be compared to one another. In other words, the beta coefficients are the coefficients that we would obtain if the outcome and predictor variables were all transformed to standard scores, also called z-scores, before running the regression. In the table 10 above **Mesh net size** have the largest Beta coefficient, 0.165, and **Education Status** has the smallest Beta, -0.557. Thus, a one standard deviation increase in **Net Size** leads to a 0.165 standard deviation increase in predicted **Fishing harvest**, with the other variables held constant. And, a one standard deviation increase in **Educationlevel of the respondents**, in turn, leads to a 0.557 standard deviation decrease in**fishing harvest**, with the other variables in the model held constant.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

Based on the findings of this study, the following conclusions were drawn.

The estimated sample size is 80 as obtained from Yamane (1967:886).Theresearcherusedsimple random sampling technique toselect the sample population.This isdone in ordertogiveequal chanceof being selected to all respondents ofLakeChamo.Moreover, Simplerandomsamplingis besttechniqueofsamplingtomake thesamplereliablerepresentativeofthewholerespondentsasthey drawwithoutthesubjective judgmentof theresearcher.

Demographic and socio-economic analyses as well the determinants of fishing harvest in the study area were analyzed in detail in the first part of the result and discussions by using descriptive analysis. The second part of the study emphasized on an in-depth analysis of factors that determines the Fishing harvest through econometric analysis of multiple linear regression models.

In order to describe the demographic characteristics of fishing harvest sample Respondents; Age, sex and education level variables were used. The average Age of the sampled fishing harvest Respondents were 32, the maximum age was 45 and the minimum age of the sample respondents were 19. The community comprised mostly of middleaged harvester averagely and out of 80 sample respondents 84% of the Respondents were male, while women were only 16%.This shows that Fishing harvest Respondents in the study area is mostly dominated by males. These proportions have revealed a gender imbalance that exists in the Fishing harvest of the population.

Eight independent variables that are hypothesized to determine fishing harvest in the study area were included in the Descriptive Analysis and Econometric model, this study employed MLRM. among the eight explanatory variables used one of them were continuous variables(Age),While Seven of them were Dummy Variables(Gender, Open Access, illegality, Adding Nutrients, Net Size,EducationLevel,Skill).

Although there were an opportunities to increase fishing harvest in Lake Chamo by training Respondents about fishing techniques when they came to cooperative and by adding nutrients for fish,

most of Respondents were illegal(out of the member of cooperatives) and can enter and out from the fishing Activities at every time.

The results reveal that skill of respondents, adding nutrients for fish and mesh net size have significant and positively effects on fishing harvest while open access, education level have significantly and negatively affect fishing harvest atLake Chamo. Also the result shows Illegal, age and gender of Respondents have insignificant affects on the fishing harvest of Lake Chamo.

Specificallywith the fishing harvestat Lake chamo. These findings indicate that the existing illegal fishers, age and gender are not so suitable for improving fishing harvest at Lake Chamo. But skill, adding nutrients for fish and mesh net size had more effects on improving fishing harvest provided of the lake chamo. This result was an emphasis on the role of skill and adding nutrients for fish and mesh net size in providing a suitable environment for fishing harvest at Chamo Lake.

5.2. Recommendation

Based on the findings of this study the following recommendations were forwarded:

- Managers of the fish production firms in Lake chamo should focus more on training of respondents and adding nutrients for fish in order to improve fish production of lake chamo.
- Policy provisions of Environmental Protection Authority of Ethiopia make the lake Chamo fortunate to pay attention.
- Concerned body should be done to change the fishing System of open access in to closed access fishing activities and to incorporate the illegal respondents in to cooperative
- Continues support for organized fishery cooperatives should be done in terms of finance and training.
- Moreover, it is necessary to conduct well-organized further studies on determinants of the harvest which consider the type and biological nature of the fishes.

REFFERENCE

Akeredolu, M.O. (1990): Constraints to technology transfer in artisanal fisheries. Ph.D. Aquaculture Planning in Africa.

Bamba, A. and Kienta, M. (2000). Integration irrigation aquaculture: Consultancy Report. Rome, FAO

Agboola W.L (2011), Improving Fish Farming productivity Towards Achieving food security in Osunstate,Abuja, Nigeria.

Mbugua MH: (2008), Opportunities and Challenges in fishing, Aquaculture inKenya.

MulgetaHizekeal (2008) Fish Stock Depletion onLakeChamo SNNP GamoGofa zone, ArbamilchUniversity.

Tesfaye W. (2008):Trainingforfisheriesmanagementplanning, Addis Ababa, Ethiopia.

MulgetaHizekeal(2008)Fish Stock Depletion onLakeChamoSNNPGamoGofa zone, ArbaminchUniversity.

YishetalDesalegn(2009): EconomicBenefitoffish production SNNP,GamoGofaArbaminch, University.

AgboolaW.L(2011),ImprovingFishFarmingproductivityTowardsAchievingfoodsecurityinOsunstate, Abuja, Nigeria.

Agriculture and Environmental Services, Washington DC20433USAInternet: www.worldbank.Org/ord

Anne Gardon, MelakuT.&Sewmehen,D. (2006):Field reportonLakeTanaMarketingSystem&OpportunitiesofMarketingforLivelihood, Amhara Region, Bahirdar, Ethiopia.

Christopher L. Delgado, Nikolas Wada, MahfuzuddinAhmed, MorkW. Rosegrant&SietMeijer (2003):Fish Supply &Demand in Changing GlobalMarketInternet, WashigtonDC,America.

DawangN.C&DasbakA.(2011): www.scholarresearchliberary.com, Estimatesofprofitability&TechnicalEfficiencyofFishermenofNaturalLakes,FromPlateauState,Abjudha, Nigegia

FAO(2007):Role ofAquaculturetofood security:htt//www.fao.org date accessed28th may2010

IkiaraMM.(1999):Sustainability, livelihoods, production and efforts supply in declining fishery:ThecaseofKenya'sLakeVictoria fisheries, AmstromdamUniversity.

Nyonje BM, Charo-Karisa H, Macharia SK and Mbugua M. 2011. Aquaculture Development in Kenya: Status, Potential and Challenges. In Samaki News: Aquaculture Development in Kenya towards Food Security, Poverty Alleviation and Wealth Creation.

Mwangi HM (2008). Aquaculture in Kenya, Status Challenges and Opportunities, Directorate of Aquaculture, Nairobi,Kenya

Mugenda, O.M. and Mugenda, A.G (2003) Qualitative and Quantitative Approaches. Research Methods Africa Center for Technology Studies (Acts) Press. Nairobi Kenya.

Food and Agriculture Organization (2004) The State of World Fisheries and Aquaculture Report.

Manyala, J. O. & N. Gitonga (2008).Omena Marketing Study in the Major Urban Centers in Kenya. GTZ-PSDA Commissioned Study.

Tilahun A, Alambo A, Getachew A. Fish Production Constraints in Ethiopia: A Review. World Journal of Fish and Marine Sciences. 2016.

SeleshiBekeleAwulachew (2006).Abaya-Chamo Lakes Physical andWater Resources Characteristics, including Scenarios and Impacts.International Water Management Institute.

ZerihunDejene(2008).southern Rift Valley lakes of Ethiopia, Lake Awasssa, Abaya and Chamo. PhD Thesis, Addis Ababa University, Addis Ababa.

EARO (2002).NFLARRC. Baseline Survey Report on Current Status of Fisheries and Other Living Aquatic Resources. Addis Ababa ,Ethiopia EEA

LFDP (1997).Proceedings of the National Fisheries Seminar, Ziway.November 1995. Lake Fisheries Development Project Working Paper no. 21 Addis Ababa. Ministry of Agriculture

Appendix

ST.MARY'S UNIVERSITY COLLEGE

INSTITUTE OF AGRICULTURE AND DEVELOPMENT STUDIES

Title; Determinants of fishing harvest at Lake Chamo, southern Ethiopia

Appendix I. Questionnairesforthe Respondents

Dear Respondent

The purpose of these questionnaires is to see the factors affecting fish production of fishermen on the case of Lake Chamo. To get these finding you are kindly requested to give relevant information and opinions on the question being rained.

Thank you for your assistance..

PART A: Personal Information's

Date of Interview :( )

Location (Kebele): ( )

PART B: demographic characteristics

Put a tick (√) or fill with appropriate response(s).

1 What is your gender? Male ( ) Female ( )

2 what is your age?

19-20	[ ]
20-30	[ ]
30-40	[ ]
40-50	[ ]
50-60	[ ]
60-70	[ ]
Above 70	[ ]

3 What is your highest level of education?

Primary [ ]
Secondary [ ]
College [ ]
University [ ]
Post graduate [ ]

PART 3**: QUESTIONS**

For each question in Part 3, read and tick either yes or no. Please give reasons to your yes response in any case on a separate sheet of paper.

If you agree with the following activities, tick [Yes] or [No];

4. Have you trained about fishing technique before you start fishing?
A) Yes B) no

5. What about the size of themesh net?

A Narrow B) Medium C) wide

6) How much to produce (catch fish) you planned by your corporative in each year?----------

7) Are you successful in your plan?
A) Yes B) No

8) If your answer is"no"in question "7"above, why no you successful your plan 100

Percent?----------

9) What are the challenges of fishing activities on LakeChamo?

A) Higher number of illegal fishermen

B) Waste (toxic) material entered by flood

C) Other problems----------

10) Are you member of the cooperative?

A) Yes B) no

11) The way of fishing on Lake Chamo is

A) Open access B) closed access

12) How much kilograms (tones) of fish do you catch per year from the lake byyour corporative?

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13) How many kilograms (tones) of fish do you supply to the market by your corporative?

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14) Are there any farm activities around the Lake?

A) Yes B) No

15) If your answer is“yes“i n question (21) above, how many meters close the farm activity to The lake? About----------meter

16) Are there any activities to increase the production of fish in the lake like adding nutrients as food for fish?

A) Yes B) No

17) What are the Opportunities of fishing activities on Lake Chamo?

A. ----------

B. ----------

C. ----------

18) Please, write any other comments, opinions or problems on LakeChamo.

A. ----------

B. ----------

C. ----------

19) Please explain some Possible Solutions for the above Problems?

A. ----------

B. . ----------

C. ----------

APPENDIX: 2 Lists of additional tables and figures

A. Regression Matrix

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	7.535	1.463		5.149	.000	4.618	10.453		
	Skill of Fishermen	1.350	.510	.148	2.646	.010	.333	2.368	.688	1.453
	iLegality of Fishermen	.517	.382	.066	1.354	.180	-.244	1.278	.902	1.108
	Level of Education of Fishermen	-1.916	.255	-.557	-7.507	.000	-2.425	-1.407	.392	2.548
	Accessability to Fishing	-.583	.301	-.097	-1.939	.057	-1.183	.017	.869	1.151
	Size of the net	.581	.260	.165	2.233	.029	.062	1.100	.395	2.532
	Adding Nutrients	1.058	.440	.162	2.404	.019	.181	1.936	.477	2.096
	Age of the Fishermen	-.012	.020	-.029	-.595	.554	-.053	.028	.911	1.098
	Sex of the Fishermen	-.631	.384	-.081	-1.646	.104	-1.396	.134	.894	1.119

B.Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Fish Production in tones per year	80	1.00	12.00	6.0875	2.89563
Age of the Fishermen	80	19.00	45.00	29.9000	6.92930
Valid N (listwise)	80				

C. ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	560.735	8	70.092	48.956	.000[b]
	Residual	101.653	71	1.432		
	Total	662.387	79			

a. Dependent Variable: Fish Production in tones per year

b. Predictors: (Constant), Sex of the Fishermen, Legality of Fishermen, Age of the Fishermen, Skill of Fishermen, Accessibility to Fishing, Size of the net, Adding Nutrients, Level of Education of Fishermen

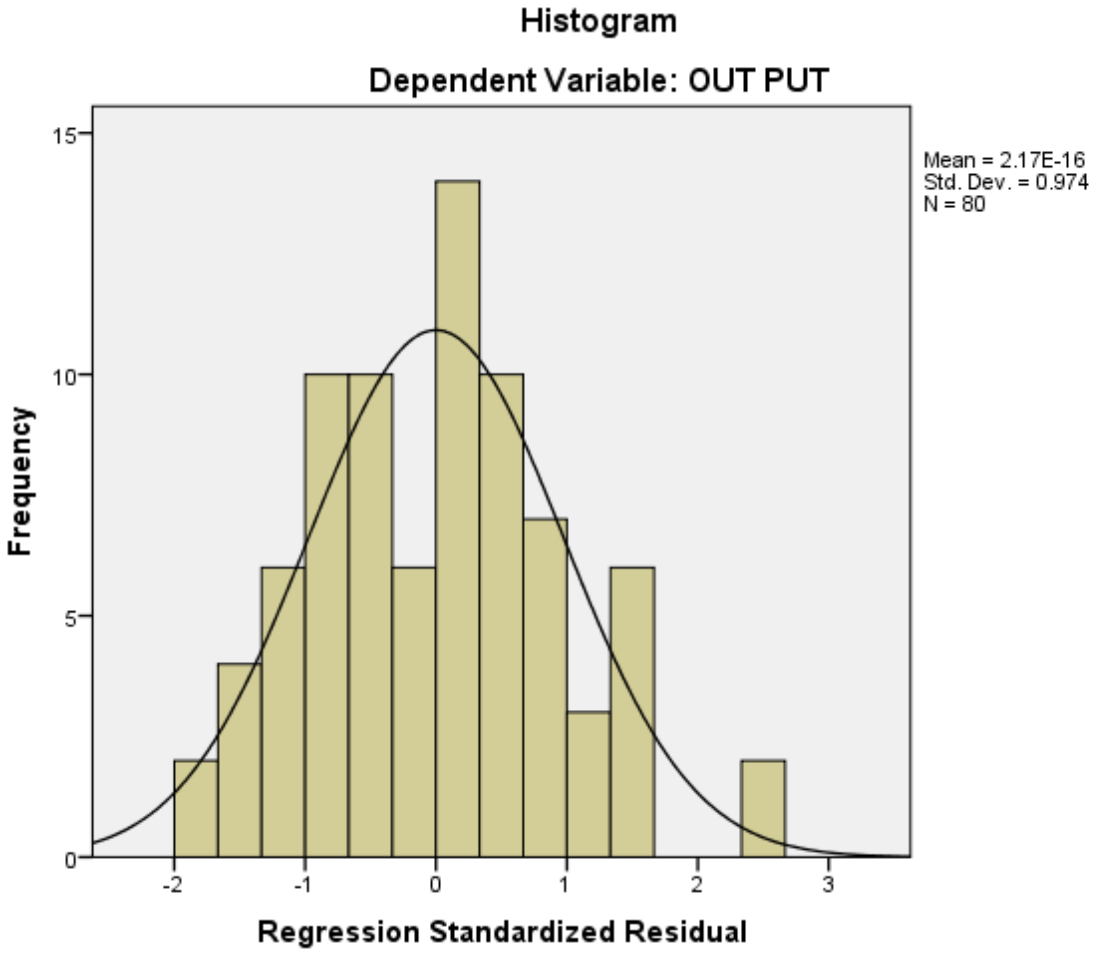
D.ModelSummary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.920[a]	.847	.829	1.19655	1.676

a. Predictors: (Constant), GENDER, ILLEGALITY, AGE, SKILL, OPEN ACCESS, NET SIZE, ADDING NUTRINTS, EDUCATION STATUS

b. Dependent Variable: OUT PUT

E


Histogram
Dependent Variable: OUT PUT
Mean = 2.17E-16
Std. Dev. = 0.974
N = 80
Frequency
15
10
5
0
-2
-1
0
1
2
3
Regression Standardized Residual

F. Coefficients[a]

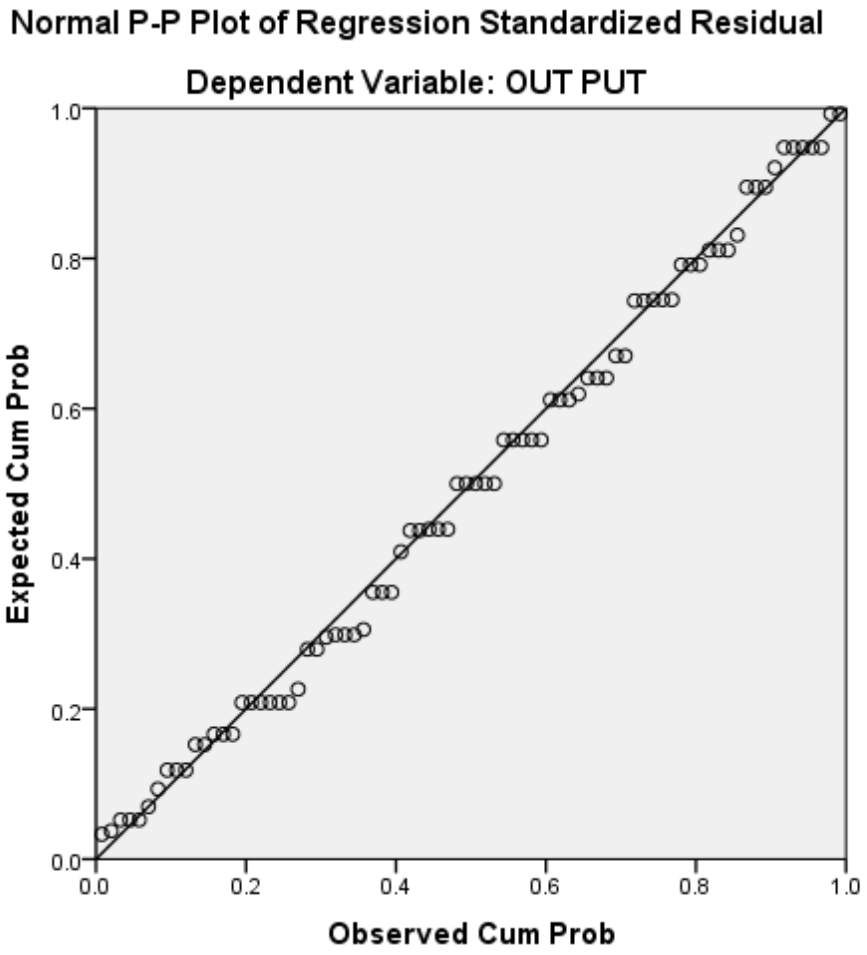
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.535	1.463		5.149	.000
	Skill of Fishermen	1.350	.510	.148	2.646	.010
	iLegality of Fishermen	.517	.382	.066	1.354	.180
	Level of Education of Fishermen	-1.916	.255	-.557	-7.507	.000
	Accessability to Fishing	-.583	.301	-.097	-1.939	.057
	Size of the net	.581	.260	.165	2.233	.029
	Adding Nutrients	1.058	.440	.162	2.404	.019
	Age of the Fishermen	-.012	.020	-.029	-.595	.554
	Sex of the Fishermen	-.631	.384	-.081	-1.646	.104

a. Dependent Variable: Fish Production in tonnes per year

G. Univariate Statistics

	N	Mean	Std. Deviation	Missing		No. of Extremes[a]	
				Count	Percent	Low	High
FP	80	6.0875	2.89563	0	.0	0	0
SK	80			0	.0		
IF	80			0	.0		
ED	80			0	.0		
OA	80			0	.0		
NS	80			0	.0		
AN	80			0	.0		
AG	80			0	.0		
GR	80			0	.0		

a. Number of cases outside the range (Q1 - 1.5*IQR, Q3 + 1.5*IQR).



APPENDIX.2H**Correlations**

		SK	IR	ED	OA	NS	AN	AR	GR
	Pearson Correlation	1	.165	-.426**	-.178	.350**	.507**	-.114	-.050
SK	Sig. (2-tailed)		.144	.000	.114	.001	.000	.313	.662
	N	80	80	80	80	80	80	80	80
	Pearson Correlation	.165	1	-.202	-.181	.198	.199	.092	-.010
IR	Sig. (2-tailed)	.144		.072	.108	.078	.076	.417	.928
	N	80	80	80	80	80	80	80	80
	Pearson Correlation	-.426**	-.202	1	.125	-.731**	-.611**	.152	-.162
ED	Sig. (2-tailed)	.000	.072		.268	.000	.000	.179	.151
	N	80	80	80	80	80	80	80	80
	Pearson Correlation	-.178	-.181	.125	1	-.229*	-.200	-.014	-.181
OA	Sig. (2-tailed)	.114	.108	.268		.041	.076	.899	.108
	N	80	80	80	80	80	80	80	80
	Pearson Correlation	.350**	.198	-.731**	-.229*	1	.621**	-.197	.074
NS	Sig. (2-tailed)	.001	.078	.000	.041		.000	.079	.514
	N	80	80	80	80	80	80	80	80
	Pearson Correlation	.507**	.199	-.611**	-.200	.621**	1	-.223*	.122
AN	Sig. (2-tailed)	.000	.076	.000	.076	.000		.047	.280
	N	80	80	80	80	80	80	80	80
	Pearson Correlation	-.114	.092	.152	-.014	-.197	-.223*	1	.072
AR	Sig. (2-tailed)	.313	.417	.179	.899	.079	.047		.524
	N	80	80	80	80	80	80	80	80
	Pearson Correlation	-.050	-.010	-.162	-.181	.074	.122	.072	1
GR	Sig. (2-tailed)	.662	.928	.151	.108	.514	.280	.524	
	N	80	80	80	80	80	80	80	80

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations