

**ADDIS ABABA UNIVERSITY**  
**COLLEGE OF NATURAL AND COMPUTATIONAL**  
**SCIENCES**  
**DEPARTMENT OF ZOOLOGICAL SCIENCES**



**A STUDY ON STATUS OF FISH PRODUCTION & MARKETING IN  
LAKE ZIWAY, ETHIOPIA**

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## ACRONYMS

ANOVA	Analysis of Variance
APHRD	Animal and Plant Health Regulatory Directorate
CSA	Central Statistics Agency
DDT	Dichlorodiphenyltrichloroethane
EIAR	Ethiopian Institute of Agricultural Research
NMCE	National Meat Corporation of Ethiopia
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
HCH	Hexachlorocyclohexane
JERBE	Joint Ethio-Russian Biological Expedition
LFDP	Lake Fisheries Development Project
MARD	Ministry of Agriculture and Rural Development
NFALRC	National Fishery and Other Aquatic Life Research Center
SFCS	Sebeta Fish Culture Station
SIDS	Small Island Developing State
SPSS	Statistical Package for the Social Science

## ABSTRACT

*Lake Ziway, which is the third largest lake in Ethiopia, is the most overexploited lake for the use of fishery, irrigation, recreation, road construction and tourism .The primary data was collected during, June 7-21, 2019 in Adami-Tulu Jido Kombolcha district at Wafeqo landing site. This study had attempted to assess fishermen's socio-demographic nature in relation to fish production, market condition and other means of income, determine factors of fish production and possible lake management measures in Lake Ziway. Descriptive statistics, one way ANOVA Tukey post hoc model and pearsons' chi-square independence test were used to analyze the data using IBM SPSS version 22. A total of 104 fishermen (100% male), 1 member of fish processor enterprise (time keeper) and 3 key informants from Adami-tulu animal and fish development office and Batu Fish and Other Aquatic Life Research Center were involved in data collection. Among the respondent fishers, 94 (90.3%) were members of the cooperatives while 10 (9.7%) were not. The livelihoods of people were known to directly depend on fishing activities around Lake Ziway including that of the interviewed fish processor. The study found out that fishing time, fishing instrument, means of boat type, mode of fishing, level of education, access to training, and age of fishermen had a direct effect on the amount of fish catch. Night time fishing had maximum amount of fish catch in terms of fishing time. Besides, fishermen who had better level of education and access to training used better means of transportation and fishing instruments. It was also indicated that there is high fish catch by using beach seine even if it had got legal restrictions with respect to fishing gears. Fishermen were not directly benefited from the market system. In addition to these, the study found out that illegal fishing, unauthorized use of fishing gears, overfishing, excessive use of the lake's water for irrigation and road construction, emission of chemicals from the nearby flower farm and motor oil discharges are the major challenges for the existence of the lake. Generally the absence of effective lake management system accelerated the decline of the fish resources in Lake Ziway. To overcome these adverse impacts on the fish resource, there should be continuous professional follow up and trainings, diversification of employment for youth and organization of individual fishers into fishermen association.*

*Key words: Ethiopia, Fishery, Lake Ziway, Overexploitation, Rift Valley*

# CHAPTER ONE

## INTRODUCTION

### 1.1. BACKGROUND OF THE STUDY

Small-scale fisheries are found mostly in developing countries, accounting for approximately 40% of world fish catches (around 90 million tons; FAO, 2019), and providing direct employment for more than 90% of the 39 million capture fishers worldwide.

It is estimated that the inland fisheries of Africa produce 2.9 million tons of fish, which represents 25% of the total global production from inland waters. In comparison to marine fisheries, inland fisheries production is relatively small, representing only 1.7% of total global capture fishery production. Uganda, Nigeria, Tanzania, Egypt and Congo, which altogether yielded 52% of the inland fishery catch of the continent, were major fish producing countries in 2016 (FAO, 2018).

Yet, these fisheries as social-ecological systems are poorly understood due to the structure and dynamics of harvesting resources in a complex fishing process, which involves subsistence, recreational and commercial users as well as interaction with a governance subsystem influenced by cultural, social and political factors (Defeo *et al.*, 2016 as cited in FAO, 2019).

Thus, sustainability has been far more difficult to achieve in small-scale fisheries than is commonly thought. A mix of pressures, including intensive harvesting, increasing temperatures, rising sea levels and environment degradation have damaged both productivity and ecosystem health in small-scale fisheries, leading in several cases to collapses of fisheries and even to eradication of certain locally exploited fish populations. Maintenance of such pulling factors and creation of a sound ecosystem is a key point in conservation of the ecosystem (Leveque *et al.*, 2009 as cited in Alebachew Tilahun *et al.*, 2016).

In Ethiopia, industrial based fishery production is low that it is mainly dominated by artisanal small scale practices. Thus, fishery sector has limited practices that it has got low role in the economy. The estimated potential annual production is 94 000 tonnes, with a current production of about 51,500 tonnes valued at USD 44 million. The per capita fish consumption is estimated to be 0.5 kg per year. This shows that Ethiopians have got a low tradition in the use of fish in their meal in comparison with other African countries (FAO, 2017).

Ethiopia has more than 24 natural lakes and many artificial reservoirs; with a total surface area of about 7500 km<sup>2</sup>. 80% of the country's fish production comes from these lakes and the major rivers which stretch over 7000 km and which accounted for the rest 20% fish production. Almost all the catches from the sector are destined for human consumption. However, information on small-scale fisheries for the formulation of management decisions is often not available or is inadequate (FAO 2014).

Based on the composition of fish fauna, Ethiopian freshwater systems are classified into seven drainage basins: Abay (Blue Nile), Awash, Baro-Akobo, Omo-Gibe, Rift Valley Lakes, Tekeze and Wabi-Shebele Genale. More than 180 fish species are harboured in these water bodies. Even if the Ethiopian Fish fauna diversity lacks adequate research, the possible effects of such estimated potential on Ethiopia's freshwater systems could only be assessed if the current biodiversity was known (Redeat Habteselassie, 2012).

The fishery sector can be considered a marginal sector in terms of the aggregated economic output in Ethiopia. It is estimated that the sector accounts for about 0.1 percent of the national GDP whose contribution to budget revenue is negligible. Despite this low contribution at the aggregated level, the fishery sector in Ethiopia plays an appreciated role in terms of providing employment with estimated number of 45 000 fishers involved (14 000 being fulltime fishers and 26 700 part-time fishers). Women are mainly involved in processing, net making and retail trading (FAO, 2014).

Fisheries are very important for food security and nutrition because they provide high quality protein and a source of income (Kurien *et al.*, 2013 as cited in Breuil & Grima, 2014). To enhance food security and to realize revenue, fish export plays a pivotal role as there is almost equal share of exporting fish and importing food costs regarding low income in food deficient countries. In these regards, improved and better fishing practice helps to realize economic development and get rid of poverty. To meet this reality, the use of Artisanal freshwater which has been employed in Ethiopia plays significant role (Esayas Hailu *et al.*, 2017).

Among lakes in the country, Lake Ziway which is a fresh water lake of low salt concentration takes an important role in the fish supply. Though the estimated capacity of the lake in fish yield is about 15% of the total capacity of the main lakes of the country, it gives more than its potential (24 % of the current provision of the major lakes). This overexploitation indicated the community's dependence on the lake and the lake's socio-economic advantage to the community and the country at large (Esayas Hailu *et al.*, 2017).

Despite failures in productions, overfishing results in fishery collapse which leads to fishery and institutions which based on fishing activities failures. Nowadays, 70% of fish species are fully exploited, overexploited, or depleted, because of overfishing beyond the capacity of the water body or /and lack of a well-defined legal bindings (Dawit Garoma *et al.*, 2014). With this regard, Lake Ziway faced challenges and threats regarding the lake's and the surroundings' ecological conditions due to overexploitation in line with overfishing, excessive water abstractions and irrigation, which in turn influence tourism oriented investments and visit to the existing monastery (Megerssa Endebu *et al.*, 2015).

The attainment of updated and plausible information plays a significant role so as to render timely and valid data to any concerned body like the government to help resource sensitive policy design. In light of this, the study will contribute its share to the knowledge base of fishery, more specifically Lake Ziway, by exploring the determinants that influences the utilization of fishery resources.

## **1.2. STATEMENT OF THE PROBLEM**

Much of fish supply in Ethiopia appears to come from the Ethiopian Rift Valley lakes and much more amount of it is attained from Lake Chamo, Lake Ziway and Lake Abaya. However, within ten years the practice of fish catch in Lake Ziway has decreased. Regarding this, figures showed that there is a year to year reduction rate of annual fish catch in Lake Tana (25%), Lake Ziway (19%), Lake Langano (19%), Lake Chamo (18%) and Lake Abaya (12%) of the national total production (ACP, 2012 as cited in Felegeselam Yohanes, 2003).

Agricultural practices along the lake side of Lake Ziway have changed the level of the lake because of poor soil conservation trends at the catchment zone (Dagnachew Legesse & Tenalem Ayanew, 2006). Furthermore, unwise irrigation practices play a significant role for the reduction of the volume of the lake and the increment of soil salinity. In addition to this, the emissions of toxic chemicals like Dichlorodiphenyltrichloroethane (DDT), Hexachlorocyclohexane (HCH), Chlordane and Heptachlors have also contaminated the lake (Dessie Tibebe, 2017).

A study conducted by Lemma Abera (2016) showed that the fish catch of Lake Ziway declined from 3180 tons in 1997 to 1157.14 tons in 2014 and access to sustainable infrastructure was one of the most essential factors affecting livelihood security of fishermen. Various studies have been conducted related to fishery resources in Lake Ziway. However, most of them focused on the biological and chemical aspect and management plan of the

sector and there is limited work done on socio-economic status of fishermen around the lake. Therefore, the purpose of this study aimed at studying the current status of fish production and marketing of Lake Ziway, using both quantitative and qualitative research approach.

### **1.3. RESEARCH QUESTIONS**

1. What is the status of fish production in Lake Ziway?
2. How is the market availability regarding fish resources?
3. What are the determinant factors which are significantly contributing to the fluctuations of fish catch and challenge fishery trend of the lake?
4. Are there possible measures that can be taken to keep the Lake Ziway's fish resource utilization sustainable?

### **1.4. OBJECTIVES OF THE STUDY**

#### **1.4.1. GENERAL OBJECTIVE**

The main objective of the study is the assessment of the current existing condition of fishery in Lake Ziway for better management of the sector.

#### **1.4.2. SPECIFIC OBJECTIVES**

- ✓ To assess the status of fish production in Lake Ziway.
- ✓ To examine market system with respect to fish resources.
- ✓ To determine factors influencing fish production in fish catch.
- ✓ To assess possible measures which are helpful in fish related management of the lake.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1. TRENDS OF SMALL SCALE FISHERY IN ETHIOPIA**

According to the definition of FAO (2015) small scale fishery should be treated in accordance with its employee participation, processing activities, the type of technology used in exploiting the aquatic resources. Besides, the time the people spend during fishing, the targeted local society during distribution or for consistent use of the people determines the activation of this sector. However, the increased global integration and economic bond creates export-based small scale fishery production in the past one and two decades. In light of employment creation, women has been working on fish processing, marketing, shore harvesting when men work on fishing, fish marketing and distribution. Activities like net-making, boat building engine mending are also creating job opportunities in the community. In general this sub sector should be given due attention by designing sound working policies so as to maintain food security and adversity reduction. Having taken basic features of both fisheries, it can be defined as 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. It also comprises of subsistence or commercial fisheries, providing for local consumption or export (FAO, 2015).

Small scale fishery is defined as various events like fish catching, processing, distribution, and marketing that are practiced by migrant, part-time, and full-time fishers, with specialized associate stakeholders (auctioneers, wholesalers, transporters, retailers, etc) (Bonfiglioli & Hariri, 2004). Additionally, it is characterized by low revenue, small amount of investment in line with man power capital, dependency towards external bodies, seasonality of production level because of migratory fish species and use of simple technology and materials.

Generally, there are no commonly accepted definitions globally considering the terms due to varied countries' experience that small scale in one country may be large scale in other county (Kurien, 1998 as cited in Breuil & Grima, 2014 ).

Fishery in Ethiopia is characterized with small scale fishery that included about 45,000 fishers (30% of them were full time fishers) (FAO, 2014). Even if there were no conducive conditions, small scale fishery has been practiced together with horticulture and livestock production in small fish ponds. This practice can play a dominant role to satisfy the peoples'

need in protein consumption though the country's annual per capita fish consumption is very low. Figure 1 shows that the production level accelerated from 2007 to 2012 with 13,000 tons to 29,000 tons of production, respectively (FAO, 2015).

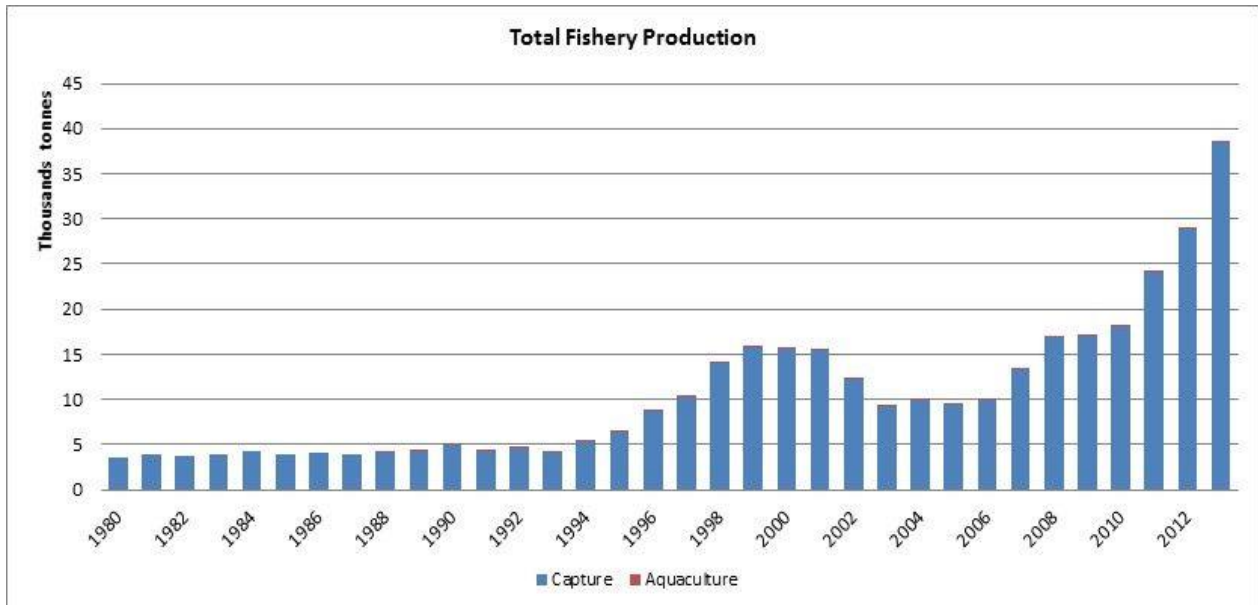


Figure 1: Annual fish production from 1980 -2012 in Ethiopia. (Source: FAO, 2015)

### 2.1.1. CHALLENGES OF SMALL SCALE FISHERY DEVELOPMENT

In Ethiopia, there have been lots of challenges to practice small scale fishery including eutrophication, introduction of exotic fish, aquatic pollution and over fishing. Additionally, potential problems of the institutions, weak fishermen's association, unreliable data gathering system, distance of fishing zones, shortage of infrastructure and materials, degraded natural resource and lack of adequate funds to employ the country's strategies, plans and laws in accordance with aquaculture development. (MARD, 2004 cited in Tarekegn Shado, 2006).

#### 2.1.1.1. EUTROPHICATION

Eutrophication dominantly results in an increased production of phytoplankton, released toxic substances by some algae into the water bodies which affect the taste and odour of the water, deoxygenating the water that mainly brings economical failure because of change in fish species, death of fish, missing the entertainment value of the water due to slime, weed infestation bad water smell and being problematic for water transportation due to dense weed growth (Huai-en *et al.*, 2003 as cited in Dessie Tibebe, 2017). Currently, major efforts are made worldwide to improve the ecological quality of eutrophic shallow lakes by reducing external nutrient load (reduced usage of fertilizers and pesticides around the surface water).

These have often resulted in lower in-lake total phosphorus and decreased chlorophyll-a level in surface water (Jeppesen *et al.*, 2007 as cited in Dessie Tibebe, 2017).

Here are the main factors which expose lakes to eutrophication.

**Catchment degradation of water bodies:** Intensive agricultural activities and the subsequent deforestation lead to catchment degradation and soil erosion, which results in increased siltation into lakes. Such anthropogenic impacts do not only affect the breeding ground of aquatic organisms but cause gill clogging of small fishes. Increasing human populations and the subsequent demand for food lead to farming marginal land and lake shores which enhances soil erosion. Accordingly, the following are the main threats to fish breeding and spawning activity in the aquatic ecosystem (Aschalew Lakew *et al.*, 2016)

**Deforestation:** Of the catchment and the subsequent soil erosion that results in increased surface runoff and siltation, woody debris and sawdust into the shoreline, which is the main spawning habitat for many fish species.

**Inland navigation:** Construction of canals and unregulated dredging for effluent discharge in the lake basins can change stream flows (inflows), which can either fill in or remove important habitats.

**Mechanical macrophyte harvesting:** along the littoral spawning ground for many fish species and feeding site for juvenile fish will be affected easily. This decreases the newly fish recruitment of the stock and reduce the annual fish yield.

**Shoreline modification, fragmentation and destruction:** due to the intense investment activities alongside the shore of lakes, the habitat or environment which could be the main breeding site for fish will be destructed.

**Water abstraction:** (using water pumps) from the lake shore during breeding season, which possibly remove the eggs of the fish.

**Urbanization and Industrialization:** maximised the lakes' exposure to eutrophication and loss of a sound ecosystem (Malefia Tadele, 2012). Hence, the lakes have lost their prior quality water content and filled with agrochemicals which have been released by horticultural and floricultural activities. The pollutants either from point or non-point sources could lead to changes in physical, chemical and biological processes of the lakes which in turn distress fisheries and the functioning of the whole aquatic ecosystem. The growing population and industrialization of major cities cause serious consequences on the lake limnology. Since fish production and

sustainability depend on the health of the fish habitat, there is a need to consider management of pollution and eutrophication along with the fisheries management. Moreover, leaching of heavy metals from some of the effluents into the lake systems and their bio-magnification renders the fishery resources more vulnerable and the fish unsuitable for human consumption in the future. A related pollution source is the growth of urban centers and industries around the lake. While this is inevitable, the discharge of untreated or semi-treated industrial and municipal wastes should be prohibited legally (Zinabu Gebremariam & Zerihun Desta, 2002).

#### **2.1.1.2. CLIMATE CHANGE**

The impact of climate change on fisheries extend to warming of freshwater ecosystem, on organisms across all levels of biological organization resulting in negative effects on freshwater fisheries that provide food, employment and recreation worldwide. In a severe case, species extinction and extirpation can happen. Temperature and rainfall are major climatic factors that can govern fish production in a given water body. The aquatic water bodies mainly rivers and lakes are most affected by the climate change. Raise in temperature increases the rate of evaporation and reduced the inflow rate into lakes which in turn lowers the level of lakes and reservoirs. The littoral regions which are the breeding and feeding ground of juvenile fish will be affected easily. This decreases the newly fish recruitment of the stock and reduces the annual fish yield. According to the survey conducted by EIAR on Koka, it is stated that there is a drastic decline of the reservoir, which has not been observed over the last decade. This fluctuation of the lake water level is believed to be due to El Nino induced by the climate change (Berhan Asmamaw *et al.*, 2018).

#### **2.1.1.3. LIMITED RESEARCH ON FISHERY**

The history of research on natural water bodies dates back to the 1930s associated with the Italian invasion. However, the involvement of Ethiopian scholars on lake fishery and limnology started relatively late in the 1980s. Most of these studies focused on the limnology (Amha Belay & Wood, 1982) and the taxonomy and systematics of Ethiopian fish fauna carried out mainly by the Joint Ethio- Russian Biological Expedition (JERBE) group since 1987 (Golubtsov & Mina, 2003). The scientific information so far generated by different scholars is vital for proper management of the lake fishery and in understanding of the trophic stats of the lakes. However, such studies are limited in terms of coverage, seasonality and discipline. The fish biology for example focused on mainly two commercial fish species the Nile tilapia and catfish. In most cases the biology focused on the feeding and

reproductive, age and growth aspect which is associated with the interest of the researchers and their training background. Therefore, the research in the future should include other fish species which are less addressed so far. Moreover, the research so far relied mainly on Lake Fishery and seems to ignore the diversified fauna of the river fish fauna. Thus, the biological research should give attention to the highly diversified fish fauna. In addition, the MSY of Ethiopian fishery should be studied based on catch effort data and other biological parameters of the fish, which give more accurate estimate than the crude empirical ones we have at present.

### **2.1.2. FACTORS WHICH AFFECT THE FISH CATCH**

The decreased fish catch and fish stock is caused due to these major factors.

**Over fishing:** Due to increased over fishing, the existence of large fish species have been cleared out of the water bodies that smaller fish species are highly exploited (Cushing, 1982 as cited in Zerihun Dereje, 2008). Consequently, some of the growth potential of these smaller fish is not realized before they are caught. An excessive high fishing mortality, in some cases combined with unfavourable environmental conditions, can also reduce the size of the sexually mature portion of the population that the rate of reproduction is no longer sufficient to replace the numerical loses and the population declines. Additionally, earlier reports indicated that most Rift Valley lakes have shown signs of overfishing and hence depletion of major stocks (Reyntjens & Tesfaye Wudneh, 1998). In particular the *O. niloticus* stock of Lake Ziway and the Nile perch of Lake Chamo have been depleted due to the use of illegal gear mainly seine nets and Gancho nets, respectively which removed the juvenile and adult fish indiscriminately. On the other hand, fish is the only aquatic resource recognized and exploited from aquatic resources in Ethiopia. Other exploitable resources like freshwater crustaceans (e.g. crabs, shrimps, edible snails) are poorly known. A microalga of great economic potential with high nutritional benefits to humans known as Spirulina, which is renamed as Arthrospira, is another un-exploited aquatic resource in the country. The presence of these aquatic resources is shown in previous studies conducted in major river systems in Rift Valley lakes Aranguade, Chitu and Kilotes (Elsabeth Kebede & Ahlgren, 1996). However, none of these resources is exploited for human consumption, mainly due to lack of awareness, scientific information and production technologies.

**Unprotected and free access to the fishery resources:** FAO, (1999 as cited in Aschalew Lakew *et al.*, 2016) reported multifaceted problems in accordance with free access to fishery resources. Primarily, many fish stocks around the globe are endangered as there aren't well designed legislation, lack of enforcement and absence of scientific knowledge to maintain it. In this regard, adjusting the number and capacity of fishing fleets to what each water body can sustainably support and the introduction of sustainable fishing methods have been the major difficulty for sustainable use of fishery resources. According to the report, the current worldwide fishing fleets are two to three times as large as needed to take present-day catches and as what water bodies can sustainably support. This unsustainable use of fishery resource can lead to two serious environmental problems. One is loss of species as well as entire ecosystems and the other is the risk of losing a valuable food source upon which many depend for social, economical and dietary reasons. Accordingly, 25% of all the world's fish stocks are either overexploited or depleted and 52% is fully exploited that the world's fishery is under risk.

**Poor coordination between stakeholders:** To maintain an advanced fishery practices and fishery management, there should be basic information like the relationships between sustainable catch and fishing effort, the biology of the fish species, the nature and type of the fishery, the economic and social aspect and knowledge of environmental condition of the water body (Charles, 1998). Sustainable catch is the quantity of fish in terms of weight which can theoretically be caught year after year without a change in the intensity of fishing. Additionally, FAO (1999) stated that the best possible supplies of fish for the future generation could be guaranteed when all those involved in fisheries work together to conserve and manage fish resources and habitats. Resource management should be based on the best available information so that appropriate decisions can be made that take into account the social, biological and economic aspects of the fishery. The FAO Strategy for Improving Information on the Status and Trends of Capture Fisheries also recognizes the importance of small-scale and multispecies fisheries, particularly in developing countries, and highlights the need for improving data and information for this sector. There are different institutions, which are conducting research on fisheries, aquaculture and limnology in the country. Thus, strong linkage and communications based of stakeholders, and formation of common form between them could synergize the research and minimize duplication of efforts.

**Unhygienic post harvest processing of fish:** Ethiopian lakes and rivers have got various challenges but fish contamination, spoilage and unhygienic handling and processing are the main ones at landing sites. In order to develop marketing structure across borders, there should be quality standards focusing on quality and sanitation. Regionally harmonized quality standards should increase competitive access for traders and help to ensure improve quality of fish for consumers (Aschalew Lakew *et al.*, 2016). Besides, capacity building for all those involved in the value-chain is an important prerequisite to consider. Fishermen, fish processors and traders in the country often rely on simple equipment and work in remote areas where basic services and facilities are absent. The processors also lack knowledge, skills, and hence fish is often handled and processed in unhygienic conditions causing spoilage, contamination and loss of income as fish are sold for a low price. It is worth remembering that all stakeholders involved in fishery activities have a responsibility to make sure that fish is handled in the best possible way and in the best conditions possible, so that the consumer receives good quality and safe fish food.

**Introduction of exotic fish:** Since 1993, more than 10 exotic species have been introduced in Ethiopia (Shibru Tedla & Fisseha Hailemeskel, 1981). Among the introduced fish species carp, trout and tilapia have developed their population while *Esox lucius* and *Gambusia hollbrooki* and *Ctenopharyngodon idella* failed to survive. There have been subsequent fish introduction so as to improve fish production in the country. There can be lakes' exposure to lose their indigenous fish species if the introduction isn't done with care like missing the indigenous fish like *O. niloticus* in Lake Ziway (Aschalew Lakew *et al.*, 2016)

## **2.2. PRODUCTION AND SUPPLY POTENTIAL OF MAJOR ETHIOPIAN WATER BODIES**

Lakes, reservoirs, rivers, and small water bodies are the major water systems in Ethiopia. There are diverse aquatic life ranges from microscopic flora and fauna to the giant African hippopotamus in lakes and rivers. A great numbers of fish have been accessed as there are about 200 fish species in the water bodies of the country; therefore, about 51500 tonnes are being produced annually from these water bodies.

Here are the main Ethiopia's fish catch zones.

- Lake Chamo, Lake Abaya, Lake Ziway are from the Great Rift Valley lakes and the northern part of Lake Turkana

- Lake Tana, the largest lake in the country
- Reservoirs, lots of rivers, small water bodies and natural impoundments

Based on the report by FAO (2014), the annual fish catch constitutes 80% from lakes, 7% from rivers and 13% from dams and small water bodies. Thus, the lakes' contribution was great in comparison with other water bodies.

Table 1 : Fish production potential estimates from water bodies of Ethiopia (Modified from Gashaw Tesfaye & Wolff, 2014)

Major water bodies	Area (km <sup>2</sup> )	Length (km)	Potential yield (ton/yr)
Major lakes	6477		38727
Major reservoirs and dams (area >10 km <sup>2</sup> )	857		8059
Major rivers		5785	26314
Small rivers		1400	15974
Small water bodies (area <10 km <sup>2</sup> )	275		5426
Total	7609	7185	94500

### 2.2.1. DEMAND AND CONSUMPTION OF FISH

Ethiopians have the desire to attain whole fresh fish that most of the caught fish are sold along the lake side towns though the frozen fillets are transported to Addis Ababa. There are some institutions which are equipped with the basic fish preservation equipment like refrigerators even if majority of the traders lack cold chains and insulated containers. The main facilities are the chill store and ice at Ziway, freezing and cold store at Arba Minch, and a cold store at Bahir Dar area on Lake Tana. Due to shortage of the preserving equipment, fish traders stock excess fish production only for two days especially during the fasting periods which takes more demands. More commonly employed preservation method at excess time is drying which is more available in large consumption centres like Addis Ababa. Fish canning is the other alternative which have been performed by the Ethiopian Meat Concentrates, a subsidiary of the government-owned National Ethiopian Meat Corporation (NEMC) other than the traditional methods (FAO, 2015).

The following factors play significant role for low fish consumption in Ethiopia:

- Lack of integrating fish in daily diet

- Season based fish use due to some religious influences. I.e. The orthodox Christians have got the custom of eating fish during their fasting moments.
- Absence of considering the average consumers regarding high price

Due to underexploited fish production the current fish demand is four fold of fish supply

Table 2 : Ethiopia – Projected fish demand (FAO, 2015)

No	Year	Demand in tons
1	2003	67000
2	2015	95000
3	2025	118000

Including fish in one’s daily diet can serve as alternative source of protein, micronutrients, minerals and essential fatty acids which brings food security access to poor community members (Thorpe *et al.*, 2005; 2006; cited in Workiyie Worie, 2009). This is due to the fact that aquatic animals in general contain a high level of protein (17-29%) with an amino acid profile, similar to that of the meat of land animals. The flesh of a fish is also readily digestible and immediately utilizable by the human body, which makes it suitable for complementing the high carbohydrate diets.

Nowadays, the rapid growth of population and the progressive shortage of livestock products had changed the situation to a growing demand of fish (Anon, 1999 as cited in Abdurehaman Kelil, 2002).

### 2.3. AQUACULTURE SUB-SECTOR IN ETHIOPIA

The construction of ponds in Bishoftu and Akaki which are found near Addis Ababa was the beginning of aquaculture in Ethiopia in 1955. As of the development of Sebeta Fish Culture Station (SFCS) in 1975, (currently organized as the National Fish and other Aquatic Life Research Center- NFALRC), there has been the construction of various ponds in the country to grow Nile Tilapia. Less was done in aquaculture development in the country in spite of some efforts to extend artisanal ponds in some rural areas with pond sizes ranging between 100-300 m<sup>2</sup> (Rothuis *et al.*, 2012 as cited in Mulugeta Wakjira *et al.*, 2013). Culture oriented stock establishments have been major performances other than a few fish ponds. Under this practice new reservoirs were developed for the purpose of hydroelectric power supply or/and

irrigation that were dominantly stocked by fingerlings of Nile tilapia taken from various existing water bodies.

In general, aquaculture in Ethiopia is at a very low level of development due to lack of extension support and training, shortage of expertise, lack of fingerlings, lack of funding, little research and institutional capacity, etc.

The aquaculture capabilities of several species present in its rivers and lakes are yet to be explored. Meanwhile, Nile tilapia (*O. niloticus*), a tropical species predominantly cultured worldwide, remains the most common aquaculture species and more appropriate for any proposed pond aquaculture development in Ethiopia for some reasons. Primarily, the species appears to be more adapted to the country’s natural conditions as it is evident from its greater contribution to total fish landing from capture fisheries. NFALRC has also bred and distributed ornamental fish, gold fish (*Carassius auratus*), Common carp (*Cyprinus carpio*), and Grass carp (*Ctenopharyngodon idella*) which is an aquatic weed basically introduced in Fincha biological control (FAO, 2015).

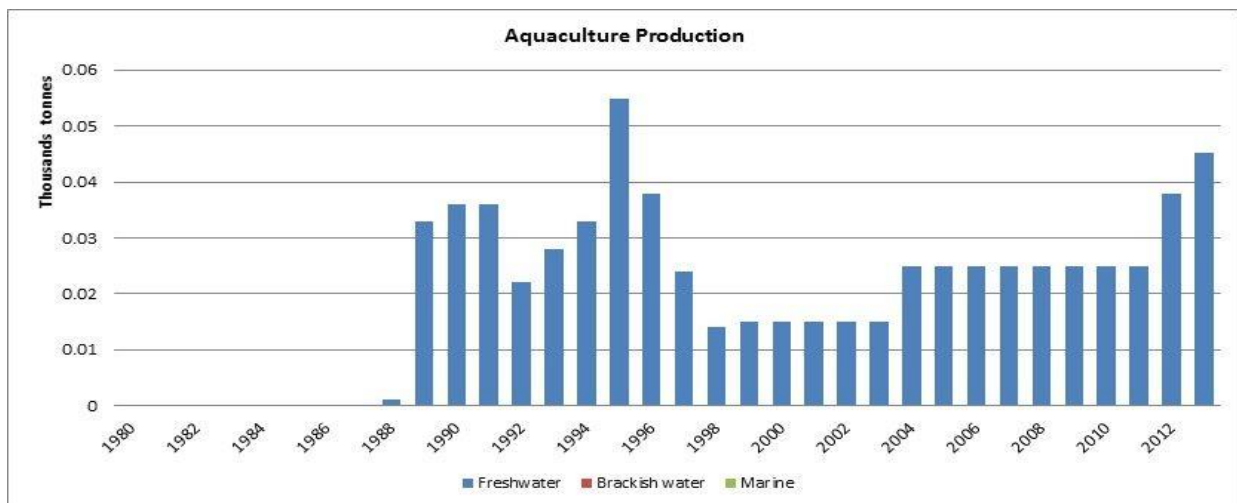


Figure 2: Aquaculture production amount from 1980 – 2012 in Ethiopia (Source: FAO, 2015).

### 2.3.1. AVAILABILITY AND ACCESS TO AQUACULTURE INPUTS

Various sectors have been conducting a study regarding fishery practices in Ethiopia. Among all NFALRC conducted and published its work on international and local journals as indicated in Yared Tigabu *et al.* (2011) on areas like various culture systems (mono and mixed sex, poly culture, cage culture, integrated aquaculture agriculture) fish feeds, characterization of Nile tilapia from geographically isolated water bodies, growth & survival of culture fish species, semi artificial and artificial fish breeding techniques.

Bahirdar Fishery and other aquatic research center and Ziway fishery resource centers are local oriented research institutions focusing on farm aquaculture more dominantly on farm seeds and culture activities. Higher institutions (Addis Ababa University, Hawassa University, Ambo University and Jimma University) have also worked on aquaculture practices. Even if there has been efforts made to advance the field of fish farming in Ethiopia, low improvement and development are seen. The National Aquaculture Development Strategy was developed with the cooperative practice between the government of Ethiopia and FAO in order to support commercial aquaculture activities and investment subsidies (FAO, 2015)

There is lack of reliable food supply in aquaculture practices which basically are based on plant and animal origins and researches are conducted on the use of locally available ingredients, which will be helpful to increase or to sustain Nile tilapia farm. Besides, there is trial in integrating Nile tilapia pond culture with poultry farming or even use artificial fertilizer to maximize the production level (Adugna Gindaba, 2013). “Alema Kodijs”, poultry and livestock feed production center, noted the capacity to produce fish feeds which can be prepared from locally available ingredients. The attainment of fishing gears isn’t challenging like shortage of fish feeds due to existing selling centers of fishing gears like gill nets at Ziway, Bahir Dar and Deneba (near Jimma) (Rothuis *et al.*, 2012 as cited in Mulugeta Wakjira *et al.*, 2013).

Aquaculture comprised of improvement on the subsector regarding the national strategy and development plan. The following listed factors are the main pulling reasons to maintain commercial aquaculture in Ethiopia.

- ✓ Unavailability of fish farming customs.
- ✓ Citizens low economic level to buy fish.
- ✓ Low human and institutional potential
- ✓ Insufficient training provision and lack of support to fishers.
- ✓ High competition among capture fisheries.

Thus, adequate technical support and training in the advancement of the fishery practices can increase the improvement of aquaculture practices (FAO, 2015).

## **2.4. EXISTING SITUATION OF LAKE ZIWAY: THE LAKE ZIWAY FISHERY PRACTICES**

Lake Ziway is found in the Great East African Rift Valley and in the Northern most Rift Valley lakes of the country. It is located between 7°51'N to 8°07'N and 38°43'E to 38°57'E. It has an open water area of 434km<sup>2</sup>, shoreline length of 137km and average depth of 4m. The lake has two tributaries and has one outflow in the south (LFDP, 1996). The fishing ground is used by co-operative members and private fishers where the latter occasional fishers are motivated and supported by occasional fish traders. Most fishermen are willing to pay for fishery management program but some fishermen are not willing for different reasons (ACP, 2011).

### **2.4.1. FISH PRODUCTION**

The attainment of adequate support from EDF fishery development plan enabled Lake Ziway to render maximum number of fish production from phase I (1981-1984) and Phase II (1991-1998) (Felegeselam Yohanes, 2003).

There are 30 known landing points on the lake divided over 20 fishing communities. Fishermen of one community shift frequently between landing sites of that community but rarely to those of another. According to Mathewos Hailu (2011) the fishing activity of Lake Ziway is operated by three types of gears: beach seine, gillnet and long line.

The lake comprises of ten species in families Cyprinidae, Clariidae and Cichilidae. *B. paludinosus*, *C. carassius*, *C. carpio*, *G. dembecha*, *G. makiensis*, *L. ethiopicus* and *L. intermedius* are from the Family Cyprinidae. *C. gariepinus* from the Family Clariidae, and *O. niloticus* and *C. zillii* from the Family Cichilidae. Additionally, *C. carpio*, *C. carassius*, *C. gariepinus* and *O. niloticus* are commercially significant fish types which are currently existing. It has been reported that the population of *Oreochromis niloticus* and *C. gariepinus* was declining in 2017 (Lemma Abera *et al.*, 2018).

1997 was a year which had maximum fish exploitation because of an elevated fish demand and favorable sector wise conditions. This over-exploitation result in a steady decline in 2015 with 1157.14 tons of production against 3180 tons of production in 1997. The recommended annual catch of the lake, that is the fisheries resource rent, which can be tapped without damaging the parent stocks is estimated to be 2,163 tons (Lemma Abera *et al.*, 2018).

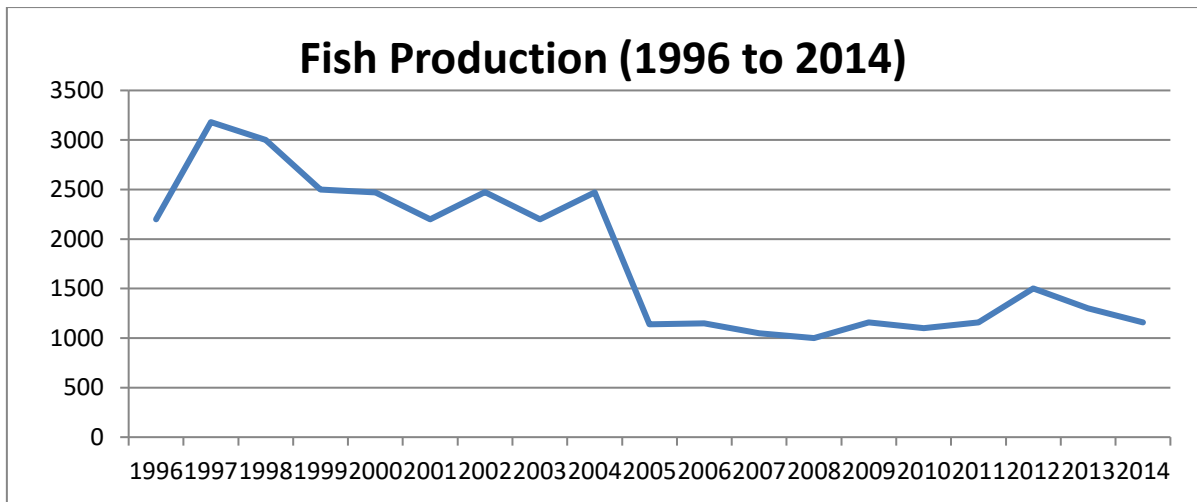


Figure 3: Fish production of Lake Ziway from 1996 – 2014. (Source: Tarekegn Shado (2006 and Lemma Abera *et al.* 2018)

Fish catch in Lake Ziway is elevated during the period from January to March due to great demand at the time of fasting i.e. this increment occurs at the vulnerable stage in the life cycle of the parent and the juvenile tilapia fishes (Spliethoff *et al.*, 2009).

#### 2.4.2. MANAGEMENT OF THE FISHERY PRACTICES IN LAKE ZIWAY

The lake’s fishery activities aren’t under the government law and regulations but 20 fishing communities and 12 cooperative societies have been managing the routine fishery practices of the lake (Seleshi Ashine, 2001 as cited in Wubshet Birhanu, 2015). This practice is common to other lakes of the country which permits open access that the fishing activity has no limit.

After the failure of Derg regime in 1991, anybody can work in fishing activity being member of a cooperative organization. As most of fishing associations apply, the most common traditional regulatory measures of Lake Ziway are mesh size regulation, catch limits, and closed seasons or areas. Allowed mesh sizes for beach seines and gill nets are 8 and 10 cm respectively but most of fishermen use illegal fishing gears (LFDP, 1996).

Closed seasons, closed fishing areas, restriction on number of fishers, catch quotas, mesh size restriction, restriction on beach seines and banning beach seines are helpful to maintain an effective fishery management in the lake (Abdurehaman Kelil, 2002). Fishing should be prohibited in the main spawning grounds of valuable fishes during the spawning period and in the feeding grounds of the young. The correct decision on dates allowing fishing operations is very important and may vary for each species and different areas. It also varies from year to year according to climatic conditions of a water body. The spawning seasons

and areas of dominant fish species in Lake Ziway are not well studied. This might have influence on the implementation of closed seasons that is characterized by the protection of particularly vulnerable stages in the life cycle of a stock. Protection of vulnerable stages may include the protection of juvenile fish, and spawning stocks.

In most cases, fishermen use rafts made either from papyrus reeds or from local softwood. The growing shortage of the construction material, especially softwood would limit the number of these rafts. This in fact is a management measure that would limit the number of boats, but this option does not sound realistic.

Closed area as a management measure would be possible to implement in lakes that are not accessible from any landing point. Lake Ziway has landing points that are already scattered along the full length of the shoreline that makes the implementation of area closure difficult (LFDP, 1996).

## **2.5. OTHER MEANS OF LIVING FOR LAKE ZIWAY FISHERMEN**

In Ethiopian central rift valley mixed agricultural trends are common that in addition to farming livestock plays a prominent role to subsidize their economy regarding power generation, income generation, food provision and means of transportation (Mekonnen Hailemariam & Lemma Abera, 2011). Besides, livestock ownership ensures existence when there is less crop production during famine and drought. Bedru Beshir (2004) indicated field crops, pulses, and horticultural crops are mainly produced crops. Among field crops maize, teff, and wheat are principal in terms of both area and yield, while haricot bean is a dominant crop. Onion, tomato, pepper and cabbage are important among horticultural crops; and papaya is the main vegetables. These practices have got substantial contributions to the livelihood security of the fishermen.

Hussien Abegaz (2010) reported that over 67,000 people and about 337,000 people get their subsistence directly or indirectly on fishing practices, respectively. Especially, those businessmen working on processing transport and marketing of the fish across the value chain are directly benefitting from the sector.

## CHAPTER THREE

### MATERIALS AND METHODS

#### 3.1. DESCRIPTION OF THE STUDY AREA

The study was conducted on Lake Ziway located in Adami Tulu, Jido Kombolcha district. The district is located in the central Rift Valley of East Shewa Zone bordered by Arsi Negelle, SNNPR, Dugda and Ziway Dugda district (Arsi Zone) in the south, west, north and east, respectively.

Lake Ziway is part of the rift valley lakes and it is 175 km southeast of Addis Ababa. The lake is 1636 meters above sea level and it comprises an area of 434 km<sup>2</sup> as well as on average 2.5 m deep. The lake's watershed is found between 7°15'N to 8°30'N latitude and 38°E to 39°30'E longitude and 7300 km<sup>2</sup> area coverage. The area has got climatic conditions which ranges from semi-arid to sub-humid with 650mm and 25°C annual precipitation and temperature, respectively (Spliethoff *et al.*, 2009).

Dugda, Adami Tulu Jido Kombolcha and Ziway Dugda are the three administrative districts of Lake Ziway. Dugda and Adami Tulu Jido Kombolcha bordered the catchment and Ziway Dugda to the west and to the east, respectively. Tulu Gudo (4.8 km<sup>2</sup>), Tsedecha (2.1 km<sup>2</sup>), Funduro (0.4 km<sup>2</sup>), DebreSina (0.3 km<sup>2</sup>) and Galila (0.2 km<sup>2</sup>) are the five islands in Lake Ziway. River Meki and River Ketar are the tributaries of the lake and Bulbula is the outlet river (Wubshet Birhanu, 2015).

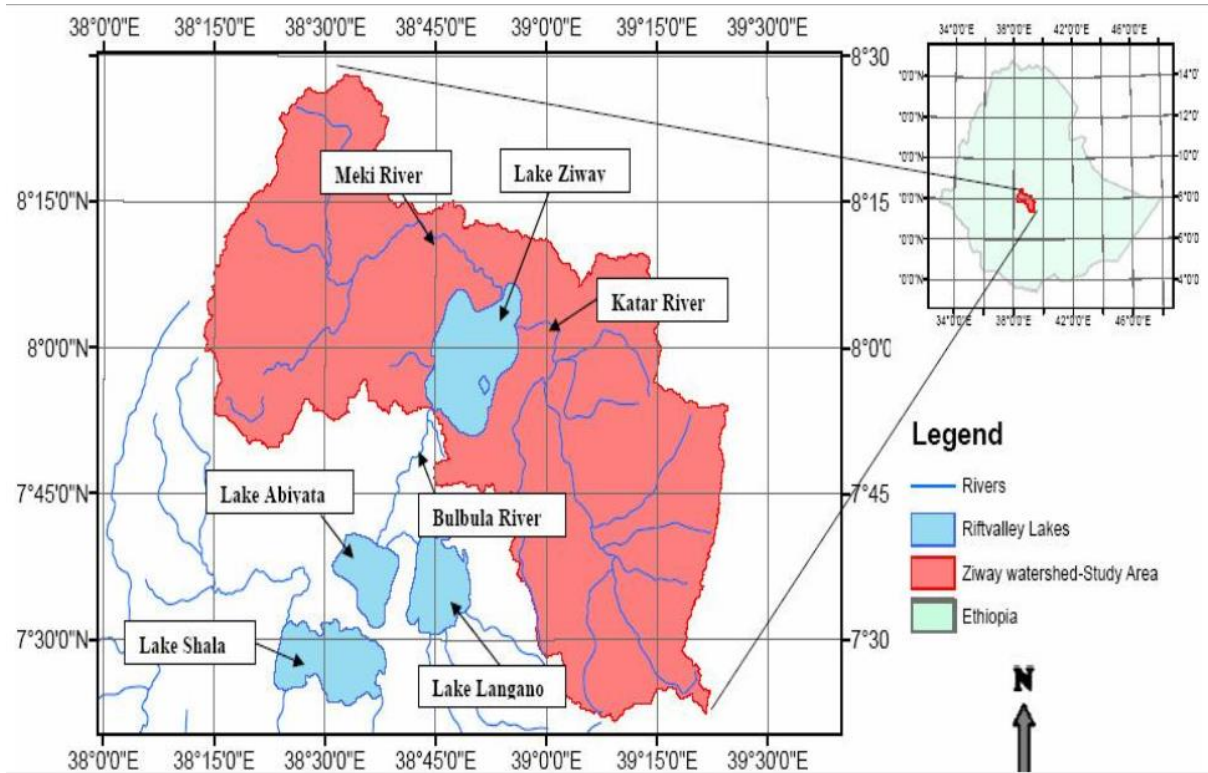


Figure 4 : Lake Ziway (Source: Amare Mazengia, 2008)

### 3.2. METHODS

In order to achieve the objectives of the study and for the sake of gathering data concerning the current status of the fish and fisheries of Lake Ziway both primary and secondary data were used.

**Primary data-** Primary data was collected through:

- Field observation
- Questionnaires, and
- Interview

**Secondary source:** Documented information related to the study was reviewed.

- Books
- Journals, and
- Internet web sites were accessed to collect related information about the research area.

### 3.3. POPULATION AND SAMPLE SELECTION

There are fishermen who live in 25 total Kebeles in which there are 9 Kebeles in Dugda, 11 Kebeles in Adami Tulu Jido-Kombolcha and the rest 5 Kebeles in Ziway Dugda district.

Among these, the study selected Adami Tulu Jido-Kombolcha as it covers large shoreline, being in main road line, accessible to market and possesses the necessary infrastructure. Hence, focusing on time of establishment, the study purposely selected 3 cooperatives (Ziway Batu Fishermen Cooperatives, Bochessa Fisher Cooperatives, Abeyi Burkitu Fisher Cooperatives) which have been working in Adami Tulu Jido-Kombolcha. Thus, all the cooperatives use almost similar gear type, mesh size, and other activities that the study just considers those cooperatives with more than 10 years and above experience. Besides, the selected sites use the same landing site (Wafeqo) that it enables the researcher to attain them as required. Based on these facts, the study sampled 94 fishermen from the total 105 fishermen regarding the 3 cooperatives using Taro Yamane's formula as shown below (Israel 2013 as cited in Wubshet Birhanu, 2015). Using the formula, participants were determined from each cooperatives to maintain proportional participation of informants.

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the sample size, N is the population size, and e is the level of precision.

Furthermore, to increase the validity of the research findings, the study included illegal fishermen other than those who are part of the mentioned cooperatives. Thus, these fishermen were part of the study regarding availability sampling considering those who availed themselves at the time of the survey. In light of this, the study included 10 illegal fishermen who were available during data gathering.

In addition to the fishermen, the study interviewed 3 experts, from Batu Fish and Other Aquatic Life Research Center and one time keeper from small and micro-fish processor's enterprise.

Table 3 : Cooperatives working in Adami Tulu Jido Kombolcha

Zone	District	No	Name of Cooperatives	Number of Members	N
East Showa	Adami T/J/K	1	Ziway Batu Fishermen Cooperatives	58	50
		2	Kontola Fisher Cooperatives	30	
		3	Bochessa Fisher Cooperatives	30	28
		4	Abeyi Burkitu Fisher Cooperatives	17	16
		5	Abosa Fisher Cooperatives	26	
Total number of cooperatives members				161	
Total number of sampled cooperatives members					94

Source: Adami-Tulu animal and fish development office

### **3.4. DATA ANALYSIS**

Quantitative and qualitative data analysis methods were used in order to determine the average fish catch and to indicate the various challenges regarding fish catching in Lake Ziway. Hence, descriptive statistics like percentage, frequency, mean, standard deviation, one way ANOVA and chi-square test were applied. Furthermore, the study analyzed the findings related to the interview qualitatively.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.1. PRODUCTION STATUS OF LAKE ZIWAY

##### 4.1.1. DEMOGRAPHIC AND SOCIO-ECONOMIC STATUS OF PARTICIPANTS

###### 4.1.1.1. RESPONDENTS' AGE IN COMPARISON TO BOAT TYPE

According to Table 4, all of the respondents were males due to the tiresome nature of the activity. Majority (54.8%) of the respondents were based on canoe (a long narrow boat that is made up of grass) in light of level of age and means of transportation. The rest (45.2%) used timber boats (wooden boats) when fishing. Regarding age category, most of Timber boat users are adults which comprised 16% of 26-35 years and 23% of above 36 years old. Besides, majority of youngsters used canoe with 16.3% and 9.6% of 16-20 years and below 15 years, respectively. This difference indicated economic insufficiency regarding youngsters that they were forced to use canoe in comparison with adult participants and it may be because of the nature of the operating system of the boats. In the case of canoe, it is expected to stand on the canoe for long period of time keeping their balance which is somehow difficult for older age.

In addition to the above descriptions, a chi-square test was performed to determine age and means of transportation relationships. Thus, there was a significant difference between age category and the means of transportation employed  $X^2 = 27.929$ ,  $df = 4$ ,  $n=104$ ,  $p = 0.004$ .

Table 4 : Respondents' age in comparison to boat type

		Number and (%)			Total
		Sex	Type of boat		
		Male	Timber Boat	Canoe	
Respondents' Age	Below 15	4 (3.8%)	0 (0.0%)	4 (3.8%)	4 (3.8%)
	16-20	13(13%)	3 (2.9%)	10 (9.6%)	13 (12.5%)
	21-25	22 (21%)	5 (4.8%)	17 (16.3%)	22 (21.2%)
	26-35	38 (37%)	16 (15.4%)	22(21.2%)	38 (36.5%)

	Above 36	27 (26%)	23 (22.1%)	4 (3.8%)	27 (26.0%)
Total		104 (100%)	47 (45.2%)	57 (54.8%)	104 (100%)

#### 4.1.1.2. RESPONDENTS' LEVEL OF EDUCATION TO ACCESS TO TRAINING

Table 5 depicts that 73.1% of the fishermen didn't get trainings on fishing practices, however, (26.9%) of them had access to training. (43.3%) and (35.6%) of the fishermen attended junior primary school and primary school, respectively. 15.4% of the participants had high school experience, but (5.8%) of them had no formal education.

A chi-square test was performed and a relation was found between respondents level of education and means of access to training,  $X^2=35.008 \cdot df = 3, n=104, p = 0.001$ .

The chi square test implied significant relationship between participants' level of education and access to training that (12.5%) of fishermen with advanced level of education had better access to training in comparison with primary school and no formal education.

Based on the findings of Kidanie Misganaw & Addis Getu (2016) education has got positive effect in the provision of training and so as to modernize fishing activities and life of the fishermen.

Table 5 : Respondents' level of education with regard to access to training

		Number and (%)		
		Access to Training		Total
		Yes	No	
Respondents' Level of Education	No Formal Education	0 (0.0%)	6 (5.8%)	6 (5.8%)
	Primary School	2 (1.9%)	35 (33.7%)	37 (35.6%)
	Junior secondary School	13 (12.5%)	32 (30.8%)	45 (43.3%)
	High School	13 (12.5%)	3 (2.9%)	16 (15.4%)
Total		28 (26.9%)	76 (73.1%)	104 (100%)

#### 4.1.1.3. RESPONDENTS' FISHING EXPERIENCE

Considering fishing experience based on Table 6, most of the fishermen have spent more than 11 years in fishing activity. Hence, 36 (34.6%), 32 (30.8%), and 19 (18.3%) of the participants spent 16-20 years, 6-10 years and 21-30 years in fishing, respectively. However, 4 (3.8%) of the respondents were within the category of 11-15 years and 6 (5.8%) of them spent above 31 years in fishing in Lake Ziway. At last, 7 (6.7%) of the participants were teenagers who attained the fishing practices from their family and they have stayed in the activity for 1-5 years. The majority of the experienced fishermen feel sense of ownership for fisheries resources better than the less experienced youth fishermen.

Table 6 : Respondents' fishing experience

Description	Number and (%)
1-5 Years	7 (6.7%)
6-10 Years	32 (30.8%)
11-15 Years	4 (3.8%)
16-20 Years	36 (34.6%)
21-30 Years	19 (18.3%)
Above 31 Years	6 (5.8%)
Total	104 (100%)

#### 4.1.1.4. CREDIT AND TRAINING ACCESSIBILITY, ALTERNATIVE INCOME AND BOAT OWNERSHIP

In addition to the fishing experience of the fishermen, Only 22 (21%) had additional income from other sources, such as farming, animal husbandry, and fish trading. Those who had additional income undertake the fishing business because they earn less income from their primary job. Very small proportion of fishers 19 (18%) and 28 (27%) had access to credit to buy spare parts and nets and had access to fishing related training, respectively. Due to financial constraints most of the fishers are unable to change their boat and net; as observed in the field most of the fisher's gears and their boats are very old as a result of serving for long period of time and this may have constrained the fishers from better production. Although, 76 (73%) of the respondents used their own boat, most of them were traditional (canoe) and the rest 18 (27%) fishers worked with boat owners and shared the daily catch with them. Lack of access to credit, alternative income and boat ownership affected fishermen capacity to attain better fish production. Thus facilitating working conditions in realizing credit could have made them own better fishing equipments and facilities as well (Dawit Garoma *et al.*, 2013).

Table 7 : Credit and training accessibility, alternative income and boat ownership

Variables	Number and (%)	
	Yes	No
Access to credit	19 (18%)	85 (82 %)
Access to market	62 (60%)	42 (40 %)
Alternative income	22 (21%)	72 (79%)
Access to training	28 (27%)	76 (73%)
Boat ownership	76 (73%)	18 (27%)

#### 4.1.2. DAILY FISH CATCH DISTRIBUTION OF PARTICIPANTS

The average daily fish catch in Lake Ziway was 23.49 kg with a standard deviation of 21.59 (Figure 5). Besides, majority of the fish catch was below the mean level. This low daily fish catch was caused due to lack of advanced fishing gears or/and majority of the fishermen were not owners of fishing gears rather they work for owners of the fishing gears.

Wubshet Birhanu (2015) indicated an average daily fish catch of 30 Kg with a standard deviation of 15 Kg. This implied poor current conservation of the lake’s fishery practices.

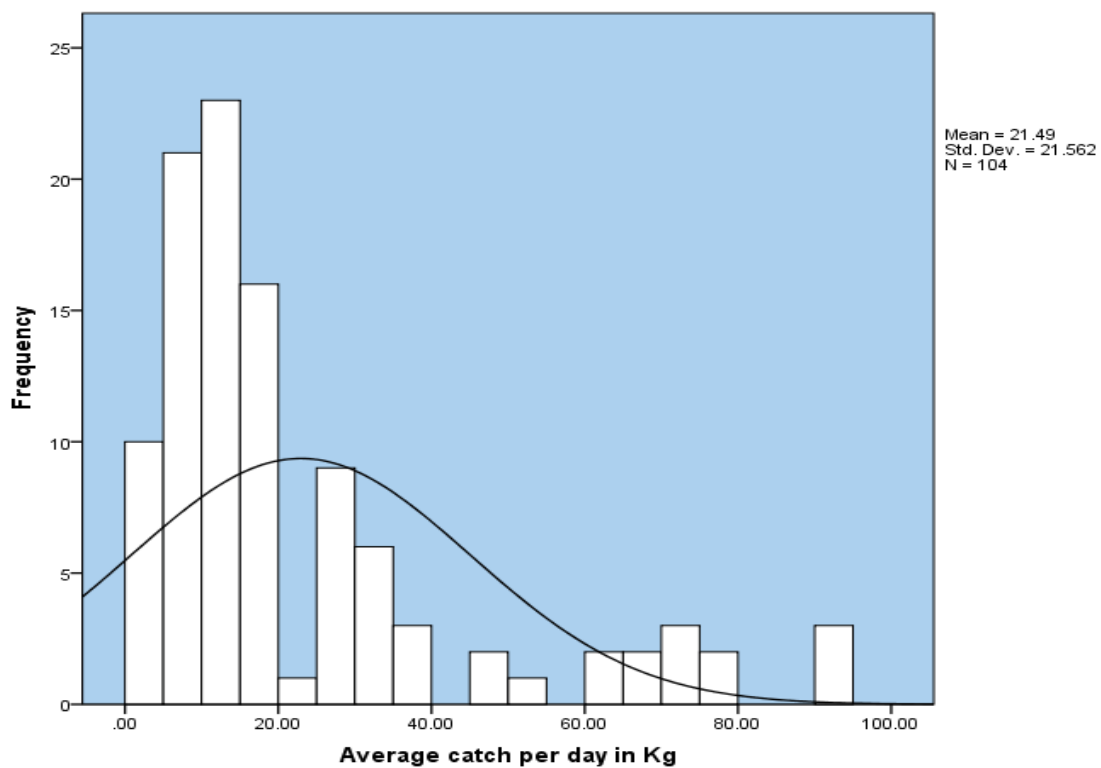


Figure 5 : Average fish catch in Kg per day in Lake Ziway

#### 4.1.2.1. FISHING GEARS AND BOATS

According to one-way ANOVA, there was statistically significant variation in fish catch with respect to fishing gear type used ( $F(3,100) = 77.950, p < 0.000$ ; Table 8). A Tukey Post hoc test indicated that fish catch was statistically and significantly greater in using combination of fishing gears compared to Beach Seine, Gill Net and Long line & hooks alone ( $54.3200 \pm 9.232$  Kg,  $p < 0.001$ ). Beach Seine had also greater fish catch ( $25.184 \pm 4.29$  Kg,  $p < 0.001$ ), compared to Long line and Gill Net, respectively.

There was no statistically significant difference between using Gill Net and Long line & hooks type of fishing gears ( $p = 0.594$ ).

Furthermore, the mean catch of fishers who used Gill net (12.98 Kg) and Long Line and Hooks (9.07 Kg) was very low compared to those who used Beach Seine (25.18 Kg). However, those who have been using combinations of fishing gears caught much more daily fish with mean score of 54.32 Kg. In this regard, the combined fishing gears produced a maximum daily production of 90 Kg and a minimum daily production of 20 Kg followed by Beach Seine with 50 Kg and 12.5 Kg maximum and minimum daily production, respectively. Additionally, the Gill net and Long Line and Hooks fishing gears caught a maximum and a minimum daily fish catch of 25 Kg, 5 Kg and 15 Kg, 3 Kg, respectively.

Table 8 : Fishing gears and fish caught

Fishing Gear	Mean (kg)	Std. Error	95% Confidence Interval		F	Sig
			Lower Bound	Upper Bound		
Beach Seine	25.1842	2.04311	20.891	29.476	77.950	.000
Gill Net	12.9815	0.7686	11.401	14.561		
Long Line and Hooks	9.0758	0.7124	7.624	10.527		
Combinations	54.3200	4.4731	45.087	63.552		

With respect to an interview with key informants, the average length of beach seine at this time is estimated between 700-800m; the mean height was 3.4 m. The recommended minimum beach seine mesh size in the cod end was 6 cm, minimum mesh size in the wings was 8 cm, and maximum allowed length 150 meters for Lake Ziway. The beach seine under use is three times as long as the recommended length, whose wing mesh size is less than 8 cm and whose cod end mesh size is less than 6 cm.

It was also revealed that most of gill net users were using gill nets whose mesh size is less than 8 cm which is against the allowed mesh size with the exception of those who have been targeting Jape fish type with wider mesh size. The average number of hooks per long line user was 533. Even though there has been low fish catch, about half million hooks with a size which ranges from size No 1 to size No 12 (follows Norwegians numbering) were employed so as to catch fish in the lake. With this regard, 2 kg of fish which is too small as long as 100 hooks were used.

### 1. FISHING GEAR WITH REGARD TO MODE OF FISHING

Regarding Table 9, a chi-square test was performed and a relation was found between mode of fishing and type of fishing gear,  $X^2 = 18.746$ ,  $df = 3$ ,  $n = 104$ ,  $p = 0.005$ . In light of this relationship, (23.1%) and (22.1%) of full time fishers and members of cooperatives were using long line and hooks and combinations of fishing gears, respectively. (16.3%) of them used gill net and the rest (15.4%) employed beach seine fishing gears.

Majority (76.9%) of the fishermen were fulltime and members of cooperatives while (9.6%) of them were full time but not members of cooperatives. The rest (13.5%) were part time fishers. Besides, (31.7%) and (26%) of the fishermen were using long line and hooks and gill net fishing gears, respectively. 24% of them were depending on combinations of the fishing gears and 18.3% used on beach seine fishing gears.

Table 9 : Mode of fishing related to fishing gears used

		Fishing Gears in Number and %			
		Beach Seine	Gill Net	Long Line and Hooks	Combinations
Mode of Fishing	Part time fishers	3 (2.9%)	4 (2.9%)	8 (7.7%)	0 (0%)
	Fulltime but not members of the cooperatives	0 (0%)	7 (6.7%)	1 (1%)	2 (1.9%)
	Fulltime and members of the cooperatives	16 (15.4%)	16 (16.3%)	24 (23.1%)	23 (22.1%)
Total		19 (18.3%)	27 (26%)	33 (31.7%)	25 (24%)

### 2. FISHING GEAR IN ACCORD WITH BOAT TYPE

In order to see the interrelationship between fishing gear and boat type, a chi-square test was performed (Table 10). Hence relationship of the two variables was determined using  $X^2 = 92.608$ ,  $df = 3$ ,  $n = 104$ ,  $p = 0.001$ . Under this relationship, canoe using fishermen didn't use Beach Seine fishing gears due to its expensiveness and inconvenience to fishing.

In addition to the chi-square test, the percentage statistical description of the type of boat and fishing gear indicated variation in the level of fish catch. Most of the fishermen (30.8%) using Canoe along with long line and hooks followed by (24%) of canoe with Gill Net users. 19% of Timber Boat based fishermen used Beach Seine fishing Gears. None of Canoe using fisher men based on combined fishing gears, but (24%) of Timber boat using fisher men employed combinations of the fishing gears. In general, 54.8% and 45.2% of the fishermen are using Canoe and Timber boat, respectively.

Table 10 : Fishing gear and boat types' relationships

		Fishing Gear in Number and %			
		Beach Seine	Gill Net	Long Line and Hooks	Combinations
Type of Boats	Timber Boat	19 (18.3%)	2 (1.9%)	1 (1%)	25 (24%)
	Canoe	0 (0%)	25 (24%)	32 (30.8%)	0 (0%)
Total		19 (18.3%)	27 (26%)	33 (31.7%)	25 (24%)

Additionally, based on an interview held with key informants, 7 steel boats, 163 timber boats and 703 canoe types of transports were recorded. Increase in number of fishing gears indicated an increased pressure on fishery. Besides, steel boat costs 65,000 birr, timber 4,100 birr and canoe 241 birr. Due to its low cost, poor fishermen prefer canoe. On the other hand, timber boats are usually employed along with beach seine while canoes are mostly employed either with long line or gill net fishing activities. Steel boats are mainly used to collect/purchase fish from fishermen on landing sites or in open water to the nearest towns, either Batu/Ziway or Meki.

### 3. FISHING GEAR COMPARED TO PRODUCTION SEASON

Based on Table 11, 45% of fishers who use long line produce maximum production in September to December; and also all of the fishers (100%) who use beach seine got the maximum production in January to April. On the other hand, gill-net users confirmed that they had maximum production in both September to December (41%) and January to April (56%). Fishermen who use combination of fishing gear (60%) have maximum production in January to April.

42%, 67%, 58% and 88% using Beach seine, Gill Net, Long line and a combined type of fishing gear, respectively confirmed that they had minimum production in May to August, since it is the main rainy season the fishing activity is not productive. Though, Beach seine users had much better (42%) catch than the others.

Table 11: Comparison of production period versus fishing gears used in Lake Ziway

Month	Fishing gear											
	Beach Seine			Gillnet			Long line & hooks			Combination		
	High	Ave	Low	High	Ave	Low	High	Ave	Low	High	Ave	Low
Sep- Dec	16	47	37	41	44	15	45	43	12	40	60	-
Jan- Apr	100	-	-	56	37	7	6	67	27	60	36	4
May- Aug	42	16	42	11	22	67	27	15	58	12		88
Total												

#### 4.1.2.2. FISHING TIME

There was a statistically significant difference between fishing times as determined by one-way ANOVA ( $F(2,101) = 9.321, p < 0.000$ ; Table 12). A Tukey post hoc test revealed that fish catch was statistically significantly greater at night time ( $31.863 \pm 7.446$  Kg,  $p < 0.001$ ), ( $31.863 \pm 7.446$  Kg,  $p < 0.032$ ) compared to afternoon and morning times, respectively.

Furthermore, there was statistical difference considering the mean value of morning, afternoon and night time fishing in which night time fishing (31.863 Kg) was greater than afternoon (8.972 Kg) and morning (20.675 Kg) time fishing. This means, the average fishing catches at night, afternoon and morning times ranges in between 24.39 Kg to 39.28 Kg, 5.30 Kg to 12.63 Kg and 16 Kg to 25.4 Kg, respectively.

There was also a considerable variation in maximum and minimum fish catch regarding the time of fishing. Thus, there was 90 Kg maximum and 10 Kg minimum night time catches while 25 Kg maximum and 3 Kg minimum afternoon catches. Besides, there was an optimum maximum (50 Kg) and minimum (5 Kg) morning time fishing.

Table 12: ANOVA analysis of fish catches along fishing time

Fishing Time	Mean	Std. Err.	95% Confidence Interval for Mean		F	Sig.
			Lower Bound	Upper Bound		
Morning	20.675	2.35	15.909	25.442	9.321	0.000
Afternoon	8.972	1.73	5.306	12.637		
Night	31.836	3.70	24.390	39.282		

#### 4.2. MARKET AVAILABILITY IN FISHING PRACTICES

According to the respondents, the selling price of the fish is seasonal; during the time of fasting season, then the selling price would go up in comparison with other times. During the observation, in the landing site there were fixed local traders and these local traders received all the catch from the fishers and gave it to fish processors.

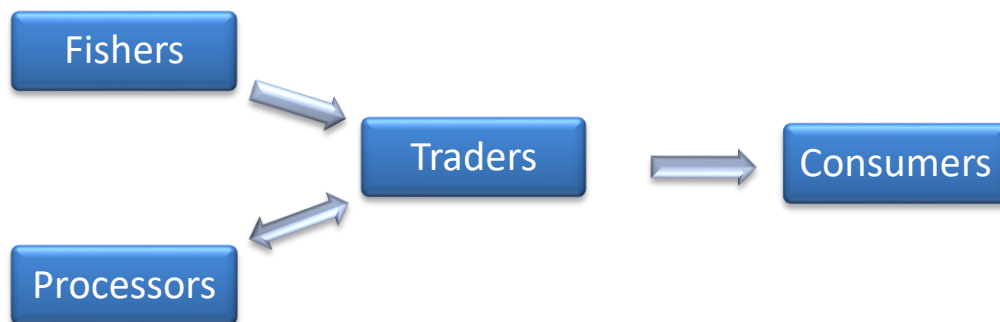


Figure 6: Fish market chain model diagram

According to the processors, they have no contact directly with the fishers and have been paid based on the amount (kilo) of fish they filleted per catch by the traders. In addition to this, the traders set a price and don't allow the fishers to communicate with direct consumers or buyers who came from other places especially from Addis Ababa. This made the fishers always a victim and receives low prices. Due to lack of enough storage facilities, fishers sell at low prices during periods of high harvest. According to the assessment made most of the beneficiaries were the local traders because of the market chain problem.

Adamneh Dagne (2015) discussed the direct benefits of fishermen with regard to Lake Hawassa. This is because of direct market channel existence among fishermen, cooperatives,

local consumers, hotels and consumers. Such marketing channels help to capacitate the livelihood of fishermen and advance fishery practices.

Table 13: The mean price of fish in Ziway

2.2.Price of Fish based on their Type				
Family	Fish Species	Local Name	Quantity No/Kilo	Price in Birr/ No or Kilo
Cyprinidae	<i>Carassius carassius</i>	Dube	No	5-20
	<i>Cyprinus carpio</i>	Jape	No	8-30
Clariidae	<i>Clarias gariepinus</i>	Ambaza	Kilo	35-40
Cichilidae	<i>Oreochromis niloticus</i>	Qereso	No	5-12
	<i>Coptodon zillii</i>	Adisse	No	5-10

As Table 13 indicated, various types of fish were used with respect to different meals. Among all, *Oreochromis niloticus* (Qereso) was suitable for any meal type like fish roast, 'dullet', sauce, and 'leleb' that it is overexploited and has got minimum catch. Nowadays, *Cyprinus carpio* (Jape), *Carassius carassius* (Dube) and *Oreochromis niloticus* (Qereso) have been widely caught and utilized in the market. Additionally, *Clarias gariepinus* (Ambaza) has been conveniently used for sauce while *Cyprinus carpio* (Jape) and *Carassius carassius* (Dube) were dominantly employed for 'leleb' and fish roast, respectively. In recreation center nearby the lake a roasted tilapia fish type was served at Br.30 which was recognized as this fish type was preferred for roasting instead of other fish types.



Figure 7: Roasted tilapia fish served during lunch time

#### **4.2.1. COMMERCIALY IMPORTANT FISH**

Even though there are twelve fish species that exist in the lake, according to the respondents (Processors) only five fish species are commercially exploited, which include;- *Oreochromis niloticus* (Qereso), *Coptodon zillii* (Addise), *Cyprinus carpio* (Jape), *Carasius carrasius* (Dube) and *Clarias gariepinus* (Ambaza). *O. niloticus* has been highly demanded by consumers and most fishers have targeted to catch it. But at this time because of its low catch, fishers shifted to another fish species *Labeobarbus intermeidius* (Bilcha) in addition with the other four fish species listed above.

#### **4.2.2. ALTERNATIVE LIVELIHOOD**

Based on the interview conducted with the fish processors, it could be known that, they were being organized in small and micro enterprise as fish processors by Adami-tulu animal and fish development office. They said that, most of them were fishermen that totally relied on fishing before they joined the enterprise. According to the finding of Megerssa Endebu *et al*, (2015), there were few fishermen who diversify their income to other activities in addition to fishing. The activities included gear making, crop farming and cattle rearing. Tsion Handcraf Association, organized in 2010 with the support of USAID/ESTA - Ethiopian Sustainable Tourism Alliance at Tullu Guddo Island in basket making and textile weaving. The association had 23 members with 65% women. Currently, the members started selling handmade personal and home accessories and earning income, becoming less dependent on the fishing sector. Such activities need to be practiced in other parts of the lake to minimize the fishing pressure.

### **4.3. FACTORS THAT CAUSE FISH RESOURCE DEPLETION IN LAKE ZIWAY**

#### **4.3.1. OPERATION OF ILLEGAL FISHERS**

As stated on table 14, 77% of the respondents mentioned the current challenges due to illegal fishery. Although it is difficult to know the exact number of illegal fishers, a report by Megerssa Endebu *et al*, (2015) 127 beach seine (having a total length of 37,330 meters), 1,445 gill nets (72,255 meters) and 408,561 hooks were recorded in the lake. From this 8 beach seines, 463 gillnets (23150 meters) and 193420 hooks were owned by illegal fishers. But according to the respondents the number is more than this and the number also fluctuates in off-farm and fasting seasons during which the number of illegal fishers increases tremendously.

Based on the researcher's observation at lake, there was poor and traditional fishing performance regarding the practices of the fish processors which resulted in the occurrence of dirty environmental situation due to their by-products. Besides, their traditional fishing gear caught fish types which haven't been utilized in the market which added additional burden to maintain clean and better environment. Illegal fishermen, who had been fishing and selling fish at the bus station, could be causes to various diseases because of their poor hygiene and fish handling.



Figure 8: Filleting fish at shore of Lake Ziway

#### **4.3.2. ABSENCE OF POST-HARVEST PROCESSING PLACE**

Based on table 14 below, 76% of the respondents responded fishers don't have enough places for storage with the required facilities that can preserve the fish until it reaches the consumers

#### **4.3.3. LACK OF GOVERNMENT SUPPORT AND FOLLOW UP**

According to the respondents all the fishers, after being members of the cooperative, use their own boats and gears, and there is no any common asset that belongs to the cooperative. Examination of records of the cooperatives revealed that most of the members do not contribute to the cooperative in terms of finance even though all members are obliged to contribute 10% of their monthly income as a saving. These further strengthen the argument presented above that membership is used as a mechanism of getting license to be a legal operator. Except during period of fasting, government inspections are literally absent. In

addition to this, (74%) of the respondents replied that the fishing cooperatives never received financial support although they were legally recognized by the government (Table 14). Due to this, their performances are not significantly different from individual fishers who operate independently. These have put also a setback on cooperative membership and some members also quite and start operating as individual fishers.

A study by Assefa Mitike & Lemma Zemedu (2015) discussed that, even if there was a proclamation for fishery resource utilization, still the governmental bodies did not give attention for fishery sector. In monthly reporting format the fishery was not included and due to this extension contact was zero.

#### **4.3.4. LAKE WATER LEVEL REDUCTION**

According to the researcher's observation water is being abstracted from the lake for Mojo-Hawassa express way development road project. This has contributed to the decline of the water level of the lake in addition to drought and inflow water reduction of Bulbula River, expansion of farm lands, deforestation on the shore line, that cause soil erosion & flooding to the lake. As a result, the soil sedimentation was aggravated and caused decline in water depth. Based on table 14 below, about 64% of the respondents agreed that they have observed significant decline of the water level of Lake Ziway. This and other factors were meant for environmental degradation and made the lake susceptible to damage.



Figure 9: Water extraction and environmental degradation in Lake Ziway.

A dramatic increased water demand resulted in over abstraction of water from Meki-Ziway sub-basin. Ziway Pressurized irrigation, Katar irrigation diversion and Meki irrigation from

dam and Ziway, Meki irrigation demand sites were the major reasons for the existed decrease of the water bodies (Abebe Guadie & Kassa Tadele, 2016). Thus, Lake Ziway is directly impacted with these practices of the mentioned water basins.

#### **4.3.5. INCREASED NUMBER OF INDIVIDUAL FISHERS**

The lake is freely open to everyone in the surrounding, and as stated on table 14, 50% of the respondents confirmed that anyone interested is free to join the fishing business. The only criterion, at least in principle, to enter into the fishing business is to be a member of one of the fishing cooperatives legally recognized in the area. Therefore, membership to a cooperative is used as a license to join the fishing business. This is supported by the findings of Spliethoff *et al.* (2009), who argued that entry into the fishing business in Lake Ziway is similar to the cases in other lakes and rivers in Ethiopia, and all the resources are exploited based on the principle of “open access”. Due to this free access to the water resource, over-exploitation of the fishery remains challenge to Lake Ziway. Although most fishers are organized in cooperatives, a considerable number of fishermen are operating outside the framework of cooperatives in Lake Ziway. Furthermore, Fishery cooperatives are structures supposed to implement community based management of the lakes and fish population. They were supposed to create market opportunity exclusive to their members to enable them benefit from sale of the fish output at competitive price. Despite the fact that, their performance is loose which is perhaps limited to collection of the fish output from members at the lake site. The collected output was delivered to wholesalers, retailers, hotel and restaurants, and individual customers with low price. Hence, there were no clear demarcation of services provided to the member house-hold and the non-members. As a result, fishermen were reluctant to join fishery cooperatives. Different studies (Felegeselam Yohanes, 2003; Dawit Garoma *et al.*, 2014) also came up with similar findings in different lakes of Ethiopia.

#### **4.3.6. DEPOSITION OF WASTES AND CHEMICALS FROM FLOWER FARMS IN THE AREA**

Table 14 below indicated that 43% of the respondents reflected that lake pollution is one of the main reasons for the decline of fish production in the area .This is due to high level of fertilizer residues in the farm which promotes the growth of algae. Besides, the algal bloom blocks the entrance of sun light which created oxygen depletion because of decompositions of dead phytoplankton. In general, it disturbs the food chain in the lake and minimizes the level of fish production.

Table 14: Challenges of fish production based on the perception of respondents

Type of constraints	Number and %
Illegal fishers	80 (77%)
No filleting place	79 (76%)
Limited government support	77 (74%)
Lake water level reduction	67 (64%)
Open access	52 (50%)
Deposition of wastes	45 (43%)

The phytoplankton domination of Lake Ziway brought an increased trophic level and caused low energy transfer in the trophic level which is even much less than other productive African lakes. Besides, an overexploitation of the lake resulted in the low value of transfer efficiency from trophic level II which is the major part of the lake fishery ecosystem structure, trophic link and functioning of a shallow rift valley (Mathewos Hailu, 2011).

#### 4.4. SUGGESTED LAKE MANAGEMENT MEASURES

As stated on table 15, 70 (67%) and 65 (62%) of respondents agreed on building post harvesting places and improving market chain respectively were essential in managing the lake effectively. Additionally, 70 (67%) of the informants indicated the increment of fish population benefits in management of the lake efficiently.

Table 15: Suggested lake management measures based on the perception of respondents

Suggested measures	Number and %
Controlling illegal fishers	75 (72%)
Increasing fish population	70 (67%)
Building post harvesting place	70 (67%)
Provision of government support	69 (66%)
Improving market chain	65 (62%)
Maintaining water level of the Lake	50 (48%)

Among all, daily water transportation of water from the lake minimized the water volume of the lake which in turn has affected the ecological conditions of the area. This, in fact, impacted the fishery activities in terms of fish catch. To alleviate the problem, the institution together with other concerned bodies has made different efforts, however, there was no solution attained. This indicated loose policies in the management of the lake. Besides, as

indicated on table 15, 50 (48%) of the participants showed the adequacy of maintaining the water level of lake to save from over water abstraction.

With regard to awareness creation, the institution tried various practices in the provision of trainings and support to the fishermen even if it wasn't done as required. This little effort made the society to participate in illegal fishing which could affect fish catches in terms of volume and efficiency. Based on table 15, 69 (66%) of key informants indicated governmental support in various conditions regarding the lake's management

Though the government was expected to develop a convenient working conditions in the management of the lake, it's got little role which would have the potential to endanger the existence of the lake and the entire eco-system of the environment. Besides, the city government and the society at large should have given special attention to realize its future existence. Hence, the governments along with other concerned individuals were supposed to pass legislations in regulating fishery activities, to render trainings on how to realize effective fishing, and to facilitate conditions to support fishing activities materially and financially.

In addition to the above conditions, the interviewees agreed on the development of well made legal guide and policy on how and to what extent the lake is exploited. This could capacitate the management of the lake in avoidance of illegal fishing and over exploitation of the lake in terms of water use and fishing practices. Furthermore, most of the fishermen have been using traditional fishing gears and means of transportation that fish yield was not as intended. Thus, maintaining sound conditions in modernizing equipments and other situations could result in the attainment of better fish catch. As indicated on table 15, 75 (72%) of the respondents stated benefits of controlling illegal fishers through regulating and setting legislations.

In general, the interviewees indicated the creation of advanced regulations and policy frameworks is helpful for the maintenance of the lake's overall current conditions and future existence.

In addition to the interviews, FAO, (2017) suggested the listed points with respect to a report prepared by the FAO Subregional Office for Eastern Africa Workshop on Improving Small-scale Fisheries in the Context of Food Security and Poverty Eradication.

Which include:-

- promote, support and coordinate sustainable development for small-scale fisheries communities;

- improve governance of small-scale fisheries through effective participatory management for inclusive decision-making;
- enhance effective bilateral and regional cooperation in management of shared resources

## **CHAPTER FIVE**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1. CONCLUSIONS**

Based on the research findings above, the study made the following conclusions.

- Level of fishing production in lake Ziway was low due to most fishermen were not owners of modern fishing gears rather they worked for owners of the fishing gears. However, there were fishermen who had benefited from overexploitation of fish as they own modern fishing gears (beach seine). Access to credit had lots of problems in its implementation that the fishermen were in difficulty to advance their current traditional practices which pull back their efficiency in fish production. Besides, their low level of education also contributed its part as they were incapable to use advanced means of transportation and fishing gears.
- Moreover, there was no a well-developed direct market chain which connects the fishermen to the consumers. This exposed the fishermen to unnecessary exploitation and loss of income. Because of this fishermen were not direct beneficiary of fishing, but traders had got better benefit from fishing activities. This system initiated illegal fishing that most fishermen were reluctant to be members of cooperatives. The fishermen were also economically insufficient due to lack of alternative income which supplements their livelihood and they don't have their own modern fishing gears.
- The fishing practices in the lake were employing legally prohibited sized fishing gears (beach seine and gill net) which altered the fishing production and threaten the existence of small sized fish. There was also excessive water abstraction from the lake, which could endanger the lake water capacity and the existence of aquatic life in

the lake. As the lake openly accessed, it initiated illegal fishery. Additionally, lack of filleting places and deposition of wastes are other challenges of the lake. This indicated poor control and management by the concerned individuals, mainly by the regional bureau of agriculture.

- In general, the fishermen and the fishing trends in Lake Ziway have got multifaceted problems along with financial support, use of better fishing gears and means of transportations as well as keeping the ecological safety of the lake and the surroundings. Thus, controlling water abstraction, increasing fish population, maintaining advanced market chain and filleting places make fishing effective and efficient.

## **5.2. RECOMMENDATIONS**

In light of the research findings and conclusions made so far, the study forwarded the following recommendations:

- To realize better ecological conditions in the environment, the Oromia bureau of agriculture is supposed to develop advanced laws and regulations in line with fishing gears used and water abstraction from the lake.
- Maintaining other means of income could capacitate the livelihood conditions of the fishermen. Besides, the provision of trainings on fishing activities and related activities could also maximize fish catch and develop better ecosystem.
- Recognizing better market chain between the fishermen and consumers could save unnecessary loss of income by creating conducive condition to access credit which enables to own better fishing gears and means of transportations.
- Recognizing an orchestrated fishing management in accordance with access to credit and trainings, use of legally allowed fishing gears, water transportation from the lake and safe ecosystem could capacitate the fishermen's livelihood and the lake's wellbeing.
- Finally, the study was based only on assessing status in fishing practices of Lake Ziway and conducting further studies regarding on the role of fishing cooperatives on socio-economic and fisheries resource development can be helpful for better fishery management.

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**Appendices: Questionnaires**  
**ADDIS ABABA UNIVERSITY**  
**COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES**  
**DEPARTMENT OF ZOOLOGICAL SCIENCES**  
**APPENDIX A: QUESTIONNAIRE FOR FISHERMEN**

Dear respondents,

The purpose of this study is to investigate the current fishery trends around Lake Ziway. Thus, it tries to focus more objectively on the assessment of the existing physical condition of the lake. In light of this, the study attempts to recognize the factors which challenge the lake's condition, state the lake's current situation and determine aspects of fishing related activities.

Regarding the above points, you're kindly requested to give due attention in responding each question as your advanced effort strengthen the validity level of the study. Besides, this questionnaire is confidential and the analysis of results will be held collectively and exclusively for the purposes of the thesis.

Thank you in advance for the kind support.

Site No: \_\_\_\_\_ Name of Kebele administration \_\_\_\_\_

General Directions: Tick "✓" mark to each question of the questionnaire.

**A: Demographic Characters**

1. Sex: 1) Female                       2) Male
2. Age: 1) Below 15     2) 16-20     3) 21-25
- 4) 26-35)     5) Above 31
3. Level of education
- 1) No formal education     2) 1-6     3) 7-8     4) 9-10
-

- 5) 11-12                      6) College Diploma                       7) Above diploma
4. Marital status:-1) Single                       2) Married                       3) Divorced

Part 2: Basic Questions of the Study

A. Family Related Facts

5. Religion: - 1) Christian-Orthodox                       2) Christian-Protestant
- 3) Muslim                       4) Other (Specify) \_\_\_\_\_
6. What is your fishing experience (in years)? \_\_\_\_\_

B: Major Fishing Practices

7. What is the total family size? \_\_\_\_\_
1. Below or equal to 18 years old children? \_\_\_\_\_ 2) other dependents? \_\_\_\_\_
8. Family background:-1) Fisher                       2) Farmer                       3) Laborer
- 4) Other (Specify) \_\_\_\_\_
9. Why did you start fishing? (Specify reason) \_\_\_\_\_
10. Were you involved with other work before fishing?                      1) Yes  2) No
- 10.1. If yes, what was the work? (Specify) \_\_\_\_\_
- 10.2. How much income you used to earn from your previous work? \_\_\_\_\_ per month/week (Underline the correct Unit)
11. Which mode of fishing are you involved in? 1) Part-time                       2) Full-time
- 1.1. If your response to question no 1 is part time, what other means of livelihood do you have other than fishing? \_\_\_\_\_
- 1.2. If you have got other means of income, which one help you earn more income?
- 1) Fishing                       2) The additional job
- 1.3. If you work on fishing as a full-timer, how do you work?
- 1) Individual fisher                       2) Organized or cooperative member
12. How many days do you spend in fishing in a Week? \_\_\_\_\_
13. What is your income in Birr per Month?
- 1) During good months \_\_\_\_\_ 2) During bad/Poor months \_\_\_\_\_
14. In which month do you produce maximum, average and lowest catch level?
1. Maximum \_\_\_\_\_ 2 Average \_\_\_\_\_ 3. Low \_\_\_\_\_
- 14.1. What is the reason for this fluctuation regarding experience? \_\_\_\_\_
- \_\_\_\_\_

15. How many kg of fish do you catch per a single effort?

15.1. When you catch very high \_\_\_\_\_

15.2. When your catch is average \_\_\_\_\_

15.3. When your catch is low \_\_\_\_\_

16. How many fish (or in kg) is consumed with in your family per day? \_\_\_\_\_

17. What type of fish species is dominantly caught regarding peoples' positive interest?  
\_\_\_\_\_

18. How much is the price of a single fish? (Depending on the given species of fishes)

Family	Fish Species	Local Name	Quantity Kg/No	Price Birr/Kg
Cyprinidae	<i>Carassius carassius</i>	Dube		
	<i>Cyprinus carpio</i>	Jape		
Clariidae	<i>Clarias gariepinus</i>	Ambaza		
Cichilidae	<i>Oreochromis niloticus</i>	Qereso		
	<i>Coptodon zilli</i>	Adisse		

19. Your fishing time 1) Morning \_\_\_\_\_ 2) Afternoon \_\_\_\_\_ 3) Night \_\_\_\_\_

20. What type of fishing gears do you use when fishing? 1) Gillnet

2) Beach seine  3) Hooks and lines  4) A combination

5) Others \_\_\_\_\_

21. Where do you get the nets from?

22. The price of the nets?

23. What is the size of gill nets you have been using in fishing?

1) Length (cm) \_\_\_\_\_ 2) Width (cm) \_\_\_\_\_ 3) stretched mesh size (cm) \_\_\_\_\_

24. What is the number of transportation means do you have regarding the listed ones?

1) Timber boats \_\_\_\_\_ 2) Motorboats \_\_\_\_\_ 3) Canon \_\_\_\_\_

25. Who is the owner of the means of transportation you use?

1) Private Owned \_\_\_\_\_ 2) Rental \_\_\_\_\_ 3) Association owned \_\_\_\_\_

C: Regarding with market availability

26. To whom do you sell most of your catch?

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27. How do you preserve the quality of fish you catch?

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28. How do you sell your fish? (You can choose more than one)

1) The whole fish\_\_\_\_\_ 2) Processed\_\_\_\_\_ 3) Fillet Coked\_\_\_\_\_

29. Which infrastructure and services are there at the landing sites?

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30. Would you list some of the challenges in fish selling, regarding users or/and trade associations if they exist?

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D. Challenges and opportunities in fishing practices

31. Could you mention any challenge which hampered the fishing activity to happen effectively and efficiently?

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32. What possible opportunities have you recognized in fishing practices in the concerned lake so as to maintain advanced performance?

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**አዲስ አበባ ዩኒቨርሲቲ**  
**የተፈጥሮ ሳይንስ ኮሌጅ**  
**ዘሎጂካል ሳይንስ ትምህርት ክፍል**  
**ክፍል አንድ፡ አጠቃላይ መረጃ**

**አባሪ ሀ. ለአሳ አጥማጆች የተዘጋጀ የጽሁፍ መጠይቅ**

ውድ መላሾች፡- የዚህ መጠይቅ አላማ በዝግጁ ሐይቅ ያለውን የአሳ ማጥመድ ሁኔታ ለማጥናት ሲሆን በይበልጥ ደግሞ በአሁኑ ጊዜ በሐይቁ ላይ የተጋረጡ አሳ ከማስገር ጋር የተያያዙ ችግሮች ላይ ያነጣጥራል።

ከዚህ በመነሳት ያለዎትን ልምድ እና እውቀት በመጠቀም በቻሉት መጠን አጽኖት ሰጥተው ትክክለኛ እና የተሟላ መረጃ እንደሚሰጡኝ ተስፋ አደርጋለሁ።

አመሰግናለሁ

አካባቢ/ቀጠና \_\_\_\_\_

ቀበሌ \_\_\_\_\_

አጠቃላይ መመሪያ፡- ጥያቄዎቹን ካነበቡ በኋላ በሚመረጡት ሰጥን ውስጥ የ ✓ ምልክት ያስቀምጡ።

ክፍል አንድ፡- የመላሾች አጠቃላይ መረጃ

1. ጾታ፡ ሴት  ወንድ
2. እድሜ 1. ከ 15 አመት በታች  4. ከ 16-30 አመት
2. ከ 16-20 አመት  5. ከ 31 አመት በላይ
3. ከ 21-25 አመት
3. የትምህርት ደረጃ 1. መደበኛ ትምህርት ያላገኘ  ከ 1-6 ክፍል
3. ከ 7-8 ክፍል  4. ከ 9-10 ክፍል  5. ከ 11-12 ክፍል
6. የኮሌጅ ዲፕሎማ  7. ከኮሌጅ ዲፕሎማ በላይ
4. የጋብቻ ሁኔታ፡ 1. ያላገባ  ያገባ  የፈታ
5. ሃይማኖት፡ 1. ኦርቶዶክስ ተዋህዶ  ፕሮቴስታንት

3. ሙስሊም  4. ሌላ \_\_\_\_\_

6. የቤተሰብ ብዛት ሁኔታ:

- 1. ከ 18 አመት በታች ያሉ የቤተሰብ አባላት መጠን በቁጥር \_\_\_\_\_
- 2. ሌሎች ራሳቸውን ያልቻሉ የቤተሰብ አባላት ብዛት \_\_\_\_\_
- 3. ጠቅላላ የቤተሰብ ቁጥር \_\_\_\_\_

1. በዓሳ ማጥመድ ስራ ምን ያህል ዓመታትን አስቆጥረዋል? \_\_\_\_\_

8 . በዓሳ ማጥመድ ለመሰማራት ምን

አነሳሳዎት? \_\_\_\_\_

9 . ከዓሳ ማጥመድ በተጓዳኝ በሌላ ስራ መስክ ተሰማርተዋል? አዎ አይደለም

9.1. ምላሽዎ አዎ ከሆነ በምን የስራ መስክ ላይ ተሰማርተዋል? \_\_\_\_\_

9.2. እንዲሁም በስራው ባላማካይ የወር ገቢዎ ስንት ነበር? \_\_\_\_\_

ክፍል ሁለት: መሰረታዊ የዓሳ ማጥመድ እና ያዓሳ አጥማጆች ምላሾች

10. በሰሜን በአማካይ ምን ያህል ቀናትን በዓሳ ማጥመድ ያሳልፋሉ? \_\_\_\_\_

11. ከስራው በወር አማካይ ገቢዎ ስንት ነው? \_\_\_\_\_

12. የሚከተሉትን የማጥመጃ ወቅቶችን መሰረት ያደረገ ገቢዎ ስንት ነው?

1. በተሻለ የማጥመጃ ወራት \_\_\_\_\_ 2. አስቸጋሪ በሆኑ የማጥመጃ ወራት \_\_\_\_\_

13. ወርን መሰረት በማድረግ ከፍተኛ፣ መካከለኛ፣ እና ዝቅተኛ የዓሳ መጠንን ይግለጹ?

1. ከፍተኛ \_\_\_\_\_ 2. መካከለኛ \_\_\_\_\_ 3. ዝቅተኛ \_\_\_\_\_

14. ልምድዎን መሰረት በማድረግ ለመጠኑ መለዋወጥ ዋነኛ ምክንያት ሊሆኑ የሚችሉ ነጥቦችን ይግለጹ? \_\_\_\_\_

15. በአንድ ጊዜ ምን ያህል ኪግ የአሳ መጠን ያጠምዳሉ?

1. ከፍተኛ \_\_\_\_\_ 2. መካከለኛ \_\_\_\_\_ 3. ዝቅተኛ \_\_\_\_\_

16. በቤተሰብዎ ውስጥ በቀን ምን ያህል አሳ ለምግብነት (በቁጥር ወይም በኪግ) ይወላል? \_\_\_\_\_

17. ምን አይነት የአሳ ዝርያ በአብዛኛው ያጠምዳሉ (የተጠቃሚውን ፍላጎት መሰረት በማድረግ)? \_\_\_\_\_

18. የሚከተሉትን የአሳ ዝርያዎች መሰረት በማድረግ የአንድ አሳ ዋጋ ስንት ነው? \_\_\_\_\_

Family	Fish Species	አካባቢያዊ	መጠን	ዋጋ ብር
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		መጠሪያ	በኪግ/በቁጥር	በኪግ/በቁጥር
Cyprinidae	<i>Carassius carassius</i>	Dube		
	<i>Cyprinus carpio</i>	Jape		
Clariidae	<i>Clarias gariepinus</i>	Ambaza		
Cichilidae	<i>Oreochromis niloticus</i>	Qereso		
	<i>Coptodon zilli</i>	Adisse		

19. በየትኛው የቀን ክፍል አሳን በአብዛኛው ያጠምዳሉ?

1. ጠዋት  2. ቀን  3. ማታ

20. አሳን ሲያጠምዱ ምን አይነት የማስገሪያ መሳሪያ ይጠቀማሉ?

1. Gillnet  2) Beach seine  3) ባለመንጠቆ ገመድ   
4) በማጣመር

21. የማስገሪያ መሳሪያውን ከየት

ያገኛሉ? \_\_\_\_\_

22. የአንዱ መረብ ዋጋ ስንት ነው? \_\_\_\_\_

23. የማስገሪያ መረቡ ከሚከተሉ ነጥቦች አንዱ መጠኑን ይግለጹ::

1. ርዝመት \_\_\_\_\_ 2. ወርድ \_\_\_\_\_ 3. የአንዲቱ ቀዳዳ ርዝመት(ገመዱ ሲዎጠር) \_\_\_\_\_

24. ከሚከተሉት የውሃ መቅዘፊያ መንገዶች የትኛውን ለማስገሪያ ይጠቀማሉ?

1. የጣዉላ (የእንጨት) ጀልባ  2. የሞተር ጀልባ  3. ታንኳ

25. የሚጠቀሙባቸው የውሃ ላይ መጓጓዣዎች የማን ናቸው

1. የራስ ንብረት  2. የኪራይ  3. የማህበር

ክፍል 3. ገበያ ነክ መረጃዎች

26. ያሰገሩትን አሳ ለማን ይሸጡታል?

\_\_\_\_\_

27. ያሰገሩትን አሳ ሳይበላሽ ለረጅም ጊዜ ለማቆየት ምን አይነት መንገድ ይጠቀማሉ?

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28. ያሰገሩትን አሳ በምን አይነት መልኩ ይሸጡታል?

1 ማቀዝቀዣ (ፍሪጅ)

2. በቅጠል መሸፈን

3. በትኩሱ (ወድያውኑ) በመሸጥ

4. ሌላ\_\_\_\_\_

29. በአሳ ማጥመጃዉ አካባቢ የትኞቹ የመሰረተ ልማት አዉታሮች ይገኛሉ?

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30. ከቀጥተኛ ተጠቃሚዎች እና/ወይም ጅምላ ሸጭ ነጋዴዎች አንጻር ገበያ ተኮር ክፍተቶች አጋጥሞት ከሆነ ያጋጠመዎትን ችግሮች ይዘርዝሩ።

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ክፍል 4. ክፍተቶችና የተሻሉ አሳ የማጥመድ ሁኔታዎችን በተመለከተ

31. የተሻለ የአሳ አጠማመድ ሁኔታ እንዳይኖር ያደረጉ ተግዳሮቶችን ይዘርዝሩ

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32. እነዚህን ተግዳሮቶች ለመቅረፍ ምን ማድረግ ይገባል ብለው ያስባሉ?

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**ADDIS ABABA UNIVERSITY**  
**COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES**  
**DEPARTMENT OF ZOOLOGICAL SCIENCES**  
**APPENDIX B: INTERVIEW QUESTIONS TO PERSONNELS**

Dear respondents,

The purpose of this study is to investigate the current fishery trends of Lake Ziway. Thus, it tries to focus more objectively on the assessment of the existing physical condition of the lake. In light of this, the study attempts to recognize the factors which challenge the lake's condition, state the lake's current situation and determine aspects fishing related activities.

Regarding the above points, you're kindly requested to give due attention in responding to each question as your advanced effort strengthen the validity level of the study. Besides, this questionnaire is confidential and the analysis of results will be held collectively and exclusively for the purposes of the thesis.

Thank you in advance for kind support.

Part 1. Demographic Characters

1. Field of the study \_\_\_\_\_
2. Experience at work \_\_\_\_\_
3. Name of the organization you work in \_\_\_\_\_

Part 2. Main Questions of the Questionnaire

1. How do you evaluate the current status of the fishing activity around the lake?
2. Is/Are there external factors that are out of your organizations capacity to control Lake Ziway fisheries management? If yes, describe and explain with respect to the following?
3. What is the role of your organization in community awareness creation in accordance with protection and management of the lake?

4. How do you evaluate the people's practice regarding the lake's fishery condition?
5. Which Government body is most responsible for the management of the lake?(Rank them)
6. What is expected of the government and other concerned body in the fishery management of the lake?
7. What are the most priority issues in Lake Ziway fisheries that need intervention?
8. What fisheries management measures would be appropriate?
9. Do you have any additional suggestions for the protection and proper use of Lake Ziway fishery?
10. Do you think the fishermen have got alternative income in addition to fishing?

