Value chain analysis of fish in Gamo zone, Southern Ethiopia

Kusse Kamaylo1, Duge Galtso1, Tsebaye Tsala1, Kassa Tarekegn1, Endrias Oyka1 and Markos Dukamo2

Abstract: This study aims to identify value-chain actors, estimating the profit share of each actor in the chain and identifying constraints and opportunities along the fish value chain. Data from 120 sampled respondents were collected through extensive personal interviews; field observation and the collected data were processed in a (SPSS) statistical package for social science. The study identified six main value-chain actors (fishermen, fishermen cooperatives, wholesalers, processors, retailers, and end-users/consumers) who were involved in value-adding, supplying, collecting and marketing, and consuming, but still there were slightly strong market linkage among actors. They lack a win-win strategy in the overall share of cost and profit. For instance, of the value-chain actors in districts, fishermen share high costs but as evident, they earn little profit. The sector faces many production constraints (lack of modern knowledge and poor harvesting and storage facilities, illegal fishing materials, weak governance, and many harvesting sites) and marketing constraints (price fluctuation, poor quality supply-insufficient value-added and seasonality of market). However, to ensure the benefit of the actors and profitability of the sector there should be a need for building good governance for better proper management of monitoring and evaluation and thereby strengthen the chain. Creating an enabling environment of postharvest handling and optimal value addition. Further, there is still a need for studying standard mesh size, weight and maturity stage of each fish species in each lake.

Subjects: Aquaculture; Environment & Resources; Environmental Policy; Economics; Environmental Economics

ABOUT THE AUTHOR

Kusse Kamaylo, Duge Galtso, Tsebaye Tsala, Kassa Tarekegn, Markos Dukamo, Endrias Oyka are Agricultural Economics and gender researchers at Southern Agricultural Research Institute (SARI) of Arba Minch Agricultural center. The main focus of the team (researchers) are value and market chain analysis, production and efficiency analysis, adoption and impact studies, gender and climate change research thematic areas. The team as researchers primarily focus on the crosscutting and new emerging issues related to the listed thematic areas to respond appropriate adapting measures in meeting with momentum rising demand and extended to fostering the agricultural policy of the region.

PUBLIC INTEREST STATEMENT

Fish are currently one of mean of the livelihood for many households and youth in Gamo Zone. It creates job opportunities, sources of food and serve as main sources of income. The fishermen were harvesting on open access natural lakes. Rather than price makers, they are price takers these might due to perishable nature of product, lack of harvesting material, and storage facilities, weak market linkage among actors, and improper filleting-might due the lack of knowledge of value adding. Nevertheless, it is crucial to tackle the value chain problem of fish by well cooperating all actors in the chain, setting rule and regulation that govern them, creating value adding environment and addressing update information.
Keywords: Fishery; Value chain; Margin; Gamo zone

1. Background and justification
Among the east Africa region, Ethiopia were known as a water tower of the region, it provides 86 percent to Nile River (i.e. the composite of Blue Nile (56%), Sobat/Barokoba (14%), Tekeze River (13%) (Swain, 1997) and other water bodies. It contains several rivers, lakes, and reservoirs. Thus, these body of waters serves as the shelter for a diverse (different) aquatic animals which include above 200 fish species and of these species, 40 existed only in Ethiopia (endemic) (Redeat, 2012). In addition to rivers, lakes and reservoirs constitutes 7000 km² to 8000 km² with having a fish population of 23342 tons and 4399 tons per year, respectively, and rivers stretch over 7000 km in holding 21788 tons of fish population per year. Besides, lower water bodies like crater lakes and reservoirs makeup 275 km² of holding 1952 tons of fish population.

According to Food and Agricultural Organization FAO (Food and Agricultural Organization) (2014), fish total production potential in Ethiopia is to be estimated more than 51,481tons in annually from the main water bodies. The Lake Chamo and Abaya are among diversified, productive, and economically feasible water bodies/lakes of the Ethiopian rift valley, they constitute a total area of 1621 mk² of having 5100 tons of fish per year (Assefa, 2014). These lakes in the Southern part of a country is known as a lakes having high source of fish production.

Of the naturally endowed resources fishery sector serves as the base for the development of many developing countries and they serve as reliable sources of income for many rural households to sustain their life(Bene & Friend, 2011). Indeed, it is the key sector for reducing poverty and is considered as a potential strategy that helps in diversifying the income of households (Olale & Henson, 2013). Fish are the one of aquatic animals that contributes about 17 and 7% of animal and all protein, respectively. It is also important to serve more than 3 billion people in developing regions (FAO Food and Agricultural Organization), 2018).

Among known aquatic animals, fish serves as for source of food for humans. It is vital for the well-being of people over the world in terms of employment, recreation, trades, and economy (Assefo, 2014). According to (Abebe & Hassein, 2018), this sub-sector attracts younger fishermen households, which deals with the sector are the sources of income mostly for the growing young population and serve as employment opportunities. Indeed, it is the means of sources of job opportunity for land less rural youth and jobless youth in urban. In these regards, extending the sector from fisheries to value chain development further provides room for various job opportunities that remains untapped in the fishery sector (Kaplinsky & Morris, 2000).

Fishery sectors, despite their importance, have numerous constraints. The constraints, lack of good policies and structural setup of the institution, lack of good management of resources, insufficient use of modern harvesting materials and updating the existing materials resources and market constraints are the core problems. It was extended that in addition the catchments deforestation, shore damage, pollution of fishing and overfishing were highly threatened inland fishing on water bodies like lakes (MoARD (Federal Democratic Republic of Ethiopia Ministry of Agriculture and Rural Development), 2004).

Fish are highly perishable (subject to loss) substance that needs immediate transport to consumers on time (Ali et al., 2008). This perishable nature and other factors like rise in temperature, flooding, exploiting juvenile fish, existence of predators, and delaying of market contributes to the post-harvest loss (Ayalew et al., 2018). Also capture fisheries faces challenges of balancing the wide demand, lower production, and low flow (supply) of the product to the market (Kumolul- Johnson & n.d.imele, 2011; AKande & Dieu-Ouadi, 2010). However, the overall exploitation of the current potential of the fish stock cannot meet the demand for fish. This was justified the demands of 67 thousand tones for fish were observed in year of 2003 which are envision/forecasted to rise
to 95 thousand tons in 2015 and further it was forecasted that in 2015 it will rise to 118 thousand tons (Assefa, 2014). However, to address these demand gaps the other sources of production opportunities would be needed (Christopher, 2003). The way to understand its importance and tackle the constraints, it is important to assess the performance of this sector from the perspective of the value chain.

In this sense, conducting value chain analysis intends to provide insights for researchers to understand the product flow from sources/destination to end consumer, activities, opportunities and constraints and overall system along with it. According Porter, (1985) value chain is also known as value chain analysis in his book of competitive advantages. It is defined as the basic tool for diagnosing competitive privileges and finding ways to enhance its value chain, which divides firms into different value addition activities, were it is composed of sequential chores undertaken to add/provide value in customer-oriented basis within the firm together.

The interaction and the relationship of different individual firms/actors along the channels of the flow of certain commodities lead to a marketing map of the value of the product in the chain. These flow of chains together show the overall function, activities in the chain are normal, what value was added, from to whom it flows, actors, the enabling environment and services providers are defined in the chain. The enabling environments that create the operating conditions such as infrastructures, policies, and regulation as well as institutions and processes that shape the market ecosystem (Hellin & Meijer, 2006). On the other hand services providers, includes the business or extension services that provide support to the value chain, such as the providers of market information, financial services, transport services, R&D facilities, and accreditation services. Further, it is the strategic way of evaluating efficiency and effectiveness of firms business and help in differ the environment that need improvement for superior product which is competent to another firm. This is happening on the basis of satisfying different needs of customer-oriented (Ovidijus, 2013).

According to (Abera et al., 2014), a decrease in water (contributes to the destruction of fish habitats), coupled with low price, poor market linkage and lack of postharvest handling are the major constraints to the species in the sectors. According to In Ethiopia, the fishermen are at the infant stage (Tola et al., 2017), where they are not decision-makers since the product is subject to perishable and needs immediate market (Ali et al, 2008). To more specific, Lake Chamo and Abaya are open-access natural resources, in which anyone can invest in it. Those endowed natural resources in which their property right are incomplete provides an immeasurable benefit (it contributes $100 tons of fish per year (Assefa, 2014), not just to the people in districts, for the whole of the country and simultaneously face many impediments (Dastan et al., 2017). However, unfortunately, value chain analysis is not yet studied.

Recently, Buchale et al. (2019) found that the fishing effort was below the effort of maximum sustainable yield, a decline in fish stock was mainly related to growth in overfishing with reduced mesh size and other factors might due to natural mortality, buffer zone agricultural practices, the application of monofilament nets and lack of political commitment for monitoring and evaluation. Besides, during the problem inspection fishermen reports some of the constraints as insights for the researchers that they face for instance, lack of infrastructure, lack of modern harvesting technology, and postharvest handling materials, weak legal system, and problem-related fish marketing. In the end, it was found that there is no systematic and adequate information about the overall fish marketing and value chain analysis in districts. To better understand and tackle these mass of bottlenecks for the development of this sector, it is crucial to undertake this value chain analysis study with aim of identifying and mapping value chain actors, to estimate profit of each actor in the chain and to identify constraints and opportunities along the value chain.
2. Method of study

2.1. Description of area of study

Lake Abaya and Chamo are naturally endowed lakes (Figure 1). It was found in southern nations nationalities and peoples region of Gamo zone Arbaminch zuria woreda, Arbaminch town and Mirab abaya woreda. The lakes are separated by a natural bridge called Egizhar delidy. Lake Abaya found in east of Guge mountain and Arbaminch town lie in the southeastern shore and southern shore are Nechisar national park. It is 60 km long, max-width 20 km, surface area 1162 km², max depth 13.1 m and having surface elevation of 1175 m. Lake Chamo is to the south of Lake Abaya and Arbaminch town, east of Guge and west of Amaro Mountain. It is 32 km long, max-width 13 km, surface area 317 km², with maximum depth of 14 m and has a surface elevation of 1110 m (Gashow & Matthias, 2014). Many fish species are found in the lakes but commercial fish species are tilapia, Nile perch, catfish and bagrus.

2.2. Sampling and size determination

To draw the sample of respondent’s technique of multi-stage sampling was used. Starting from the first stage, Arbaminch Zuria and Mirab Abaya districts were drowned purposively for there were many fishermen. In the second stage, fishermen are listed in each selected landing site and categorized as fishermen cooperatives. In the third stage, from each district, two fishermen cooperatives were selected randomly. Finally, through proportion to the size of fishermen cooperatives following the sampling procedural formula of Yamane (1967) sample of 120 fishermen was selected.

\[
 n = \frac{N}{1 + N(\varepsilon)^2} = \frac{5000}{1 + 5000(0.009)^2} \times 120
\]

Where \(n\) = required sample size (120), \(N\) = total fishermen who catch fish (5000), \(\varepsilon\) = level of precision (9%)

In addition, to address the scope of the study 11 traders, 9 processors and 8 consumers of sampled respondents were interviewed through snowball sampling techniques.

2.3. Data collection procedures

To collect data from value chain actors this study adopted both qualitative and quantitative approaches. Following this approaches the data were collected from different sources. Before the preparation of survey instruments (questionnaire and checklists) and data collection both reliability and the precision of data were taken into consideration. The survey instruments like questionnaires of
semi-structure, KII (Information from key informant), focus group decisions, field observation and literature reviews are employed. The pre-prepared instruments (questionnaires and checklists) were pre-tested, then appropriate modifications were made upon it and the required data from both primary and secondary sources were collected through extensive personal interviews and field observation, entered, and processed in a statistical package for social science (SPSS).

2.4. Data analysis
To analyze the collected data from different sources, this study was adopted descriptive statistics. Descriptive statistics like percentage and mean employed to analyze socio-economic data, profit share among each actor in the traceability of the product in the value chain and other related information of sample respondents. To the end, qualitative data were discussed in narrative form.

2.5. Chain actors and profit margin
Marketing margin can be defined as the difference of consumer purchase price (price in which he/she paid for product) that he/she pays to product he/she accessed and what the farmers receive (Engle & Quagrainie, 2006) and (Jolly & Clonts, 1993). In value chain the concept, it is crucial to identify activities undertaken by actors in the chain and finding other activities, which minimize cost with high satisfaction, reduce and or eliminate wastage and finally lead to profit maximization. Its final goal is to maximize profit in win-win strategy Tayler (2018). Profit can be calculated as total revenue earned from fish operation/catch and or traded by actor minus total cost incurred during operation and marketing. It can mathematically be expressed as,

\[ \Pi = TR - TC \]

\[ \Pi = \Sigma TFC - \Sigma TVC \]

Here, profit share of the actors = average sell price/kg—average total operation and or marketing cost/kg including average purchase prices.

To elucidate, one can compute the profit share of the actor’s in value chain level by considering purchase price and sale price for computation of marketing margin and taking marketing cost–cost of value added into consideration. The profit share of each actor along the value chain can be calculated by deducting marketing cost from the marketing margin David and Satish (2012) and Leston et al. (2013).

\[ Mm = SP - PP \]

\[ \Pi = Mm - Mc \]

\[ PP = \text{purchase prices/kg} \]

\[ Mc = \text{marketing cost (cost of value added)/kg} \]

\[ \Pi = \text{Profit share of actors in value chain market (\(\Pi\))/kg} \]

3. Result and discussion

3.1. Demographic and socioeconomic information

3.1.1. Demographic and socioeconomic characteristics of fishermen
In this part of the research work, demographic information like age, education level, year of practicing fishing and time of fish harvesting were shown (Table 1) and discussed. As shown in the result above, the majority of the fishermen are young with their average means of age was 31 years. This implies that the fishermen are young enough to operate the fish in the lakes.
Another important socioeconomic variables are education it is a so-called weapon/vehicle for the development of one individual or nation. Of the total sample of respondents, 93 (77.5%) were literate which can and able to read and write, 27 (22.5%) are illiterate. In line with this, the major (89%) of fishermen are engaged in a permanent job on fish harvesting on the lakes on regular working time base and only the remaining 11% practice as minor occupations. The fishermen are experienced with having operating mean year experience of 14 years. Even if more than 89% of fishers are operating fish on a regular base they were reported as they haven’t had their refrigerator this enforces them to supply their product to the market immediately after catch. Likewise, they lack modern instruments like modern boats, filleting instruments and even icebox in minimum to transport their product to the market.

3.1.2. Demographic and socioeconomic of traders
The demographic and socioeconomic characteristics were considered as one of the factors that affect the engagement of people on fish trades (Table 2). Survey results showed that the mean age of traders was 35 years with min age of 28 years and a max of 40 years. Under socioeconomic characteristics, instruments like refrigerator, working capital, motorcycles, and sources of working capital were discussed. According to the survey result, 45% of traders were running their business by their capital and the remaining 55% of traders in addition to their capital they access loans and run their business. As the store is the base for the trade of grain, a refrigerator is the one of a basic instrument for storing fish so according to the survey results, almost 97% of traders have their refrigerator and the remaining 3% of the trader use a shared refrigerator. More, at minimum, all traders have mobile phones and motor-cycles to transport their fish products from sources to destinations and from destinations to customers.

3.1.3. Commercial fish species and catching profile
In districts, the commercial and demanding fish species in which the fishers targeting are tilapia (koda/koroso), Nile perch (Nech-aso), catfish (Ambaza) and bagrus (kerkero) (Table 3). To catch/harvest these fish species fishers use different fishing method and materials where fish harvesting was on the base of open-access natural resources. All fishers use different mesh sizes and hooks to catch these fish species the size of mesh depending on the interest of the fishermen and the available size and weight of fish in lakes. For instance, the fishermen locally use an average mesh size of 7.92 cm to harvest tilapia with a standard maximum mesh size of 18 cm (LFDP (Lake fisheries development project), 1997. As shown in Table 3, all fishers have different strategies to harvest maximum fish. However, they have an average mesh size of 7.92 cm to harvest tilapia, 29.09 cm (Nile-perch), 18.06 cm (catfish), and 27.33 cm (Bagrus). For this situation, it is better to conclude that

### Table 1. Demographic and socioeconomic characteristics of fishermen

| Average Age of fishermen | Educational status | Experience of fishing (In year) | Time of practice |
|--------------------------|--------------------|--------------------------------|-----------------|
| 31 year                  | 77.5% (93)         | 14 years                       | 89% (107)       |
|                          | 22.5% (27)         |                               | 11% (13)        |

| Table 2. Demographic and socioeconomic of traders |
|-----------------------------------------------|
| Age                                           |
| Mean 35                                       |
| Min 28                                        |
| Max 40                                        |
| Access and use of credit                      |
| yes(having access) 55%                        |
| no(no access) 45%                             |
| Having refrigerator                           |
| yes(own) 97%                                  |
| No(not own) 3%                                |
there were different fish species with different size and weight that the fishers target. This is still requiring revision of mesh size to the standard. They have good traditional and indigenous knowledge in operating fish but lacks a modern way of operation. Among fish species, Tilapia is one of the edible fish species and is economically important as well as highly demanded and acceptable by the consumers in Ethiopia particularly in rift valley areas where its production is very high (Buchale et al., 2019).

Tilapia considered as one that currently fills the demand of people in districts. It has high production (126,306 kg) compared to other fish species. Due to its availability, most fishermen operate/target this fish species. Of the fish species, Nile perch was one of the important fish species in the eastern part of Africa and in districts, in which fishery was improved on subsistence fishing practices to profitable ways. It is the popular demanded fish species by wholesale traders in relative to other fish species but it was limited by its low production (42,205.5 kg/year) compared to other fish species. Than other fish species, this is considered as exportable fish that costs a high price (157.11ETB/kg) followed by bagrus (104.09ETB/kg) (ETB is the Ethiopian Birrs currency. 1 ETB = 0.021 €). In districts, the wholesale traders demand it first followed by Bagrus whereas, consumers prefer tilapia (Oreochromis niloticus) followed by Nile perch; they also consume Balch and Barbo in districts for the broth in which they believe that they contains a high quantity of oil content and bony. Catfish (Chrysichthys spp.) are also another commercial important species, which is distributed widely in brackish and fresh waters in Western, parts Africa Holden and Reed (1991). Now in districts Catfish are one among the

| Table 3. Volume of catch per fish species |
|------------------------------------------|
| **Volume of catch of fish species/year (kg)** | **Average selling per species (ETB)** | **Standard deviation (std)** | **Average mesh size (cm)** |
| Commercial fish species | Catch/year (kg) | | |
| Tilapia (kada/koraso) | 126,306 | 64.23 | 28.33 | 7.92 |
| Nile perch (Nech-aso) | 42,205.5 | 157.11 | 21.29 | 29.09 |
| Catfish (Ambazo) | 64,223 | 43.03 | 32.58 | 18.06 |
| Bagrus (jerkero) | 64,534 | 104.09 | 32.09 | 27.33 |
| Total | 297,268.5 | | | |

| Table 4. Total fish catch and catch per fisheries/landing sites (kg)/year |
|--------------------------------------------------------------------------|
| **Measurements** | **Value** |
| Total number fishers (no. Obs) | 120 |
| Number of day of harvest/year | 35,472 |
| Total catch per year (kg) | 297,268.5 |
| Average catch per day/fishers | 8.38 |
| **Volume of catch per fisheries/landing sites (Kg)/year** | |
| Sego fish cooperatives | 55,897 |
| Harura-boche fish cooperatives | 53,512.5 |
| Fura fish cooperatives | 91,557 |
| Algae fish cooperatives | 96,302 |
| Total | 297,268.5 |
| Average selling price | 93.0 |
four commercial fish species with having total catch of 64,223 kg/year. Compared to the other species (Nile perch, Bagrus and Tilapia), it has a poor market during high/available production of fish with having average sell price of 43.03ETB/kg.

Upon the two lakes (Chamo and Abaya), there were many fisheries—individual fishermen cooperated legally to operate fish called fishermen cooperatives (Table 4). Among the fishermen cooperatives in the districts Segoe and Harura-boche fish cooperatives from Lake Chamo, and Fura and Algae fish cooperatives on Lake Abaya were selected as samples that have their landing site on different parts of lakes in which they operate fish. Both of these cooperatives were cooperated by the government to reduce youth unemployment. They were operating fish in lakes in different parts where fishes were caught. The cooperatives have had a total catch of four 297,268.5 kg/year. This volume of total catch of produce of year is comprised of total catch of fisheries (Segoe (55,897 kg), Harura-boche (53,512.5 kg), algae (96,302 kg) and Fura fish cooperative (91,557 kg)). These fisheries have an average selling price of 93ETB/kg. It is estimated that fishers operate total numbers of 35,472 days per year with an average catch per day/fishers of 8.38 kg in which fish operating practices were carried throughout the year.

3.2. Fish value chain

3.2.1. Actors and their function

The first task in value chain development is chain mapping Faße et al. (2009). With aim of giving justification for the identified actors in the chain and roles they undertake, information and financial flows in the chain. In line with this, it is to differentiate the traceability of the flow of products starting from input to final destination in the map of a chain.

The major actors in this chain are suppliers of input, fish operators, retailers, fishermen cooperatives, wholesalers, processors, and end-users and support providers.

**Input suppliers:** among the inputs in which input providers supply for the operation of fish are net, gear net, and packing plastic materials. In addition, net and packing plastic materials suppliers for the fishermen are fish traders and shops/traders.

**Fishermen:** they are individuals or households who operate fish. They often use their labour, family labour and hired labour. They are operators who use their instruments to catch fish. The fishermen’s are the members of cooperatives.

**Fishermen cooperatives:** called a group of fishermen’s; this is another actor in the fish market which serves as the intermediary between traders and fishermen’s where fishermen’s dispose of their products or catch through cooperative. They were cooperated and licensed by the government body. They have cooperated on the behalf of developing together by accessing working instruments that cannot be accessed by individual fishermen; for instance, refrigerators, finding a better market for the product.

**Wholesalers:** Wholesalers are individual traders who collect wholesale from different landing sites and distribute wholesale. In this case, they have a contractual agreement with fishermen’s cooperatives. They know the demanding species outside of the market and average trends of daily catch at landing areas.

**Retailers:** are small trader which come from nearby districts or in districts and stands for market stability. They are individuals and cooperatives who buy small amounts of fish produce and retail either on the market or in small shops.

**Processors:** they are hotels and restaurants that change the shape and forms of fresh fish into food products.
Support providers: Of the chain, actors who provide support services are zonal and district livestock and fishery office, Omo-microfinance, office of trade and industry, Arba Minch research center, Arba Minch University and NGO’s (One Village One product Project). They have crucial roles in providing awareness creation, extension, financial services, and information and consultation services. Services like extension services, training, credit service, market information, and research services, which determines the state of success of the fish value chain by creating a conducive environment for the main actors.

3.2.2. Governance of fish value chain in districts
Governance is a set of rules, regulations and actions designed to govern an organization/institution, which comprises a combination of many systems under which affairs are managed. Challenges of the governance under management of this sector put forth step of management rules and norms to lead decision (Jentoft, 1989). Management comprises systematic way of rule of scheme under a given resources attain the outcomes of management Hanna (1995).

In Ethiopia, the sub-sector was underdeveloped; this might be poor in capital of production, improper fishery management guidelines, ineffective administrative setups, and lack of expertise. For these, some of the stock like Tilapia and Nile perch in Awassa and Chamo lakes shows of overfishing. Of course, there is a fishery management proclamation No. 315/2003 set up in 2011 at the federal level, which provides management direction to the aquaculture, food safety and conservation of resources. However, since the federal and regional proclamation of the fishery management is inactive. Instead, in 2013 the other co-management of fishery sectors was developed for the sustainable management of reservoirs and lakes especially lake Chamo (Abebe & Hassein, 2018). Through co-management approaches, the following fishery management measures was developed

- Licensing a fishermen and limitation of gear nets,
- Closing season for tilapia(O. niloticus) breeding (June–July),
- Mesh size limitation according to lakes fish species,
- Reduction and prevention of beach seine in near shores by placing obstacles
- Shore/coastal line plantation of lake and area closure for fish breeding. These measures still need to revise to the status of fish species, size and weight by the lakes.

In districts, the fishermen are cooperated by cooperative unions and form fishermen cooperatives. Fishermen cooperatives have contractual market agreements with the licensed traders and sell their produce through legal ways in the pre-deposition of money by traders on the bank account of fishermen cooperatives before a week’s to receive a daily produce. In this case, if he/she fails to receive produce, then the pre-deposited money would punish him/her. In the case of fishers’ cooperatives, each member of the cooperative is restricted to dispose of their daily catch to the cooperative warehouse and receive their price of sale in the form of a salary after a month. Accordingly, they have also a penalty, so if the fishermen—a member of fisherman’s cooperatives sell his/her fish produce outside of the cooperative for the first time he/she be warned and the repetition will fire from being a cooperative member. Despite these, they did not access on-time support from supportive actors. To more specific, fish are the classical example of the tragedy of common that occurs when the property rights are incomplete and access to the resources is open. However, in the districts, except for licensing the fishermen cooperative there is no follow-up and implementation of measures as well as setting guidelines for fishermen to access these open-access lakes (Chamo and Abaya) following guidelines by cooperators called cooperative union and other government bodies. They fail to protect and secure the sustainable management of the resources. This implies there is weak governance by the government to keep the naturally endowed resources and assure the sustainability of the resources.
3.2.3. Map of value chain of fish

Figure 2 shows the map shows various actors has involved in the value chain analysis of fish, their functions including the traceability of the product through various linkage channels. This map includes main actors (fishermen, fishermen cooperatives, wholesalers, retailers, processors and consumers), value chain functions, the value chain supporters and input suppliers include fish traders and traders/shops. The linkage between fishermen, fishermen cooperatives and traders are rigid in the sale of their product; where fishermen are limited to deposit their catch to fishermen cooperatives and fishermen cooperatives are restricted to sell many parts of their products to the wholesalers and processors (who have formal contractual market). Contractual agreement and lack of enough transporting facilities at fishermen and fishermen cooperatives level constrains them to transport their fish product to the central market, and even to sell for other traders.

This chain comprises supporters and suppliers of input under the supporting chain, of the four selected sample fishermen cooperatives the Sago fishermen cooperative was supported by (OVOP project) one village one product project, but the cooperative union and other stakeholders support all fishermen cooperatives in the districts. The OVOP project provides office supplies, refrigerators and trainings. In addition, the neighbor provides advisory services for the fishermen. Along the chain, the input suppliers include fish traders and traders/shops, they supply gear nets and nets and packing materials. Indeed, supporters under this value chain sectors have undertaking crucial role. They provide enabling/conducive environment and supporting services. Despite this, they linked less likely to this value chain actor cannot provide optimal support required from them. For instance, lack of good governance and providing sufficient information, lack of credit services, poor market integration and presence of illegal operators and traders were listed as serious bottlenecks in districts.

Specifically, six actors under this value chain undertake value adding, supplying, collecting, and reselling, as well as consuming. At a primary market, fishermen perform value-adding activities like
cleaning/removing gill, gutting (removing of unwanted materials in the body of fish), and filleting whereas some of the fishermen cooperatives cool and pack the product depending upon the demand of buyers. Here, the end receivers or final players are consumers who receive and consume the product passed under different rooms of value and through different channels.

Since the fish product is subject to damage before receiving the product all actors except fishermen check for the quality of fish. The damaged/spoiled fish product was detected by smelling, touching and observing, where it was rejected if it produce bad-smelling, change in body color (greenish and black) and softening of muscle/limp floppy. According to their report, the change in size and weight difference among fishes does not affect quality, and does not reject by the traders–hence this needs further quality checkup and investigation. As shown, the traceability of products in the value chain map above, fishermen catch and dispose of all its product to the fishermen cooperatives. They dispose of their total (100%) daily catch to the fishermen’s cooperative warehouse. Fishermen cooperatives then add a certain margin on their purchase price, and cost of performing value addition activities like cooling the product/store. They then distribute 71% of total production to the wholesaler, 10% to a retailer, 14% to processors and according to that governance of value chain in districts, they were obligated to sell at least 5% of their product to the neighbor. Wholesalers are the bulk buyers of the product from fishermen cooperatives with having the strategic selling either immediately and otherwise store for a week for a better price, in response of if the market price of the product falls. They come from Arba Minch, Mirab Abaya town and other parts of the country. They also supply their product to Jinka, Sodo and the central market (Addis Ababa). Except fishermen, all actors sell their product to the consumer this is the restriction of rule that they have with fishermen cooperatives. In the map, fishermen are limited for information; mostly they receive/share only with fishermen cooperatives. Hence, the linkage among actors in the districts was still slightly strong.

### 3.3. Market profit share of each actor in the fish value chain

There are several players in this value chain. Fishermen are primary players among chain actors who catch the fish and supply it to a primary market called fishermen cooperatives. In this study, fishermen have to incur both cost of instruments like the cost of a traditional boat called zatara, gear net/nets, and wage for hired labour, transportation cost, tax, electricity, VAT (Value Added Tax) and other expenses including their own labour cost. Compared to the other actors they are performing multiple roles (starting from harvesting input purchase and preparation till to filleting and supply to the market). As evident, they share a high cost (64.5 ETB (Ethiopian Birr)/kg) and earn little profit (28.4ETB). Whereas fishermen cooperatives are intermediaries and serve as facilitators for fishery sustainability, they are important links in this value chain in communicating fishermen, cooperative unions and traders. They also involve in price setting as stakeholders. Indeed, they also play a key role in communicating with government bodies. They add only certain margin facilitation costs, (in which their role is to facilitate market finding and linkage among fishermen and other main actors) upon their purchase prices and then distribute their product with having total cost of 85.2ETB and net income of 90.2ETB and earn net income/profit of 5.0ETB

| Actors             | Average marketing/production cost (ETB/kg) | Average total return per kg (ETB/kg) | Profit (ETB/kg) |
|--------------------|-------------------------------------------|--------------------------------------|-----------------|
| Fishermen          | 64.6                                      | 93.0                                 | 28.4            |
| Fishermen cooperatives | 85.2                                      | 90.2                                 | 5.0             |
| Retailers          | 95.96                                     | 100.2                                | 4.24            |
| Wholesalers        | 118.1                                     | 160.5                                | 42.4            |
| Processors         | 183                                       | 350                                  | 167.0           |
In a retail market of this value chain, the retailer are those who sell the product to the processors and end consumer, serve as market stabilizers by adding a certain margin (cost of transportation) upon their purchase prices and have little marketing cost. They have less profit (4.24ETB/kg) than fishermen cooperatives, where their profit share is approximately equal to the marketing margin. In this value, chain retailers share the cost of icing and transportation.

Under the wholesale, the bulk of the product was exchanged. The cost of this actor incurred includes both variables and fixed costs. The variable costs include total purchase price, washing and packing cost, transportation cost, loading/unloading, storing and icing and other expenses while fixed costs include permanent payment for hire, electricity, rental and tax. On average they earn gross income of 160.5ETB/kg and incur a cost of 118.1ETB/kg thus earn the net income of 42.4ETB/kg.

In Table 5, of the actor in the fish value chain, the better the profit sharer is processors. In the path of computation compared to other actors, they have good value-added. The cost of the processors under this value chain includes fixed and various variable costs. They earn gross income of 350ETB/kg and the average total cost incurred including the average purchase price was 183ETB/kg, with a profit/net income of 167ETB/kg.

3.4. Constraints and opportunity along the value chain

3.4.1. Catching/operation and marketing constraints
Most of the fish sectors in Ethiopia are open accesses that are at the infant stage (Tola et al., 2017). Similarly, the sector in the Gamo zone is associated with many constraints along the fish value chain. Some of the identified constraints during survey and field observation are:-

- improper post-harvest handling, weak governance and follow up,
- poor infrastructure (road),
- poor knowledge of value addition,
- lack of modern technology or poor storage facilities,
- lack of working capitals and low access and use credit,
- poor market knowledge (leads fishermen and fishermen cooperatives price takers),
- lack of enough product due to overexploitation,
- lack of extension/training services–capacity building and expansion of farmland to shores are some of the constraints.

3.4.1.1. Catching/operation constraints. Table 6 shows major catching and operation constraints identified in the study. These constraints are:-

**Transportation problem (poor road)**

This has high implication in affecting the supply of fish to the market. They face difficulty in accessing lakes to find presences of the fish caught in the nets or hooks and to transporting products to the market. It is explained as a bottleneck by respondents over 80.8% (97). As a result, they face a loss of the product on the lake (death of product in the net) and deterioration during supply or transporting to the market; this might not due to lack of available products in lakes but loss/damage on water and during transportation.

**Lack of capital, access and use of credit**

Access and use of credits are important factors that improve the fishermen's harvesting capacity in engaging in operating more fish. Those fishermen who have more capital or chance to access and use more credit build their capacity to catch more fish by purchasing different nets, building additional traditional boats, maintaining existing boats or mesh net and even use for other income-generating activities. In total of sampled fishermen, 80% (96) of fishermen are not accessing credit, according to
their response, this is due to lack of availability of credit and collateral (since they are youths and landless) and high bureaucracy, while, the remaining only 20% (24) have a chance of access and use of credit. The main credit providers in this include cooperatives and Omo microfinance. This confirms with a similar study studied by (Abebe et al., 2016) that unavailability or low of credit facilities hinders fishermen not to buy different harvesting materials like mesh as well as a motorized boat to harvest more and supply more of fish to markets.

Robbery/theft of equipment
In intra and inter fishermen cooperatives there are no strong management rules that govern them. The fishermen face loss of fish harvesting materials like loss of nets and boats. Add to them, the presence of illegal operators in both lakes (chamo and abaya) results in frequent loss of operating materials of fishermen. They operate inside of Nechisar national parks, while other sides of lakes were operating by licensed cooperatives known as fishermen cooperatives. They use the park as a shelter to hide themselves just they are illegal’s.

Many harvesting sites
For the sustainability of the fish stock, it is better to engage the fishermen upon the existing fish stocks. In the study sites, the cooperated fishermen and illegal operators added together result in exploiting existing open-access natural resources without any contribution to the production of fish stocks and the conservation of resources. According to (Buchale et al., 2019), even if there is a protected area for fish breeding there was still the problem of illegal fishing practice in the area. This especially happens in Lake chamo in which its future yield is under the status of drastic reduction. They exploited matured fish and now catching underweighted/immature fish by using undersized mesh and result in a decrease in stock, and thereby a decrease in harvest and low supply of fish products to market. Hence, the exploitation of adult fishes leads the fishermen to fishing juveniles.

Illegal fishing material
The existence of many harvesting sites coupled with illegal fishing materials was reported as a serious problem for the depletion of genetic resources. During survey and field observation unwanted and not recommended mesh net used for fish stock in lake Chamo and Abaya called Nylon mono (Figure 3) having a mesh size of 3.5 inch was identified in which all fishermen and illegal fish operators are employing it to operate the fish. It was narrower than the recommended minimum mesh size of 18 cm (LFDP (Lake fisheries development project), 1997). The fishermen reported that this net might contain a toxic chemical in it since it kills fish entered into it; which needs further investigation. The respondents reported that after the introduction of this net the fish stock was decreased. They also added that since it catches under-weight (immature) and cannot leave all fish entered into the net, it might disappear or deplete genetic resources. Indeed, they also added that if this net were not restricted and other measurements would not be taken on the lake Chamo and Abaya by the corresponding government bodies, after few periods we will seek to see the fish of especially Lake Chamo on television.
Expansion of farmland to shores and discharge of chemical into lakes

The expansion of farmland and deforestation of shores results in increasing water turbidity, decreasing fish breeds and fish stocks. According to the survey result, some fish like tilapia can breed themselves around shores. Of course, there is no species of fish that could persist in a body of water that did not have a place to breed themselves. So in absence of small grass around the shores of lakes, the fish could not get suitable conditions to breed until to mature and migrate. More the respondent also reported that fishes are sensitive to sound, in the presence of little noise they will be apart from the place into the depth of lakes. Thus, faces the fishermen difficulty during harvesting.

It can constrain not just fishermen and fish stock, it affects all fauna. Also, during the cultivation of shores call production of vegetation around shores, the spray of chemicals for pests and insects and washing of cars in rivers discharge some toxic chemicals directly into Lakes and result in the death of fish species.

| Table 6. Major constraints identified and its rank |
|-----------------------------------------------|
| Constraints (no. obs = 120) | Frequency | Percentage | Rank |
| Transportation (poor road) | 97 | 80.8 | 5 |
| Lack of capital, access and use of credit | 108 | 90 | 2 |
| Lack of awareness | 87 | 72.5 | 8 |
| Many harvesting sites | 104 | 86.7 | 3 |
| Illegal fishing materials | 112 | 93.3 | 1 |
| Expansion of farmland to shores | 101 | 84.2 | 4 |
| Theft/robbery of equipment | 85 | 70.8 | 7 |
| Lack of storage facilities | 81 | 67.5 | 9 |
| Attack of wild animals | 93 | 77.5 | 6 |

3.4.1.2 Marketing and value addition constraints.

In the study area, there are many constraints identified by a sample of respondents (actors) and experts that affect the environment of the value chain to product supply to the markets. Of them, some are discussed.

**Low price of the product and weak bargaining power**

Good fisheries management is essential to ensure that the fishermen will reap the benefit from higher export prices. Since fish are subject to loss/damage (high perishable), its price of product was very sensitive and seasonal. It can change if the product is low/high and the price of fish in other parts of the region in a country changes. On other hand, varying in the price will happen in day today, which is the characteristics of commodity product and as all it is based on the decline and or bulk of supply and increase of demand. This and due increment in cost of harvesting instruments like a refrigerator, icebox, filleting and packing materials, and the net will enforce the fishermen to use not recommended instruments and operate undersized fish which causes deterioration of the products, improper postharvest handling, thereby low quality and quantity and leads fishermen earn low prices. Indeed, poor knowledge of post-harvest handling, improper filleting, and lack of early finding the net (lack of specific time to find whether fish enter into a net or not) will contribute to the low price of a product at fishermen level. Thus, still without proper management in place, the increased price can lead to increased fishing pressures and hence hamper the continuity of the stocks and profitability of fishing sectors (FAO (Food and Agricultural Organization), 2012).
In addition to the low quality of the product, change in prices does not consider operating costs. Here, cooperative union with traders and fishermen cooperatives together set the price of the product (setting price of fish by cooperatives unions, fishermen cooperatives, and traders) without incorporating the fishermen and considering the cost of production and harvest. This leads fishermen simply to take price called price takers. Moreover, the presence of payment of VAT (Value Added Tax) to the government was also reported by fishermen and fishermen cooperatives as factors that constrain the improvement of the job and hinder their privilege of the business.

Furthermore, some of the constraints in fish traders were extended from fishermen for instance, improper gutting and filleting, improper postharvest handling and insufficient value added at fishermen level results in a reduction in both quantity and quality of fish products at traders’ hands.

3.4.2 Production and marketing opportunities
The endowment of the two lakes (Abaya and Chamo) is a huge potential resource not just for the districts it serves the country as a whole. It provides plenty of opportunities. It creates job opportunities over more than thousands of people. In districts, fish sub-sectors fostering young who have no more land called landless rural and urban dwellers who are jobless. The sector-improving livelihoods of many households by creating employments and generate income. The expansion of Arba Minch city and nearside of the city to Lakes makes the sector more efficient and effective. The presence of soke (type of tree) used for the production of a traditional boat called Wogelo helps fishermen to operate fish and use it in moving around the shores of lakes. Fishermen, having legal/official permission to operate fish and sell their products freely without fear provides freedom and independence in deciding over their sphere of business.

4. Conclusion and recommendation
There are four commercial fish species in districts like tilapia, Nile perch, bagrus and catfish. Production of fish is seasonal, susceptible to weather change and the product is subjective to perish-ability. Fishermen are operators of fish products. They have good traditional and indigenous knowledge in operating fish but lacks a modern way of operation. All fishermen dispose of their total product/catch to the fishermen cooperatives immediately due to lack of preserving equipment like refrigerators. Along the value chain, it was identified that there are six actors (fishermen, fishermen cooperatives, wholesalers, retailers, processors and consumers) who involve firmly in participate fish production, value addition, distribution and marketing. In the value chain, the actors perform value-adding activities like cleaning/removing gill, gutting (removing unwanted materials in the body of fish), filleting, and cooling and packing the product depending on the demand of buyers. The actors have to incur cost and thereby share profit in the chain. Among the actors’ processors, compared to other actors have good value-added and share good profit. The actors form a network of systems call value chain maps; where supporters create an enabling environment for the well-functioning of a chain but still the strength of the value chain among the actors was weak and subject to constraints.

It was identified that the chain is constrained by harvesting/production and marketing constraints. Finally, this fish value chain faces lack of good management governance in the sphere of its sector in districts which will lead actors to reap low benefit.

However, the further recommendation has been drawn upon the result of the study. Since the fishery resources are open access so it needs appropriate government interventions and stringent resource monitoring. For the sustainability of the sector, first there should be the owner of resources having complete property right then,

- Operators would be engaged upon the availability of existing resources (volume of stock to hold fishermen/operators) for optimal use
- All operator should be licensed and legalized
• There should be closing season as well as area closure for fish breeding.
• Restriction of net and hook size to the standard

Arranging appropriate credit supply for fishermen would be expected that it will fill the capital shortage and encourage fishermen’s to repair/maintain their net, zatra (wooden boat) and buy a motorized boat and attract informal/illegal fishermen to be cooperated legally and creating an enabling environment for optimal value addition. To ensure the benefit of the actors and profitability of the sector there should be a need for building good governance for better proper management of monitoring and evaluation and thereby strengthen the chain. There should be a requirement of training for actors upon postharvest handling and to add a required value to optimize the profit in each stage of the chain in a win-win strategy among actors.

Further, currently, there is a need for studying the size, weight, and maturity stage of each fish species, which is available for food under the lake to set the standard mesh size and beach seine.

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Author details
Kusse Kamaylo 1
E-mail: kussitokamaylo@gmail.com
Duwe Gaitsa 1
Tsebaye Tsada 1
Kassa Tarekign 1
ORCID ID: http://orcid.org/0000-0001-9571-1849
Endrias Oyka 1
Markos Dukamo 1

1 Agricultural Economics and Gender Research Directorate, Arba Minch Agricultural Research Center, Southern Agricultural Research Institute P.O. Box, 2228 Arba Minch, Ethiopia.

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