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Value Chain Analysis of Fish in Selected Water Bodies of central rift valley Oromia Region of Ethiopia

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value addition,
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Abstract

This study was undertaken in West Arsi zone (Nagele Arsi district), East shoa zone (A.T.J. K, Lume and Bora district) and Arsi zone (Ziway dugda district) of Oromia region, with the title of Fish Value Chain Analysis in Selected Water Bodies of Oromia Region (Langano lake, Ziwai Lake and Koka reservoir). The main objective of this study is to assess the value chain analysis of fish in selected Oromia Water bodies of the three selected zones and to analyse market performance of fish along the chain actors. Both primary and secondary data were collected for this study. The data were collected by means of a semi-structured questionnaire from 240 respondents (180 fishermen, 5 fishing equipment supplier, 10 primary processors, 15 fish marketers, 15 fish consumers, 10 fish restaurants and 5hotels). Multi-stage sampling technique was followed to select households for the study purpose. During the first stage all districts where fishery production were taken place were identified purposively and at the next stage about 180 fishermen and marketing actors were selected randomly. The main functions in the fish value chain in the central rift valley area includes: input supply, production, processing, marketing and consumption of fish and fish products. The main value chain actors identified by the study were input suppliers, fish harvesters, fish processors, fish marketers and individual consumers in the study area.Total gross marketing margin in fish marketing is highest in channels VIII; it accounts a TGMM of 75.2%. Fishery cooperatives enjoy the highest net marketing margin that is 37 birr in channel VI. Binary probit model indicated that the fish processing and value addition were significantly affected by Access to modern transportation services, Access to the credit services, Education level of household head, Frequency of extension contact, household size, Availability of fish processing & equipment in

the nearby town and selling price of fish in 2020. Illegal fish and fish product harvester and marketers, presence of illegal fishing equipment in lake Dambal and Koka reservoir, which can cause the serious over fishing problem, presence of bad weeds (water hygicienith) and chemicals from different factory which can cause fish disease in the Dambal Lake and Koka reservoir, high purchase prices of fishing equipment, Poor fishing nets, poor boating services, over fishing and low price were found to be the fish production and marketing constraints along the value chain actors in the study area.

Introduction

Ethiopia covers a total area of 1.1 million km^2 and an estimated population of 100 million in 2010. Ethiopia is endowed with several water bodies that contain a high diversity of aquatic fauna. The main drainage basins of Ethiopia are flowing away from the rift system either towards the Nile system in the west or to the Indian Ocean in the Southeast. The Ethiopian fresh water systems can be classified into seven drainage basins. These are the Abay, Awash, Baro Akobo, Omo-Gibe, Rift Lakes, Tekeze and Wabishebele-Genale basins (Alamu and Azadi, 2018, Awel and Shumeta, 2020,).

Oromia's key assets are its diverse natural (water, soils, forests and wildlife) and human resources. The region has enormous water resources, with high potential for irrigation, hydroelectric generation, fishing, and other uses (Gelebo *et al*, 2021, Misganaw and Lemma, 2023; Geleta eat al., 2023).

The fishery sector's contribution to the local economy is tremendous. Despite significant contributions that fisheries make to employment and trade in the developing world, it is rarely included in national development policy and donor priorities. This is largely due to the problems with valuation of small scale fisheries, as a policy makers often does not have access to data which reflect the importance of fisheries to the development.

1.1. Statement of the Problem

Ethiopia has many lakes, rivers and reservoirs and its approximately 960km at red coast line are fertile fishing grounds. Traditional processing of fish, smoking has been tried to meet the market demand to the temporary settlement of community. The critical problem for decline of fish production and marketing system in different lake and river in Ethiopia are over harvesting and households home in to water bodies. This decreases biological activities of fish and creates shortage of special people live in and around the coastal area (Hussen and Hailu, 2019; Waktole and Colleagues, 2022).

In Ethiopia, the major problems that were identified by the stakeholders (the producers, consumers and hotel owners) involved in the fishing activities were lack of proper fishing gears; most of them use hook for fishing, Poor post-harvest handling and lack of proper fish processing and storage facilities, low price of fish as a result of low bargaining power of producers, lack of awareness, lack of transportation facilities, and lack of permanent fish market places or shops (Mebrate and Ayalew, 2020, Hirpho, 2017). The fishing sector of the economy has various problems, among others, mismanagement of the resources, inappropriate policies and institution, inadequate technical and material backup to the sector and market are the major ones.

1.2. Objectives of the Study

I. To identify major fish value chain actors and their roles
II. To analysis market performance of fish along the chain actors
III. To identify determinants of value addition of fish production in the study areas
IV. To assess the major challenges and opportunities of fisheries sectors in the study areas

2. Research Methodology

In this chapter, description of the study area, sample size and sampling techniques, types and method of data collection were presented

2.1. Description of the Study Area

The study was conducted in selected districts of Arsi zone (Ziway Dugda district), West Arsi zone (Nagele Arsi district) and East Shoa Zone (A.T.J K, Bora and Lume district) of Oromia region. The study was conducted in three major water bodies (Langano lake, Dambal lake and Koka reservoir) of Oromia regional state and adjacent town including Arsi Nagele, Batu, Maqi, Alemtena, Modjo, Adama and Addis Ababa.

Lake Dambal is one of the freshwater Rift Valley lakes of Ethiopia. It is located about 160 Km South of Addis Ababa. The districts holding the lake's shoreline are A.T. J K, Dugda, and Ziway Dugda. On average, the lake is located at an elevation of 1650 masl and the lake is shallow and has an open water area of 434 Km^2 and shoreline length of 137 Km, a maximum depth of 8.9 m and an average depth of 2.5 m (Von Damm and Edmond, 1984). The maximum length and width of the lake is 32 km and 20 km, respectively. There are two main feeder rivers to Lake Dambal, namely, Meki originating from Gurage Mountains in the Northwest and Ketar from the Arsi Mountains in the East; and it has one out flow in the South through Bulbula River, draining into Lake Abijata. Lake Dambal contains five main Islands: Tullu Guddo (4.8 Km^2), Tsedecha (2.1 Km^2), Debresina (0.3 Km^2), Funduro (0.4 Km^2) and Gelila (0.2 Km^2). Debresina and Gelila have only a few inhabitants, the other three are inhabited by several hundreds of people .

Koka Reservoir is located in the Awash River Basin in central Ethiopia (8 26^0N, 39 02^0 E). The 1200 Km-long Awash River, which has its headwaters in the plateau near Addis Ababa at 2300 masl, discharges below sea level into Lake Abbe in the Danakil Desert. Koka Reservoir is located at 90 Km South of Addis Ababa at an elevation of 1600 m. The districts holding the lake's shoreline are Bora, Lume, Adama and Doddota. It has a surface area of about 200 Km^2 and a capacity of 1650 mm^3. Koka reservoir consists of concrete with a length of 458 m and a maximum height of 47 m. It was created by the construction of the Koka Dam across the Awash River. The reservoir has an area of 180 km^2. The reservoir supports a fishing industry; according to the Ethiopian Department of Fisheries and Aquaculture.

Langano Lake

Langano is a lake in the Oromia Region of Ethiopia, exactly 200 Km by road South of the capital city of Addis Ababa, on the border between the East Shoa zone and West Arsi Zones. It is located to the East of Lake Abijata in the Main Ethiopian Rift at an elevation of 1,585 meters (Lake Langano is 18 kilometers long and 16 km wide, with a surface area of 230 km^2 and a maximum depth of 46 meters (CSA, 2005). The lake has a catchment 1600 square kilometers in size, and is drained by the Hora Kallo river, which drains into the adjacent Lake Abijata. Lake Langano is popular with tourists and city-inhabitants. The lake is brown in color and at first sight one may think that the lake is not clean.

2.2. Sample size and sampling technique

Multi-stage sampling techniques were employed for this study. At the first stage representative districts like Nagele Arsi, A.T.J.K, Bora, Lume and Ziwai Dugda were selected purposively based on the potentiality of fish production and marketing. In consultation with respective agriculture and rural development offices, potential kebeles having a fish production and marketing were listed. In the second stage, the 3kebele were selected randomly from listed kebeles based on the potentiality of fishing activities and presence of individual fishermen and potential fish cooperative from the selected water bodies. At the third stage a total of 180 fish producers were selected using proportionate simple random sampling methods from a total of 326 fish producer of the five selected districts.

Finally; 5 fishing input supplier (2 from Batu town, 1 from Maqi town and 2 from Addis Ababa) , 10 fish processors (2 fish processors from each selected five districts), 15 fish and fish product marketers (3 fish and fish product marketers from each five districts) and 15 fish and other fish products consumer individual (3 fish and other fish product consumer individual from each five selected districts), 10 restaurants (each 2 restaurants from Batu, Maqi, Mojo, Adama and Addis Ababa) and 5 Hotels (each 1 Hotels form Batu Maqi, Mojo, Adama and Addis Ababa town) were purposively selected after specifying their name based on the information collected from the target respondents that for whom they sell their fish. In addition to this , key informants interview and 5 focus group discussions were held which contain 5-9 farmers were selected and involved in this study.The sample size determination was resolved by means of Yamane (1967) sampling formula with 95% confidence level.

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

Where: - n is sample size, N is the total number of fish producers in the selected districts (from Nagele Arsi 39 Fish producers, from A.T.J.K 87 Fish producers, from Bora 72 Fish producers, from Lume 81 Fish producers, and from Ziway Dugda 47 Fish producers) and e is the desired level of precision which is 0.05.

2.3. Types of data and Method of Data Collection

In this study, both qualitative and quantitative data types were collected from primary and secondary sources. Secondary data were collected from zonal and district office published and unpublished material by using check list. Primary data was gathered from the fishermen, fish processors, fishery cooperatives, fish consumers and fish and fish product marketers (brokers, wholesalers and local collectors). The formal survey was done using semi-structured questionnaire and checklist prepared for each group (i.e. fish producers, fishery cooperatives, local collector, individual consumers, wholesalers, retailers, and restaurants/hotels).

2.4. Methods of data analysis

Based on the objectives of the study, both descriptive statistics and econometric models were employed to analyse data and come up with the results. Statistical tools such as Stata version 14 were used for analysis and provide output for the descriptive as well as for econometric models. Descriptive analyses were used to analysis characteristics of sample respondents. Costs and margins along the value chains were analyzed.

3. Results and Discussion

This chapter discusses the results obtained from the primary and secondary data. It consists the descriptive and econometric analysis of the sampled household characteristics in the study area.

3.1. Demographic and Socio-economic Characteristics of the sampled households

In this section descriptive analysis were used to describe characteristics of the sample households in the study area**.** Both continuous and categorical variables were used in order to describe the sample households included in this study.

Table1. Sex of sample respondents in the study area

Zone	Districts		Sex of household head		Total
			Female	Male	
West Arsi	Nagele Arsi	Count	7	19	26
		% within Survey district	26.92	73.08	100
East Shoa	A.T.J.K	Count	13	27	40
		% within Survey district	32.5	67.5	100
	Bora	Count	15	43	58
		% within Survey district	25.86	74.14	100
	Lume	Count	17	57	74
		% within Survey district	22.97	77.03	100
Arsi	Ziway Dugda	Count	9	33	42
		% within Survey district	21.43	78.57	100
	Total	Count	61	179	240
		% within Survey district	25.41	74.589	100
		% of Total	25.41	74.59	100

Sex of household head: Out of 240 sample respondent, 25.41% were female household head where as 74.59% of them were male headed household. In Nagele Arsi District, 26.92 % were female and 73.08% were male headed household. In A.T.J.K district out of 40 respondents 32.5% were female while 67.5% were found to be male headed household. In Lume district out of 74 respondents 22.97 % were female headed while 77.03% were male headed household. In Bora district 25.86% were female while around 74.14% were male headed household head. In the case of Ziway Dugda district, 21.43% were female headed while about 78.57 were male headed household in the study area.

Table 2 shows the percentage of the sample respondents based on household head`s access to the modern transportation services in the selected survey districts.

Zone	Districts		Household head`s access to the modern transportation services		Total
			Accessed	Not accessed	
West Arsi	Nagele Arsi	Count	9	17	26
		% within Survey district	34.62	65.38	100
East Shoa	A.T.J.K	Count	11	29	40
		% within Survey district	27.5	72.5	100
	Bora	Count	9	49	58
		% within Survey district	15.51	84.49	100
	Lume	Count	40	34	74
		% within Survey district	54.05	45.95	100
Arsi	Ziway Dugda	Count	16	26	42
		% within Survey district	38.09	61.90	100
	Total	Count	85	155	240
		% within Survey district	35.42	64.58	100
		% of Total	35.42	64.58	100

Household head`s access to the modern transportation services: Out of 240 sample respondent, 35.42% of them have got access to modern transportation services on fishing activities where as 64.58% of them had not obtain access to modern transportation services on fishing activities in the study area. In Nagele Arsi District out of 26 sampled respondents, 34.62 % of the respondents have got access to modern transportation services on fishing activities and 65.38% of them have not obtain access to transportation services on the fishing activities in the area. In A.T.J. K district out of 40 respondents 27.5% of the respondents have got access to the modern transportation services on fishing activities and 72.5% of them have not obtain access to it on the fishing activities in the area. In Lume district out of 74 respondents 54.05% of the respondents have got access modern transportation services on the fishing activities and 45.95% of them had not obtain access to it on the fishing activities in the area.

Table 3 shows, the percentage of the sample respondents based on household head`s access to the market in the selected survey districts.

Zone	Districts		Market access		Total
			Accessed	Not accessed	
West Arsi	Nagele Arsi	Count	10	16	26
		% within Survey district	38.46	61.54	100
East Shoa	A.T.J.K	Count	18	22	40
		% within Survey district	45	55	100
	Boora	Count	22	36	58
		% within Survey district	37.93	62.06	100
	Lume	Count	30	44	74
		% within Survey district	40.54	59.46	100
Arsi	Ziway Dugda	Count	12	30	42
		% within Survey district	28.57	71.43	100
	Total	Count	92	148	240
		% within Survey district	38.33	61.67	100
		% of total	38.33	61.67	100

Household head`s access to the nearest market: In the study area out of 240 sample respondent, 38.33% of them have an access to the market to sell their fish and other fish products where as 61.67% of them had not access to market to sell their fish products in the study area. In Nagele Arsi District out of 26 sampled respondents, 38.46 % of the respondents have got access to the market to sell their fish and other fish products and 61.54% of them have not obtain access to market to sell their fish and other fish products in the study area. In A.T.J. K district out of 40 respondents 45% of the respondents have got access to market to sell their fish and other fish products and 55% of them had not obtain market access to sell their fish and other fish products in the study area. In Lume district out of 74 respondents 40.54% of the respondents have got access to market to sell their fish and other fish products and 59.46% of the had not obtain market access to sell their fish and other fish products in the study area. In Bora district, 37.93% of the respondents have got access to the market to sell their fish and other fish products whereas 62.07% of them had not obtain market access to sell their fish and other fish products in the study area.

Table 4 shows, the percentage of the sample respondents based on the availability of fishing equipment in the selected survey districts.

Zone	Districts		Availability of fishing equipment		Total
			Yes	No	
West Arsi	Nagele Arsi	Count	8	18	26
		% within Survey district	30.77	69.33	100
East Shoa	A.T.J.K	Count	25	15	40
		% within Survey district	62.5	37.5	100
	Bora	Count	27	31	58
		% within Survey district	46.55	53.45	100
	Lume	Count	39	35	74
		% within Survey district	52.70	47.30	100
Arsi	Ziway Dugda	Count	15	27	42
		% within Survey district	35.71	64.29	100
	Total	Count	114	126	240
		% within Survey district	47.5	52.5	100
		% of Total	47.5	52.5	100

Availability of fishing equipment in the district: Out of 240 sample respondent, 47.5% of them have said yes whereas 52.5% of them have said No response about the availability of the fishing equipment in the study area. In Nagele Arsi District out of 26 sampled respondents, 30.77 % of the respondents had given yes response whereas 69.33 have given No response on the availability of fishing equipment in the district. In A.T.J. K district out of 40 respondents 62.5% of the respondents had given yes response whereas 37.5% have given No response on the availability of fishing equipment in the district. In Lume district out of 74 respondents 52.70% of the respondents had given **Yes** response whereas 47.30% have given **No** response on the availability of fishing equipment in the district. In Bora district 46.55% of the respondents had given Yes response whereas 53.45% have given No response on the availability of fishing equipment in the district.

Table 5 shows, the percentage of the sample respondents based on household head`s access to the credit services in the selected survey districts.

Zone	Districts		Access to credit services		Total
			Access	No access	
West Arsi	Nagele Arsi	Count	11	15	26
		% within Survey district	42.30	57.70	100
East shoa	A.T.J.K	Count	16	24	40
		% within Survey district	40	60	100
	Bora	Count	23	35	58
		% within Survey district	39.65	60.35	100
	Lume	Count	40	34	74
		% within Survey district	54.05	45.95	100
Arsi	Ziway Dugda	Count	12	30	42
		% within Survey district	28.57	71.43	100
	Total	Count	102	138	240
		% within Survey district	42.5	57.5	100
		% of Total	42.5	57.5	100

Household head`s access to the credit services: In the study area out of 240 sample respondent, 42.5% of them have an access to the credit services for enhancing their fishing activities where as 57.5% of them had not access to the credit services for enhancing their fishing activities in the study area. In Lume district out of 74 respondents 54.05% of the respondents have got access to credit services whereas 45.95% of them have not obtain access to credit services for enhancing their fishing activities in the area. In Boraa district, 39.65% of the respondents have got access to the credit services whereas 60.35% of them have not obtain access to credit services for enhancing their fishing activities in the area. In the case of Ziway Dugda district out of 42 respondents, 28.57% of the respondents have got access to credit where as 71..43% of them have not obtain credit access for enhancing their fishing activities in the area.

Table 6 shows, the percentage of the sample respondents based on household head`s membership in the fishery cooperatives in the selected survey districts.

Zone	Districts		Fishery cooperative membership of household head		Total
			Yes	No	
West Arsi	Nagele Arsi	Count	10	16	26
		% within Survey district	38.46	61.54	100
East Shoa	A.T.J.K	Count	27	13	40
		% within Survey district	67.5	32.5	100
	Bora	Count	27	31	58
		% within Survey district	46.55	53.45	100
	Lume	Count	39	35	74
		% within Survey district	52.70	47.30	100
Arsi	Ziway Dugda	Count	13	27	42
		% within Survey district	30.95	69.05	100
	Total	Count	116	126	240
		% within Survey district	48.33	51.67	100
		% of total	48.33	51.67	100

Household head`s membership in the primary fishery cooperative (Yes/No Answer): In the study are, Out of 240 sample respondent, 48.33% of them have said yes whereas 51.67% of them have given No response whether they were a member of primary fishery cooperatives or not in the study area as a whole. In Nagele Arsi district out of 26 sampled respondents, 38.46% of them have said yes whereas 61.54% of them have given No response whether they were a member of primary fishery cooperatives or not in this district. In Lume district out of 74 respondents 52.70% of them have said yes whereas 47.30% of them have given No response whether they were a member of primary fishery cooperatives or not in this district. In Bora district 46.55% of the respondents have said yes whereas 53.45% of them have given No response whether they were a member of primary fishery cooperatives or not in this district. In the case of Ziwai Dugda district out of 42 respondents, 30.95% of the respondents had given yes response whereas 69.05% have given No response whether they were a member of primary fishery cooperatives or not in this district.

Table 7. Description of demographic characters for continuous variables

Variables	Nagele Arsi	A.T.J.K	Bora	Lume	Z.dugda	Overall	p-value
	(N=26)	(N=40)	(N=58)	(N=74)	(N=42)	(N=240)	
	Mean (SD)	mean (SD)	mean (SD)	Mean (SD)	mean (SD)	Mean (SD)	
Female in household	3.1(1.6)	3.3(1.8)	3.4 (1.9)	3.2 (1.4)	3.8(1.3)	3.3(1.5)	0.912
Male in household	4.4 (1.4)	3.6(1.5)	3.7(1.3)	3.4 (1.5)	4.7(1.6)	3.9(1.3)	0.047
Total household size	7.5 (2.4)	6.9(2.7)	6.7(2.2)	6.6 (2.8)	8.5(3.2)	7.2(2.3)	0.357
Female B/n 15-64 years	1.6(1.1)	1.4(1.8)	2.2(1.4)	1.4 (1.6)	2.1(2.4)	1.7(1.6)	0.743
Male B/n 15-64 years	1.8(1.3)	1.3(1.7)	1.5(1.8)	1.7 (1.8)	1.1(2.0)	1.3(1.7)	0.537
household size B/n 15-64	3.4(1.7)	2.7(1.9)	3.6(1.5)	3.1 (1.7)	3.0(1.9)	2.9(1.8)	0.235

Household size: The average family size of the sample respondents was found to be 7 person in the study area. The average male member in the sampled household was around 4 person. In Arsi Nagele District it was 4 person, in A.T,J.K district 4 person, in Bora district 4 person, in Lume district 3person and in Ziway dugda district was around 4 person. The significance value of the t-test shows rejection of hypothesis that the average number of male in household is equal across the districts. So the average number of male in household is significantly different across the study districts at 10 % of significant level (Table 7).

Table 8. Description of demographic and socio-economic characters of sample respondents

Variables	Nagele	A.T.J.K	Bora	Lume	Z.dugda	Overall	p-value
	(N=26)	(N=40)	(N=58)	(N=74)	(N=42)	(N= 240)	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Household head education level	3.0(2.3)	3.8(3.1)	3.4 (2.9)	3.2(3.0)	3.8(3.5)	3.3(1.9)	0.003
Household head Fishing experience	8.0 (6.3)	9.2(7.8)	9.4.7(7.3)	8.4(7.5)	5.7(5.1)	8.2(7.4)	0.000
Household head`s Farm size	0.6(0.4)	0 .5(0.8)	1.0(0.7)	0.2(1.0)	0.4 (0.2)	0.5(1.0)	0.001
Fish caught by kg per day	45(21.1)	68(24.8)	64.2(19.4)	50(22.1)	47.3 (20.4)	54.9 (29.6)	0.751
Frequency of extension contact per year	4.2(3.5)	3.2(2.4)	4.7.(3.8)	5.7(4.8)	6.1 (5.2)	4.7(3.7)	0.043
Fish price per kg in 2019/20 G.C	21(13.7)	30.5(17.9)	26.4(18.5)	28.1 (14.7)	25 (11.9)	26.2(17.4)	0.035
Income from fish per month in 2019	2500.2(1350.1)	2708.1(1307.3)	2503.7(1333.2)	2642.5(1297.3)	2591.4(1428.7)	2589.18(12861.9)	0.079

Education of household head: Education equips individuals with the necessary knowledge of how to make living decision. Literate individuals are very ambitious to get information and use it**.** The average year of formal schooling of total sample respondent is grade 3.The average year of formal schooling is grade 3, grade 4, grade 3, grade 3 and grade 4 in Arsi Nagele, A.T.J.K, Bora, Lume and Ziway dugda districts respectively .The mean difference of the groups is statistically significant at 1 % of probability level. It shows that, on average sample respondents has significance mean difference of year of schooling across all districts at 1 % of probability level.

Fishing Experience of Household head: In the study area, the average fishing experience of the respondents were found to be 8 years, while that of Nagele Arsi, A.T.J. K, Bora, Lume and Ziway Dugda districts were 8,9,9,8 and 6 years respectively. It showed that the average difference between the group is significant at 1% significance level. This showed that the average

fishing experience of the respondents in all districts is not equal (see table 8).

Frequency of extension contact per year: The result of the study indicated that the average frequency of extension contact per year for the total sample on the fishing activity was 5 times. The average frequency of extension contact per year on the fishing activities is 4, 3, 5, 6 and 6 time in Nagele Arsi, A.T.J. K, Bora, Lume and Ziway dugda districts respectively. The mean difference of the groups is statistically significant at 5% of probability level. It shows that, on average sample respondents has significance mean difference across all districts at 5 percent of probability level.

Farm Size: On average total sample respondents have 0.5 ha of farm size for crop production in the study area. The average farm size of respondents is 0.6 ha, 0.5ha, 1, 0.2 and 0.4ha in Nagele Arsi, A.T.J.K, Bora, Lume and Ziway Dugda districts respectively.

Price of fresh fish per kg in 2020 G.C by ETB: The average fish price per kg in 2019 production year for the total sample respondents was 26 ETB in the study area. In Nagele Arsi District it was 21 ETB, in A.T.J.K district 30.5 ETB, in Bora district 26.4ETB, in Lume district 28ETB and in Ziway dugda district it was around 25ETB per kg respectively for all commercial fish species (Nile tilapia, African catfish, Common carp and crucian carp) found in the selected in the selected water bodies. The significance value of the t-test shows rejection of hypothesis that the average fresh fish price per kg is equal across the districts. So the average whole fish price per kg of household head is significantly different across the study districts at 5 percent of significant level (Table 8).

Income from fish per month in 2020 G.C (ETB): The average monthly income of the total sampled respondents in 2019 production year was 2589 ETB in the study area. In Nagele Arsi District it was 2500 ETB , in A.T.J.K district 2708 ETB , in Bora district 2504 ETB , in Lume district 2643 ETB and in Ziway dugda district it was around 2591 ETB respectively for all commercial fish species in the study area. The mean difference between all groups was found to be significant at 5% probability level. This shows that the average monthly income from fresh fish of sample households across all districts is not equal.

3.2. Fish Value chain analysis

In value chain analysis, it is important to select potential value chain, which could create a potential impact on the livelihood of the target society or industry. This demands, analysis of value chain, which have a practical implementation in the development intervention from different perspectives.

3.2.1. Main Functions and actors in the Value chain of fishing activities in the study area

The main functions in the fish value chain in the central rift valley area includes: input supply, production, processing, marketing and consumption of fish and fish products, thus different activities were performed by the different actors.

The fish value chain passes through 5 key functions to reach the final consumer in general. However, these key functions are not mandatorily undertaken at a point of time and node but at different time.

Moreover, the whole fish and fish products supplied to the final consumers is not mandatory passes through these functions.

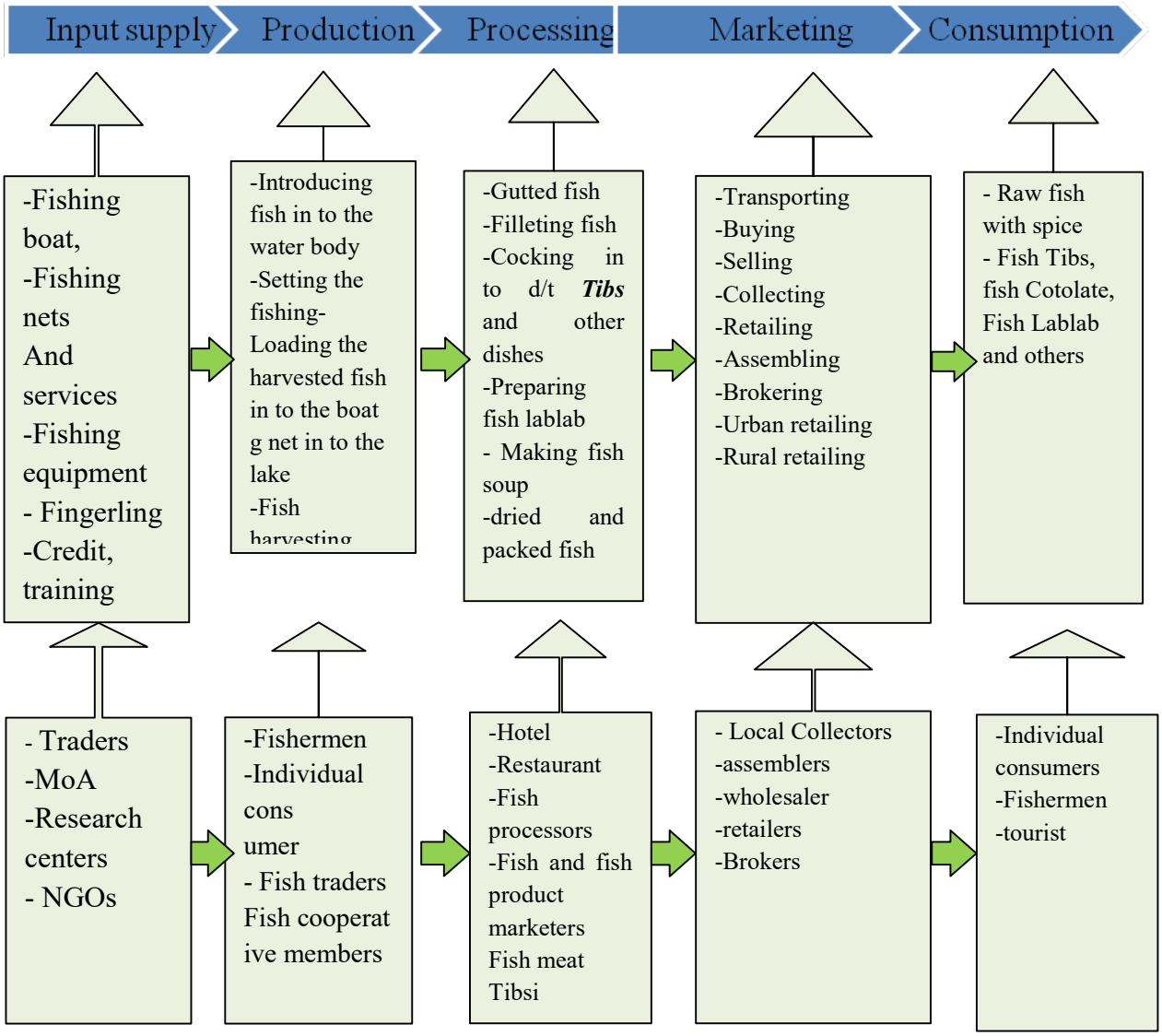

Figure 1. Main fish value chain function, marketing chain Actors and supporting actors

3.2.2. Actors and their role in fish value chain

There are several actors in fish value chains in the study area who engaged in various activities from fishing up to consuming. These actors have defined roles specific to the activities they perform and/or services they provide within the chains. In the case of this study area fisheries sector, an attempt had been made to analyze the current fish production and marketing channels and key actors involved in these chains and other relevant issues. Based on their roles and responsibilities the actors participating in this chain are discussed as follows.

Primary actors: The primary actors in fish value chain in this study area were input supplier, individual fish producers', fish producer cooperatives, fish processor, fish and fish product marketers and consumers. Each of these actors adds value in the process of changing product title. Some functions or roles are performed by more than one actor and some actors perform more than one role.

Input supplier: At this stage of the value chain, there are many actors who are involved directly or indirectly in fish input supply in the study area. Currently, individual fishing equipment trader at different town, district and zonal Office of

Livestock and fishery development agency, Batu fish and other aquatic life research center, Sebeta fish research center, government and NGO's such as world vision Ethiopia and fish for all are the main fish input supplier. The World Vision Ethiopia and Batu fish and other aquatic life research center is also supporting the fishermen on the lake and reservoir in giving the training and funding for provision of training and fishing equipment purchasing.

Fish producers/Fishermen: Fishermen are people who earn their living by exploiting fish resources. Individual fish producers are the first link and major actors who perform the work of fish production and supply to the market in this study area's fish value chain. Their major functions in this value chain are mainly processing of fish at preliminary stage such as: putting the fishing net in to the lake, loading the caught fish on the fishing boat, fish harvesting, washing, cleaning, gutting, filleting and transport to their next customer.

Fish production overview: In the study area there are four commercial fish fish species such as: Nile Tillapia, Common carp, African Cat fish, and Crucial carp. The most productive and preferred species of fish in the study area is Nile tilapia fish species because of its availability and more sweet and can be easily filleted and gutted than the other species in the study area. The majority of the sample producers used the fishing equipment which was previously offered by support provider (supporting agents such as NGO: World vision Ethiopia and Batu fish and other aquatic life research center). The equipment's are timber made boat, fishing net, and motorized boat, additionally some of the individual fish producer uses locally constructed boat. As the respondents indicated they are responsible for the supply of **71,720kg** fresh fish/month of fish to the market in this study area. From Langano Lake, as the survey result indicated us the fishermen are responsible to supply **8,580 kg** of fish to the Nagele Arsi and Batu market in 2020 production year monthly. In Dambal lake as the survey result indicated us the fish producers are responsible to supply **29,480** kg of fresh fish to the Batu, Maki and Addis Ababa city in 2019 production year monthly. In Koka reservoir the survey result showed us **33, 660 kg of** fresh fish were supplied to the Maki, Alemtena, Modjo, Adama and Addis Ababa market in 2019/2020 production year monthly.

Fishing Frequency: In the Langano Lake from the total of target respondents the average fishing day's frequencies per week of individual fish producer were 4 days per week with the minimum and maximum of 2 and 6 days per week respectively. In the Dambal Lake From the total of target producers the average fishing day's frequencies per week of individual fish producer were 5 days per week with the minimum and maximum of 3 and 7 days per week respectively. In the Koka reservoir from the total fishermen, which are selected from Bora and Lume district the average fishing day's frequencies per week of individual fish producer were 5 days per week with the minimum and maximum of 3 and 7 days per week respectively.

Table 9: Fishing frequency of the respondent fishermen per week in the study area

Water bodies	Production Days/week	Frequency	%age	Min	Max	Mean
Langano lake	2	4	16	2	6	4
	3	4	16			
	4	7	28			
	5	6	24			
	6	4	16			
	Total	25	100			
Dambal Lake	3	16	18.8	3	7	5
	4	21	24.7			
	5	15	17.65			
	6	18	21.17			
	7	15	17.65			
	Total	85	100			
Koka reservoir	3	13	18.57	3	7	5
	4	17	24.29			
	5	10	14.29			
	6	16	22.86			
	7	14	20			
	Total	70	100			

Source: own survey result, 2020 and 2021

Fish Production, selling and Consumption overview: Fish production in the study area takes place all year round. However, the peak period for fish harvesting is between January and June. Based on the survey result the daily average fish production of an individual fish producer was 5.92kg/person and the average monthly volume of production was 71,720kg and 45,890kg (10,200kg from Langano, 21,100 kg from Dambal Lake and 14,590kg from Koka reservoir) for whole and semi-processed (filleted) fish respectively. Some fishermen produces a combination of whole and filleted fish and very few fishermen produce only one of the two i.e. whole or filleted fish only. Accordingly from the total volume of fish produced monthly in the study area 19.5% were used by fishermen for home consumption, 5.5% were lost in different w ays and the remaining 75% was supplied to the m arket through different market channels.

Table 10: Monthly average fish production, consumption, sale and their average sale price during fasting and non-fasting season of fish in the study area

Water bodies	Type of fish produced	Average monthly produced	Monthly co nsumption (%)	Average monthly sale	Average sale price per kg	
					Fasting season	Non fasti ng season
Langano lake (n=25)	8,580 +10, 200					
	Whole fish	343.2kg			35 ETB/kg	28.5ETB/ kg
	Semi processed	408kg			100 ETB/KG	70.2ETB/ kg
	Total	**751.2kg**	4.5%	17.25%		
Dambal Lake (n=85)	29,480 +21, 100					
	Whole fish	346.82kg			37.5	31
	Semi processed	248.23kg			105.3	77.5
	Total	**595.05kg**	9.5%	34.5%		
Koka reservoir (n= 70)	33,660+14,590					
	Whole fish	480.86kg			39.4	33.7
	Semi processed	208.4			105	79.5
	Total	**689.3kg**	5.5%	23.25%		

Individual raw Fish and fish products consumers: Consumers are those who purchase the fish and other fish products from different sources of fish supplier for individual and home consumption purpose. They consume fish as a substitute protein food. Especially at Christian fasting season the preference of consumer to fish is highly increases. They prefer fresh, dried and filleted fish for consumption.

Those, who live near the lake and reservoir and passengers who travel from Hawasa to Addis Ababa also buy from the fishermen themselves at different landing site.

Fish marketers: This actor consists Local collect ors, wholesalers and retailers.

Local Fish Collectors: These are traders in assembly markets who collect fish from individual fisher at their production/landing site area and fishery cooperative for the purpose of reselling. As indicated from this study, they use their financial resources and their local knowledge to handle and transport their fish to their customer area. They play an important role in fish value chain in linking producer with traders and responsible for trading of fish and fish products from production area to wholesaler, retailers and consumer markets in the study areas. The other function of these actors is doing for time and place utility. Their role is buying and assembling, transporting and selling to the next actors in this value chain.

Wholesalers: In case of this study area most of fish whole sellers are averagely found 3 km far from the selected lake and reservoir in the selected districts and village and they are who buys whole fish, gutted, and filleted fish from the fishermen, local collector and fish producer cooperatives. They are the main assembly centers for fish in their respective surrounding areas and play an important role in linking fish producer with the other actors in the chain and doing for value addition as time and place utility. As this study indicated they are responsible for trading of **37,728.4kg** of fish monthly. They can transport to

where their customer is located. Their mode of transportation is mainly using Lorry, Bajaj, bicycle, motor cycle and car to collect from their supplier and passenger car and minibus to transport to Batu, Maqi, Modjo, Adama and Addis Ababa town. They have better storage facility, transport and communication access than other actors in the chain.

Retailers: They are key actors in this value chain who link between producers and consumers. Mostly they buy from wholesalers and sell to consumers. As indicated from this survey their role in this study area is that; they clean and stores, provides fish and their products directly to the final consumer and sometimes they supply to restaurant and hotels at Batu, Maqi, Mojo, Adama and Addis Ababa town when there is shortage of fish supply. Consumers usually buy the product from retailers as they offer according to requirement and their purchasing power.

Fishery Cooperatives: Fishery cooperatives are one of the fish value chain actors in this study area and have a great role in this value chain. They are the second fish collector from fish producer. Their role in this fish value chain includes buying of fish from the individual producer at their store house and selling for their customer such as for wholesaler and direct consumer. Most of the fishery cooperatives have an opportunity to sell their fish to Hawasa to Addis Ababa voyagers at their shop since they are at the side of the main road. They are responsible to supply averagely 15,276.4kg of whole fish monthly to the restaurants, Hotels, final consumers and other market chain actors in the area.

Restaurants and hotels: The restaurants and hotels are where the consumers consume value added fish. Once they buy fresh fish from wholesalers; they store in refrigeration, prepare by roasting and pickling (addition of spice and vegetable) and called ‘’Asa batikilt, Asa Tibsi, Asa dulet, Asa soup, Asa lablab, raw fresh Asa by adding spice and liqour and Asa Kotelete’’ to satisfy their customer

Supporting actors: are those who provide supportive services for fish producers on the selected lake and reservoir including supplying fish seed, fishing net like beach siene, gillnet hook line, long line and other inputs, training and extension, different information, financial and credit services and legality concern services.

Fish processing and post-harvest handling: Fish which is produced in the study area was supplied to the market either as gutted, whole fish or filleted fish. As the survey result indicated there were no further fish processing activity undertaken but mostly the fish producer accomplish only the preliminary fish processing activity such as: washing, filleting, gutting, cleaning and sorting and very few of them add some processing and preservation activity such as plastic packing and storage facility. Once the fish is caught they do only for preliminary processing (i.e. washing, gutting, cleaning) and taken directly to the market for selling without any further processing and value addition.

Table 11 shows the existing ways of fish processing and value addition in the study area

Type of fish processing and value addition	Respondent response	
	Frequency	rank
Washing	27	6th
Cleaning	100	3rd
Gutting	135	2nd
Filleting	155	1st
Plastic Packing	41	4th
Storage and Refrigeration	30	5th

3.4. Fish Market performance along the chain actors

Marketing performance of fish market was analysed by estimating the marketing margin, by taking into consideration associated marketing costs for key marketing channels. The marketing margin refers to the difference between prices at different levels in the marketing system. The total marketing margin is the difference between what the consumers pays and what the producer/fishermen receives for his fish, in other words it is the difference between retail price and farm price. A wide margin means usually high prices to consumers and low prices to producers. Market performance can be evaluated by analysing costs and margins of marketing agents in different channels.

Estimates of marketing margin are the best tools to analyses performance of market. The cost and price information used to construct marketing cost and margin have been gathered from fish value chain actors such as, producers, collectors, retailers, wholesalers and consumers. Computing the total gross marketing margin (TGMM) is always related to the final price paid by the end buyer and is expressed as percentage.

3.4.1. Fish marketing channel in the study area

The marketing channels of fish identified below shows how commodity fish and fish products passes through eight complicated routs of intermediaries on the way from point of fishermen to reach ultimate users. From the Figure 3 below, one can understand that the main receivers of fish product from the producers were Central wholesalers (52.6%), Fishery cooperatives (21.3%), consumers (16.1%), Hotel and restaurants (7%) and fish processors (3%). Based on the volume of fish products flown, the marketing channels were compared with each other. Accordingly, the producer- fishery cooperatives- central wholesalers-retailers-consumer channel, (channel 6) carries the larger volume of fish products transacted followed by producer- central wholesalers — retailers -- consumer channel, (channel 4).

The major identified channels of fish and fish products during the survey were explained as follows in Figure 3 below.

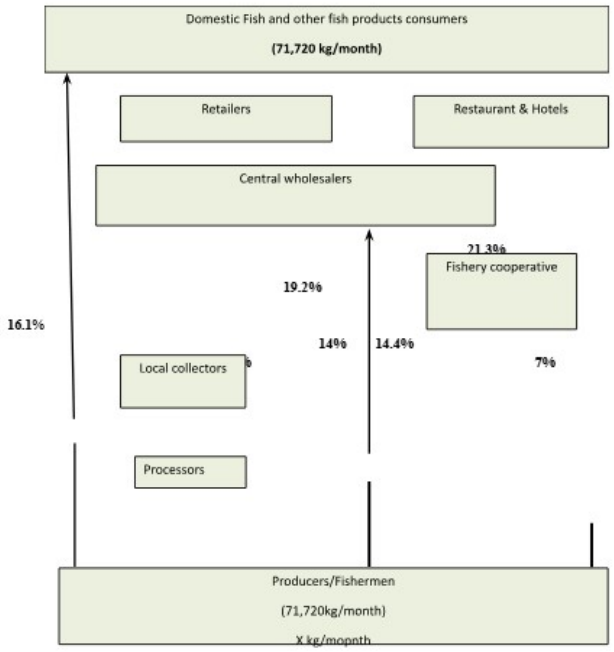

Figure 3. Fish and fish product marketing chain in the study area

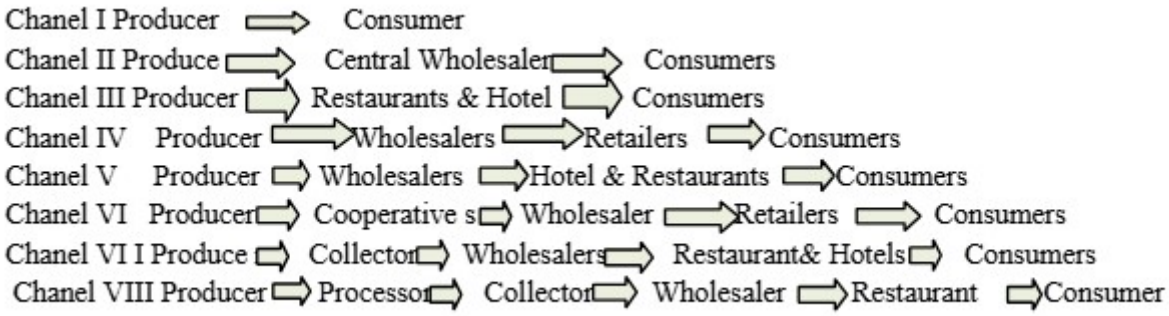

Figure 4. Major identified channels of fish during the survey

3.4.2. Fish gross marketing margin and value share

Fish market performance in the study area was examined by analysing marketing costs and price margins among the different fish marketing activities in order to measure the degree of fish marketing efficiency. Computing the total gross marketing margin (TGMM) is always related to the final price paid by the end buyer and is expressed as percentage (Mendoza, 1995).

$$\text{TGMM} = \frac{\text{Final Consumers Price} - \text{Producers Price}}{\text{Final Consumers Price}}$$

Where, TGMM is total gross marketing margin

In addition to margins, the share of each participant from the final price paid by the consumer will also computed for each participant in the channel by dividing their respective profit margin with the consumer price. The comparison of this information with marketing costs incurred at each level in the channel helps to suggest the point where problems may exist in the marketing channel, thereby indicating where improvements can be made to achieve efficient coffee marketing. The producer's margin or share in the consumer price (GMMp) is calculated as:

$$\text{GMM}_{\text{P}} = \frac{\text{Consumers Price} - \text{Marketing Gross Margin}}{\text{Consumers Price}} \quad \text{Or} \quad \text{GMM}_{\text{P}} = 1 - \text{TGMM}$$

Table 12. Marketing margins maintained by marketing actors in fish marketing channel.

Marketing actors	Fish marketing channels (Birr/Head)							
	I	II	III	IV	V	VI	VI I	**VI I I**
NMM_{proc}	-	-	-	-	-	-	-	**11**
NMM_{col}	-	-	-	-	-	-	17	14
NMM_{cop}	-	-	-	-	-	**37**	-	-
NMM_{ws}	-	19	-	33	31	20	23	27
NMM_{rt}	-	-	-	34	-	25	-	-
NMM_{rs}	-	-	28	-	24	-	20	24
TGMM (%)	35	34	32.5	55	55.3	70.8	71.7	**75.2**
Producers margin or share (%)	65	**66**	**67.5**	45	45.6	29.2	28.3	24.8

The above table, Table 12 summarizes marketing margins maintained by each actor in various fish marketing channels. Total gross marketing margin in fish trading is highest in channels 8; it accounts a TGMM of 75.2%.Fishery cooperatives enjoy the highest net marketing margin that is **37** birr in channel VI . Producers share from the price paid by consumers is highest in channel III, which accounts 67.5% & followed by channel II which accounts 66% of the price paid by consumers. The lowest net marketing margin, which accounts **11Birr**, is associated with fish processor in channel VIII of fish marketing channel in the study area.

3.5. Determinants of fish value addition along the chain actors in the study areas

Thirteen variables were hypothesized to explain the determinants of fish value addition of individual fish producer in the study area; such as household size, access to the modern transportation services, Education level, fishing experience, availability of fishing equipment, sex of household head, farm size, household head annual income, access to extension service, selling price of fish in 2020, membership of fishery cooperative, access to nearest market information and access to credit service. Out of these eight (household size, education level, access to the extension services, access to credit services, selling price of fish and other fish products in 2019, access to the modern transportation services and access to the nearest market information and availability of fishing equipment) of the variables were found to be significant, while the remaining six were less powerful in explaining the determinants of fish producer's processing and value addition on their fish and other fish products in the study area. The maximum likelihood estimates of the logistic regression model show that household size, education level, access to the extension services, access to credit services, selling price of fish and other fish products in 2020, access to the modern transportation services and access to the nearest market were important factors influencing fish value addition in the study area. The following table 9 shows the probit model results of this study. The Pseudo R^2 shows approximately 0.78. Indicating that variations in probabilities of value addition of fish by the actors in the sample surveyed were explained by about 78 % of the probit model.

Table 13: Estimated binary probit model and the effects of explanatory variables on the probability of fish value addition along the chain actors

Variables	Coefficient	Robust Std. Err	Z	Marginal effect
Access to the credit services	**0.8893*** **	0.3168	2.81	0.2301
Access to the market information	**0.0798*** **	0.0271	2.94	0.0207
Access to the modern transportation services	**0.7695** **	0.3497	2.20	0.1805
Education level of household head	**0.3138*** **	0.1163	2.70	0.0814
Access to extension services	**0.0564** **	0.0242	2.32	0.0146
Household size	**0.603** **	0.;281	2.150	0.137
Selling price of fish in 2019 G.C	0.0004	.1265	0.003	0.251
Fishing experience	-0.8513	0.6328	-1.35	-0.1634
Availability of fishing equipment	**1.4504*** **	0.4246	3.41	0.3465
Sex of household head	0.0004	0.0224	.0224	0.0001
Membership of fishery cooperative	0.1265	.092	1.37	0.0328
Farm size	0.0923	0.2338	0.39	0.0239
Annual income of household head	0.2352	0.3852	0.61	0.0612
Pseudo R^2	0.78			
Log likelihood	-31.53			
Prob > Chi^2	0.0000			
Wald chi2(13)	110.33			
Number of observation	180			

***, ** and * represent level of significant at 1%, 5% and 10% respectively

Access to modern transportation service: It had a positive and statistically significant effect on the producers` participation production and in fish value addition in the study area. The model result indicated that the probability of participating in fish value addition increases by 18% if the head gets access to modern transportation service. Modern transport improves the quality of fish product by minimizing the perishability of the product and facilitates the interaction between surplus and deficit geographical areas. This indicates that transportation service is a crucial factor to create a market for fish production and processing, which improves the living standards of the households. Fish is the most perishable food item especially in the tropical climates of developing countries. Therefore, modern transportation service is a viable solution to minimize the degree of perishability. Similarly, most of the fish catch from the lakes reach the market by traditional means of transportation which causes mechanical stress to fish products (Awel and Shumeta). This entails that modern transport service enables farm households to supply raw and processed fish in different areas where fish products have higher demand. This helps them to receive a better price for their product and increase their benefit from their product which leads to the improved living standard of their household members. The discussion by Awel and Shumeta (2018) reported that fish is one of the most perishable of human food item, which starts spoiling soon after death. The perishability nature of fish after death and lack of modern transport service heavily hamper the participation of farm households in fish production. Therefore, effective transportation service coupled with value addition activities minimizes the spoilage of fish after death. This entails that modern transport services increase farm households' participation in fish value addition in the study area.

Access to the credit services: The results of the probit model show that this variable affects the processing and value addition of individual fish producer on their fish product is positively and significant at 1% probability level. The marginal effect value shows that whenever the producers' access to credit service increases by 1% the processing and value addition on their fish product increases by 23%. This means accessing credit of individual fish producers increases the capacity to purchase fishing and processing equipment of the fishermen to accomplish further processing and value addition on their fish. This finding is consistent with the study of (Awel and Shumeta, 2018).

Access to the market information: It affected the process of value addition of individual fish producer on their fish positively and significantly at 1% significance level. This is the binary probit estimate for a one unit increase in market information; given the other variables in the model are held constant, increases the value addition on the fish by 2%. This means whenever fishermen try to get market information they collect about the type of product the customers want.

Education level of household head: This variable was found to be an important variable in fish value addition of individual fish producer on their fish and other fish products and affects positively and significant at 1% significance level. The marginal effect of this value shows the probability of value addition of fish and other fish products is found to be increased by 8 % when the level of education increases by 1 % of who learnt formal education. Therefore, if individual fish producers' gets formal education and learn more, there is a possibility to apply more fish processing and value addition activity in the study area. This is in-line with (Mebrate and Ayalew, 2020; Tereda, 2020) who found that education is an important factor which can determine level of awareness on the value addition in fish and other fish products.

Access to extension services: The results of the probit model show that this variable affects the processing and value addition of individual fish producer on their fish product is positively and significant at 5% probability level. The marginal effect shows that whenever the producers' access to credit service increases by 1 unit, the processing and value addition on their fish product increases by of 1.46%. This means

accessing credit of individual fish producers increases the capacity to purchase fishing and processing equipment of the fishermen to accomplish further processing and value addition on their fish and other fish products (Mebrate, 2020).

Household size: This variable had a positive and statistically significant effect on households' participation in fish and fish products processing and value addition. The model result revealed that the probability of participating in fish processing and value addition increases by 13.7% for a unit increase in household size. This relationship indicates that large household size increases the households' participation in fish and fish products processing and value addition. This is because having a large household size requires more food and income to satisfy their basic needs. In the study area, fish production is the dominant income and food source. As a result, the household head who has a large household size has to participate in different fish production, fish and fish products processing and value addition activities to full fill the basic needs of his/her household members. The result of this study is consistent with previous studies (Tereda, 2020).

Availability of fishing processing &equipment in the nearby town: Fishing and processing Equipment is another variable which is significantly related to the dependent variable and that affects positively and significantly at 1% probability level. The marginal effect of this variable shows that the probability of fish processing and value addition of an individual fish producer increases by 34% when an individual producers having more fishing equipment increases by 1 unit. The reason behind this is that an individual fish producer farmers accessing more fish processing and handling equipment's have more opportunity to do more processing and value addition for their fishes and other fish products; because when the fishermen own more fishing equipment they can further process and do for more value addition on their fish and fish products (Hussen and Hailu, 2019).

3.6. Major Constraints and opportunities in fish Value chain in the study area

3.6.1. Major Constraints in fish Value chain in the study area

Accordingly major constraints faced by fish production system, based on interview of respondents, focus group discussion and key informants interview, in the study areas were identified and are presented in the following table

Table 14. Major Constraints along the fish value chain in the study area

Major Constraints in the area	**Frequency**	**rank**
Expansion of illegal fishermen, traders and illegal fishing nets	50	3rd
Lack of improved fishing technologies	48	4th
Fishery regulation problem	26	5th
water hyacinth and waste disposal problem at Dambal Lake and Koka reservoir	60	1st
climate change, fish disease and low yield of fish species	56	2nd

3.6.2. Major opportunities in fish Value chain in the study area

According to the respondent, focus group discussion and key informant interview response, the major opportunities for fish production, processing and value addition in the study area include creation of job opportunities for the youth (29.5%), Presence of Oromia saving and credit institute in the area and this may give some insight to the fishers to become ec onomically more influential (5%). Likewise, the p resence of fishery proclamation contributes to ban illegal fishing instruments and protect the fishery (2.5%), Presence of different resorts, fishery cooperative and international and domestic

tourists in the area (11.36%), presence of Batu fish and other aquatic life research center at Batu town, which mainly support fishery development sector and establish a lot of fish cooperative within which fishing activities are encouraged (17%), presence of indigenous knowledge of the farmers about the fishing activities (7%), increased fish product demand by international and domestic tourists (9%), expansion of Arsi Nagele, Batu, Meki, Alemtena, Modjo and Adama city and nearside of the city of the above mentioned lakes and reservoir makes the sector more efficient and effective (11%) and the presence of Bofofe (type of tree) used for the production of a traditional boat called Yabala helps fishermen to operate fish and use it in moving around the shores of lakes (14.54%). Fishery cooperatives are one of the fish value chain actors in this study area and have a great role in this value chain. They are the second fish collector from fish producer. Their role in this fish value chain includes buying of fish from the individual producer at their store house; store it in refrigeration, plastic packing and selling for their customer such as for wholesaler and direct consumer. Most of the fishery cooperatives have an opportunity to sell their fish to Hawasa to Addis Ababa voyagers at their shop since they are at the side of the main road.

4. Conclusion and Recommendation

The analysis of fish value chain revealed that the main value chain actors are input suppliers, fishermen, fish producer cooperatives, local fish collectors, wholesalers, retailers, restaurants and hotels and finally consumers. Currently the district and zonal office of agriculture, Batu fishery research center, Bureau of agriculture, micro financial institution, and NGO's such as world vision Ethiopia are the main support provider.

With regard to econometrics results the determinants of fish value addition were found to be an important element in the study of fish value chain. Thirteen variables were hypothesized to explain the determinants of fish value addition of individual fish producer. Finally; the result of binary probit model shows that only seven variables were important factors influencing positively and significantly individual fish producers' value addition on their fish in this study area.

Therefore, to promote fish value addition in a sustainable way some policy implications are suggested to be addressed by stakeholders: Hence, it improves their skill to further processing and value addition on their fish. Finally, the future research need to be conducted on production and value addition of fish to identify the existing limitation on market need based fish production, further processing and encouraging them for commercial fishing system by using of modern fishing equipment to make the fish producer more benefited.

Conflict of interest

The authors does not declare the conflict of interest

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