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Value Chain Analysis of Fish Production and Marketing from Lake Tana, Ethiopia

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Abstract

A value chain is a sequence of related enterprises (operators) conducting activities (functions) so as to add value to a product from its primary production, through its processing and marketing, to the final sale of the product to consumers. The main objective of this research was studying fish value chain in major fish production and marketing from Lake Tana and Sort out major problems on fish production and marketing. Stratified random sampling was used to ensure that sole fishers in the catching and landing sites were equally represented in the survey. Ninety One (91) fishers were interviewed from 4 landing sites selected on a stratified random basis. There are four major fish market outlet from L.Tana. Fish traders and respected stakeholders were also interviewed. Fishers travel daily from primary landing sites to fish market places for 68 minutes on average. At landing sites, the whole fish price ranges from 20-25 birr per kilograms for Tilapia and Barbus. Wholesaler selling price of filleted fish range of 65-75, 55-65 and 50-60 birr per kilogram for tilapia, Barbus and Catfish, respectively. Women who do filleting, the time spent for a kilogram of Tilapia can took an average of 25 minutes. Fishery cooperatives should strongly work on value adding activities instead of selling whole fish.

Keywords: Tana, Value chain, Channel, fish, fisher and traders

Introduction

A value chain is a sequence of related enterprises (operators) conducting activities (functions) so as to add value to a product from its primary production, through its processing and marketing, to the final sale of the product to consumers. The functions of each link in the chain involve sourcing inputs, making and producing, and then delivering and selling the product to the next

link in the chain (Kaplinsky and Morris 2001; Macfadyen et al. 2011). Value chain analysis was first described and popularized by Michael Porter in the mid-1980s (Porter 1985). The methodology is used to assess the relative importance of factors affecting competitiveness and the costs and earnings for those involved in the value chain. The value chain approach helps to enhance the competitiveness of sectors, identify and understand major opportunities for upgrading, driving constraints to market growth, and to generate recommendations for priority actions that can result in increased benefits for fishermen and value chain actors. Kaplinsky and Morris (2012) outlines that there are at least four important aspects of value chain analysis, namely mapping the actors in the value chain, identifying and analyzing the distribution of the benefits of the actors in the value chain, examines the role of upgrading in the value chain and analysis of the role of governance in the value chain.

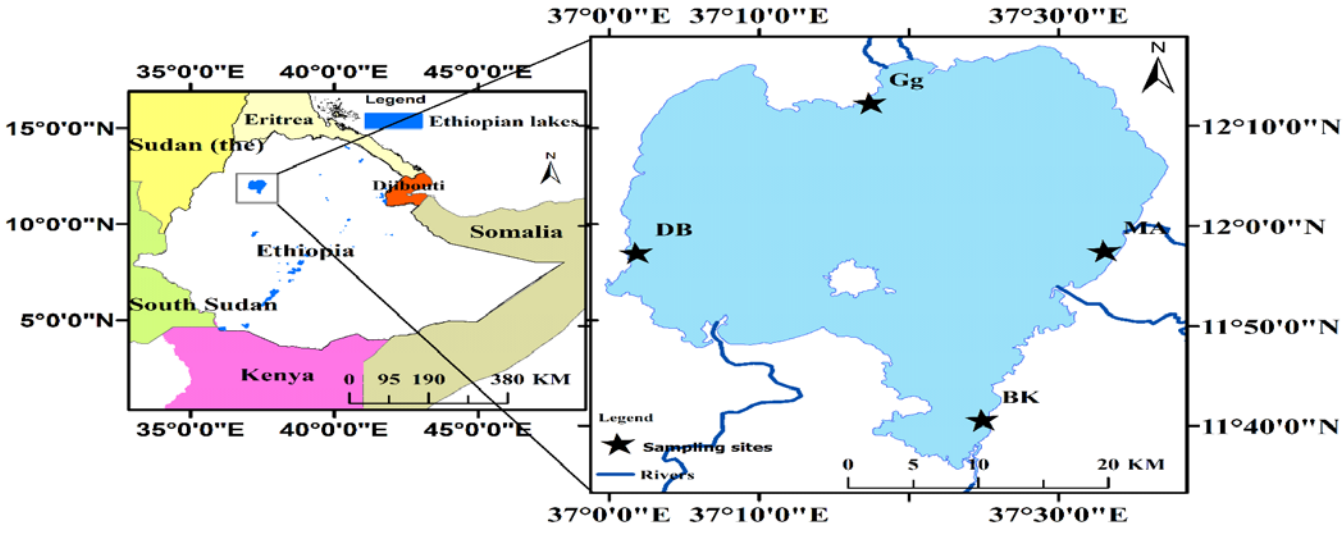
Total catches of fish from the wild reached a plateau in the early 1990s. And even though the production of both low- and high-value aquaculture (grass carps for food and shrimp for export, for example) has continued to grow, concerns have been raised about environmental risks associated with the ongoing intensification and spread of fish production, as well as competition between poor traditional fishers and large-scale operations. Choices for both technology and policy development are at a critical crossroads. The stakes concern how small-scale fishers will retain their access rights to future fisheries resources in the face of the demands from large-scale operators, how to rebuild depleted fisheries resources and then maintain their exploitation at sustainable levels, and how the benefits from fisheries will serve the interests of poor people and low-income countries in the face of increases in both fish consumption and trade (Christopher L. *et al*, 2003).

Small freshwater pelagic fisheries in closed lakes are very important to millions of people in sub-Saharan Africa providing livelihoods and nutritional security. However, returns from these fisheries have been shown to fluctuate in response to climatic variability. In order to understand the impact of these fluctuations on the livelihoods of people depending on these fisheries, information on how the fish value chain is organized and how it functions in response to variation in supplies is required. The information generated will be used to develop strategies

that will build resilience in fishing households against the uncertainties arising from unstable ecosystems (Levison *et al*, 2012). Even if so many studies on fish biology and other limmunological aspect were done by scholars like Eshete D *et al* , 2017, there is a large information gap on market and value chain concept of fish from L. Tana. Thus, this study was done to fill this gap and come up with recommendations. This study focused on mapping of main value chain of fish from Lake Tana , assessing the role of key actors on fish value chain and calculating profit distribution among actors within the fish value chain.

Methodology

Stratified random sampling was used to ensure that sole fishers in the landing sites were equally represented in the survey. Ninety One and twelve fishers and traders were interviewed from 4 landing sites and towns respectively. To ensure equal representation in the value chain analysis survey, fishers were selected on a stratified random basis in the four fish landing sites (Bahird Zuria, Gorgora, Metreabaworka and Bata kebele). The traders were 16 in number based at Bahirdar, woreta and Goregora. The survey instrument was pre-tested to detect inconsistencies and unclear language. Callbacks were made on respondents who were not available during the first visit, giving a hundred percent completion rate.



Key: BK- Bata kebele;MA- Metreabaworka;Gg- Goregora and DB- Dengel Ber

Figure 1. Map of Lake Tana and sampling sites(Landing areas)

The in-depth interview was widely used in gathering data for this study. The interview was guided by a semi-structured questionnaire. Using this method, participants were interviewed once to seek more depth in the information provided (Veal, 2005). These interviews were electronically recorded (coded in the computer using SPSS 20 version) and transcribed. Information was also gained from informal discussion with members of the value chain. The analysis was made by using descriptive statistics and applying linear regression model for sorting out important variables of daily harvest.

Result and Discussion

Study area

Lake Tana is situated in the north-western highlands of Ethiopia (12°N, 37°150E) on a basaltic plateau at an altitude of 1,830 m and covers an area of ca. 3,050 km2. It is the source of the Blue Nile River (Great Abbay), with a catchment area of ca. 16,500 km^2. The fish production potential of the Lake estimated by Asefa M. by the year 2014 was 1,454 tons per year . Lake Tana is shallow (average depth 8 meters, maximum depth 14 meters) Seven permanent and more than 40 small seasonal rivers feed the lake with water. The Blue Nile is the only outflowing river (Eshete D *et al* , 2017).The land use in the Lake Tana basin is predominantly cultivable Land (71%), grazing (9%),Infrastructure (6%), forest (3%) and others. The major type of land cover includes farm land, water bodies, wetlands, forest, wood land, shrubs, rangeland, grassland and settlements (Goraw & Shimelis, 2017).

Demographic Characteristics

The demographic behavior of fishers (Table 1) indicates that the average age of fishers was 35.5 years. This age stage indicates that fishers found in their productive stage of fish harvesting. The average formal education level of the respondents were from grade one up to six. The overall family size of respondents was addressed and fishers have family size of 5 including male and female. Fishers travel on average 68 minutes per day to from primary landing site to the fish market .To get all weather road fishers has to travel 48 minutes from the landing site. Fishers were asked about fishing experiences they have in years and the average years of experience was 12 years which indicates that they are very much experienced.

Table 1. Demographic characteristics of fishers.

No.	Economic Variables	Mean	Std. Err	[95% conf. Interval]	
1	Age	35.5	.8593816	33.83115	37.24577
2	Educational level	1.7	.0898594	1.546753	1.903796
3	Family size	5.4	.2842896	4.841802	5.971384
4	Distance to Market(Minutes)	67.9	5.698455	56.64606	79.28801
5	Distance to main road(Minutes)	48.2	5.473254	37.28027	59.02742
6	Experience of fishing (Years)	12.2	.7333366	10.7409	13.6547

The overall socioeconomic behavior of fishers mainly characterized by the mean volume of harvest of fish mainly expressed in terms of number with fish type and livestock ownership presented in Table 2. The daily harvest of fish from different landing sites fluctuate based on marketability of fish type. Tilapia fish type dominate the mean value among different sites due to its market demand which ranks first by having 29 fish per day. The size of tilapia potentially harvested ranges from 13 to 20 centimeters depending on the type of harvesting net applied for fishing. Landing sites where proxy to cities use very small size net which harvest a small sized fish and fishers tried to look market for their catch even if with a lower price. The fish type which placed in second rank was Catfish having a daily harvest of 12. This fish type has a good flesh even if it has lower price as compared with Tilapia. The size of this fish type harvested per day was 35 to 50 centimeters. The third ranked fish type was Barbus having a daily harvest of 8 which was close to three fold less than Tilapia. Fishers responded that this fish has a lesser market demand as compared to Tilapia and Catfish. The livestock ownership of fisherman was assessed which directly linked with household wealth statues measurement. Accordingly, oxen, cow, goats, sheep and donkey were included for assessment. The distribution of these animal per household dominated by sheep having at least one. However, donkey and goats were less available per household.

Table 2. . Socioeconomic characteristics of fishers.

No.	Economic Variables	Mean	Std. Err	[95% conf. Interval]	
1	Tilapia harvested per day(Number)	28.5	2.94864	22.53762	34.25359
2	Barbus harvested per day(Number)	8.4	.7974133	6.811404	9.979805
3	Catfish harvested per day(Number)	12.3	1.212577	9.920674	14.73867
4	Number of Oxen	0.6	.093833	.839141	.8567452
5	Number of Cow	0. 6	.0841216	.4262844	.7605288
6	Number of goats	0.3	.1349657	-.0153856	.5208801
7	Number of sheep	0.9	.2157257	.428566	1.28572
8	Number of donkey	0.3	.0809516	.1029119	.4245607

Fishers Economic Characteristics

The overall fishing activity in the landing sites surveyed was done by using locally made papyrus and wooden boats. The fishing gears with 8-12 cm stretch mesh size and, hooks with long lines are used for fishing. Fishers have at least one papyrus boat which can have economic value of 400 Eth.Birr and can be replaced every two years. In addition to this, fisher also have one gill net (30 meters length and 1.5 meter width) with an economic value of 5000 Eth.Birr. This gill net can serve for one and half year with continuous maintenance. The durability of the net also depends on weekly fishing effort and the existing scenario of theft of net. The other resource which fishers have is wooden boat that will cost from 4000 to 5000 Eth.Birr. The daily fish (Tilapia) harvest depends on the number of gill net having appropriate size and type of boat the fishermen have. Fishers having a wooden boat can harvest more than who have leafy boat.

Fish Collectors Economic Characteristics

Fishers in distant landing sites are unable to deliver fish to target users. Thus, they deliver the catches to collectors in relative lower price. The average daily collection ranges from 50 to70 kilograms of fish usually Tilapia, Catfish and Barbus species. In most fish marketing activities in areas where placed in distant landing sites fish collector harvest fish on count base which three tilapia and Barbus as one kilogram. The Catfish selling and buying follow similar trend by putting visual judgment especially in distant landing sites. The resource ownership of fish collectors was assessed and majority of them use bicycle and animal driven truck for collecting fish by using linen luggage.

Wholesalers Economic Characteristics

There are only four fish wholesalers at Bahir Dar and Gonder. The overall fish marketing activities of wholesalers in both cites depends on delivery of fish from collectors in most cases as well fishers based nearby. Wholesalers buy whole fish from collectors and fishers daily at midday add value by gutting and filleting. The overall business of fish buying and selling is done by the owners and on average creates a job opportunity of 2-3 individuals. The wholesalers directly send their fish to Addis Ababa packing with plastic bags. They do have 4-7 big refrigerators having 200-370 kilograms capacities. The wholesalers can also involve 10 to 20 thousand Ethiopian Birr transaction per day and the do have an average working capital of 400 thousand Ethiopian Birr.

Market Channel assessment

There are four major fish market outlet from Lake Tana. The first channel starts from Bata Kebele to Bahir Dar. This channel is characterized by having big catch as compared from other landing sites (more than 300 kilograms per day) and retailers directly link with local inhabitant based in Bahir Dar. The wholesalers of Bahir Dar distribute the fish to big hotels in Bahir Dar and sell in their shops. The second channel starts from Metere Abawarka landing sites particularly focused on delivery of fish to Gonder area. Due to diversified nature of fish harvested in this area, local collectors use small boats from the lake and bicycle from landing sites for collecting daily catch delivering to wholesalers. The wholesalers can deliver to hotels in Gonder area as well as they can sell to consumers directly and retailers in Gonder city.

The third channel starts from Dembia (Goregora) landing sites. From this landing site fishers directly offer their catch to local collectors based at Goregora then wholesalers of Gonder and Bahir Dar. Local inhabitant in Gonder directly buy from wholesalers. The unique opportunity fishers get from this channel is value adding facility particularly for filleting prepared by Goregora port. Hence the local collectors get processed fish, fishers have a better price as compared to other landing sites with a margin of 20 to 25 Birr per kilogram. The last channel started from Alepha (Dengel Ber) where there is relatively a least fish consumption trend in local inhabitant. Thus, fishers get the minimum landing site prices as compared to other channels. Fishers in this channel wait a half day to get buyers from Addis Ababa and in most cases they are price takers.

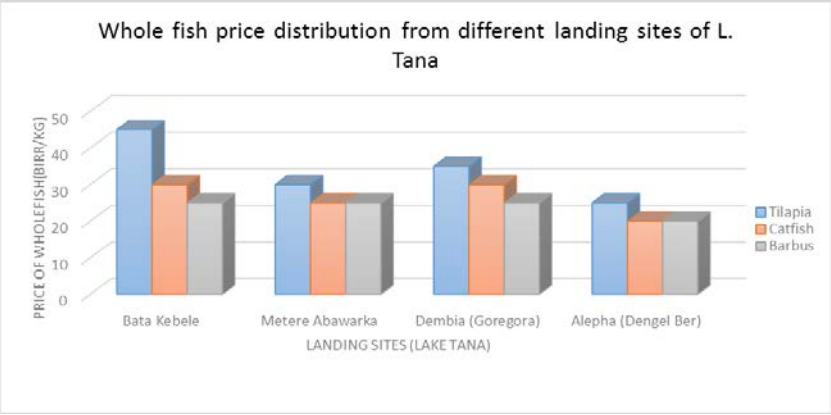


Figure . 2. Whole fish price distribution from different landing sites of L Tana.

The price distribution of whole fish as dipicted in figure 2 above among different landing sites were assesed. Accordingly, Tilapia had a leading price on four landing sites. The level of price for Catfish and Barbus on Metere Abawarka and Alepha were found in similar position. There was relatively a high dinamics in price at Bata kebele landing site among fish type than other landing sites.

The filleted prices of fish from different landing sites vary seasonally. The Pick demand of filleted fish was during main fasting period and tilapia was the dominant fish type by having a highest price as dipicted in table 3 below. The leastfileted fish price among landing sites were recorded for Barbus which had a 10 birr price margin.

Table 3. Fileted fish price distribution from different landing sites of L Tana.

No.	Landing sites	Price distribution of Fish(Birr/Kg)		
		Tilapia (fileted)	Catfish (fileted)	Barbus(fileted)
1	Bata Kebele	75.00	60.00	55.00
2	Metere Abawarka	65.00	55.00	50.00
3	Dembia (Goregora)	70.00	50.00	50.00
4	Alepha (Dengel Ber)	60.00	50.00	45.00

The daily fish purchase of traders vary from landing site to landing site (Fig. 3).The amount of tilapia purchased averagely 150 kilograms per day while the amount of catfish purchased 105 kilograms. On the other hand the amount of Barbus purchased was about 95 kilograms per day (Fig 2). The wholesalers' volume of fish purchasing trends looks stable as compared to retailers as well as local collectors.

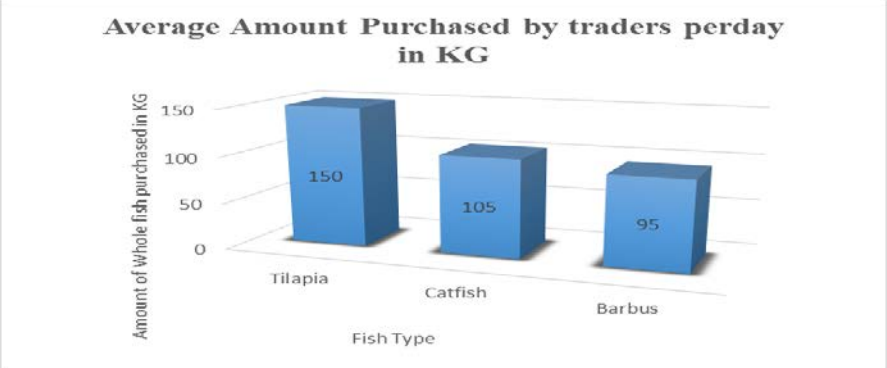


Figure 3. Distribution of fish purchased by traders per day

The selling price of different fish (Tilapia, Catfish and Barbus) in Figure 4 revealed that the highest price of filleted tilapia was 100 birr per kilogram. The second price was Catfish which was 85 birr per kilogram and the least price was having 70 birr per kilogram.

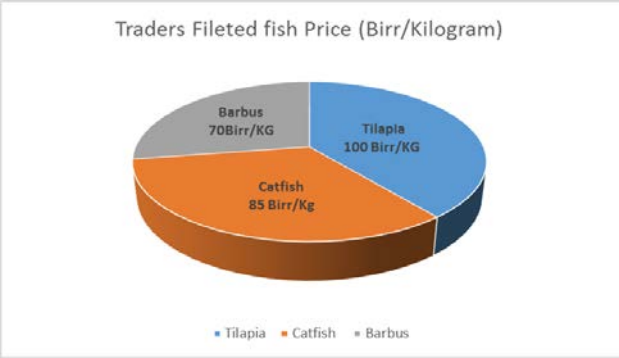


Figure 4. Price distribution of filleted fish for traders

Traaders of different cities around L.Tana were very much aware about filleted price dinamics of different fish species. Thus, it is difficult to get a stable prics of filleted fish round these areas. Accordingly, the highest price was tilapia followed by Catfish and Barbus as dipicted in figure three above. The result expressed in figure three, traders have a bigger interst to have Tilapia than other the reast species. This also have a negetaive impact on not missing genetic resources of the L.Tana by using under sized meash sized particularly monofilments.

Production Constraints

The level of production constraints were ranked from 1 to 5 where 1 for most sever and 5 for least sever. Based on the order of importance poor boat service, poor fishing net, low price of tilapia and over fishing of tilapia ranked based on the order of importnce (Table 4).

Table 4. Tilapia production constraints

No.	Measurement Variables	Mean	Std. Err	[95% conf. Interval]	
1	Poor Boat services (PBS)	1.3	.0527014	1.246948	1.456349
2	Poor fishing net (PFN)	1.4	.0521641	1.324938	1.532204
3	Low price of tilapia(LPT)	1.5	.052676	1.378866	1.58817
4	Over fishing of tilapia(OFT)	1.8	.0502513	1.658409	1.858075

The boat onership of fishers in L.Tana dominated by made of local leafy material called *Dengel*.This type of boat have got short service as well as lower carrying capicity. Thus, fishers were forced to abandon their harvest if the daily catches were beyond the carrying capacity of the boat. Moreover, this type of boat need more diving power than other boat type and fishers were unable to reach nearby landing sites as they were to be. Thus, fishers were loosing a primium prices for their daily catches. The second important production variable is fishing net. There is a strong associattion between this variable and daily harvest of fish in fish type and size. The ownership of small sized monofilament net can allow fisher to harvest small sized fish which

potentially unmarketable. Thus, fishers were discouraged on daily economic loss due to these small sized net which has a similar result obtained in Abebe *et al* 2012. The third variable that hinders daily harvest of Tilapia is the low level of price. The price of tilapia at landing sites particularly on whole fish form is very low having a highest price margin. Hence, fishers who forced to sell their catch at landing sites get a discouraging price as compared with secondery and third market places. The fourth variable is overfishing of tilapia from L.Tana which forces fishers to set their harvesting net to distant places. Thus, they are in a great problem of not to deliver their catch as early as possible to nearby market places.

Gender role in fish value adding activities

The roles of women in fishery cooperatives are very vital. Women can collect the harvested fish from boat to processing unit. They sort out the fish based on the size, fish species, physical appearance (healthy or spoil). After that they take the record of weight as well as number targeting for local inhabitants market and whole sellers. In addition to these, they actively involved in value adding activities particularly on filleting. While filleting, the time spent for a kilogram of Tilapia can took an average of 25 minutes better than male who will took 30 minutes per kilogram of similar fish type. After filleting, women actively involved in cleaning the filleted fish by taking maximum care and packed the final product with plastic bags of different weights. The men role in value adding also have a vital role particularly delivering fish early as possible to proximate market places. Moreover, men actively involved on loading and unloading processed fish from original source to different market places.

Women role in fish selling

The fish marketing activity in area around Bahir Dar open market places where dominated by women . The participant women are retailers who directly buy the fish from fishery cooperatives or whole sellers based in Bahir Dar. The market place is very poor in terms of infrastructure which is liable for spoilage. The structure of fish open market in Bahir Dar lacks facilities like unavailability of waste disposal which creates a big problem of bad smell; poor processing facility with no or low water supply in the site; in most cases, retailers sell the whole fish by measuring each unit of fish by visual judgment which forces women to loss much profit; nonexistence of tax collection site which leads the government loss much amount of money from the sector.

The sale whole fish of tilapia and other species just by visual judgment having irregular price of 45-65 birr per a pile of 4-5 fish near to a kilogram weight. Selling whole fish by visual judgment leads to

uncertainty for both the sellers and buyers. In addition to these, they are forced to sell their fish by lower price if the time goes to afternoon after (after 11:00 PM) since they didn't have cold storage facilities as well as no electrification facility in market places.

Fish export

In the past ten years(2004-2013), international trade patterns moved in favor of trade between developed and developing countries. Developed countries still trade mainly among themselves and, in 2014, in value terms, 78 percent of fishery exports from developed countries were intended for other developed countries. However, in the last three decades, the share of their exports going to developing countries has increased, also owing to their outsourcing the processing of their fisheries production. At the same time, while developed countries remain their main markets, developing countries have increased trade among themselves, and fishery trade between developing countries represented 40 percent of the value of their exports of fish and fishery products in 2014(FAO,2016).

Fishers in areas around Gonder tried to sell their catch to collectors who are collecting for export. The exported fish to Sudan mainly on value added by salting and sun dried methods. In salting, local collectors use a proportion of one kilogram salt (Sodium chloride) for 25 liter water for dressing the filleted Catfish and exposed it to sunlight for 3-6 days and get dried. Local collector packed the fish with very thin sticks for aeration. The wholesalers of dry fish buy the packed fish on kilogram base and it ranges the price from 70 to 95 Ethiopian Birr. In addition to this, wholesalers sell their product by transporting to areas nearby boarder of Ethiopia and Sudan with higher than 3 fold price margin as compared to fishers and local collectors.

Fish Trader Socioeconomic and Market characteristics

Traders around Lake Tana were assessed based on their socioeconomic characteristics (Table 5). The age category of traders range from22 to 40 years having a mean value of 31.3 years. The average family size of respondents was 3.5 members and the average education level of the respondents was 2.8 (in the category of 7-12 grades).The number of family members who are involved in the business of fish trading were 2 female and 1 male family members.

Table. 5. Traders' socioeconomic characteristics

No.	Economic Variables	Mean	Std. Err	[95% conf. Interval]	
1	Age	31.3	1.591288	27.7476	34.75242
2	Family size	3.5	.4351941	2.542144	4.457856

3	Education level	2.8	.4787136	1.696359	3.803641
4	No.of family member involved in business	1.7	.9639984	-.4550795	3.788413

The average working capital of the traders was 2145 Birr. The average capital including other value adding materials like refrigerators was 91,783 Birr. The amount of fish species appear in the market varies from one landing site to other landing site. The average amount of Tilapia, Catfish and Barbus fish species purchased per day was 54, 22 and 19 kilograms, respectively (Table 6).

Table 6. Traders market characteristics

No.	Economic Variables	Mean	Std. Err	[95% conf. Interval]	
1	The average working capital	2145.8	315.9556	1450.42	2841.247
2	Ownership of Refrigerator	91783.3	38010.89	8121.921	175444.7
3	The average amount of Tilapia	54.2	12.68549	26.24609	82.08725
4	The average amount of Catfish	22.1	5.821145	9.271079	34.89559
5	The average amount of Barbus	19.2	3.684187	11.05783	27.27551

The Econometric Results

The econometric result of liner regression model depicted in Table 7 which sort out variables that determine daily harvest of tilapia. Accordingly, four variables marital status, overfishing of tilapia, Ownership of arable land and expensiveness of fishing inputs were significant at different level of significance. The first two variables were significant at 0.05 level of significance. The marital status of fishers due have a positive impact on daily harvest of tilapia which married fishers can invest much of their time on fishing that help to get more fish for market as well as home consumption. The second variable was overfishing of tilapia from L.Tana. This variable affect the daily harvest of tilapia negatively and it has a 1 percent level of significance. Thus, fishers drive more distance per day to get enough amount of tilapia. The third variable that potentially affect the daily harvest of tilapia was the ownership of arable land. There was a 10 percent level of significance among respondents which affect the daily harvest of tilapia from L.Tana. Fishers having an arable land can participate on fishing occasionally as compared with fishers haven't land. Therefore, off fishing activity like farming potentially affects negatively daily harvest of tilapia from L. Tana. Fishing inputs price can affect the daily harvest of tilapia negatively which states that the more expensive the inputs, the less harvest of tilapia. Fishers are less motivated to harvest fish and it is significant at 0.1 level of significance.

Table 7. Econometric Model result on fish harvested by fishers.

Source	SS	df	MS	Number of obs = 91
Model	25495.9818	28	910.57078	F(20, 62) = 1.24
Residual	45711.7764	62	737.286716	Prob > F = 0.2418
Total	71207.7582	90	791.197314	R-squared = 0.3581 Adj R-squared = 0.0681 Root MSE = 27.153

Tilapia Harvested per day	Coef.	Std. Err	t	P>|t|	[95% Conf. Interval	
age	-.1247665	.5776884	-0.22	0.830	-1.279549	1.030016
Sex	-2.265478	9.200237	-0.25	0.806	-20.65649	16.12553
Education level	-2.927031	4.071503	-0.72	0.475	-11.06585	5.211788
Marital Status	17.86368	6.163252	2.90	0.005***	5.543514	30.18384
Having arable land	-16.36729	8.938512	-1.83	0.072*	-34.23513	1.500539
Over fishing of Tilapia	-17.42669	8.322767	-2.09	0.004***	-34.06366	-.7897156
Expensiveness of inputs	-16.16863	8.834421	1.83	0.072*	-1.49113	33.82838
_cons	74.5325	70.57442	1.06	0.295	-66.54376	215.6088

Key: *,*** are 10 & 1% level of significance

Conclusions

There are four major fish market outlet from L.Tana. Actors in fish value chain found in young age category which can help for adapting improved technology on the sector. Women have got a remarkable role in value adding but their share on benefit is minimal. There is a huge market margin between price of whole and processed fish at landing sites and secondary market places. In price setup of fish dominated by tilapia followed by Catfish and Barbus. Export of dried fish to Sudan play a significant role on promoting the sector to get foreign currency for the country. Four variables like marital status, overfishing of tilapia, Ownership of arable land and expensiveness of fishing inputs were significant at different level of significance.

Recommendations

- The price margin between landing sites fishers and traders should be narrowed by creating direct linkage between fishers and consumers.
- Women should encourage participating on fish value adding activities.
- Fish exporting activities to Sudan should be encouraged by modern value adding facilities
- Fishery cooperatives should strongly work on value adding activities instead of selling whole fish.
- There should be a strong work for shortening the channel in order to bring onboard fishers and consumers.

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