



## The Contribution of Fisheries to Livelihoods of Communities around Alwero Reservoir in Abobo District, Gambella, Ethiopia

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### ABSTRACT

This research was planned to study the contribution of fishing and fishery-related activities, and identify its threats. Primary data were collected from the Kano locality around the Alwero reservoir through a questionnaire survey, field observation, and Focus Group Discussions. Both purposive and simple random sampling procedures were adopted in this study. The result revealed that fisheries and fish-related activities are benefiting the society as a source of employment opportunities, income, provision of food that is rich in nutrients (protein), reliable household income (average annual household income contributed by fishing and fish-related activities being 611.8 USD and 69.3 USD, respectively). Besides, the result also indicated that fishing is being performed by less experienced people, who are using traditional fishing gear and preservation methods, and there is also a serious problem of overexploitation. The regression result indicated that fish price and preservation techniques have affected the average annual household income significantly. The study provided more information on the importance of fishing and its related activities to a household in the Kano locality at Abobo district. It identified overfishing as the major anthropogenic activity threatening the fish abundance and diversity in the reservoir.

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## Introduction

Fisheries and their related activities have great economic importance to a household and even at a country level as a source of foreign earnings and revenue. It can provide employment, livelihoods, subsistence, and income to a household (Sobo 2012). Income, defined as the output of activities that measures both cash and in-kind contributions governs the well-being of a household (Schwarze 2004). According to AIMS (2001) household income, levels, and diversification of income sources are critical determinants of household welfare. Generally, household income, rather than personal income, is the preferred measure for the analysis of people's economic well-being. This is because the major determinant of economic well-being for most people is the level of income they have and what other family members living in the same dwelling receive. Household income covers from employment (both paid and self-employment), property income, production of household services for own consumption, and current transfers received. Artisanal fishing is responsible for approximately 90% of all fishing jobs worldwide and it

provides critical income for millions of families (Batista et al., 2014). In any fishing communities, fisheries have a direct link to household incomes. This household income explains the levels of income in which at the end indicates whether a given fishing household is benefiting or not (Bilame 2012). Fisheries can provide an important contribution to household cash income. A study in Tanzania found that between 65 and 90% of fish production is sold, compared to only 15% of agricultural production in the same communities (Andersson and Ngazi 1998). This cash income gives access to other benefits such as education, health services, clothing, other foodstuffs, etc. It also allows investment in other assets or enterprises such as land, livestock, or fishing gear, which in turn can further reduce vulnerability to poverty. Concerning food security and nutrition, fishing provides a significant contribution to animal protein consumption (FAO 2008). Reservoirs are becoming important environments for subsistence fishing as a substitute for fisheries based on rivers and floodplains (Jackson and Marmulla 2001). Alwero reservoir is one of the

most productive water bodies that annually produces 394 tons of fish per year on which several fishing communities depend for their living. They do practice traditional fisheries involving fishing households using a relatively small amount of capital and energy. However, serving all these purposes, they may have a significant environmental impact that must be managed effectively to ensure sustainability. Human activities can affect the fisheries industry in so many ways. Overfishing, habitat destruction, pollution, the introduction of invasive alien plant species, eutrophication, and over-abstraction of water are the major challenges facing almost all of the water bodies in Ethiopia. This research is, therefore, planned to study the importance and contributions of fisheries and associated activities to the households' income and identify major threats to the fisheries resources of the study area.

## Materials and Methods

### Description of the Study Area

The study was conducted in the Alwero reservoir (Figure 1) in the Kano locality of Abobo district, Anuak zone, Gambella National Regional State. The reservoir was built by the then United Soviet Socialist Republic (USSR) for irrigation purposes. It is located at 7.8631°N, 34.4939°E and has a total area of 22.1km<sup>2</sup>. The reservoir has a water holding capacity of 74.6 million m<sup>3</sup> and is found at a distance of 47km south of Gambella city (Hussien et al., 2010). Abobo district has a total human population of 15,741(CSA 2007).

### Data Collection Method

Kano locality, which is geographically closer to the reservoir was systematically selected and respondents (N=48) were interviewed after they were briefly told about the objectives of the study. A semi-structured questionnaire was used to gather information on the socioeconomic status of the respondents, fisheries contribution, fish price, and challenges of fisheries activities in the area. Focus group discussion was also held with experienced fishers, head of administration, and fisheries experts of the district to generate further information on the general aspects of the fishing activities in the study area.

### Data Analysis

Descriptive statistics (mean, frequency distribution, percentages) of both quantitative and qualitative explanatory variables were calculated using SPSS version 16 (2015) software. To explore variables that affect household income, linear regression ( $Y = a + bX$ , where X is the explanatory variable, and Y is the dependent variable) analysis was carried out. Annual income contributed from fishing and fish-related activities were considered as dependent variables while those points directly or indirectly affecting income were taken as independent variables. ArcGIS (1995) was used to map the study area.

## Results

### Socioeconomic Information

This study was based on the primary data generated after interviewing 48 people living in the locality around the reservoir. The major characteristics that influenced the livelihood of society were described in Table 1.

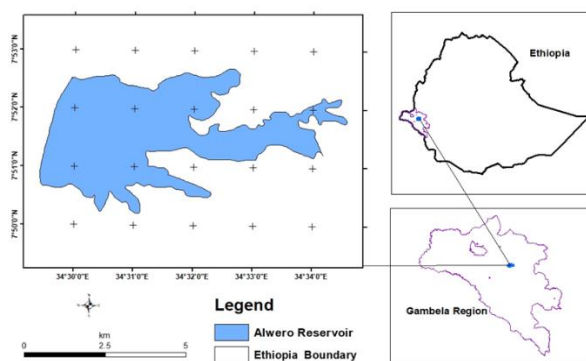


Figure 1. Map of the study area

Different economic activities can be considered as major sources of household income in a given society. In this study, the major household income was generated from the activities listed in Table 2. In the same way, the contribution of fishing and fish-related activities to the annual household income was estimated by the respondents as given in the same table.

Among the major contributions of fishing to the wellbeing of a society, economic contribution comes first. Its positive impact on the livelihood of a fishers' society depends on the amount of money it generates in the market. The three major economically important fish species and their market value were estimated by the respondents as presented in Table 3.

Fisheries contribute to the well-being of a household in so many ways. In the study area, it is also being used as a source of different means of livelihood to the society as listed below in Table 4.

There might be many different challenges and threats to a fishing society at a given water body. Alwero reservoir and the fishing society near it are also experiencing several challenges ranging from the absence of transport, cooling facilities, market etc. to a traditional preservation method being practiced in the area, which in a way affect the quality of the fish catch negatively. Table 5 summarizes the major challenges raised by the respondents.

### Factors Influencing Average Annual Income Contributed by Fishing

The result of the regression model is presented in Table 6. Among the different factors, fish preservation techniques, the price per kg of *Heterotis niloticus* (Ullawak), and distance from the reservoir in minutes significantly ( $P < 0.05$ ) affected the average annual household income contributed by fishing.

## Discussion

The result of this study revealed that the majority (79.17%) of the respondents are with a non-formal educational status that might affect the level of understanding of the society about biodiversity conservation. According to Olusumbo et al. 2018, a level of education will help fishers to adopt good handling practices to reduce fish losses indicating that the higher the educational level or well learned the fishermen are, the lesser the post-harvest losses. In the same manner, a very high rate of illiteracy (71.12% and 63.33%) in fishermen was reported elsewhere (Hossain and Pingali 1998; Shahjahan et al., 2001).

Table 1. Socioeconomic information of the respondents

Socioeconomic parameters	No	Percent (%)	Remark
Sex			
Male	33	68.75	
Female	15	31.25	
Age	Range 17 – 40		Average 22.8
Marital status			
Married	34	70.8	
Single	14	29.2	
Educational status			
No formal schooling	38	79.17	
Elementary	6	12.5	
High school	4	8.33	
A total number of the household of the respondent?	Range 1 – 10		Average 6 (SD 2.73)
Distance from Alwero reservoir in minutes?	Range 2-22		Average 6 (SD 7.15)
Land possession			
Yes	33		Average 1.58ha, (SD 1.29)
No	15		
Economic activity livelihood depends on			
Fishing	11	22.97	
Farming	10	20.81	
Trading	8	16.64	
Fishing and farming	19	39.58	
Are you involved in any fish related activity?			
Yes	47	97.9	
No	1	2.1	
Which type of fishing activities do you prefer?			
Fishing	18	38.3	
Fish trading	12	25.5	
Fishing and fish trading	13	27.7	
Vessel making, fishing, and fish trading	4	8.5	
Are you a member of a fisher’s organization/cooperative?			
Yes	45	93.8	
No	3	6.3	
How many years did you spend fishing (experience in years)?			
Less than a year	21	43.8	
2-5 years	13	27.1	
6 – 10 years	12	25	
Greater than 10 years	2	4.2	

Table 2. Employment and household income

Source of income	No	Percent (%)
What is the source of your household income?		
Full-time Fishing	14	29.2
Fish related activities	2	4.2
Farming	5	10.4
Trading	7	14.6
Livestock rearing	2	4.17
Fish related activity and farming	18	37.5
What is your average annual income in USD contributed by only fishing?	Range 53 – 1053USD	Average 611.8 USD
What is your average monthly household income in USD contributed by fishing-related activities?	Range 5.3- 184USD	Average 69.3 USD

Table 3. Price of fresh fish at Alwero reservoir

Fish price	Range	Average
What is the price of 1 kg of <i>Heterotis niloticus</i> (Ullawak) in USD?	0.26-2.6USD	1.105USD
What is the price of 1 kg of <i>Clarias</i> sp. (Agwella) in USD?	0.26 –1.31USD	0.75USD
What is the price of 1 kg of <i>Barbus docmac</i> (Udwara) in USD?	0.28 – 1.58USD	0.85USD

Table 4. Contribution of the fishery to a household

Contribution	No	Percent (%)
Do you consume the fish you catch (subsistence or local consumption)?		
Yes	48	100
No	0	0
Do you sell the fish you catch (cash income)?		
Yes	48	100
No	0	0
In what way does income from fishery contributes to your livelihood?		
Home consumption, to educate children, family health care,	48	100
How frequently do you eat fish in a week?		
One time	1	2.1
Two times	12	25
Three times	11	22.9
Four times	4	8.3
Five times	20	41.7

Table 5. Challenges related to fishing activities at Alwero reservoir

Challenges	No	Percent (%)
What kind of fishing gear are you using to catch fishes?		
Achiy	48	100
What kind of fishing boats are you using to catch fishes?		
Wooden boat	47	97.9
Motorized boat	1	2.1
Do you have access to transport and preservation facilities for the fish you catch?		
Yes	0	0
No	48	100
What techniques of preservation are you using?		
Sun-drying	35	72.92
Smoking	13	27.08
Refrigeration facilities	0	0
Are you getting any financial support or loan from the government/microfinance institutes?		
Yes	1	2.1
No	47	97.9
Do you have access to a market in your area where fish are sold?		
Yes	2	4.2
No	46	95.8
How far (km) is the nearest market to sell your fish catch?	Abobo market (6km) and the market at Gambella city (47km)	
Have you ever taken any basic pieces of training in food handling and proper hygiene during storage and transportation?		
Yes	0	0
No	48	100
On average, how much fish you catch per trip? (In Kg)	Range 3 – 70kg, Average 42.67Kg (SD 24.8)	
What are the major challenges that affect the fishing activity at the Alwero reservoir?		
Fishing gear and boat theft	20	41.66
Transport problem	25	52.08
In what form do you utilize the fish catch?		
Dried and fried	39	81.25
Dry and smoked	9	18.75
How do you transport fresh fish to the market with?		
Plastic dish	3	6.3
Hanging	7	14.6
plastic bag (polyethylene sack)	22	45.83
Hanging and plastic dish	16	33.3
What is the status of the effect of overfishing on the Alwero reservoir?		
Most serious	32	66.7
Second serious	15	31.3
Third serious	1	2.1
What is the status of the effect of an increased number of fishers?		
Most serious	35	72.9
Second serious	12	25
Third serious	1	2.1
How is the current fish production as compared to 20 years ago?		
Increased	2	4.2
Decreased	46	95.8

Table 6. The results of regression analysis (N=48)

Model	B	Std. error	Beta	t	Sig.
(Constant)	16364.463	6539.478	-0	2.502	0.017
Preservation techniques (sun drying and smoking)	-3811.041	1469.075	-0.381	-2.594	0.014*
The price of 1 kg of <i>Heterotis niloticus</i> (Ullawak)	222.137	67.191	0.406	3.306	0.002*
Fish production in Kg	-37.816	70.633	-0.059	-0.535	0.596
Distance from Alwero reservoir in minutes	-49.488	25.240	-0.220	-1.961	0.058
Market distance	-9.061	61.382	-0.018	-0.148	0.883
The price of 1 kg of <i>Clarias</i> sp. (Agwella)?	215.479	129.232	0.195	1.667	0.104
Land possession?	-845.640	763.890	-0.120	-1.107	0.276

\* = Significant at P = 0.05.

The respondents are dominated by an average age group of just 23 years old, which vividly shows how energy-demanding fishing and related activities are, hence a high number of youngsters. The same result was reported before whereby fishing is indicated to be physical and demands energetic people (Akufuna et al., 2015, Olusumbo et al., 2018). The majority of the respondents are married perhaps people may have more pressing demands and problems to solve than singles or divorcees (Kwen et al., 2013).

Accordingly, the number of household members of the respondents is 6, which is higher than what is reported for the district (4.1) by CSA (2007). This high number of people living at a distance that takes an average of 6 minutes also indirectly indicates the human pressure that is being exerted on the reservoir. The lower the distance between the fisher's house and a water body, the higher will be the rate of exploitation of the fish resource. These high household members of the respondents are not benefiting from the existing weak fishers' society.

According to the respondents, they prefer to do the fishing and fish trading activities together to avoid the involvement of middlemen who, most of the time, play a major role in devaluing the product along the value chain. In doing so, respondents in the study area are using fishing and fish-related activities as employment opportunities, in the same way as reported elsewhere (Neiland et al., 2000, Welcomme et al., 2010). In Ethiopia, contributions of another reservoir (Tendaho) in the same manner as the result of this study, has been indicated to be a good source of employment for youth, livelihood income for the pastoralists-fishermen of the Afar people, improved nutrition, and food security (Mesay et al., 2019).

Fisheries contribute a lot to the well-being of a household in every fishing society. It plays a great role in the enhancement of livelihood by becoming a source of income and assets, creating job opportunities, and providing food that is rich in nutrients for the health of family members (Dayanandan 2019). In the current study, fishing and fish-related activities are found to be the first and second most reliable sources of household income. According to the respondents, the contribution of fishing and fish-related activities to the average annual income of a household is 611.8 USD and 69.3 USD, respectively. They are getting on average a fish yield of 42.6kg per trip. The result of this study is in line with the findings of (Ayalew et al., 2018), whereby the average annual household income from fisheries at Tekeze man-made reservoir and Lake Hayq (Ethiopia) was estimated to be 586USD.

Besides, it can also generate income which serves as a source of livelihood for millions of people (Nowsad 2010). Fisheries-related activities have also contributed to the household income of the fisher society in the study area in the same way as (Bene 2006) reported where millions of people from rural areas are seasonally or occasionally dependent on fisheries-related activities. This study also revealed that fishing contributes a lot to the food security of a household as being a good source of protein (subsistence or local consumption) and cash income for a family to be used to cover children's education and health cost. Fisheries provide a food and protein source to fishers' households and the wider population. Fish provide the main source of animal protein to about one billion people globally and in coastal areas, the dependence on fish is usually much higher (FAO 2003). Fisheries contribute a lot to the animal protein requirements of many communities in both the industrialized and developing worlds (Adewolu and Adeoti 2010). In the current study, respondents pointed out that fish is being consumed five times a week in a household ensuring the food security of the household. In the same manner, Bene et al (2009) also indicated that poor households are highly dependent on fisheries as a protein source for family consumption and as a source of cash income. Fishery products often supplement family incomes of low-income human communities living near reservoirs and, in many cases, provide the only source of animal protein (Beard et al., 2011).

This study has also indicated that 70% of the respondents have less than five years of experience in fishing and fish-related activities, in a way indicating that the job is being performed by individuals who perhaps do not know how much fish they need to harvest concerning the expected post-harvest loss before market. The negative balance of production and post-harvest loss affects the abundance and diversity of fish in the reservoir. Similarly, fishing experience is statistically significant to post-harvest fish losses, indicating that level of experience will help the fishermen to handle properly their fishing business (Olusumbo et al., 2018).

At Alwero reservoir, a traditional fishing gear called *Achiy* is being used at a full scale. The use of this traditional fishing gear can cause fish quality loss. This result is in line with a work reported by (Olusumbo et al., 2018), in which traditional fishing gear used by the fishermen was considered as one of the main causes of quality loss. It is also a wooden boat that fishers are using which may affect their efficiency. The profitability of fishing is directly related to available capital invested in fishing equipment and fishing method (Abiodun and Ayanda 2008). The income of fishers to a great extent determines their ability

to purchase improved fishing gear, improved fish processing equipment, etc. (Agbontale 2009).

The preservation methods (sun drying and smoking) used, absence of refrigeration facilities, and unhygienic way of fish product transportation (with plastic bag i.e., polyethylene sack, hanging and plastic dish) to the nearest markets at Abobo town (6km) and Gambella city (47km) with polyethylene sack on motorbikes affect the quality of the fish product, hence decreased market value. The unhygienic way of fish transportation and consumption of low-quality fish has a dangerous effect on human health (Kumolu-Johnson and Ndimele 2011). According to Jephchirchir and Zacharia Shitote (2019), the traditional post-harvest technologies for fish preservation can no longer handle large volumes of fish, hence fishers are at great risk of losing significant amounts of their fish harvest and consequently their income, due to their inability to properly store their harvested fish. Traditional practices such as exposing fish for long periods to weather elements coupled with traditional methods of preservation (hot smoking, sun-drying, and deep-frying) and poor storage are subjecting fish to different kinds of degradation (Michael 1988). According to Rahman 2013, very high levels of post-harvest loss occur during pre-processing, processing, storage, and transportation of fishery products. The result of this study, in general, is in line with the findings of Ward and Jeffries (2000), who reported that fish post-harvest losses can be exacerbated by unreliable transportation, inadequate preservation techniques, adverse weather conditions, species of fish, type of processing methods, fish supply greater than demand, and a fish market not developed.

According to the respondents, no basic training in food handling and proper hygiene during storage and transportation has been given to them. Besides, respondents indicated that they are not getting any financial support or loan from the government/microfinance institutes and have no access to credit facilities. This limits their ambition in becoming profitable in the fishery sector. In addition to these, they are facing problems related to fishing gear and boat theft, overfishing, and an ever-increasing number of fishers, which they used to justify the current decreased fish production as compared to 20 years ago. Overexploitation is one of the reasons that made inland fisheries the most endangered groups of species in the world (Dudgeon et al., 2006). The cumulative effect of all these factors exacerbates the post-harvest loss, increasing the negative balance between fish yield and loss. In severe cases, a direct loss of exploited species and the associated biodiversity is imminent. Artisanal fishers are, in general, low-income earners, and their insufficient investment capital, in turn, affects their net profit (Abiodun and Ayanda 2008).

The result of the linear regression model indicated that preservation techniques fishers are using (sun drying and smoking), the price of 1 kg of the fish, *Heterotis niloticus* (local name Ullawak) and the distance from Alwero reservoir in minutes significantly ( $P < 0.05$ ) affected the average annual household income contributed by fishing. The higher the frequency of the use of those traditional fish preservation techniques (sun drying and smoking), the lower will be the average annual household income contributed by fishing. This is in line with the findings of

Jephchirchir and Zacharia Shitote (2019) which indicated that the traditional preservation methods can no longer handle large volumes of fish, therefore there is a huge risk of losing the fish products and expected price of it. However, as the price of 1 kg of the commercial fish species in the area (*Heterotis niloticus*) increases, the average annual household income also increases. As the distance between fishers' houses and the reservoir increases, their average annual household income decreases because they need to travel some distance which, in addition to the high ambient temperature, fastens the deterioration of fresh fish quality negatively affecting the price in the market.

## Conclusion

The study provided more information on the importance of fishing and its related activities to a household in kano locality at the Abobo district. The society is being benefited from fishery and its related activities in the study area because it is serving as a source of employment opportunities, income, provision of food that is rich in nutrients (protein), reliable household income (average annual household income contributed by fishing and fish-related activities being 611.8 USD and 69.3 USD, respectively). Overfishing was the major anthropogenic activity threatening the fish abundance and diversity in the reservoir. Traditional fishing gear and preservation methods used are other challenges identified by the respondents. The fish price and preservation techniques also affected the average annual household income significantly ( $P < 0.05$ ). This research considered a relatively small sample size, which can be considered as a limitation.

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