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Research Article

Determinant of Households Participation on Wetland Utilization in the Case of Tinshu Abaya Lake in Silte Zone, Central Ethiopia

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Abstract

Wetlands provide several significant benefits not only to the local community but also to those who reside far away. They are recognized across the world for their crucial role in supporting a diverse range of biodiversity and supplying products and services, as well as key natural resource sources on which rural economies rely. This study was conducted in Silte zone; to identify the determinant of household's participation in wetland utilization and extent of utilization in the case Lake Tinshu Abaya wetland ecosystem service. A total of 178 sample households were selected from four Kebles adjacent to Lake Tinshu Abaya using a simple random proportional sampling technique. In this study, a cross-sectional research approach was used. Both primary and secondary data were used in this study. Primary data (qualitative and quantitative) was collected using field observations, Focus Group Discussions, questionnaires, and key informant interviews. Descriptive statistical analysis techniques including mean, frequency, and percentages were used to analyze the socio-economic, institution factor, and demographic variables. Econometrics models such as Heckman's two-step sample selection model were used to determine the factors that influence participation in wetland utilization and the extent of wetland utilization. The study result shows that the decision to participate in wetland utilization is significantly influenced by age, family size, education, marital status, annual income, land size, off-farm activity, distance, and livestock number. And the age, family size, education, annual income, land size, off-farm activity, distance, and livestock number significantly determined the extent of wetland utilization. Lake Tnishu Abaya wetland ecosystem provides services like provisioning services, regulating services, supporting services, and cultural services. Wetland-friendly socioeconomic activity operations should designed to safeguard the long-term survival of Lake Tinshu Abaya wetland. The concerned government body should participate in conserving to preserve the sustainability of the wetland ecosystem.

Keywords

Heckman Two-step Selection Model, Wetland Utilization, Utilization Extent

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1. Introduction

1.1. Background the Study

Wetlands are defined as: “areas of marsh fen, peat land or water whether natural or artificial permanent or temporary with water that is static or flowing fresh brackish or salt including areas of marine water the depth of which at low tide does not exceed six meters [1].

Wetlands cover at least 6% of the Earth’s surface and the area is estimated to be 7 to 9 million km^2 [2]. Global wetlands are categorized into Coastal wetlands, Inland wetlands, and Human-made wetlands [3]. Africa's wetlands, which are thought to include 131 million hectares, are a vital supply of water and nutrients that are necessary for both human survival and biological productivity. Despite their significance, wetlands in Africa are being altered or reclaimed; these actions are frequently motivated by financial and commercial factors [4].

Wetlands are among the world’s ecosystems that provide socio-economic and ecological benefits to people worldwide in different ways [5]. For the underprivileged segments of the community, wetlands are essential to their way of life [6]. wetland delivers wide collections of goods and services to the local communities and also the people living outside the margin [7]. The wetlands’ ecosystems provide a wide range of benefits known as ecosystem goods and services. These goods produced by wetland ecosystems include food (meat, fish, vegetables, etc.), water, fuels, and timber, while services include water supply and air purification, natural recycling of waste, soil formation, pollination, and the regulatory mechanisms that nature, left to itself, use to control climatic conditions and populations of animals, insects and other organisms [8].

Ethiopia is home to a variety of wetlands of environmental and socioeconomic value on a national, regional, and international scale [9]. According to numerous academics' statistics, marsh areas make up around 2% of Ethiopia's total land area [10]. Wetland resources offer several social, economic, and ecological advantages and are regarded as an essential part of Ethiopia's ecology [11]. But wetlands are among the most endangered ecosystems in Ethiopia, and sadly, wetland loss and degradation are still occurring [9]. The value of wetlands is frequently misunderstood by planners and decision-makers because of the absence of market value or zero market prices for many goods and services of wetlands. Such a lack of understanding of the value of wetlands has led to their omissions or lower priorities in public decisions and policy initiatives on the protection and management of wetlands that contribute to the deterioration and loss of wetlands [12].

The Central Rift Valley (CRV) lakes area is one of the environmentally very sensitive and susceptible areas of Ethiopia. The overall resilience and sustainability of wetland resources in the area have been threatened to owe to overgrazing, conversion, water extraction, waste disposal, and deforestation. The threats to the lake have continued to worsen and cause problems such as falling lake levels, worsening water quality, and a decline in biodiversity [13].

1.2. Statement of the Problem

Ethiopia is highly gifted with different types of wetlands, which have several ecosystem services. However, due to a variety of anthropogenic and natural causes, wetlands are being degraded and lost [14]. Lake Tinishu Abaya wetland is one of the wetlands where the local community has been using the Lake for different purposes for a long period. It is a source of livelihood and supports many socioeconomic activities [15]. Some studies were conducted in the study area regarding ecological productivity and water quality and productivity assessment are conducted by [16], and the role of social capital in natural resource conservation conducted by [15] . To the best of the researcher knowledge any study has not been conducted in the area on the determinants of household’s participation on wetland utilization participation and the extent utilization in case of Lake Tinshu Abaya wetland; thus, this study focuses on determinant of household’s participation on wetland utilization and the extent of utilization on Lake Tinshu Abaya wetland.

1.3. Objectives of the Study

1. To estimate the determinants of the probability of participation in wetland utilization and participation level in the Lake Tinshu Abaya wetland ecosystem.
2. To determine factors those affect the extent of wetland utilization.
3. To assess the ecosystem goods and services provided by Lake Tinshu Abaya.

2. Literature Review

2.1. Wetland Ecosystem Condition

Due to a lack of comprehensive surveys and a lack of consensus over the definition of wetlands, the amount of wetlands in numerous large regions, such as South America, Africa, and Russia, remains unknown. Minor depressions, ephemeral wetlands, and minor riparian wetlands along low-order streams are sometimes overlooked, although they can add up to substantial expanses [17]. Areas with intensive agriculture around the world have often been created in river catchments by draining large wetland complexes and converting them to agricultural production [18]. The quantity and quality of wetlands are continuing to decrease on a global scale. The environmental services that wetlands offer to society are thereby reduced [19]. More than 58 wetlands in

Ethiopia provide environmental and socioeconomic benefits [9]. The central highlands, rift valley regions, and mostly the southwest boundaries of Ethiopia are home to the country's wetland resources. They provide several benefits to local societies. These include food crops by drainage and recession farming, important sites for dry season grazing, resource extraction, raw materials, papyrus supply, fish harvest, source of medicinal plants, and sites for a tourist attraction [20]. Like other developing countries, most of Ethiopia's wetlands are threatened with degradation and loss due to population growth, policy-related issues, on-site and off-site management problems, cultivation of wetland due to fall of upland production, draining, farmer's need to meet their household food requirements and occurrence of drought [10]. Wetland assets in Ethiopia are not fully documented. They are currently endangered all over Ethiopia [21]. However, the statistics of many researchers indicate that about 2% of the total land covered in Ethiopia is wetland [10].

2.2. Significance of Wetlands Ecosystems

Wetlands provide a variety of ecological, social, cultural, and economic purposes that are essential to local, national, and international society. Demand and supply in the market may dictate the worth of some of these services and functions [20]. Wetland provides building materials, energy resources such as peat and plant material, transportation services, medicinal plants, and renewable fresh water for human use [22]. In addition to these, they are commonly used as areas of agricultural and grazing lands [23].

Ethiopia's wetland resources offer several social, economic, and ecological advantages and are considered an essential component of the nation's ecology [24]. Due to their abundance of biodiversity, particularly rare, endangered, and vulnerable bird species, Ethiopia's wetlands are also extremely important biologically, for example, the Geferesa reservoir, wetlands of the Awi region, the marshes of Lake Tana, Fincha, and Chomen, the plains of Sululta and Guassa (Menz) are important areas for birds endemic to Ethiopia because these wetlands are where rich in biodiversity resources, large numbers of societies depend on these wetlands for their livelihoods [17]. These wetlands also serve as flood and erosion control and water purification, are part of the ecological values of the wetlands, and are affected when wetlands are used unsustainably [16]. In Ethiopia, wetland resource ecotourism opportunities are spread across the country. Significant places with ecotourism potential include the resort-style Rift Valley Lake, aquatic ecotourism activities and bird watching, Gambella Wetland National Park, and the floodplain, waterfall, stream, and hot springs in Sheko district and dam and gorges of the Awash River with spectacular waterfalls in Awash National Park among others [25].

2.3. Conceptual Framework

The framework also shows factors that determine wetland utilization participation are grouped into four categories such as 1) the demographic factors include, age of the household, education of the household head, sex of the household head, marital status of household head, number of families, and, 2) Socioeconomic factors such as net annual income, off-farm activities, livestock number; 3) institutional factors includes extension service, credit usage, 4) the physical factors such as distance and land size.

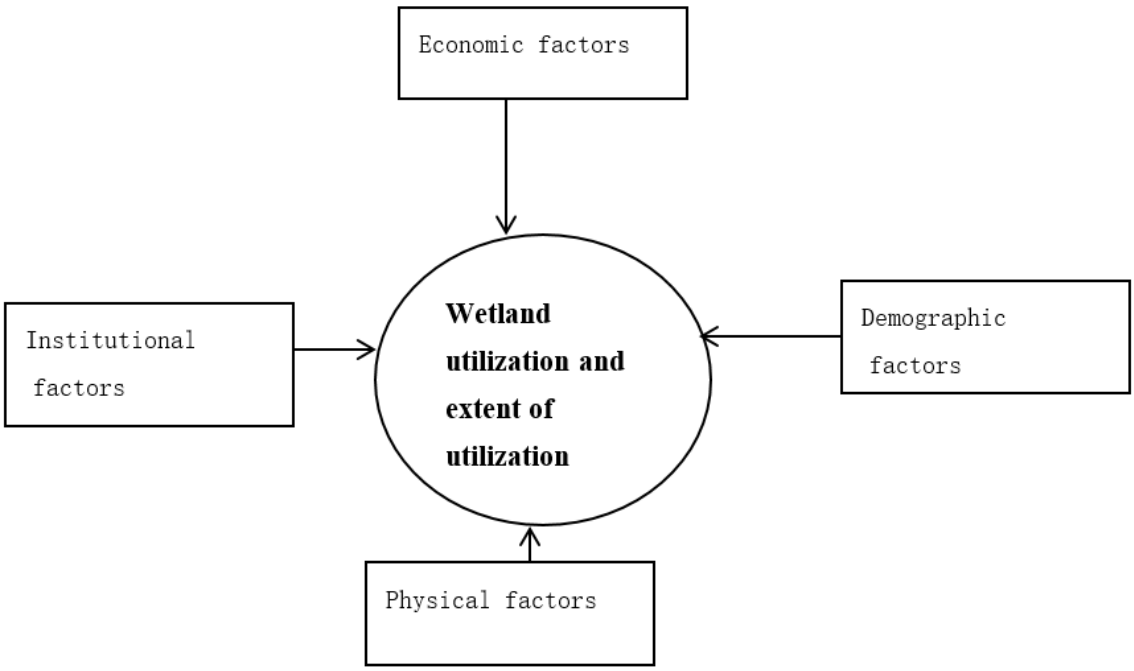

Figure 1. *Conceptual frame work.*

2.4. Empirical Literature

The study [6] conducted a study on determinants of household use of wetland resources in West Bengal, India. In this study both Logit and Tobit mode were employed. In this study sex of the household head, years of education of the head, land holding size, distance to wetland, family size significantly influenced wetlands use. [26] conducted a study on social factors affecting wetlands utilization for agriculture in Nigeria. For this study 200 farmers who cultivate wetlands were selected using a simple random sampling technique, and a structured questionnaire was used to gather data on the socioeconomic determinants influencing the status of wetlands utilization for agriculture. In order to find relevant variables that are predictors of wetland utilization, a multiple regression analysis was performed after the obtained data were presented using frequency and percentage. The finding of the study revealed that variables like crop preferences, farming system, culture, taste, land tenure, knowledge of wetland cultivation, perceived suitability, farmers' tribe, location of wetland, and farmers' age were significantly affect status of wetland utilization. [27] conducted a study on socio economic impact of wetland cultivation in South –Bench, South west Ethiopia. The aim of the study was to identify the socio-economic impacts of wetland cultivation. Focus groups and a semi-structured survey of 252 households were used to evaluate the effects. The study not employed econometrics model only descriptive statistics was employed to analysis the data. The study's findings indicate that most households (65.48%) profited from wetland agriculture by cultivating a variety of crops. However, the socioeconomically significant biological elements deteriorated as a result of wetland cultivation.[28] conducted a study on factors driving utilization patterns of marshlands in the vicinity of south-kivu urban agglomerations based on rapid assessment of wetland ecosystem services. This study used methodology combined both analyses of satellite images and household surveys. The study employed econometrics model and descriptive statistics to analysis the data. According to the finding factors driving utilization patterns are combined both bio-physical and household socioeconomic characteristics. These include mainly reinforcement of restrictions for wetland use, the household head's age, income, and household size. [29] conducted study on the determinants of access patterns to goods and services from wetlands in Tanzania and the impact on sustainable wetland management. The study used choice modeling to identify the determinants of the access patterns and their impacts on wetland sustainable management. The results indicated that variables such as location, income and education significantly determine what type of access one chooses to accrue products and services from the wetlands. [30] conducted a study on level hoods and economic benefits of wetland utilization in Tanzania in this study gross margin analysis was used to estimate the total economic benefits of wetlands utilization, and the contingent valuation method was used to measure the contribution of wetlands services to household welfare and multiple linear regression model was used to determine the factors influencing utilization of wetlands resources. In this study age, farming experience, access to markets, number of dependents, and household size significantly influenced wetlands utilization.

3. Materials and Methods

3.1. Description of the Study Area

3.1.1. Geographical Location

Lake Tinshu Abaya is a small freshwater lake located in the Rift Valley, nearly 160 km southwest of Addis Ababa (the capital city of Ethiopia). Geographically, It is located at 7° 29′03.65′′N, 38°03`17.79′′E and its altitude ranges from 1870- 2000 m a.s.l. It is located within Lanfuro, Misraqsiliti, and Siliti districts. It is a shallow lake with a maximum and a mean depth of 3.7 m and 2.9 m, respectively, having a surface area of 1253 ha. Dacha and Bobodo rivers are the two main feeder rivers for lake Tinishu Abaya.

3.1.2. Climate of the Study Area

Dry weyna dega is the prevailing agro-climate in the district. It is characterized by frequent droughts, and hence moisture stress is a central problem in agricultural production. It has a bimodal distribution of rainfall in summer and autumn, with a maximum mean annual rainfall estimated to be less than 900 mm. The maximum annual temperature range, recorded in winter, is 30°C while the minimum annual temperature recorded in summer is which is 18°C [15].

3.2. Method of Data Collection and Analysis

3.2.1. Sampling Techniques

Tinshu Abaya lake wetland is found in Silte zone of the Central Ethiopia region. From Silte zone Silti, Misraqe silti, and Lanfuro Woreda were chosen for this study because Lake Tinshu abaya wetland is bordered by these three districts. A preliminary survey, discussions with various focal persons as well as other concerned district officials, and a literature review helped the author in identifying the sample Kebeles. A multistage sampling procedure was applied. Firstly, the three districts were selected purposively because they are bordering Lake Tinshu Abaya wetland of Silte zone. Secondly, by using the purposive sample method four Kebeles were selected from the three districts because of more adjacent to the wetland area. In the third stage, sample households were selected for a detailed household survey by using a simple random sampling method. To facilitate this final stage, lists of household names were obtained from the three districts' finance and economic development offices.

3.2.2. Sample Size Determination

The sample size for the study was identified by using the

rule of thumb. Several rules-of-thumb have been suggested for determining the minimum number of sample households required to conduct multiple regression analysis. The study used a method developed by Green to select the total sample size from the total households. He suggested a rule-of-thumb that $n \geq 50 + 8m$, (where n is the minimum number of sample households required for regression analysis and m is the number of explanatory variables used in the regression analysis) [31]. The explanatory variables used in this study were thirteen. So that the minimum sample size is $n \geq 50 + 8 \times 13 = 154$. However, considering the benefits of a large sample size to increase the quality of the study by adding additional samples, a total of 178 sample households were surveyed for the study.

Table 1. *Sampling Technique and Sampling Determination.*

Name of district	Sampled Keble	Total household	How to compute (proportionally)	Total sample
Misraqe Silti	Mirabe yeqoche	1000	$\frac{1000*178}{3382}$	53
	Sedagora	887	$\frac{887*178}{3382}$	47
Silti	Seda berango	745	$\frac{745*178}{3382}$	39
Lanfur	Gebaba	750	$\frac{750*178}{3382}$	39

3.3. Research Design and Data Sources

3.3.1. Research Design

A cross-sectional research design was employed in this study. According to [32], it allows the process of collecting data at a single point in time without repetition from the target population for the determination of relationships of variables. The design was preferred also because of time limitations for data collection.

3.3.2. Sources of Data and Collection Techniques

Both primary and secondary data were used in this study. Primary data (qualitative and quantitative) was collected through field observations, focus group discussion, key informant interview and questionnaires, Indeed to enrich the primary data the secondary source also was collected from the published and unpublished documents of the districts as administration offices and agricultural offices.

3.4. Methods of Data Analysis

The raw data were analyzed using the Statistical STATA software version 15 and Excel for windows software. Data were analyzed using both qualitative and quantitative techniques. The techniques were intended to avail information on the socio-economic characteristics of the respondents, agricultural utilization of the wetland Lake Tinishu Abaya (socio-economic activities and crops grown in the dry and wet seasons), as well as the economic importance of wetlands to households, and the factors that influence utilization of wetlands resources. The data was collected through different instruments (non-quantifiable information from open and close-ended questions, key informant interviews, observation and focus group discussions) tallied, and tabulated, the analysis and interpretation were conducted by qualitative descriptions using STATA software version 15. Descriptive statistical analysis techniques including mean, frequency, and percentages were used to analyze the socio-economic, institution factor, and demographic variables. Heckman's two-step sample selection model was used to determine the factors that influence participation in wetland utilization and participation level.

3.5. Econometrics Model Specification

3.5.1. Heckman Model

Regression models which evoke a yes or no or present or absent response are known as dichotomous or dummy dependent variable regression models. They are appropriate in a wide variety of fields and are used extensively in surveys or census-type data. And, regression model in which the variation in the dependent variable (Yi) is explained by an independent variable (xi) continuously is known as the classical linear regression model [33].

The third objective of this study was targeted to determine the factors that affect participation in wetland utilization and extent of wetland utilization which is measured in birr. Thus the independent variables are of both types in that they are categorical and continuous. Wetland utilization participation is a dependent variable, which is dichotomous taking on two values, one (1) if the household participates in wetland utilization and zero (0) otherwise. Estimation of this type of relationship requires the use of qualitative response models. In this regard, the non-linear probability models, logit, and pro-

bit models are the possible alternatives.

The ordinary least squares (OLS) regression and linear probability models lead to biased estimates because one of the dependent variables in this study is a dummy variable which takes a value of zero or one depending on whether or not the households participate in wetland utilization. The other reason for the appropriateness of linear regression analysis is that the effect of wetland utilization may be over or underestimated if the participants are more or less able (due to certain unobservable characteristics) to derive benefits compared to eligible non-participants.

To correct for the unobservable sample bias problem in the regression, Heckman's two-step estimation (Heck it) procedure can be applied, as suggested by [34]. Heckman's two stages rely on the assumption that specific distributions of the unobservable characteristics jointly influence participation and outcome. In the first stage, a probit regression is computed to estimate the probability that a given household being wetland utilizer or not. In this stage, the household's decision is modeled as a dichotomous choice problem of nonparticipant and participant households on wetland utilization. Then, the inverse Mills ratio for every household is estimated by the dichotomous-choice probit model describing the ratio of probability density function to cumulative normal distribution function. The model can thus be estimated as follows; in the first step of deciding whether to participate in wetland utilization or not. This can be specified as:

$$\mathrm{P}i(0,1) = \beta 0Xo + \beta 1X1 + \beta 2X2 + \cdots + \beta nXn + e$$

Where participation is denoted by 1 and non-participation is denoted by 0, β0 is a constant, β1….. n are parameters to be estimated are a vector of explanatory variables.

The Second step which involves the income proportion of participants in wetland utilization is estimated by use of an OLS as follows;

$$\mathrm{Y}= \beta 0Xo + \beta 1X1 + \beta 2X2 + \cdots + \beta nXn + e$$

Where Y denotes the proportion of household wetland income, β0 is a constant, β1….. n are parameters to be estimated Xs are a vector of explanatory variables.

3.5.2. Model Specification

I). Heckman Two-step Procedure

Step 1: (Selection equation):

$$Pi(0,1) = \beta 0Xo + \beta 1X1 + \beta 2X2 + \cdots + \beta nXn + \varepsilon$$

$$Pi(0,1) = \beta o + \beta 1Age + \beta 2Gend + \beta 3Family\ \ size + \beta 4Edu + \beta 5Maritalstuas + \beta 6Farming\ \ exp + \beta 7Landsize + \beta 8creditusage + \beta 9Extensiontraining + \beta 10\ \ OffFarming + \beta 11Distance + \beta 12NumberLivestok + \beta 13HHincome + \varepsilon i$$

Step 2. (Outcome equation)

$$Yi = \beta 0Xo + \beta 1X1 + \beta 2X2 + \cdots + \beta nXn + \varepsilon$$

$$\mathrm{Yi} = \beta \mathrm{o} + \beta 1\mathrm{Age} + \beta 2\mathrm{Gend} + \beta 3\mathrm{Family}\ \ \mathrm{size} + \beta 4\mathrm{Edu} + \beta 5\mathrm{Maritalstuas} + \beta 6\mathrm{Farming}\ \ \mathrm{exp} + \beta 7\mathrm{Landsize} + \beta 8\mathrm{Creditusage} + \beta 9\mathrm{Extensiontraainig} + \beta 10\ \ \mathrm{OffFarming} + \beta 11\mathrm{Distance} + \beta 12\mathrm{HHincome} + \varepsilon \mathrm{i}$$

3.6. Variable Description & Hypothesis

Table 2. Definition and Notation of Study Variables.

No.	Variables	Category	Measurement	Expected sin
	Dependent Variables			
1	Participation in wetland utilization	Dummy	Yes or No	
2	Participation level	Continuous	ETB	
	Independent Variables			
1	Household head age	Continuous	Number of year	+/-
2	Gender	Dummy	1 for male, 0 for female	+/-
3	Family size	Discrete	Number	+
4	Education level	Discrete	Year of school	-

No.	Variables	Category	Measurement	Expected sin
5	Marital status	Categorical	1, if married, and 0, if single	+/-
6	Land size	Continuous	Number of hectors	+
7	Credit usage	Dummy	1 for yes, 0 for no	+
8	Extension training	Discrete	1 for yes, 0 for no	+
9	Off-farm activity	Dummy	1 for yes, 0 for no	-
10	Distance from the lake	Continuous	Kilo meters	-
11	Tropical livestock unit (TLU)	Continuous	Number	+
12	Farming experience	Discrete	Year	+
13	Net annual income	Continuous	ETB	+

Source referring to different literature

4. Results and Discussion

This section presents and discusses the results in three successive sections. The first section deals with assessing the ecosystem goods and services provided by the Lake Tinshu Abaya wetland. The second section estimates the economic value of the major ecosystem goods and services provided by Lake Tinishu Abaya wetland. Finally, the third section discusses estimating the determinants of participation in wetland utilization and participation level.

4.1. Determinants of the Probability of Participation in Wetland Utilization

Table 3. Marginal effect output of probit model.

Variable	dy/dx	Std. Err.	P-value
Age	.0711104**	.00436	0.013
Gender	.1301457	.08611	0.131
Family size	.100873 **	.04174	0.016
Education	-.0463871***	.01612	0.004
Marital status	.1715309 ***	.04387	0.000
Farming experience	.0023082	.0065	0.723
Annual income	.0401265***	.00001	0.000
Land size	-.0705802*	.03725	0.058
Credit usage	.0664416	.07008	0.343
Extension training	.1206768	.07784	0.121
Off farm activity	-.2822416***	.08752	0.001
Distance	-.0159567**	.03502	0.049
Tropical livestock unit	.0190846 **	.01412	0.020

***- **-* indicates significant at 1%, 5% and 10% level of significance respectively
(*) dy/dx is for discrete change of dummy variable from 0 to 1
Source: computed from own survey, (2025).

Age: - As shown in Table 3, age positively and significantly influenced wetland utilization participation of the households at a 5% significance level. This result indicated that an increase in the age of the respondents by one year would increase the probability of participation in wetlands utilization resources by 7% holding all other independent variables constant. This is due to as the age of household increase they would become more experienced in wetland utilization practices. This result is confirmed by the finding of [35] who reported that there was a significant positive relationship between the age of the household and the probability of adoption of fish farming in wetlands. This result is also fitted with the of [36] who reported that Wetland utilization for food security is higher among households with older heads possibly because they have improved access to social networks through which to access common pool resources including wetlands. But the study result is inconsistent with the finding of [37] who reported that age negatively affected forest dependably of the household.

Family size: - As shown in Table 3, the family was positively and significantly related at a 5% significant level with wetland utilization participation. The result indicates that the family size in the household increased by one the probability of the household's participation in wetland utilization increased by 10%. The positive and significant correlation between family size and wetland utilization practice might be due to the relation between larger family size and the corresponding higher labor availability that investment to collect goods and services of the wetland. This result is in line with the finding of [38] who reported that the number of the labor force in the household was found to influence households' decision to participate in small-scale irrigation positively and significantly. And also the result is in line with the finding of [39].

Education level of household head: As shown in Table 3, the education level of household head was negatively and statistically significant at a 1% level. Year of schooling increased by one year the probability of house participation in wetland utilization decreased by 4.6%. This is as the year of schooling of the household head increase they become more aware of conserving wetland and are did not more participate in wetland utilization practice. This result is in line with the finding of [37]. But this result is inconsistent with the finding of [40, 41] who report that education level had a positive relationship and promote wetland resource utilization.

Marital status of the household head: As shown in Table 3, the marital status of the household head was positively related to wetland utilization participation and statistically significant at a 1% level. By taking married household heads as a reference group, the marginal effect indicated a unit increase in the married headed would increase the wetland utilization participation by 17% percent to single-headed households. The reason is married households are more participate in collecting goods and services in the wetland area to full the demand of their family. This result is in line with the finding of [41, 8, 42] who reported that marital status was found to have a positive effect on wetland utilization practice.

The annual income of household: As shown in Table 3, had a positive correlation with wetland utilization and a statistically significant 1% level. As the marginal effect indicated the annual income of the household increased by one unit the probability of participation in wetland utilization would increase by 4%. The reason is if the household incomes increase they would become more participated in collecting goods and services from the wetland. These results are in line with the finding of [40] who report that income was significant at a 1% significance level and positively related to household participation decisions on small-scale irrigation. And the result is in line with the finding of [39, 44] who found that income has a significant and positive impact on the level of participation in wetland resource use and management and use.

Land hold size: As shown in Table 3, land size had negatively affected wetland utilization and was statistically significant at a 10% level. As indicated in the marginal effect the land size of the household increased by one unit the probability of the household's participation in wetland utilization would decrease by 7%. The reason is large land size holder households are more practice economic activities in cultivating their land rather than participating in collecting goods and services in the wetland area. These results are in line with the finding of [6] who reported that land size is negatively related to the imputed value of wetland products. The findings of [43, 44] conform to the present study finding while [45] found a significant negative effect of an increase in farmland size with the participation in resource management and use

Off-farm activity: As shown in Table 3, off-farm activity had a negative correlation with wetland utilization and was statistically significant at a 1% level. The marginal effect was indicated by taking participants in off-farm household heads as a reference group; the marginal effect indicated a unit increase in the participator in off-farm activities would decrease the probability of wetland utilization participation by 28% percent than the non-participate household heads. This implies that households who engage in other economic activities are less likely to wetland utilization compared to those who did not engage in the off-farm practice. The negative influence could be because off-farm jobs/activities/ usually demand people to move out from the village, and so households who are involved in off-farm jobs may encounter time and labor constraints to participate in utilizing wetland resources. Because of this, promoting and creating off-farm livelihood options in their locality is recommended. This will not only enhance participation but also safeguard and improve the livelihood of people thereby easing the pressure on wetlands as many HHs could shift their livelihood to off-farm activities that would otherwise (totally) depend on wetlands. The result is in line with the finding of [39] has found that engagement in off-farm activities negatively influences wetland resource use and management practices.

Distance to wetland:- As shown in Table 3, distance had

negatively affected wetland utilization participation at a 5% level. As a marginal effect indicated a unit increases in the distance decrease the probability of wetland utilization participation decrease by 1.5% percent. The reason is a household village far from a wetland area it is not suitable to participate in cultivating and collecting goods and services in the wetland. This implies that the farther the HH's home is from the nearest edge of the lake or associated wetlands, the lower the level of participation in wetland utilization. This is most likely because a distant household might cost more in terms of time and energy to travel and participate in utilizing resources and in cultivating in the wetland area. The other plausible reason could be that it is less likely for a distant household to generate more benefit from these resources and so they could have less incentive for participation in wetland utilization. This result is in the line with the finding of [39] who reported that distance negatively and significantly affects the participation in wetland resource management and use. And also the study result concurs with earlier findings [46].

Tropical livestock unit: As shown in Table 3, TLU had positive relation and was statistically significant at a 5% level. The positive coefficient of marginal effect indicates the tropical livestock unit increase by one unit the probability of wetland utilization would increase by 90%. The reason is due to wetlands being one of the most important sources of livestock feed through grazing and the availability of plentiful grass throughout the year for the households living in and around the wetlands. This result is in line with the finding of [43, 47] that the number of livestock owned is a significant positive determinant of the level of participation behavior in the wise use of resources. And also supported by [6, 39] who report that the higher the size of the livestock holding households depend on wetland greater the amount of extraction of wetland products such as grass for livestock.

4.2. Determinants of the Extent of Wetland Utilization in Lake Tinshu Abaya Wetland

Table 4. *Heckman outcome model result.*

	OLS			
Variable		**Cofec.**	**St. Err.**	**p-value**
Age		83.56927 **	45.0264	0.043
Gender		935.5111	705.7121	0.185
Family size		1010.1**	390.6774	0.010
Education level		-257.7109**	157.6544	0.012
Marital status		418.6929	1092.49	0.702
Farming experience		-1.159507	52.24921	0.982
Income		247.5645***	.0963664	0.000
Land size		-1311.36 ***	374.362	0.000
Credit usage		114.2588	672.5593	0.865
Extension training		728.6694	796.4431	0.360
Off-farm activity		-1787.966**	768.1001	0.020
Distance		-727.5512***	449.3673	0.005
Cons		7767.774	4483.613	0.083
Mills/lambda		3424.402	1295.173	0.008
rho	0.99893			
sigma	3424.4019			

***- **-* indicates significant at 1%, 5% and 10% level of significance respectively

Inverse Mills ratio (LAMBDA): According to the model output, the Lambda (inverse Mills ratio) term is significant at the one percent probability level indicating the presence of selectivity bias. The positive sign suggests that the error terms in the participation and outcome equations are positively correlated. This shows that those unobserved factors that

make the household participate in wetland utilization are likely to be positively associated with household wetland income.

Age of households head: As shown in Table 4, age of households head was found to have a positive effect on wetland income and was statistically significant at a 5% level. As the output of the second stage of the Heckman model indicated the age of the household head increased by one year the income generated by the household from the wetland would increase by 83.56 ETB. The reason is as the age of respondents increases extracted more resources and received more income from the wetland. This is because as their age increase would become more familiar with the availability, season, advantages, and use of the wetland resources than are younger people. This result is in line with the finding of [48] who reported that the age of respondents positively and significantly affected the household wetland income. The result is also in line with the finding of [49].

Family size: As shown in Table 4, the family size was found to have a positive effect on the level of wetland income and is statistically significant at a 5% level. The output of the OLS regression indicated the number of active labor force members increased by one the level of income from wetland would increase by 1010.1 ETB. The reason a big family size is an indication of labor availability in a family that could have a vital role in resource conservation and management. Households with big family sizes might not face labor limitations to engage in resource conservation and management activities. This result is in line with the finding of [50] who reported that family labor positively affects income and the findings also showed that increasing the active labor force of an average household by one unit will increase the household's total income by 3987.14 ETB. This result is also fitted with the finding of [6, 39, 51]. They reported that several youths in the household significantly affected dry forest income levels in study areas. Also the result is in line with finding of [52].

Education level: - As shown in Table 4, the annual income of households was found negative effect on the level of wetland income and was statistically significant at a 5% level. The coefficient of this variable indicated the education level of the respondents increased by one unit the level of income generated from wetland would be decreased by 257 ETB. A higher level of education was thought to be negative to wetland incomes because well-educated individuals were likely to have alternative employment and good knowledge of the negative effects of resource extraction on biodiversity and hence would be less likely to collect such lake resources, resulting in lower incomes. This result is in line with the finding of [6, 48] who reported that education negatively affected the wetland income level.

Annual income of households: As shown in Table 4, the annual income of households had a positive effect on the level of wetland income and was statistically significant at a 1% level. The coefficient of this variable indicated the income household increased by one birr the level of income generated from wetland would increase by 247 ETB. This is due to the household who has more income having the ability to use more wetland resources and can invest more in the wetland. This result is in line with the finding of [39] who reported that gross income has a positive effect on the wetland resource. The result is in line with the finding of [29, 52].

Land size: As shown in Table 4, land size was found to harm wetland income level and statically significant at a 1% level. As the result showed the land owned by household increases by one hector the level of wetland income decrease by 1311.36 ETB. This result is consistent with the finding of [38] who reported that landholding size negatively affects the imputed value of wetland which indicates that households belonging to marginal and landless, are likely to depend more on wetlands and hence extract more from it. This result is also in line with the finding of [52] who reported that land size influences forest income and dependency negatively.

Off-farm activity:- As shown in Table 4, off-farm activity was found to have negatively affected wetland income levels and is statistically significant at a 5% level. The result indicated the probability of participating in off-farm activity increases in the sampled population the level of income generated from wetland would decrease by 1787.966 ETB. The reason is the negative effect of off-farm employment on households' decision to not rely on wetland income and extract less income from wetland is probably because households with more off-farm income employment opportunities and work can meet their expenses easily from other sources while depending less on the wetland. This result is in line with the finding of [51] who reported that off-farm activity negatively affects forest income. But the result is inconsistent with the finding of [52].

Distance to wetland: As shown in Table 4, distance to wetland negatively affects wetland income level and was statistically significant at a 1% level. This is most likely because distant households might cost more in terms of time and energy to travel and participate in utilization wetland resource to generate income. The negative sign of the coefficient indicated the distance of the wetland increased by one unit the wetland would decrease by 727.774 ETB. This result is consistent with the finding of [6, 52] who reported that distance to a forest has a negative relation to forest income. And also the result is in line with the finding of [53] who reported that distance was negatively affect wetland cultivation.

4.3. Ecosystem Goods and Services Provided by Lake Tinshu Abaya Wetland

Table 3. Ecosystem Goods and Services Provided by Tinshu Abaya Wetland.

Type of ecosystem goods and Services	Goods and service
Provisioning service	Crop and vegetable products, Livestock grazing, Water supply for domestic use and livestock, Raw material e.g. grass, Fishing
Regulating services	Flood control and Water regulation
Supporting services	Nutrient cycle and Crop pollination, and Photosynthesis
Cultural services	Education e.g. research, Aesthetic E.g. Habitat for biodiversity, Holiday celebration

Source: own household survey, (2025).

4.3.1. Provisioning Service

As shown in Table 6, provisioning services provided by the Lake Tinshu Abaya wetland are one of the most essential functions performed by the wetland. The surrounding villages rely on the wetland for a variety of goods and services. The wetland produces several goods like fish, grass, and pasture, and also it supplies water for domestic use and livestock, and irrigation. The main agricultural products that contribute to the livelihoods of the surrounding populations are vegetable, fruit, and crop production which are produced by irrigation from Lake Tinshu Abaya wetland. Wheat, sorghum, maize, and sugarcane are the principal crop kinds grown in the wetland for both domestic consumption and money. Other vegetables produced on the neighboring wetland by irrigation include cabbage, beetroot, endive, carrot, onion, and potato. As shown in Table 6, about 123 households have participated in irrigation which is 69.10% of the sample households while only 30.90% of the respondent's households did not participate in irrigation practice in the wetland area. As shown in Table 6, about 25.28% of the households participated in collecting grass (bulrush) for sale, and 74.72% were not participated in collecting grass. About 50.56% of the households collected grass for pasture but about 49.44% did not participate in a pasture in the wetland area. Only 33.14% of the households have participated in fishing and 66.86% of the households did not participate. And to the survey's result, Lake Tinshu Abaya wetland also provides for animal grazing. During the dry and rainy seasons, the wetland is mostly utilized for animal grazing As shown in Table 6, about 70.22% of the respondents' households used wetland areas for livestock keeping but, 29.78% of the sampled households did not participate in grazing.

Water supply for domestic use and livestock:- As shown in Table 6, about 70.22% of the households used water from Lake Tinshu abaya for domestic use and livestock but about 29.78% of the household were not used water for domestic use and livestock.

4.3.2. Regulative Service

Flood control:- As shown in Table 6, about 78.65% of the households have gotten flood attenuation service provided from Lake Tinshu Abeya wetland but about 21.35% of the households were not gotten flood attenuation service.

Table 4. Benefited household From Lake Tinshu Abaya Wetland.

Goods service	User	Non-user
Irrigation	69.10%	30.90%
Fishing	33.14%	66.86%
Grass harvesting for sale	25.28%	74.72%
Grazing	70.22%	29.22%
Flood control	78.65%	21.65
Water supply for domestic use and livestock	70.22%	29.22%
Harvesting grass for pasture	50.56%	49.44%

Source: own household survey, (2025).

5. Conclusion and Recommendation

5.1. Conclusions

According to the focus group discussion, key informant interview, and the household questionnaire survey the goods and services provided by the wetland were provision services such (as crop and vegetable production by irrigation, livestock grazing, water for domestic use and livestock, grass, fish), regulative service (flood control, water regulation), supportive service (nutrient cycle, crop pollination, photosynthesis), cultural service (education, habitat for biodiversity, holiday

celebration). These goods and services of the wetland ecosystem are contributing to socio-economic livelihoods for the surrounding community. And they enhance the socio-economic development of the area.

Age of the household head has positive effect on participation in wetland utilization the extent of utilization. This implies that the use of wetland resources is significantly influenced by experience and perhaps improved social networks. Family size of the household has positive effect on participation in wetland utilization the extent of utilization. The presence of more labor in bigger households enhances their capacity to gather and utilize resources from wetlands more efficiently. Marital status of the household has positive effect on participation in wetland utilization. This indicates that married household head participated in wetland utilization more than non-married one. This could be explained by the fact that families' needs as a whole motivate resource gathering. Annual income of the household has positive effect on participation in wetland utilization the extent of utilization. This may be if household more income can invest more in the wetland area Livestock number the household has positive effect on participation in wetland utilization. This because as household's livestock size increase they become more dependent on wetland area Education level of household heads has negative effect on participation in wetland utilization and the extent of utilization. Participation in wet land utilization declines with increasing education, which may suggest that conservation, is becoming more important than resource extraction. Land size heads has negative effect on participation in wetland utilization the extent of utilization. This finding suggests that households with bigger landholdings might not need wetlands as much for their livelihoods, perhaps because their owned land produces enough food or other resources. Off-farm activity, heads has negative effect on participation in wetland utilization and the extent of utilization. This implies that households working off the farm might have a wider range of sources for livelihood and less dependence on wetland resources to meet their needs. Distance to wet land heads has negative effect on participation in wetland utilization and the extent of utilization. This probably reflects the higher energy and duration expenditures of getting to far-off wetlands, which can make it more difficult to participate in wetland utilization.

5.2. Recommendation

1. The study implies different goods and services are provided by the Lake Tinshu Abaya wetland ecosystem so the concerned government body should participate in conserving to preserve the sustainability of the wetland ecosystem to sustain the socio economic benefit of the wetland.
2. In this study, major goods and services and indirect values like flood control services were included but the economic value of other services like water supply for domestic use and livestock, and climate regulation were not valued. Further research should conduct on estimating the total economic value in the study area.
3. Provide educational programs that highlight the sustainable use of wetland resources by knowledgeable people in order to promote responsible participation.
4. Wetland-friendly socioeconomic activity operations should be designed to safeguard the long-term survival of Lake Tinshu Abaya wetland. This will ensure wetlands conservation as well as a long-term economic benefit to society. To realize the wetland-friendly socioeconomic activity awareness creation should be done to the society to develop an attitude toward wetland ecosystem values.

Abbreviations

HHs	Households
OLS	Ordinary Least Square
TLU	Tropical Livestock Unit

Conflicts of Interest

The authors declare no conflicts of interest.

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