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Determinants of environmental conservation in Lake Tana Biosphere Reserve, Ethiopia

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ABSTRACT

This study has investigated the factors that determine the conservation of one of the major ecosystem in Ethiopia, Lake Tana Biosphere Reserve, using primarily quantitative followed by qualitative approach to provide adequate results of the problem under study. The study has employed the descriptive design and a total of 305 samples from rural households (n = 159) and tourism-related enterprises (n = 146) were selected based on a stratified random sampling technique. Samples were drawn based on their direct attachment either in their livelihood and possess a responsibility to the study area. Data were collected through questionnaires, observation, focus group discussion, unstructured interview and secondary data was consulted. Exploratory factor analysis was used to extract dimensions for environmental awareness. Binary logistic regression was used to analyze data using SPSS version 23. Ten Socio-demographic variables of samples were used as an independent variable and environmental conservation dimensions as dependent variables. The result revealed that out of the 10 variables employed in the analysis, six variables were found significant. Hence, marital status, household size, income source, household income, membership to club and resident location were found to be significant. Qualitative analysis revealed wrong reports for political consumption driven little government attention and lack of integrated natural resource management policy and plan were major factors hindering conservation. A vivid and holistic destination management policy making with enough room to stakeholders' involvement shall be a prior task for the government for better conservation of the ecosystem and sustainable development.

1. Introduction

The problems of climate change and resource degradation has become crucial in order to make the environment sustainable. Conservation of the natural and man-made resources in this 21st century is not a voluntary choice for many countries and people within each country. Many of the protected areas were established to conserve global biodiversity and ensure a continuance of various ecosystem services that are of great importance in order to maintain ecological equilibrium (Thuy et al., 2011).

Current scenario of the world environment adheres to the conservation of the resources adjacent to the socioeconomic human effects (UNECA, 2007). It has become a global agenda with which environmental conservation issues have been kept as major aims of 2030 agenda goals for sustainable development (Rosa, 2017). It was found similar in the study of (Rosa, 2017; Lamsal et al., 2015). The management of natural resource sustainably, disposing and keeping the waste generated to a minimum has become a priority over the last few decades (UNEP, 2004). Extreme dwindling of natural resources that created climate change, instability, socioeconomic and poverty variability is mostly due to severe drought and desertification (UNECA, 2007). Thus, various environmental conferences are held in different UN member countries at different times due to augmented global warming and climate change (Lamsal et al., 2015). Conservation should be promoted to enhance local economic growth, socio-economic, political and ecological changes associated with tourism and conservation (Fletcher, 2009). Furthermore, those changes, in turn, can be made for the restructuring of the community at destination areas (Vaccaro et al., 2013). In addition, a significant change of infrastructural, economic, demographic and administrative categories could also be derived for the conservation success (Vaccaro et al., 2013).

Social science conservationists should be motivated besides natural science conservationists who could play a valuable role in socio-cultural, economic and human dimensions of the conservation science (Bennett

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et al., 2017). These have aimed to support sufficiently local residents (Campbell, 2007) in improving marine and terrestrial conservation in the theory and practice of environmental management (Bennett et al., 2017). Conservation has been used as a tactic to gain political control (Mathis and Rose, 2016). It can also become a tool for economic development as it integrates landscape into the capitalist market which in return alters the cultural practices (Adams and Hutton, 2007). Conservation would be of effective when creating economic opportunities for local people (Campbell, 2007; Mathis and Rose, 2016) by introducing valuable sectors such as tourism so as to improve the standards of living for host cultures (Mathis and Rose, 2016). Moreover, the enhancement of conservation through local conservation activities than outside induced conservation projects would be effectual (Lamsal et al., 2015).

Conservation of many protected areas and biosphere reserves including many water bodies has faced environmental problems (Admas et al., 2017) whereby water hyacinth (*Eichornia crassipes)* is the convoluted problem of Lake Tana (Asmare, 2017; Admas et al., 2017). Carelessness and lack of conservation efforts in the country brought invasive species from the southeast to northwest Ethiopia (Admas et al., 2017). Water hyacinth infestation in Ethiopia was known to appear in Koka reservoir in 1956 was dispersed and now became relentless to Lake Tana in the Blue Nile basin (Admas et al., 2017). Lake Tana and its surrounding wetlands are of immense ecological value providing the means of existence for 2–3 millions of people, however escalating human activity is causing the destruction of this unique ecosystem degraded due to high pressure on natural resources (Zur Heide, 2012). Low level of local conservation while practicing a wide range of activities has become a critical problem for Lake Tana that made water hyacinth infestation hazardous (Admas et al., 2017; Asmare, 2017).

Besides water hyacinth, Lake Tana basin suffers from easily perceivable land degradation, soil erosion and water pollution. These problems are manifested in the form of sedimentation, clearing of wetland and canalization of tributaries and increased trend of eutrophication and toxigenic cyanobacteria (Goshu and Aynalem, 2017). Sediment concentration in rivers over the last 30 years became double indicating more efficient sediment trapping in the floodplain as a result of higher lake levels, rising river beds, and farmers intervening with the course of the river near the shore (Abate et al., 2017). Conservation problem in the Lake Tana Biosphere Reserve world heritage site has increased the infestation since it was known to appear in 2011 not more than 80–100hectare (Tewabe, 2015) has reached to over 20,000 hectares (Tewabe et al., 2017) and to 50,000hectare (Worku and Sahile, 2017).

Different researches on Lake Tana regarding potentials for tourism development (Zur Heide, 2012) as well as problems giving priority to a fishery, water hyacinth infestation and many other related ecological problems were done on the present study area (Tewabe, 2015; Asmare, 2017; Worku, 2017)). Furthermore, they emphasized on the natural science dimensions of problems over the lake (Admas et al., 2017) giving less emphasis to the institutional, political and human dimensions of conservation with which the determinant factors of conservation remain uncovered. Hence, the aim of this research is an investigation of factors for the conservation of Lake Tana Biosphere Ecosystem with adequate triangulation of human and political dimensional factors. Thus, the objective of this study was to find out the determinants of environmental conservation in Lake Tana Biosphere Reserve.

An empirical study on environmental awareness and attitudes of student teachers has revealed there was a strong relationship between socio-demographic variables and environmental awareness as well as between socio-demographic variables and environmental attitudes (Özden, 2008). Household size and education were found to have a strong correlation with and were the significant determinants of environmental awareness (Özden, 2008; Mustafa et al., 2018). So does to the study of (Abdul-Wahab and Abdo, 2010) in Muscat, Oman that reported environmental awareness was associated with individual demographic characteristics (age, education level, and gender) thereby males were having higher knowledge level on their awareness of the environment. In addition, income level, the job of parents and living residence (Özden, 2008) as well as landholding and membership to farm organization (Mustafa et al., 2018) were found to have a strong correlation with and were the significant determinants of environmental awareness.

Ones people are aware of their environment and types, environmental concern is taken as a basic unit of analysis in assessing different groups' of attitudes toward ecological issues such as pollution and wildlife preservation (Grieve and van Staden, 1985). Environmental consideration and conservation of endangered species while promoting responsible and sustainable development simultaneously (Coetzer, 2005) should have the rationale for participatory environmental management mainly in low-income countries (El-Zein et al., 2006).

The study on social determinants of environmental concern has found only income level as the determinant factor but gender and education were found to be insignificant (Kölmek, 2011) which is similar to the study of (Samdahl and Robertson, 1989) where none of the socio-demographic variables were found to be significant. But it contradicts to prior research where age, sex, education qualifications, membership to youth organizations and participation in nature oriented activities were found significant with which women reflecting higher environmental concern (Grieve and van Staden, 1985; Gifford and Nilsson, 2014). The subjects were concerned about which youngsters with higher education level were more aware of their environment and concerned about the environment than the older and less educated respondents (Abdul-Wahab and Abdo, 2010). A similar study conducted on natural woodland conservation has also identified that housing, income, and place of residence as significant determinant factors for environmental concern for conservation (Al-Subaiee, 2016).

The study on the influence of socioeconomic factors on environmental concern found environmental concern is influenced by socioeconomic status (SES) in which it has a positive relationship with the income level of nations (Pampel, 2014). Another study on social bases of environmental concern revealed that younger adults, well educated, people living in urban residents, and people employed other than primary industries were found having better concern for the environmental protection than their counterparts (Jones and Dunlap, 2010).

Participatory conservation of natural resources with their habitat in protected areas is an essential approach to environmental management (El-Zein et al., 2006). Hence, both the environmental conservationists and academics with interests in environmental conservation have noticed conservation dynamism. The personal awareness, social awareness and subsequent concern about the environmental quality are the hubs of environmental protection (Shen and Saijo, 2007).

Communities, mainly of rural, should be provided with the opportunity for the integrated approach of conservation and development (Coetzer, 2005). The increase in population had increased resource demand and looming of climate change which in turn make conservation a prior agenda (Shen and Saijo, 2007). The efficacy of conservation was found to be dependent on socio-economic factors (Kretser et al., 2009; El-Zein et al., 2006; Kim, 2012). Academic degree or education and professional affiliation (Karanth et al., 2008) were found to be significant where non-academics have more likelihood attitudes of conservation than people with an academic degree. Another study found age, gender, education, belief, working status, length of residence from protected areas (PAs), access to private health insurance and crowding as determinant factors for motivation to participate in conservation (Shen and Saijo, 2007; El-Zein et al., 2006).

2. Materials and methods

2.1. Description of the study area

Lake Tana is Ethiopia's largest lake possessing half (50%) of the nation's fresh water and the source of the Blue Nile supporting the lives of over 123 million people in the Nile Basin by its 60% approximate contribution to the basin (Goshu and Aynalem, 2017). Lake Tana

Biosphere Reserve, registered on June 19th, 2015, is among the fourth UNESCO world biosphere reserve sites of Ethiopia found at the altitude of 1780masl (Worku, 2017). It is the home of 37 islands but a means of livelihood for the people around the destination located in north-western Ethiopian Highlands in the Amhara National Regional State between the geographic coordinates of 10°58′- 12°47′N latitude and 36°45′-38°14′ E longitude (Admas et al., 2017). Lake Tana is fed by the Lesser Abay, Reb, and Gumara rivers (Goshu and Aynalem, 2017); and more than 60 rivers and streams in total (Worku, 2017) with its surface area ranges from 3, 000 to 3,500 km^2 depending on season and rainfall (Admas et al., 2017).

2.2. Research framework

A mixed research approach employing both descriptive and inferential statistics was used. In addition, qualitative analyses were used for triangulation of the quantitative data and to describe data obtained through observation, focus group discussion and unstructured interview. Multi-stage stratified random sampling for self-administered survey questionnaires and judgmental purposive sampling were used for the selection of respondents and sample sites respectively. Two groups were assigned based on their main means of livelihood, perceived knowledge respondents and expected income difference. The two startups were Rural Households (HHs) and Tourism enterprises and related organizations (TEs). The samples were drawn from 6000 household population (ANRS BoFED, 2018) taken from 6 sites (Bahir Dar, Zeghe Peninsula, Kunzila, Gorgora, Yifag, Woyna) purposively selected based on the availability tourism activities, status of invasive species, and direct access to the lake with better transportation access to shore of the lake. The sample size was determined based on (Yamane, 1967) sampling design technique. The sample size was 374 and 37 were also added to reduce the non-response rate. Of those 370 were returned and 65 were excluded from analysis due to invalid responses. Thus, a total of 305 respondents based on the proportion (159 from rural households and 146 from tourism enterprises and related organizations) were used for quantitative analysis. Samples were drawn from rural households, fishing associations, souvenir shops, hotel employees, tour guide associations, boating associations, tourism office employees, agricultural and natural resource management office as well as forest, wildlife, and environmental protection offices as well as NGOs. Subjects were selected based on their responsibility related to the biosphere reserve, engagement in activities on the lake and the biosphere ecosystem and livelihood attachment to the Lake. Data were collected from September 2017 to June 2018 for 10 months and collected in 3 rounds from September–November, January–March, and May–June. It was made based on rounds because the researcher was engaged in teaching activities in employer organization seeking convenience time for data collection. Data collection was made by the corresponding author. Assistant data collectors were employed to accompany with the researcher from Kunzila, Gorgora and Woyna sample sites where the researcher has little awareness about the area.

There might be many socio-economic factors which might probably affect environmental conservation or protection. But, for this research 10 socioeconomic variables were taken. The socioeconomic variables taken for the present study include; gender, age, education, marital status, household size, household income, an income of the household, livelihood adequacy, membership to an environmental club and resident location from the biosphere reserve.

Based on the literature and researchers' own understanding, the following ***three hypotheses*** were formulated as depicted below:

H1. *Socioeconomic variables have a significant effect on environmental awareness for conservation in protected areas*

H2. *Socio economic variables have significant effect on environmental concern in protected areas.*

H3. *Socioeconomic variables have a significant effect on Participation of people in environmental conservation*

Descriptive analysis was computed to present demographic characteristics of respondents. Multicollinearity diagnosis has been executed before running the binary logistic regression analysis which was employed using SPSS version 23. The multicollinearity test result shows VIF less than 2 for all cases that revealed that there was no multicollinearity between independent variables (Montgomery et al., 2012). Binary logistic regression analysis was used because it is useful when the dependent variables are binary or dichotomous (Park, 2013; Long and Freese, 2001).

2.3. Definition of variable terms

Membership to an environmental group-refers to the respondents' membership status to civic associations on the Biosphere Reserve such as Society for Ecotourism and biodiversity conservation (SETBDC). No separate community environmental club is found in study area (Table 1).

Livelihood adequacy - refers to whether the household's average annual income is enough to sustain their livelihood.

Resident location – is the location of respondents' place of residence or workplace/office from the lake's approximate shore of the lake.

Environmental awareness is knowing things around or having information and understanding about things around in their surroundings such as living and non-living things and the environmental problems and environmental protection (Özden, 2008; Mustafa et al., 2018).

Table 1
Variables in the binary logistic regression model.

Variables	Variable type	Data type	Description
Environmental awareness (EA)	Dependent	Dummy	1 = Yes; 0 = No; recode in to dummy
Environmental concern (EnvC)	Dependent	Dummy	1 = agree; 0 = disagree; recode in to dummy
Participation (PP)	Dependent	Dummy	1 = agree; 0 = disagree, recode in to dummy
Age (Ag)	Independent	Continuous	The age group of respondents (4 groups)
Gender (Gen)	Independent	Dichotomous	1 = Male; 0 = Female
Marital Status (MS)	Independent	Multinomial	Marital status more than 2 categories
Educational level (EDL)	Independent	Categorical	Level of education of respondents background
Household Size (HHS)	Independent	Ratio	TTL number of persons in the HH
Household Income Source (HHIS)	Independent	Multinomial	Sources of income for livelihood (more than 2 categories
Household Income Level (HHIL)	Independent	Interval	Level of income/year (birr)
Livelihood Adequacy (LA)	Independent	Dichotomous	1 = enough; 2 = not enough
Resident Location (RL)	Independent	Ratio	The approximate distance measured from the shore of the lake to respondents residence or workplace
Membership to environmental group/club (MEC)	Independent	Dummy	1 = Yes; 2 = No – whether an individual respondent is a member of environmental society or association

Source: Own compilation, 2017/18.

Note: Data for dependent variables were collected on a five-point Likert scale and transformed into dummy variables to make convenience for using binary logistic regression. Dummy variables were created based on the positive answers*: high and very high for EA, strongly agree and agree for EnvC and PP as "**1**",* and negative answers*: very low and low as well as strongly disagree and disagree as "**0**"*. We have included *intermediate* and *neutral* into ***"0"*** because we believe it is slightly negative and we want to separate it from the positive answers for analysis. This is done because the binary recoding of Likert scale meets at least similar standards without jeopardizing the underlying structure of the original format (Grassi et al., 2007).

Environmental concern-refers values, attitude, intention and concern about the environment and its problems such as erosion, sedimentation, water and air pollution, deforestation and wastes …etc (Grieve and van Staden, 1985; Berenguer et al., 2005; Al-Subaiee, 2016).

2.4. Reliability and validity

Validity was checked consulting the five professionals from disciplines related to the present study and the research advisor through the instruments were not merely developed by the researcher but also adopted from a standardized questionnaire. The reliability of the items was measured employing 10% of the total sample i.e., 37 out of 374 sample respondents in a pilot test. Then, the reliability of the questionnaire was estimated based on the Cronbach's alpha value of internal consistency measure. Though minor, editions were made for the sake of clarity and preciseness of the items, reliability of the survey instruments for various items varied from 0.709 to 0.957, i.e., found to be acceptable based on (Tavakol and Dennick, 2011; Wells and Wollack, 2003) measure of internal consistency (see Table 2).

2.5. Conceptual framework of the study

This conceptual framework of the study shows how the graphic presentation of the socioeconomic factors proposed effect on the environmental conservation in the study area. Environmental awareness, environmental concern, and participation dimensions are employed in this study to measure environmental conservation (Briassoulis, 2002; Hall, 2001; Reopanichkul, 2009; Humke, 2011; Moseley, 2000; Bodmer et al., 1994; Biodiversity Conservation Network, 1995; Price, 2003). Hypotheses were also designed based on the three dimensions. The socioeconomic variables (Age, Gender, Education, Marital Status, Household Size, Income Source, Household Income, Livelihood Adequacy, Membership to Environmental Club/group, Household Residence Location) as supported by many works of literature are employed to examine the determinants of environmental conservation measured in terms of environmental awareness, environmental concern and participation in conservation (see Fig. 1).

2.6. Ethical concerns

The subjects under study are not and will not be exposed regarding the information they provide to the researcher. Thus, the subjects in the interviews and FGD or any other issues in entire research remain confidential. No misconduct in interpreting subject's response and gender issues are all respectfully made. Besides, research articles are duly acknowledged and cited.

3. Results and discussion

3.1. Description of administered questionnaire

Of the total number of questionnaires administered (n = 434), 375 (86.40%) were returned of which 70 were dropped and were not included in the analysis that were not actually fully filled. Whereas 30 (6.92%) and 29 (6.68%) of the questionnaire were returned but unfilled and unreturned respectively (see Fig. 2 below).

Table 2
Cronbach's alpha of environmental conservation dimensions for reliability analysis.

Variables in dimension	Label	Alpha before deleting	Alpha after deleting	No. of items deleted	Total no. of items tested
Environmental Awareness	EA	.956	.957	1	38
Environmental Concern	EnvC	.709	.725	1	10
Participation	PP	.888	.888	-	13

Source: Survey, 2018

As depicted in Fig. 3, out of the total 375 survey questionnaires returned, 70 or 18.67% were dropped because of inappropriately filled and partially filled because it was on self-administered basis and carelessness of respondents. The rest 305 number of the questionnaires (81.33%) were used for analysis and used for inferences to the population under study. Of those 305 questionnaires returned and used for analysis, 159 (52.13%) respondents of the questionnaire were from rural households' stratum whereas 146 or 47.87% respondents were from tourism enterprise and related organizations stratum as shown below in the bar graph.

3.2. Characterization of the sample

According to the findings, 71.3% of respondents were male and 28.3% were females from household (HHs) stratum whereas 60.3% and 39.7% were male and female respondents respectively from TEs stratum. Majority of respondents in both strata were found to be in the young age category (18–34) with 67.3% and 76.7% followed by adult age group (35–49) which accounts 23.3% and 17.1% of from the household and TEs strata respondents respectively. 29.6% and 34.2% respectively from households and TEs stratum respondents were secondary complete and having diploma or certificate. This is followed by elementary complete (22%) and a university degree (24.7%) respectively for households and TEs stratum respondents.

The majority of the respondents were married (45.3% and 43.2%) followed by a single (38.4 & 35.6 percent) and live in a partner (5.7 and 11.6 percent) for household and TEs stratum respectively. The smallest size (1–3 members of the household) found to be household size with the majority of respondents which account 43.4% and 48.6% followed by 4–6 members and 7–10 members of household that weighs (38.4 & 37)% and (15.7 & 9.6)% respondents from the household and TEs respectively. The remaining proportion of each stratum respondents found having members above 10.

In the TEs stratum, the major source of income for respondents' household was salary i.e., 71 (48.6%) followed by tourism and hospitality (34 or 23.3%) and trade (25 or 17.1%). The rest of the respondents were engaged in fishery that accounts 10 or 6.8% and wage in the travel and tourism industry which accounts 6 (4.1%). In the rural HHs stratum, 50 or 31% of respondents were engaged in farming whereas 30(18.9%), 29 (18.2%), 27 (17.0), 10 (6.2%) were engaging in fishing, trade, production and sale of handicrafts and wage as major means of livelihood respectively. The rest were found engaging in wages, wood and wood products, animal raring and beekeeping. Of the respondents majority of respondents earn less than 10,000 (ETB) average income which accounts (88 or 55.3%) and 71 (48.6%) followed by those who earn 52 (32.7%) and 48 (32.9%), 11(6.9%) and 18 (12.3%) who earn average annual income between 10,001–25,000 and 25,001–40,000 from HHs and TEs stratum respectively. Only 3 (1.9%) and 3 (2.1%), and 5 (3.1%) and 6 (4.1%) of subjects earn an income between 40,001–55,000 and Above 55,000 from HHs and TEs stratum accordingly.

Similarly majority of the respondents from each of the stratums respond that the income is not adequate for their livelihoods that account 109 or 68.6% for HHs and 94 or 64.4% for TEs. Moreover, with respect to place of the respondents' residence location majority of the respondents from both HHs and TEs stratum live within less than 3 km distance from the lake's shore that holds 62.9% (100) and 53.4% (78) of respondents. This was followed by 35 (22%) and 40 (27.4%) between 3- 6 km and 24 (15.1%) and 28 (19.2%) respondents above 6 km distance from the Lake's shore for HHs and TEs respectively. Most of respondents of the TEs were found member of the environmental conservation organizations (101 or 69.2%) whereas only 56 (35.6%) were members of organizations working in conservation activities for HHs. The remaining 30.8% and 64.4% of respondents from TEs and HHs respectively were not members

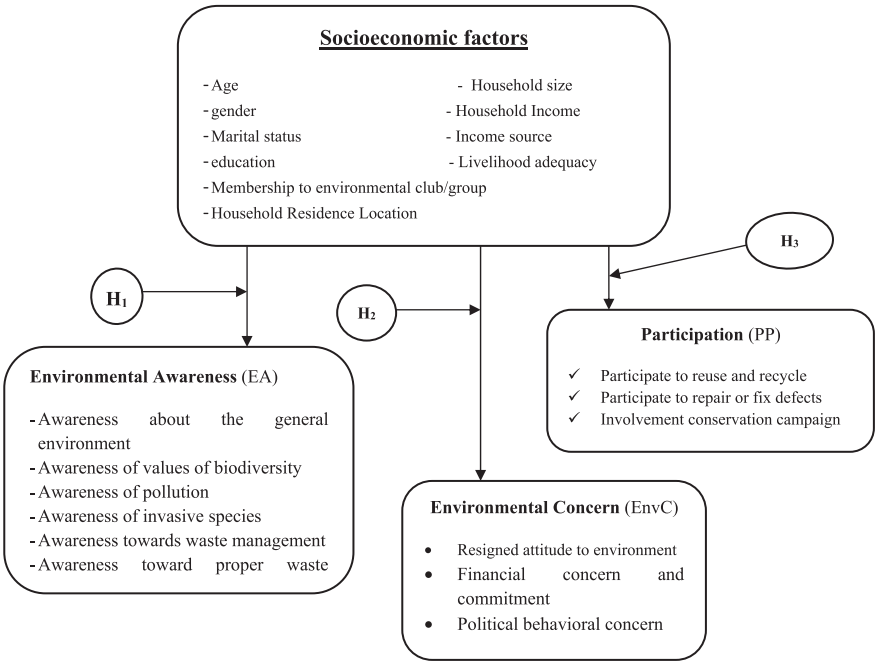

Fig. 1. Conceptual model of study variables (own compilation, 2018).

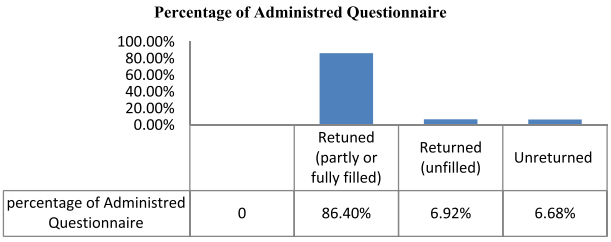

Fig. 2. A Response rate of the administered questionnaire (source: Survey, 2017/18).

of clubs or organizations related to environmental conservation. But, during the survey period no separate community environmental club or group was found. Therefore, membership to environmental club in this research refers membership of respondents for national organization working on environment related areas.

3.3. Analysis of correlation results

The Pearson correlation test was employed using SPSS version 23 to test the relationship between the three dimensions designed to measure the environmental conservation construct. The result of partial Pearson correlation showed the significant relationship between environmental awareness and participation in conservation practices ($r = .534$, $P < .05$) and environmental concern and participation ($r = 476$, $P < .05$) based on (Ratner, 2009). But, the significant relationship between awareness and concern about the environment was not found significant (see Table 3).

3.4. Empirical model

Dependent variables are discrete variables in which respondents were asked if they had ever awareness of the environment, concern and had participated or not in conservation practices. In this study binary logistic regression model were employed to determine the determinant factor for environmental conservation measured in the above 3 dimensions. This method is popularly used in different social attitude measures (Park, 2002) and environmental protection measures (Hasan and Akhter, 2011). The logistic regression model for this study would be;

$$\ln Y = \frac{P(Y=1)}{1-P(Y=0)} = \beta 0 + \beta 1(Gender) + \beta 2(Age) + \beta 3(Educ) + \beta 4(Maritstatus) + \beta 5(HHsize) + \beta 6(Memebrship) + \beta 7(ResLocation) + \beta 8(Incomesource) + \beta 9(NetHHIncome) + \beta 10(AducacyLL) + \varepsilon \quad (1)$$

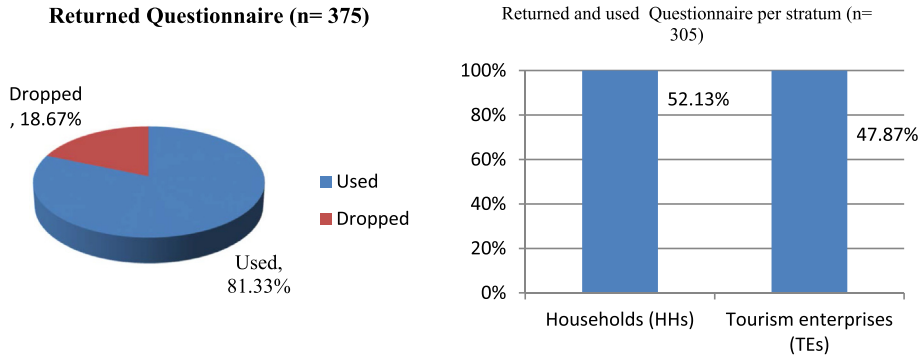

Fig. 3. Percentage of Questionnaire Used and its share per stratum (source: survey, 2017/18).

Table 3
Correlations.

Control Variables			Environmental Awareness	Environmental Concern	Participation
-none-[a]	**Environmental Awareness**	*Correlation*	1.000	.243	.534
	Mean= .7421	*Significance (2-tailed)*	.	.002	.000**
	Std. dev= .43884	*Df*	0	157	157
	Environmental Concern	*Correlation*	.243	1.000	.476
	Mean= .2830	*Significance (2-tailed)*	.002**	.	.000**
	Std.dev=.45189	*Df*	157	0	157
	Participation	*Correlation*	.534	.476	1.000
	Mean= .5912	*Significance (2-tailed)*	.000**	.000**	.
	Std. dev=.49317	*Df*	157	157	0

Source: Survey, 2018
** correlation is significant at .05.
[a] Cells contain zero-order (Pearson) correlations.

Where Y is the dependent variable, β_0 is constant when no explanatory variable introduced and $\beta 1$ to $\beta 10$ be the coefficients of independent variables in the logistic regression model.

And, the likelihood odds ratio/OR would be;

$$\textbf{\textit{ODDS}} = \frac{Probability\ of\ Y\ to\ be\ "\textbf{\textit{happening}}"}{Probability\ of\ Y\ to\ be\ "\textbf{\textit{not happening}}"} \quad (3)$$

3.4.1. Results of binary logistic regression

The binary logistic regression was used to identify the determinant factors for environmental awareness (EA), environmental concern (EnvC) and participation (PP) for the two strata: Rural Households (HHS) and Tourism Enterprises and related Organizations (TEs) which are indicators of Environmental Conservation (EC). The ten/10 socioeconomic factors were employed as independent variables. These include gender, age, education, marital status, household size, membership to environmental club/group, resident location, household income level, income source and adequacy of livelihood earnings. The 3 separate regression models, for HHs and TEs stratum, for the three dependent variables (EA, EnvC and PP) of the conservation construct were conducted.

3.4.1.1. Households (HHs). For this stratum, 3 separate hypotheses were tested for 10 socioeconomic variables. Hence, it was computed to each of the 3 environmental conservation dimensions: EA, EnvC & PP. This was done to measure the effect of socioeconomic variables on environmental awareness, environmental concern, and participation. The result of the binary logistic regression reveals the dichotomous dependent variables EA, EnvC and PP were regressed by 10 categorical and continuous socioeconomic variables. Thus, the result revealed that the equations with significant explanatory variables for each dichotomous dependent variable can be visible as follows (see Table 4).

For hypothesis 1 (environmental awareness hypothesis), only 3 out of 10 independent socioeconomic variables were found significant. The three variables were marital status, household size and household income were found as significant determinants for environmental awareness. The result of binary logistic regression for rural household stratum revealed that marital status (OR = .665, P < .05), household size (OR = 1.723, P < .05) and household income level (OR = .548, P < .05) were found significant explanatory variables. The sign of the coefficient of explanatory variables; marital status and income level shows the inverse relationship with EA but household size had a direct relationship with EA. Besides, livelihood adequacy for HHs was found significant but negatively related at P = .10 significant level (Table 4).

Out of ten independent variables introduced for environmental concern hypothesis, only two variables viz., membership to the environmental club and resident location for were found significant at 5% level of significance. The binary logistic regression result to demonstrate the determinants of environmental concern found environmental club membership (OR = .390, P < .05) and resident location (OR = 1.990, P < .05) significant where.

Moreover, the participation hypothesis also exhibited only found marital status and household size variables significant at .05 significant levels (Table 4). Marital status (OR = .668, P < .05) and household size (OR = 1.533, P < .05) were found significant for the determinants of participation in various environmental conservation activities. Moreover, household income (OR = 1.087, P < .10) and livelihood adequacy (OR = .704, P< =10) were found to be significant indicators of participation at P = .10 level of significance.

3.4.1.1.1. Measure of goodness of fit test. Moreover, the goodness of fit test for logistic regression indicated by the model summary showed -2Log likelihood (EA = 161.587; EnvC = 154.980 and PP = 196.258) was found meaningful and signficant. The Hosmer and Lemeshow Test result used to indicate the appropriateness of the model (Hosmer et al., 1997) with chi-square value of 11.448 (sig. = .178), 7.530 (sig. = .481) and

Table 4
Result of binary logistic regression for rural households.

Explanatory Variables	Dependent Variables for rural households								
	Environmental Awareness (EA)			Environmental Concern (EnvC)			Participation (PP)		
	β	sig	EXP(β)	β	sig	EXP(β)	β	Sig.	EXP(β)
Gen	.057	.899	1.059	.743	.121	2.101	.285	.485	1.329
Ag	-.068	.840	.934	-.488	.174	.614	-.049	.863	.952
EDL	.041	.803	1.042	.147	.357	1.159	.031	.828	1.031
MS	-.408	.023**	.665	.063	.724	1.065	-.403	.014**	.668
HHS	.544	.053**	1.723	-.152	.521	.859	.427	.051**	1.533
MEC	-.291	.485	.747	-.942	.041**	.390	-.609	.096	.544
RL	.161	.294	1.175	.688	.000**	1.990	-.009	.941	.991
HHIS	.028	.614	1.029	.091	.108	1.095	.083	.096*	1.087
HHIL	-.602	.011**	.548	-.032	.894	.969	-.351	.100*	.704
LA	-.788	.063*	.455	-.469	.263	.625	.093	.795	1.097
Constant	2.904	.087	18.240	-2.536	.151	.079	.813	.583	2.254

Note: *, ** significant at .10 and .05 significant level respectively (Source: Survey, 2018).

8.651 (sig. = .373) for EA, EnvC and PP respectively revealed that the models employed were appropriate. Moreover, meaningfulness of the model and total variance explained by Nagelkerke R^2 value of .173, .280 and .151 for EA, EnvC and PP respectively presented in the table and it is based on (Allison, 2014) shows the model was meaningfully improved and dependent variables were explained (See Table 5).

3.4.1.2. Tourism enterprises and related organizations (TEs). Similar to the household (HHs) stratum, three separate hypotheses by introducing 10 socioeconomic variables were tested to measure the effect of socioeconomic variables on measures of environmental conservation. The hypotheses were tested to measure whether the socioeconomic variables introduced in the binary logistic models had a significant effect on environmental awareness, environmental concern, and participation which are designed to indicate environmental conservation construct.

For the environmental awareness hypothesis for TEs stratum, all socioeconomic variables were not significant at .05% significance level. The binary logistic regression analysis result for the tourism enterprises and related organizations (TEs) didn't found any explanatory variable significant for awareness of respondents at P = .05 and even at P = .10 level of significance. And, the introduction of the variables doesn't bring a likelihood of change in the dependent variable.

For environmental concern hypothesis, only *two out of ten* variables namely; membership to the environmental club and household income source were found significant. The binary logistic model for environmental concern, demonstrated membership to environmental club (OR = .317, P < .05) and income source of household (OR = 1.395, P < .05) found to be significant determinants at .05 significant level. Whereas gender (OR = .478, P < .10) was found significant at .10 significant level. Membership to the environmental club was found having an inverse effect on the environmental concern of respondents whereas household income source had a proportionate effect on the environmental concern (see Table 6).

Finally, for the participation hypothesis, the only variable out of the 10 socioeconomic variables introduced into the model that was found significant was *membership* to an environmental club. And, no other variable introduced was significant and the decision was made which failed to reject the null hypothesis (see Table 6). The result of binary logistic regression revealed the only significant determinant factor for participation was a membership to the environmental club (OR = .440, P<=.05) (see Table 6).

3.4.1.2.1. The measure of goodness of fit test for TEs. Moreover, the goodness of fit test for logistic regression indicated by the model summary exhibited by -2log likelihood (EA = 134.775; EnvC = 158.290 & PP = 159.050) was found significantly improved. Hosmer and Lemeshow Test also indicate the appropriateness of the model which is indicated by insignificant chi-square value (EA = 11.448 (sig. = 178); EnvC = 7.530 (sig. = .481); PP = 8.651 (sig. = .373) (Hosmer et al., 1997) that indicated the model employed was appropriate. In addition, the meaningfulness of the model and total variance explained also described in the table and it is based on (Allison, 2014) that showed the model was a meaningful and best-fitted model (See Table 7).

Table 5
Measure of goodness of fit test for HHs.

Variable	-2log likelihood	Nagelkerke R^2	Hosmer & Lemeshow Test		Classification table[a]
			Chi-sqaure	Sig.	Overall %
EA	161.587[a]	.173	11.448	.178	75.5
EnvC	154. 980[a]	. 280	7.530	.481	74.8
PP	196.258[a]	.151	8.651	.373	66.7

Source: Survey, 2018.
-2log likelihood indicates the meaningfulness of the model used is significant. Negelkerke R^2- refers by how much units does the model is improved after the introduction of determinant (explanatory) variables in the model.
Hosmer and Lemshow test- indicates the econometric model employed in the binary logistic regression is best fitted model with p-value above the confidence interval 95%.
Classification table- shows the total variance explained in the likelihood of dependent variable after the introduction of the dependent variables.

4. Discussion

This research revealed that environmental conservation in terms of the three-dimensional variables namely EA, EnvC and PP has the likelihood to be affected by the socio-economic factors in the study area. The result of the present study found in line with many pieces of research done so far.

Marital status, household income level and household size were found to significant factors for EA of rural households (see Table 4) which is consistent with (Özden, 2008; Mustafa et al., 2018). But, no independent variable was found significant for EA in the TEs stratum (see Table 6). The binary logistic regression result revealed that subjects having a higher number of family members have a higher probability to aware about their environment. Respondent's income level is significantly affecting the people's awareness but negatively. This might be associated with persons who are relatively poor are highly engaged in getting their income mainly from natural resources such as fishing, a gathering of fuel-wood or any other related activities from which the people with higher income would not be likely engaged in nature-related activities mainly in tourist protected areas.

On the other hand, age (unlike the study of Yan, 2016), residence location, income source or occupation, membership to an environmental club and education (this result contradicts with the study of Mustafa et al., 2018) and household income adequacy were not significant determinants of awareness (see Table 4 and Table 6). Moreover, education was not found to be the major determinant factor for environmental awareness (see Table 4 and Table 6) which is similar with the study (Esa, 2010) that showed many teachers and students lack sufficient knowledge about their environment but posses and demonstrate a positive attitude towards the environment underlining education doesn't have significant discrepancy on the awareness.

The respondents' membership to an environmental group or club was found as the determinant factor of both HHs and TEs stratum (see Table 4 and Table 6) whereas households' resident location for households (Table 4) and the households source of income for tourism enterprises and related organizations (Table 6) likely to significantly to determines environmental concern (see Table 4 and Table 6). In line with the present study presented in Table 4 and Table 6, Samdahl & Robertson (1989) found that age, income, education and household size have nothing to do in determining the environmental concern. But, this has been disproved in which gender and age were found significantly affecting environmental concern measured in terms of egoistic, altruistic and biospheric attitudes (Davidson and Freudenburg, 1996; Fransson and Gärling, 1999).

This study revealed that marital status and household size from the household stratum and membership to an environmental group/club from the tourism and related enterprises stratum determines the participation of subjects understudy in Lake Tana Biosphere Reserve (see Table 4 and Table 6). This result is similar to findings of (Ranjit, 2014). Besides, gender was found to be a significant determinant of EA at a .10 significance level. However, at a .05 significance level for environmental concern in this research (see Table 4 and Table 6), it was not significantly determined by gender consistent with (Eagles and Demare, 1999) which is also in line with (Sivamoorthy et al., 2013). The reason behind the households' source of income and level of income having an insignificant effect on participation could be questionable. High population density which was found to be more than 150 persons/Km^2 in all sides except the west which was found less than 50 persons/Km^2 which exacerbate the conservation due to increasing livelihood demand (Teshale et al., 2002).

Table 6
Binary Logistic Regression result for TEs.

Explanatory Variables	Dependent Variables for TEs								
	Environmental Awareness (EA)			Environmental Concern (EnvC)			Participation (PP)		
	β	Sig	EXP(β)	β	sig	EXP(β)	β	Sig.	EXP(β)
Gen	-.553	.235	.575	-.738	.099*	.478	-.599	.158	.549
Ag	-.037	.924	.964	-.360	.321	.698	.115	.720	1.122
EDL	.102	.539	1.107	-.010	.943	.990	.221	.143	1.248
MS	-.161	.480	.851	-.029	.894	.972	.098	.622	1.103
HHS	.115	.709	1.122	-.187	.478	.829	-.210	.405	.810
MEC	.161	.753	1.175	-1.150	.022**	.317	-.822	.050**	.440
RL	.112	.600	1.119	-.287	.155	.750	-.290	.087	.748
HHIS	.273	.137	1.313	.333	.014**	1.395	-.034	.786	.966
HHIL	.071	.787	1.074	.129	.539	1.138	.248	.309	1.281
LA	.089	.853	1.093	-.005	.990	.995	.602	.161	1.825
Constant	.339	.840	1.403	1.666	.304	5.291	.858	.568	2.358

Note: *, ** significant at .10 and .05 significant level respectively (source: Survey, 2018).

Table 7
Measure of Goodness of fit test for TEs.

Variable	-2log likelihood	Nagelkerke R^2	Hosmer & Lemeshow Test		Classification table[a]
			Chi-sqaure	Sig.	Overall %
EA	134.775[a]	.068	11.448	.178	80.3
EnvC	158.290[a]	.176	7.530	.481	72.5
PP	159.050[a]	.143	8.651	.373	73.9

Source: Survey, 2018.
-2log likelihood indicates the meaningfulness of the model used is significant. Negelkerke R^2- refers by how much units does the model is improved after the introduction of determinant (explanatory) variables in the model.
Hosmer and Lemshow test- indicates the econometric model employed in the binary logistic regression is best fitted model with p-value above the confidence interval 95%.
Classification table- shows the total variance explained in the likelihood of dependent variable after the introduction of the dependent variables.

This might happened because people with a limited and low level of income need to diversify livelihood income source and participate in various conservation enterprise practices which were proved in research (Akbari, 2011). In a similar perspective, poverty over the indigenous communities in Lake Tana ecosystem is as much as to a cause as a consequence of the environmental degradation of the regions and the biosphere reserve in particular (Teshale et al., 2002). Akbari (2011) found income as a determinant factor of participation where it was not significant in the present study (see Table 4 and Table 6). The result of Akbari (2011) uncovered those households getting more income when participating in conservation activities will motivate them to participate and it was also found significant in (Ramsey et al., 2017) and (Ranjit, 2014). Similar results on gender and educational level were recorded in (Akbari, 2011) which were not significant to neither of the two strata in this study (see Table 4 and Table 6). Responsibility ranging from the managing the household to the conservation of own environs will be high for people who got married bearing environmental behaviors and actions are affected by the marital status which is consistent with the study of (Chen et al., 2011).

The qualitative data from informal interviews and Focus Group Discussion results revealed that respondents were asked regarding their willingness to participate in environmental conservation practices and responded as they are willing to participate in activities such as plastic wastes disposed of into the lake and removal of water hyacinth infestation. Moreover, it verified that respondents especially those who are working on boat service stated that "money researchers and Save Lake Tana Forums came and promised; government talks much on media but nothing has come practical and the lake is suffering a lot, we are becoming hopeless seeing the loss our identity heritage and thinking about our recent future lives". The reply is in line with the study of (Legesse, 2017) which demonstrated there are no policies that government institutions could work or either policies and strategies are not specific that could be practical.

During the survey, areas outlets of Bahir Dar City (Mango, Shum Abo, Shimibt as well as Abay Mado), chemical wastes into the lake from flowering farm investments between Bahir Dar and Zeghe, Kunzila, and Gorgora were found very in a serious problem of environmental degradation and pollution due to solid and liquid waste disposals in to the lake that affect both biodiversity and entire ecosystem. This finding is supported by the factors stated as the pattern of agricultural land use around the lake and Bahir Dar's bid for modernization and growth the factors that affect environmental sustainability and its value use of Lake Tana which identified in the study of (Teshale et al., 2002). Besides, Source pollution from urban waste and rural agriculture and degradation of biota in the catchment are the two main environmental threats to the Lake Tana ecosystem (Emama Ligdi et al., 2010). The present research also found that illegal fishing, inadequate training, and monitoring exacerbated by the traditional agriculture, environmentally irresponsible waste disposal from investors and households and tourism practitioners were found as headaches of environmental conservation in the ecosystem.

The insignificant correlation analysis in this study between environmental awareness and environmental concern is proved by the data collected through focus group discussions and semi-structured interviews. It revealed that people with little or no adequate knowledge together with consideration of natural sites as a means of pass-time and excitement together with aesthetic value result in resembling having positive attitudes and feelings towards the environment which is reflection concern or sense of ownership. Environmental protection in Lake Tana has also been facing anthropogenic threats which include recession agriculture, unplanned urbanization, rapid population growth, indiscriminate industrial and development activities, disposal of domestic and industrial toxic waste and free grazing (Mohammed and Mengist, 2018). A piece of evidence witnessing is the response gained from Kunzila and Bahir Dar where people feel anger observing people who remove their litter and sewerages by different organizations into the lake. Such organizations which remove their littering into the lake include flower farms and hotels as explained though people lack scientific knowledge.

Moreover, communities' resentment other than socioeconomic determinant factors was extended to the political conspiracy going on conservation. The regional and federal government didn't give due attention to the biosphere reserve conservation more than stage words. Due to lack of due attention to the ecosystem, policies and strategies are too general and failed to give a guideline for implementers, no or incapable institutions implementing even for laws available and overlapping and/or even contradicting objectives of different institutions (Legesse,

2017). Such kind of overlapping and contradictions are for instance found between environmental protection and land administration bureau, culture and tourism bureau, agriculture and natural resource management bureau as well as the Institute of fish resources development and Lake Tana Basin development which was observed during the survey period. Hence, there is little cooperation and coordination among different institutions (Legesse, 2017). In parallel, demand for labor and lack of technical support for implementing new conservation measure from experts were found the major factors influencing land conservation decisions in Debre Mewi Watershed near Lake Tana (Zegeye et al., 2010). Almost all respondents believed that political conspiracy and politically sourced institutional factors were also among the determinant factors which prohibit locals not to practice mainly removal of water hyacinth in which its coverage on the lake reached more than 50,000 ha as pinpointed by (Asmare, 2017).

4.1. Practical implications

In order to make conservation effective and development of natural heritages sustainable, particularly in developing countries, conservation efforts should be institutionalized separately for protected area management. This is to broaden flexibility and information flow as well as to enhance governance networks among stakeholders (Berdej and Armitage, 2016). The conservation of protected areas should integrate conservation with improving the local livelihood of the resident community. This helps to develop the ownership mentality and belongingness sustainably among local communities (Chitakira et al., 2012). Hence, conservation enterprises should also be organized to mutually enhance conservation and development. Community – stakeholders'- protected area council (COSPAC) should come into existence for sustainable conservation and utilization of resources in protected areas which is vital for the economically marginalized community. The integration of stakeholders will enhance peaceful management and coexistence for protected area better off (Coenen et al., 2008). In addition, land zoning with an appropriate buffer zone and development area set back should be developed. Moreover, appropriate development policies and destination management plans should be developed. Such policy frameworks were highly recommended (Miller et al., 2011). Researches in the future should focus on an area of schemes where conservation and sustainable development should be effective and heritage sites can be managed sustainable assuring communities' better off. This is due to the barriers of conservation are far beyond the socio-economic demands of the public. Thus, to overcome the loss, fragmentation and disturbance of wildlife and their habitats, invasion of exotic species, as well as over harvesting disturbance of wildlife habitats and environmental pollution and climate change become critical (Yu, 2010). Moreover, decision-makers and planners might use also the runoff and sediments in of Lake Tana to implement pertinent land management measures and thereby reduce soil loss in the sub-basin and sedimentation of Lake Tana (Lemma et al., 2019). Besides, pro-environmental policies and strategies should be designed and implemented (Berenguer et al., 2005).

5. Conclusion

Environmental degradation, sedimentation and water hyacinth as well as waste disposal have appeared to be the major threats to Lake Tana Biosphere ecosystem. This is due to both natural and manmade factors whereby man-made factors seem to outweigh threats of it. Unto investigation of conservation practices and determinants, it is essential not only to conserve the natural ecosystem with its biodiversity species but also to save and sustain the lives of millions of people whose lives are dependent on the lake. Fishing, firewood and agricultural cultivation supported by trade, travel, and tourism are now the meanings of lives of people in and around the biosphere.

Due to its vitality, environmental conservation in Lake Tana Biosphere was measured by environmental awareness, environmental concern and participation dimensions using valid and reliable items. Socioeconomic factors mainly marital status, household size, source of income, household income, membership to an environmental club and resident location were found significant determinant factors of environmental conservation at 5% level of significance measured in terms of environmental awareness, environmental concern, and participation. Gender for environmental concern in TEs stratum, livelihood adequacy for awareness, households income source and income level for participation in HHs stratum were found significant factors at 10% level of significance.

Recommendations were made such that future researches in the study area and similar protected area should focus on how conservation and sustainable development of protected areas can be integrated. Besides, the studies on factors hindering or determining conservation should further address beyond socioeconomic factors since the determinants are not limited to those socioeconomic determinants covered in this study. Furthermore, researches and or development projects should not be on a separate basis. This is due to the fact that without supporting locals' livelihood or without providing economic incentives to the communities attached to the ecosystem, conservation projects should not be effective and conservation by ignorance of people around the protected areas is also unthinkable. In general, poor level of conservation in Lake Tana Biosphere Reserve is not limited to socioeconomic determinants but also exacerbated by lack of local environmental groups, little or no government attention, political wrong reports and using the ecosystem for gaining political profits and lack of pro-environmental policies and plans.

Declarations

Author contribution statement

Zemenu Bires, Sahil Raj: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

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