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Full Length Research Paper

Agro-pastorals' adoption of soil and water conservation (SWC) technologies: The case of Aba'ala district in Afar Region, Ethiopia

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This study assessed agro-pastoralists' adoption of soil and water conservation measures in Aba'alla. A convergent parallel mixed design was used, combining quantitative and qualitative methods. Samples were taken from five selected kebelles of spate irrigation areas in the Woreda. Questionnaires, group discussions, interviews and field observations were used. About 150 households were taken from 2450 households using simple random sampling techniques for administration of the questionnaires. To examine perception of the agro-pastoralists, a five-point Likert rating scale was employed. Moreover, bi-variate and multi-variate statistical analyses were applied. The results showed that adoption of soil and water conservation technologies of agro-pastoralists is significantly and positively correlated with their perception level on soil erosion (r=.308, p<0.01) and its effect (r=.182, p<0.05). Their perception, related with household head's perception on soil erosion, is positively and significantly correlated with his/her educational status and other factors. The results showed that 35.3, 28.7, 17.3 and 8.7% of sample households are respectively: very low adoption, low adoption, moderate adoption, high adoption; and the remainder are non-adopters. They reported using structural like gabions and bunds and sometimes agronomic methods. Only a few farmers used biological soil conservation methods. Among these methods, soil management methods contour farming and minimum tillage are relatively in wider usage. Factors negatively affecting the farmers' adoption of SWC included gender, age, marital status, number of children, size of farm, credit and land ownership. However, educational attainment of household, off-farm activity, extension, participation on mass SWC campaign, perceived erosion occurrence, livestock wealth and farming experience are positively affecting it. From these factors, statistically significant ones are educational status (at p<0.01), access to extension (at p<0.01) and credit (at p<0.05), off-farm activity (at p<0.05), and land tenancy (at p<0.05), those factors significantly affecting the adoption extent and behavior of agro-pastoral community of the study area.

Key words: Adoption of conservation practices, conservation failures and preferences, demographic factors, flooding, soil and water conservation (SWC) measures.

INTRODUCTION

Land degradation has caused a series of environmental problems for a long period of time throughout the world, because it damages and reduces soil fertility. It has been the causes for soil fertility reduction, food insecurity, depletion of productive resource, influenced individual production capacity, and led to agricultural land deterioration, and decreases in its production (Masebo et al., 2014).

Land degradation is also one of the basic problems the farmers have been facing, which hindered agricultural production and caused food insecurity in Ethiopia (Mengstie, 2009). Although estimates of the extent and rate of soil erosion lack consistency, the results of various studies highlighted the severity of the problem. According to Wood (1990), Kruger et al. (1996) showed that 3.7% (2 million ha) of Ethiopian highlands had been seriously eroded. As Woldeamlak and Sterk (2003) and Bobe (2004), investigated in Ethiopia: about 27 million ha are significantly eroded; 14 million ha are seriously eroded and 2 million ha reached the point of no return with an estimated total loss of about 2 billion meter cube soil per year.

In Ethiopia in general, factors affecting adoption and continued use of soil and water conservation measures are assumed to be less studied (Wogayehu, 2005). The achievement of soil and water conservation measures is below the expectation and the country loses a tremendous amount of fertile topsoil, and threat of soil degradation is alarmingly broadening (Teklu and Gezahegn, 2003).

As a response to the problem, the country initiated urgent intervention strategies through the program of Land Resource Management; which includes soil and water conservation (SWC), sustainable soil and water conservation, and forest resource conservation. Land resource management has received special attention in recent years, particularly for use of integrated Soil and Water Conservation strategies. These strategies were classified as: Structural (mechanical) measures and Agronomic measures/Vegetative measures (Mekuria 2005; Mitiku et al., 2006).

The success and sustainability of soil conservation intervention depends on clear understanding of causes and extent of soil degradation, implementation of appropriate soil and water conservation technologies and involvement of farmers on designing and implementation, and factors that favor adoption and use of soil and water conservation technology (Kessler, 2006).

In this regard, only a few studies have been conducted in the country (Belay, 1992; Yeraswork, 2000; Atakiltie, 2003; Wogayehu and Lars, 2003; Woldeamlak and Sterk, 2003; Amsalu and Graaff, 2007; Atnafe et al., 2015). They were conducted in different parts of the country (most of them were confined to the northern part of Ethiopia) but no study has been conducted in the study area regarding this. Most of them emphasized such topics as identification of types of soil and water conservation technologies, limited factors affecting adoption of soil and water conservation technologies (Morgan, 2005).

Several interventions and programs were made in SWC and several areas have been covered with Structural SWCTs (Tesfaye, 2008). However, the SWC technologies are low because of the approaches and adoption behaviors of the farmers to transfer and development of SWCM (Shiferaw and Holden, 1999, Teklu and Gezahegn, 2003, Amsalu and Graaff, 2007). The effectiveness of LRM Efforts made and SWCTs used were also below expected due to less emphasis given for factors affecting adoption and use of Soil and Water Conservation measures, less consideration of farmer's attitudes, perception and needs towards SWCMs, and the expansion of SWCMs was without sufficient knowledge of farmer's adoption behavior among others (Wogayehu, 2005).

In Aba'ala, since the 1990s, different soil and water conservation technologies were introduced in agricultural development intervention programs, which involved the mass mobilization of the peasant association with its huge labor force. However, only a few of them were effective and productive due to the following issues: continuous soil erosion, damage of public properties in soil erosion, low agricultural productivity, and profitability of introduced SWCM (Solomon and Abebe, 2012).

The diversion of flood water into the arable lands has enabled agro-pastoralists to produce late maturing crops. This practice plays a key role in alleviating the existing moisture stress problems. However, this traditional flood diversion practice is labor intensive, requires frequent maintenance and usually the flood resources are underutilized as the agro-pastoralists divert (Ibid).

Adoption of simple and cheap technologies for flood diversion structures (gabions) rather than using traditional practices are preferable and adapted to the local soil and weather situations (Solomon and Abebe, 2012). This all implies that development and transfer of LRM technologies need multiple approaches, and profitable LRMPs, alternative strategies to develop and transfer the technologies, and adoption and use of SWC measures in an integrated manner.

Objectives of the study

General objective

The general objective of the study was to assess the agro-pastorals' adoption of soil and water conservation

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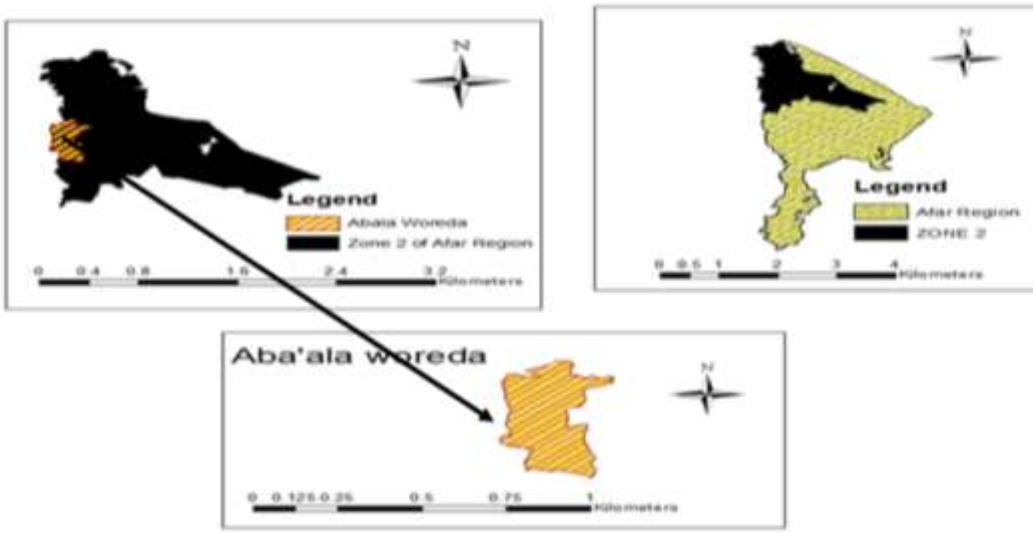

Figure 1. Locational map of the area.

technologies in Aba’ala district**.**

Specific objectives

The specific objectives of the study are:

(1) Examining the perception of agro-pastoralists’ opinions on soil erosion and its causes and effects.
(2) Assessing soil and water conservation technologies being used in the study area.
(3) Identifying and describing the extent of soil and water conservation measures that are used, failures and preferences by the agro-pastoralists.
(4) Identifying the factors that affect agro-pastoralists’ decisions on use of SWC strategies.

METHODOLOGY

General description of the study area

Physical, socio- economic and demographic characteristics of the study area

Aba’ala is located in the Afar regional state. Geographically, it is located at 13°22′N 39°45′E coordinates. It is one of the Woreda’s in the Afar Regional state of Ethiopia in zone 2 administration. It is located at the base of the eastern escarpment of the Ethiopian highlands, and bordered on the south by Megale, in the west by the Tigray Region, in the north by Berhale, in the northeast by Afdera, and in the east by Erebti. The woreda has 11 administrative kebelles (Figure 1).

Aba’ala has an aerial coverage of 1700 km^2 and from this one third is floodplain, with the remaining area being higher, hilly, and mountainous. May-Shugala and May Aba’ala are the main perennial rivers that supply water to the area. Murga and Liena are also large seasonal rivers found in the area (Solomon and Abebe, 2012). The area is a semi-arid type of climate and receiving bimodal rainfall patterns. The long rains usually occur from mid-June to mid-September, while the short rains usually come in March and April. Mean annual rainfall varies between 150 and 500 mm and the amount and reliability declines from west to east (Diress et al., 1998; Net Consult P.L.C., 2005). The rainfall intensity is usually high leading to short lived high runoff volume, and this coupled with a high evaporation rate makes the rainfall insufficient for crop production. Therefore, the agro-pastoralists in the Woreda in general, and at the Aba’ala plain in particular, depend highly on the flood water coming from the highlands of the Tigray region to produce crops (Ibid).

Generally, the area is hot with high diurnal temperature, and experiences severe heat during the dry period (May to June) with the maximum of 33 ^{0}C; and a minimum of 11.6 ^{0}C temperatures typically in June and November (Net Consult PLC, 2005). The three main land use types found in Aba’ala are cultivation, grazing and settlement. The plain is covered by woody bush dominated with many trees and shrubs (Diress et al., 1998). Subsistence crops are common, but cash crops, including cotton, oilseeds and in some areas vegetables, are also grown (Solomon and Abebe, 2012).

Currently, the economy of the Aba’ala plain people is predominantly agro-pastoralism, whereby both livestock and crop production are practiced jointly (Solomon and Abebe, 2012). Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this Woreda has a total population of 37,963, of whom 20,486 are men and 17,477 women.

Research design/approach

In this study, a convergent parallel mixed design was applied as Tashakkori and Teddlie (1998) illustrate, which has been effective for the last 20 years. A mixed research design is a procedure for collecting, analyzing, and interpretation of both quantitative and qualitative data in a single study to investigate a research problem

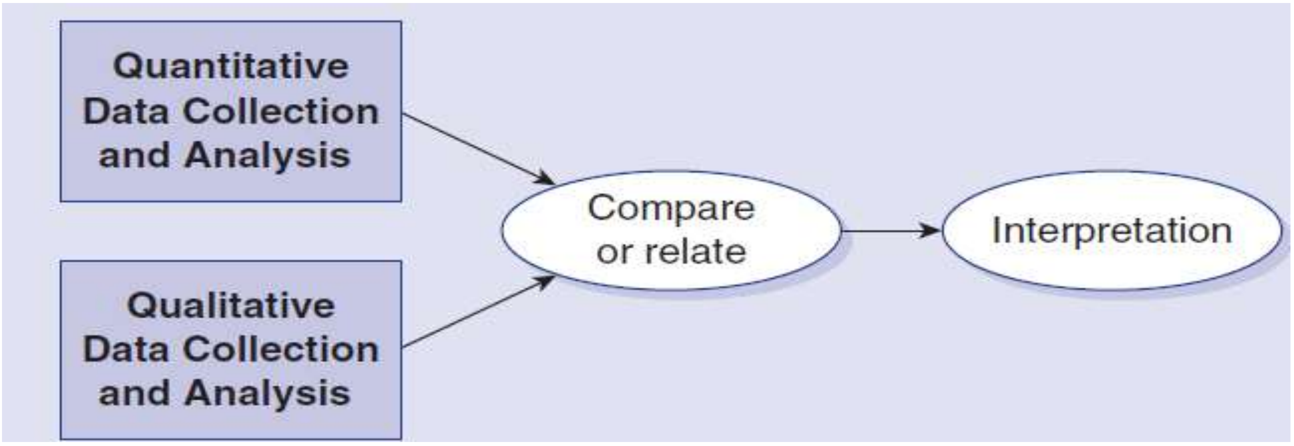

Figure 2. Convergent parallel mixed design.
Source: http://www.fischlerschool.nova.edu/appliedresearch/procedures_and_resources.

(Figure 2).

Data sources and method of data collection

Primary data was collected from land user, rural development agents, Woreda soil and water conservation experts and kebelle leaders. Secondary data was obtained from the reports, books, journals, and documents from offices of Agricultural Development and Water Resources, Land and Environmental Protection at Zonal, Woreda and kebelle level.

An important method of primary data collection for this study was critical field observation, structured interviews, formal group discussions, and a questionnaire. The questionnaire was first pre-tested and some modifications were made, before the administration of the formal survey.

Sample size and sampling techniques

The study area was selected by purposive sampling, because it is seriously affected by soil erosion in Afar Region and represents a locality where there is different soil and water conservation efforts that are carried out. From 11 kebelles in the Woreda, five lowland/plain kebelles of spate irrigation area was purposively selected as sample kebelles. The total household heads who engaged in the agricultural activities are estimated after each kebelle population is assessed by the following formula. The required sample size was determined using a simplified formula provided by Yamane (1967), as follows:

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

Where 'n' is number of representative samples to be taken for the study, 'N' is total population from which samples will be taken and 'e' is the error to be considered i.e. level of precision (9%).

If the population is small then the sample size can be reduced slightly. The sample size (n_0) can thus be adjusted using the corrected formulae:

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

Where n is the sample size, N is the population size and n_o is calculated sample size for infinite population.

This formula was applied for the total households of the five kebelles, and by its use the total samples were determined. Totally, about 150 households were taken from 2450 households of the area (Table 1). The households in the sample kebelles were taken by simple random sampling techniques as shown in Figure 3.

Methods of data analysis and interpretation

Both qualitative and quantitative data analysis and interpretation were carried out. Qualitative primary data was analyzed by using qualitative techniques (verbal description). First, it was collected, identified, organized and compiled into a short form and categorized into different themes and finally discussed. Quantitative primary data were categorized, classified, tabulated, coded and entered into a computer for analysis. For analysis, SPSS v. 20 was employed. In this case frequency and descriptive statistical analysis has been carried out through cross tabulation whereby percentages, means, medians and standard deviations were computed. To examine perception of agro-pastoralists, five-point Likert rating scales were employed. Moreover, bi-variate and multi-variate statistical analysis has been done. The uni-variate analysis provides simply descriptive statistics of key factors that influence adoption of soil and water conservation methods. In the bi-variate analysis, correlations were employed to test the association between the dependent and the independent variables. The multivariate analysis simultaneously examines the impact of many variables on probability to adopt soil and water conservation methods. In this regard, multinomial logistic models were employed to analyze the overall influence of independent variables on dependent variables. Hosmer and Lemeshow (1989) have pointed out that the logistic distribution has an advantage over the others in the analysis of a dichotomous dependent variable. It is extremely flexible, relatively simple from mathematical point of view and lends itself to a

Table 1. Statistics of five selected Kebelle administrations.

Name	Livelihood	N	n	n_o
Arkudi	Agro-pastoral	451	96.7	25
Hidmo	Agro-pastoral	348	91	23
Wakrigubi (town)	Agro-pastoral	498	99.6	30
Adi-haremele	Agro-pastoral	621	103.5	42
Assengola	Agro-pastoral	532	103.3	32
Total	2450	-	-	150

Source: Central Statistics Agency Report (2008).
Note: N = total number of household heads, n = number of sample households.

meaningful interpretation by using both *t* and *f-test*.

RESULTS AND DISCUSSION

Demographic and socio-economic analysis

Age-gender characteristics

From the sampled households, 85.3% were male-headed households and 14.7% were female- headed households. Females were family-headed when their husband was no longer present due to divorce, died, or migrated from their original residences, and for other related reasons. The interview showed us, most of the females who are household heads manage their land through share cropping or renting to families with male household heads and contract with other men from Tigray highland to plough. As shown in Figure 4, about 46.26% of the population was in the 36 to 50 age level, and was followed by 36.73% of household heads in the 18 to 35 age level. This indicates that a large number of household heads are in the medium and younger age groups. However, the other 17% of respondents lie in the age of 51 to 64 and above. These farmers, especially the elderly age groups, usually implemented and accepted soil and water conservation practices, because they have access to money for rented oxen as well as hired labor provided by the younger age group. However, the proportion of elderly people and young farmers was an age group in which labor shortage can be a hindrance to practicing soil-water conservation measures (Addisu, 2011).

Household size

The number of children in each family is shown in Figure 5. By its nature, soil and water conservation structure is labor intensive; and households with larger household size make a decision to retain structures. However, families with only a large household size fail to make decision to maintain and retain conservation structures. In most Ethiopian rural areas, the main sources of labor are the family members, including wife and children (Shiferaw et al., 2007). As shown in Figure 5, 51.33, 34.67% and 14% percent of the sample household have more than 5 children, 3-4 children and 1-2 children, respectively. The area has an advantage to adopt SWC technologies. Similarly, the finding of Habtamu (2006) in Hadiya zone on adoption of physical soil and water conservation structure supports this conclusion.

Educational status

The educational status of the respondents is presented in Table 2. The study has identified four educational levels in the study district:

(1) Illiterate
(2) Can read and write/primary education
(3) Secondary schooling, and
(4) Further education (diploma and above).

From Table 2 it is apparent that 46% of the household heads had no formal education and/or illiterate, 35.3% of the respondents had a primary education, 10.7% completed secondary schooling, and only 8.0 % pursued further education. Most of the farmer household heads in the study area were not educated; because of this, they have little information about newly introduced SWC practices. Similarly, in the finding of *Koga* watershed (highlands of Ethiopia), and *Goromti* watershed, as shown by Mengstie (2009) and Addisu (2011) educated households have more informed perceptions about soil erosion problems, SWC, and conservation activities.

Land holding and tenancy

Land distribution in the Woreda was undertaken 40 years ago during the reign of Emperor Haileselassie and since then no land distribution has been undertaken. The Afar and Tigrian agro-pastoralists are the owners of the cultivated land (Solomon and Abebe, 2012).

The result as shown in Table 3 is 67.3% have below 1 ha, 25.3% have 1 to 5 ha, and the remaining 4% have 6 to 10 ha. Similarly, more soil and water conservation practices were practiced on larger plots as the farmers have more flexibility in their decision making, greater access to discretionary resources, more opportunity to use new practice of SWC structures and have more ability to deal with the risk that takes place on their farm land.

Similarly according to Habtamu (2014), as land is further fragmented, it becomes uneconomical in size and

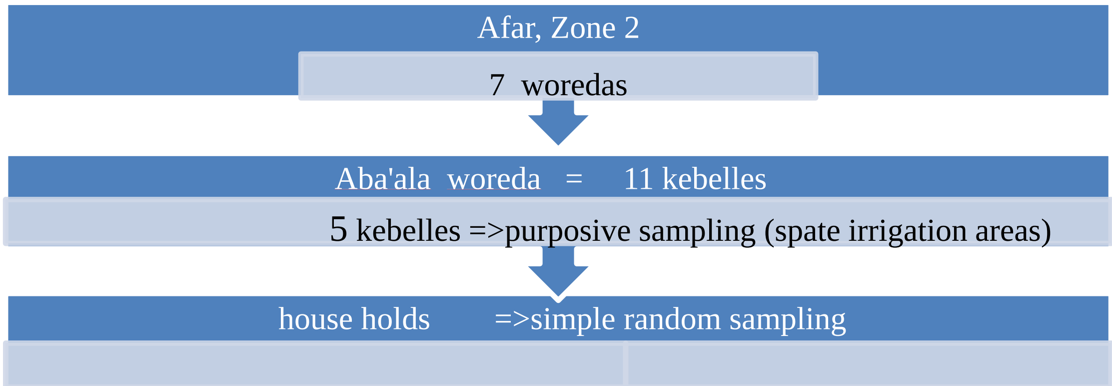

Figure 3. Sampling plan.

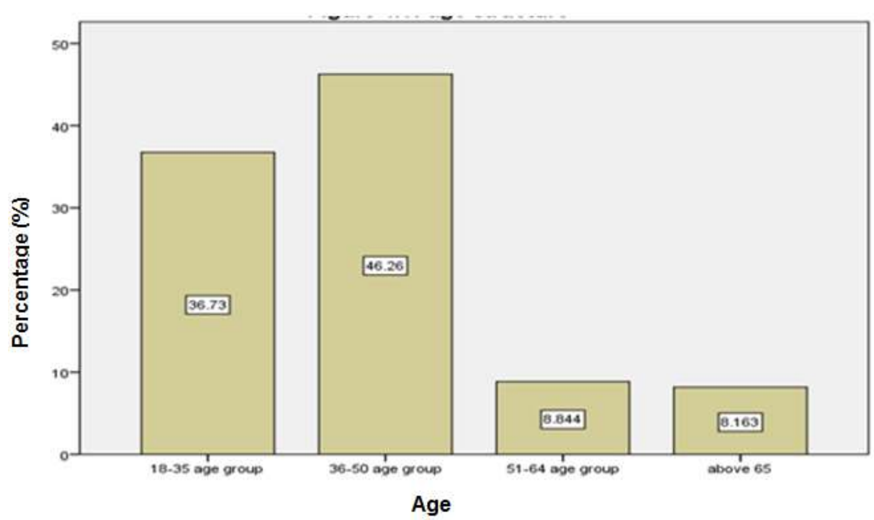

Figure 4. Age structure of respondents.

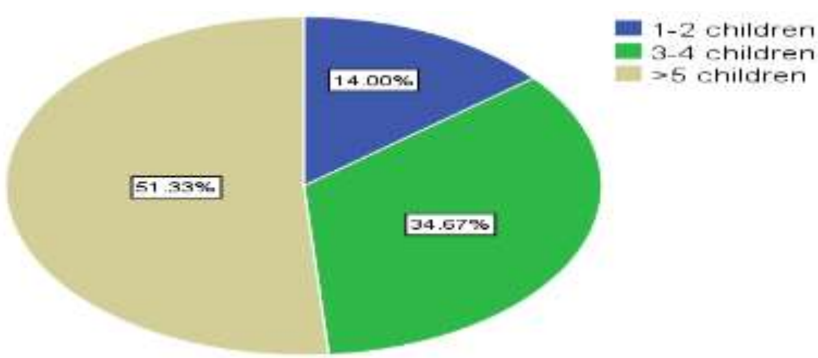

Figure 5. Number of children in a family.

left with little room for implementing structural soil and water conservation measures. Land size and practice of structural soil conservation measures have a strong positive relationship. The small farm-size holders may

Table 2. Educational status of respondents.

Education category	Frequency	Percentage
Illiterate	69	46.0
Primary education	53	35.3
Secondary education	16	10.7
Further education	12	8.0
Total	150	100.0

Source:-Field survey (2016).

Table 3. Farm land size of household.

Land size in hectare		Frequency	Percentage
Valid	Below one ha	101	67.3
	1 up to 5 ha	38	25.3
	6 up to 10 ha	6	4.0
	Total	145	96.7
Missing	-	5	3.3
Total		150	100.0

Source: Field survey (2016).

have negative attitudes towards structural soil and water conservation measures. These farmers lack trust on structural soil-water conservation measures as they only participated poorly in the planning and designing of the soil and water conservation program. Hence, farmers fear loss of land during the construction of soil bunds, terraces, and check dams.

On the other hand, in Aba'ala many farmers operate a land received on a *sharecropping* basis and *renting* of land, as interview evidence from focus group discussions with farmers show. Sharecropping is on an *in and out* arrangement. As interviewed farmers reflected in their narrative, many of crop growers are on sharecropping out basis. This highly affected their behavior of adoption of soil and water conservation technologies. The survey result of this study also showed that 96 (64%) farmers among 150 respondents own their land, while 54 (36%) do not have their own farmland.

Land characteristics

In the results obtained on soil characteristics (Table 4), about 88% of respondents stated that their soil is low in fertility, and the remaining ones report that they have infertile soil for any agricultural activities. Whereas 41.3% of the respondents said their soil fertility is medium; the others (24.0%) and 22.7% reported that their soil is low and high in its fertility. On the other hand, 70.7% of surveyed soil is on a level topography (gentle slope) and the remaining 29.3% soil is on sloppy land. As observation results show, most of these sloppy lands are toward the highland and escarpments of Tigray highlands. The study done by Demeke (2003) showed that the practice of constructing bunds on plots that is flat and not susceptible to erosion is criticized by farmers, because they may suspect that it can result in a water logging problem on the field, which is similar to findings in this study.

Access to extension service

As shown in Demeke (2003), it is a recognized fact that the diffusion of information on improved technological alternatives is an important element that contributes positively for the adoption and sustained use of a given technology. Unless there is an adequate mechanism for transmitting information, the adoption of any new agricultural practice would not be successful. Lack of relevant and timely information can prevent a widespread adoption of new technologies. In the study area, unlike the others, the widely used means of disseminating information through public extension service is very low. Similarly, in the findings of the research study reported here, about 68% of farmers did not get this service; while the remaining 32% did. There is also a positive and significant correlation between access to extension service and adoption of the technologies ($p < 0.01$).

Economy and wealth

Table 5 indicates that most of surveyed household (86%) engage in both crop production and livestock ranching, and 10% depend only on crop production. The results of the field survey and interview indicate that keeping livestock is an important component of the farming system in the study area. A vast majority of the sample households included in this survey own dominantly camels, cattle, sheep or goats and a few donkeys. The size of livestock owned indicates the wealth status of the household in the study area (in long Afar culture). A large number of sample households (98 of 145) own 1-20 livestock and 31 of 145 households own 21 to 60 of livestock, and only 6 household from among 145 own more than 60 livestock in TLU; while the other 10 respondent do not have livestock. This is also reported by Solomon and Abebe (2012), as livestock production is an important livelihood for agro-pastoralists and pastoralist communities.

In addition, about 32% of the farmers in the study area have engaged in off-farm activities. As the survey results show, most of these farmers are governmental and NGO workers and some private business workers. As it was depicted in Table 5, most of the farmers (72.0%) have no

Table 4. Soil fertility.

Land fertility level		Frequency	Valid percentage (%)	Cumulative percentage
Valid	High	34	22.7	22.7
	Medium	62	41.3	64.0
	Low	36	24.0	88.0
	Infertile	18	12.0	100.0
	Total	150	100.0	-

Source: Field survey (2016).

Table 5. Economic status of respondents.

Items	Category		Frequency	Percentage
Livelihood	Valid	Crop production	15	10.0
		Mixed farming	129	86.0
		Total	144	96.0
	Missing	77.00	6	4.0
	Total		150	100.0
Livestock in TLU	Valid	No livestock	10	8.0
		1-20 livestock	98	64.0
		21-40 livestock	31	20.7
	Missing	61-100 livestock	6	4.0
		Total	145	96.7
	Total		150	100.0
Off-farm employment	Valid	No off-farm employment	102	68.0
		Have off-farm employment	48	32.0
		Total	150	100.0
Access to credit	Valid	Enough access	0	0.0
		Somewhat enough access	5	1.3
		Not enough access	33	22.0
		No access at all	109	72.7
		Total	144	96.0
	Missing	77.00	6	4.0
	Total		150	100.0

Source: Field survey (2016).

access to credit at all, 22.0 % have access but not enough and few of them (1.3%) have somewhat enough access to credit. This generally indicated to us that the farmers in the study area have no, or very little, access to credit; which can be one of the factors that led to very little investment in soil and water conservation technologies. Similarly according to the finding of Solomon and Abebe (2012), rural households in developing countries lack adequate access to credit. This in turn impinges a significant negative impact on technology adoption, agricultural productivity, nutrition, health, and overall household welfare (Diagne and Zeller, 2001; Wogayehu and Lars, 2003).

Agro-Pastoralists' perception of soil erosion

Understanding farmers' perception of soil erosion and its impact is important in promoting soil and water conservation technologies (Chizana et al., 2006). Soil erosion is an insidious and slow process therefore farmers need to perceive its severity and the associated yield loss before they can consider implementing soil and water conservation practices (Table 6). Data in Table 6 depicted that the adopting and not adopting probability of the agro-pastoralists was significantly related with their knowledge on erosion ($r = 0.196$, $p < 0.05$). The adoption probability increases with the increasing perception level

Table 6. Perception of agro-pastoral community on soil erosion.

Variable		ADOPT	ADOPEXT	Eroknow	Erocause	Eroeffect	PEROSUM
ADOPT	Pearson correlation	1	0.578**	0.196*	0.021	0.102	0.129
	Sig. (2-tailed)	-	0.000	0.016	0.798	0.213	0.115
ADOPEXT	Pearson correlation	0.578**	1	0.308**	0.096	0.182*	0.237**
	Sig. (2-tailed)	0.000	-	0.000	0.244	0.026	0.003
Eroknow	Pearson correlation	0.196*	0.308**	1	0.465**	0.599**	0.835**
	Sig. (2-tailed)	0.016	0.000	-	0.000	0.000	0.000
Erocause	Pearson correlation	0.021	0.096	0.465**	1	0.523**	0.802**
	Sig. (2-tailed)	0.798	0.244	0.000		0.000	0.000
Eroeffect	Pearson correlation	0.102	0.182*	0.599**	0.523**	1	0.847**
	Sig. (2-tailed)	0.213	0.026	0.000	0.000		0.000
PEROSUM	Pearson correlation	0.129	0.237**	0.835**	0.802**	0.847**	1
	Sig. (2-tailed)	0.115	0.003	0.000	0.000	0.000	-

**Correlation is significant at the 0.01 level (2-tailed). Erocause = erosion cause, Eroeffect = erosion effect; * Correlation is significant at the 0.05 level (2-tailed). Eroknow = erosion known; N=150.

of agro-pastoralists about the cause and effects of erosion, but their interrelationship is statistically insignificant (at p = 0.5, and below). Perceiving the importance of the soil erosion problem and positive effect of soil conservation measures also provides a stimulus to, and shapes opinions about, accepting the merits of adopting conservation practices that stop the problem (Long, 2003; Habtamu, 2006). The Pearson product-moment correlation coefficient shows that the extent of adoption of soil and water conservation technologies of agro-pastoralists is significantly and positively correlated with their perception level on soil erosion ($r = 0.308$, $p < 0.01$) and its effect ($r = 0.182$, $p < 0.05$), but positively and insignificantly correlated with agro-pastoralists perception level on cause of erosion. The overall Likert value of farmers' perception on erosion, its cause and effect, are positively and significantly correlated with adoption extent (with r = 0. 237, $p < 0.01$). Hence in the study area, those agro-pastoralists having a better perception on soil erosion use more soil and water conservation techniques, and the reverse is true for those having lower perception on erosion, its cause and effects (Morgan, 2005).

The relationship between agro-pastoralists' perception on erosion and other factors

Table 7 presents the correlation coefficients for the relationship of the agro-pastoralists' perception on erosion with 13 other factors. As presented in Table 7, Pearson product-moment correlation coefficients show that the age, number of children and access to credit are the three factors negatively and significantly correlated with the respondents' perceptions at $p < 0.1$, and their marital status, land security, size of farm and number of livestock are insignificantly affecting the agro-pastoralists' perception on erosion. However, household head's perception on soil erosion is positively and significantly correlated with his/her educational status, participation on soil and water conservation campaign and access to extension and training (at $p<0.01$). Similar results are reported by Detamo (2011) for the relationship between education and perception of farmers; namely, that illiterate farmers differ in perceiving the soil erosion problem compared with educated farmers, and uneducated farmers are likely to differ in practicing soil conservation measures compared with educated farmers. On the other hand, gender, off-farm activity and farming experience are positively, but insignificantly, interrelated with their perception on erosion.

Soil and water conservation measures

Practices of soil and water conservation in the study area

Until 1995, the Aba'ala Woreda remained unexposed to any sort of development activity supported by external donors. However, in 1995 the Dryland Husbandry Project (DHP) was initiated and later in 1998 the Afar Integrated Pastoral Development Program (AIPDP) began a pilot phase in Aba'ala Woreda. The agro-pastoralists, while they have a wealth of knowledge on water sharing, they have no experience in field-level soil moisture conservation as well as agronomy. They did not practice

Table 7. Factors related to agro-pastoralists' perception on soil erosion.

Variable		PEROSUM	GEN	Age	MARST	EDUC	Children	Of farm	Lantenur	FM size	Partcamp	Accredit	Extension	Fertility	Livestock
	Pearson correlation	1	0.135	-0.361**	-0.048	0.649**	-0.264**	0.104	-0.154	-0.159	0.230**	-0.550**	0.276**	0.069	-0.059
PEROSUM	Sig. (2-tailed)	-	0.101	0.000	0.563	0.000	0.001	0.205	0.060	0.056	0.005	0.000	0.001	0.400	0.473
	N	150	150	147	147	150	150	150	150	145	147	144	150	150	150

**Note: Gen= gender, AGE= age, MARST= marital status, EDUC= educational status, FMSIZE=family size, PEROSUM = person sum, OFFARM = farm size.

intercropping and their fields have no field bunds (Solomon and Abebe, 2012).

As the amount and distribution of rainfall over the growing period of long season crops is very low, the crops planted in the lowland areas of Aba'ala valley, particularly sorghum and maize, suffer from moisture stress during the later stages of growth (from seed filling to full maturity). To overcome this problem, people traditionally divert flood water to use as supplementary irrigation.

Spate irrigation is a type of river basin water management that is unique to semi-arid environments. In spate irrigation systems, floods that are generated by heavy rainfall in upper sub-basins can be diverted from normally dry wadis (ephemeral streams) and distributed using earthen, brushwood or concrete structures to irrigate low-lying fields.

Traditionally, floods are diverted using a temporary diversion structure made of tree branches, soil and stone. This flood is delivered using open channels which are dug both at the left and right banks of the river as intake, which is reinforced by stones, boulders, shrubs and logs.

The agro-pastoral people living within the Aba'ala plains faced difficulties in diverting the flood water before the modernization program of creating a diversion structure by AIPDP. The traditional means of diversion demands cutting trees and frequent maintenance of the structures. In order to support the community effort to divert flood water, under AIPDP in 2007-2009, flood water diversion was designed and implemented using gabions in four of the rivers (Aba'ala, May-Shugala, Murga and Leina rivers) that drain to the Aba'ala plain. But, nowadays, this program is not serving the community.

Analysis of current adoption and failure

As depicted in Table 8, 74% of the farmers adopted and used SWC techniques on their farmland and the other 7.3% have stopped using any of SWC techniques. The remaining 18.7% of agro-pastoralists did not adopt any of SWC measure, so far. However, the researcher assumes that an agro-pastoralist who applied any measure including contour plowing is included in the study as adopted farmers. This poor adoption and use of SWC measures in the study area can be more fully understood in relation to the 'theoretical and conceptual frame' presented below.

Extent of adoption of SWC measures in the study area

Theoretical and conceptual frame

According to Semgalawe (1998), adoption of soil conservation technologies has been described based on varied criteria. These include type of conservation practices; number of conservation practices and land area under conservation measures. In this research, the first two criteria are used to describe adoption of SWC practices of the study area.

Hence, the designation of Very high adoption applied at least to two of the three SWC (physical, biological and soil management SWC) techniques. The category of High adoption applied to only one of the three SWC techniques, Moderate adoption, was found for at least one type of SWC technique, Low adoption applied to more than one type of SWC measures, while Very low adoption applied to only one type of SWC techniques. As the result showed in Table 9, 33.3% are under *very low adoption*, and 22.0% are under *low adoption* (Table 9).

The people did not experience practicing all three types of SWC methods on their land. They experienced mostly structural changes such as gabions and bunds, and agronomic methods such as fallowing. Biological soil conservation methods were practiced by some farmers, but they almost stopped using this nowadays. This is because they lacked a possibility to apply the measures like water shortage for composting and manure, as some farmers reported.

The study on practice of spate irrigation in the area by AIPDP by Solomon and Abebe (2012)

Table 8. Agro-pastoralist adoption of soil and water conservation measures

Variable	Frequency	Percentage
Did not adopted any SWC measure	28	18.7
Adopted and using SWC measures	111	74.0
Stopped using all SWC measures	11	7.3
Total	150	100.0

Table 9. Adoption extent of SWC techniques in the study area.

Adoption extent		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Not adopted	28	18.7	18.7	18.7
	High adoption	13	8.7	8.7	27.3
	Moderate adoption	26	17.3	17.3	44.7
	Low adoption	33	22.0	22.0	66.7
	very low adoption	50	33.3	33.3	100.0
	Total	150	100.0	100.0	-

showed that, although agro-pastoralists have a knowledge on water sharing, they have no experience in field-level soil moisture conservation as well as agronomy. As discussions with respondents in this study showed, there is no wide use of different biological, agronomic and soil management techniques in the area. They did not have widely organized governmental programs on this issue.

What are the major SWC techniques used in the area?

Generally, in the study area, relatively, structural soil and water conservations are used in arresting soil erosion and river flooding by water prevailing in the area. The practiced structural soil and water conservations measure practiced in Aba'alla district are presented in Table 10 and discussed more fully in the subsequent sections below.

Structural SWC measures

Gabion structures

As shown in Table 10, most of the respondents used Gabion structures and contour bunds. Gabion baskets which are designed to serve for a design period of 5 to 10 years were constructed in the Aba'ala River to improve the flood diversion efficiency and minimize the challenges faced with traditional diversion systems by AIPD in 2009 (Figure 6). In addition to this, the farmers reasoned out that they use these structures mainly because of the availability of construction materials locally.

Bunds, terraces and panya juu

The use of stone bund is still common in the study site. About 52 farmers replied that mostly farmers used stone bunds and a few farmers practice panyajuu, Bench terraces and Half-moons.

Furrows and ditch

Ditches or water ways and furrows are mostly used by farmers during flooding and water diversion to their field through tertiary canals. It is being used as a main diversion structure of flooding and discharge water around towns.

Fencing and area closure

About 30 households responded that they use fencing. As the field observation by researchers showed, the farmers use fencing in order to bound their irrigation land and to keep the safety of the crops.

Biological/Agronomic SWC measures

Agro-forestry, Mulching, Composting, Manure, Strip cropping and fallowing: As Table 10 indicates, these

SWC methods were almost not in use currently, except

Table 10. Types of SWC technologies used by respondents.

Item	Responder response (frequency)		
What types of SWC technologies you use?	**Using at present**	**Used sometimes in the past**	**Total usage**
Contour bund	34	4	48
Earthen bund	5	10	15
Stone bund	42	6	48
Gabions/check dams	86	7	93
Panya juu	23	8	31
Half moon	3	6	9
Mulching	2	18	20
Manure	2	5	7
Composting	-	6	6
Bench terraces	6	-	6
Crop residue	23	38	51
Crop rotation	22	11	33
Strip farming/cropping	-	6	6
Multiple cropping	-	-	-
Contour plowing	43	-	41
Fencing	30	5	35
Area closure	2	-	2
furrow	4	7	11
Water ways/ditch	11	2	13
Agro-forestry	-	3	3
Planting basins/ pitting	-	-	-
Fallowing	31	-	31
Minimum tillage	14	3	17

for fallowing to simply use the rest for farmland, rather than bothering to grow fallow crops.

Soil management methods: This method is concerned with ways of preparing the soil to promote dense vegetative growth and improve the soil structure so that it is more resistant to erosion.

Conservation tillage (Contour plowing/tillage, ridging and minimum tillage) and Crop rotation: Contour farming and minimum tillage are relatively in wider usage by the agro-pastoral community in the study area. Some of the farmers also use crop rotation methods. The survey result also showed that some agro-pastoralists even do not have the knowhow about when and how to plow the land. About 43% of respondents plow their land when they decide to plow, 32% plow only when it is needed, 21% plow pre-irrigation and 4% did not know it.

Preference and failure: The farmers prefer SWC technology like stone gabions, bunds, soil bunds fallowing/giving rest, contour plow and the likes. Among the aforementioned listed factors, the farmers' preference is slightly different through type of technologies they use. The most dominant factors that lead them to prefer the technologies are their easiness to use, cost creepiness, and peoples' appreciation. In addition to these, data in Table 10 shows that some agro-pastoralists stopped using some technologies and chose some others (7.3%). The factors for the failure can be seen as lack of money to invest, its difficulty to apply and keep.

Factors affecting farmers decision to adopt of soil and water conservation: There are different demographic, socio-economic, institutional and biophysical factors which affected the adoption decision of farmers in the study area.

Demographic factors

Rogers (1995) stated that the characteristics of a given technology are important determinants of adoption. In addition, the characteristics of the farmers such as age,

Figure 6. Improved Gabion basket for river diversion (Solomon and Abebe, 2012).

household size, farm size, education, experience and the farming enterprises are factors that influence the adoption decision.

From among the demographic factors, educational status is the most important positively correlated factor affecting the probability of farmers' adoption of SWC technologies significantly (r = 0.0258, $p < 0.01$). Exposure to education may enhance the awareness of a new technology and increase the capacity of the farmers to apply a given technology. This is similar with the finding of Ntege-Nanyeenya et al. (1997) and Nkonya. (2002) in the case of Uganda where they reported that education had a significant effect on farmers' choice to adopt maize production technologies.

The results of this study findings show that age negatively, but insignificantly, affected the adoption. This is also similar with the study done by Lapar and Pandey (1999) for Philippines, Shiferaw and Holden (1999), for Ethiopia and Featherstone and Goodwin (1993) for USA. They reported that farmer's age is negatively related to adoption of soil conservation practices. Similar results have been reported for the factors of gender, number of children and marital status of households. But, the size of the household has been identified to positively influence the rate of fertilizer adoption in Eastern Oromia, and the probability of adopting of improved fallow in Zambia (Keil, 2001).

Farming experience can also determine a farmers' awareness and interest in a given technology and their ability to implement it. In a study conducted in Northern Tanzania, farming experience was the most important factor positively affecting the probability of adoption of improved maize seed (Nkonya, 2002). Similarly, our study showed that farming experience is positively significant with adoption at $p < 0.05$.

Socio-economic factors

The findings that socio economic factors affect the decision of farmers on SWC, and determine households' interest and acceptance to use conservation practices, are supported by diffusion of innovation schools opened up in the area for adoption and human behaviors (Rogers, 1995). The survey results of this study indicate that socio-economic level, perception of erosion occurrence, farm experience and non-farm income have positive influence, whereas farm size and livestock owned have negative influence, on adoption of soil and water conservation in the study area; but their effect is statistically insignificant at the 0.05 level.

Institutional factors

The farmers' participation in the SWC campaign, access to agricultural extension services and training on land security are factors considered in this study. Access to agricultural extension services is necessary to provide information and enhance the knowledge and skills of farmers. The information obtained and the knowledge and skills gained through training accelerates farmer's decision to adopt soil and water conservation practices.

As this survey showed most of the farmers did not get extension service advice. There is also a positive and significant correlation between access to extension service and adoption of SWC technologies ($p < 0.05$). This result is similar with finding of Semgalawe (1998), Tesfaye (2003), Wogayehu and Lars (2003) and Yitayal (2004) for households that have access to institutional support such as extension services, soil and water conservation program, access to subsidized inputs, information and better understanding of the land degradation problem, and soil conservation practices.

Households that participate in labor sharing groups through soil and water conservation programs like, in our case, participation on a mass SWC campaign, are expected to have more knowledge, affection and get more incentives to adopt conservation measures than others. As described previously, the agro-pastoralists participation on this campaign is very low. But it positively affects the adoption behavior of the farmers, although its correlation is insignificant.

The land tenure pattern of the nation also affects the decision of farmers on soil and water conservation practices, but in this study its correlation with adoption extent is negative and significant ($p < 0.05$). The incentives given by external organizations to farmers through food for work either encourages, or sometimes discourages, farmers to use improved soil and water conservation measures.

Physical factors

The result of the finding showed that physical factors such as topography (slope) and soil fertility had no significant effect on the adoption of soil and water conservation. However, their relationship is positive for those farmers having fertile soil and gentler slope, and farmers having steeper and less fertile soil tend to adopt more technologies.

Conclusions

The study aimed at accessing agro-pastoralists' adoption of soil and water conservation measures in Aba'alla Woreda. The study indicated that a large number of household heads are more in the medium and younger age group than elder ones. About 85.3% were male-headed households and 14.7% were female headed households. The finding indicated that 51.33, 34.67 and 14.00% of the sample household have respectively: more than 5 children, 3 to 4 children and 1 to 2 children. About 46 % of the household heads had no formal education or are illiterate, 35.3% of the respondents had a primary education, 10.7% completed secondary schooling, and only 8.0 % pursued further education.

In Aba'ala, many farmers operate a land on a sharecropping basis through renting of land. About 41.3 %, 24.0% and 22.7 % of the respondents' said soil fertility in the area is medium, low and high, respectively. About 68% of farmers did not get extension services, except for the remaining 32% who did. There are also positive and significant correlations between access to extension service and adoption of the technologies ($p < 0.01$).Most of the farmers (72.0%) didn't have access to credit at all.

The probability of the agro-pastoralists' for adopting and not adopting is significantly related with their perception on erosion($r = 0.196$, $p < 0.05$). Specifically, adoption increases with increasing positive perceptions of the cause and effects of erosion, but their interrelationship is statistically insignificant (at $p = 0.5$). Similarly, Pearson correlation coefficients show the extent of adoption of soil and water conservation technologies of agro-pastoralists is significantly and positively correlated with their perception level of the issues with soil erosion ($r = 0.308$, $p<0.01$) and its effect ($r = 0.182$, $p<0.05$).

Pearson correlation coefficients show that the age, number of children and access to credit are factors negatively and significantly correlated ($p < 0.1$) and marital status, land security, size of farm and number of livestock are insignificantly affecting the agro-pastoralists' perceptions on erosion. However, household head's perception on soil erosion is positively and significantly correlated with his/her educational status, participation on soil and water conservation campaigns and access to extension and training ($p < 0.01$). On the other hand, gender, off-farm activity and farming experience are positively interrelated with their perception on erosion.

The use of biological soil conservation methods was practiced by some farmers, but they almost stopped using the technology nowadays. The study indicates agronomic SWC methods currently used were only a few. From these methods, contour farming and minimum tillage are relatively in wider usage by the agro-pastoral community in the study area. Some of the farmers also use crop rotation methods. From among the demographic factors, educational status is the most important positively correlated factor that significantly affected the probability of farmers' adoption of SWC technologies ($r = 0.258$, $p < 0.01$).

Socio-economically, perceptions on erosion problems, farm experience and non-farm income have positive correlations with adoption of SWC, whereas farm size and livestock owned have negative influence on adoption of soil and water conservation in the study area, and their effect is statistically insignificant. There is also a positive and significant correlation between access to extension service and adoption of SWC technologies ($p < 0.05$). The effect of land tenure on adoption extent is negative and significant ($p < 0.05$). Physical factors such as topography (slope) and soil fertility have no significant effect on the adoption of soil and water conservation.

RECOMMENDATIONS

Flood irrigation is the most problematic, if not the most serious, concern. Based on the finding the researchers generated, the following recommendations for the changes are made:

(1) The government should do on the attitude of agro-pastoral peoples to have a good awareness on water sharing, agronomy and soil fertility management.
(2) All of us must do on adoption extent of SWC methods to elucidate the problem.
(3) For agro-pastoral farmers, government must give training on environment and SWC techniques to equip them on the concept and their importance.
(4) To aware farmer's perception on occurrence of erosion problem, through participation of mass SWC campaign which have a positive significant effect on their adoption.
(5) Announcing the farmer and experts on spate irrigation.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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Impact of human activities on biosphere reserve: A case study from Yayu Biosphere Reserve, Southwest Ethiopia

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Little is known on wild animal threats and their relative severity in most biospheres reserves of Ethiopia. This study was conducted during the period of May 2015 to June 2015 and was aimed at documenting relative severity of current threats of Yayu Biosphere Reserve, Southwestern Ethiopia. One hundred farmers in and around Yayu biosphere reserve were interviewed. The most relatively severe threat factors were conversation of land use, deforestation and degradation, grazing, firewood and investments. This study evaluates the degree of pressure and threats from human activities on wild animal in Yayu biosphere reserve. Five Kebeles of Yayu biosphere reserve were randomly selected as representative sample sites, namely Achebo, Wabo, Bondewo, Geji, and Witaetia. Primary data was collected through rapid assessment and prioritization of biosphere reserve designed through semi-structure questionnaire, recommended for evaluation of management effectiveness of biosphere reserve. All sites of biosphere reserves were severely threatened by logging, unsustainable use demand and exploitation of natural resource by the local communities surrounding the biosphere. Thus, these findings emphasize the biogeographical importance of this biosphere reserve within the Biodiversity Hotspot, and the need for more study. With increasing human encroachment at its door-step, it is time for policy makers to upgrade this reserve to a higher level of protection.

Key words: UNESCO, unsustainable use, wild animal threats, Yayu biosphere reserve.

INTRODUCTION

Ethiopia is the largest landlocked country in Africa with an area of 1.13 million kilometer square that is located in the northeast of Africa between 03° 40' and 15° N latitude and 33° and 48° E longitude. The country is one of the top 25 biodiversity-rich countries in the world, and hosts two of the world's 34 biodiversity hotspots, namely; the Eastern Afromontane and the horn of Africa hotspots (EBI, 2014). The altitudinal difference with the highest peak at Ras Dashen (4,620 m above sea level) and the minimum 126 m below sea level in the Afar depression is the main reason that makes Ethiopia one of the very few countries that is rich in biodiversity (EWNHS, 1996; Tefera, 2011;

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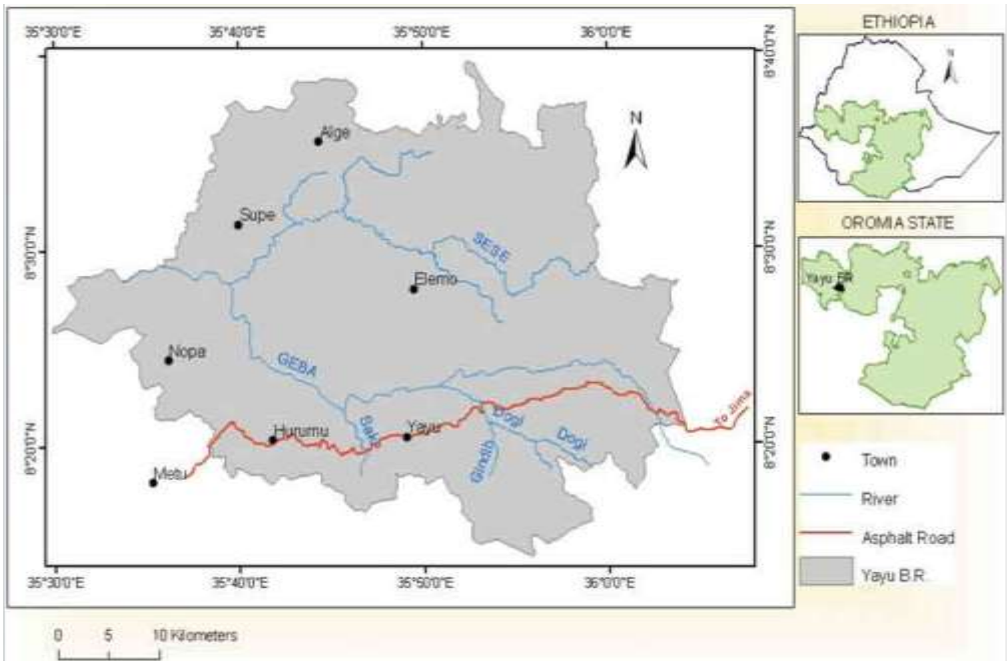

Figure 1. Map of Yayu Biosphere Reserve (Source: UNESCO, 2013).

EBI, 2016). According to the current world network of biosphere reserves there are about 651 biosphere reserves in 120 countries including 15 trans-boundary sites are designated globally (UNESCO, 2013). In the same manner, Ethiopia has four internationally recognized sites namely Kafa biosphere reserve, nominated in 2010, Yayu biosphere reserve nominated in 2010, Sheka biosphere reserve, nominated in 2012 and Lake Tana biosphere reserve nominated in 2015. The country has diverse flora and fauna most of them are endemic. Currently, Ethiopia supporting more than 2,985 described species of animals and 7,000 of higher plant species with 12% endemism, among the fauna 320 are mammals with 36 endemism, 926 birds with 24 endemism, 1,265 arthropods with 21 endemism, 200 fish with 40 endemism, 201 reptiles with 16 endemism and 73 amphibians with 30 endemism many of the biodiversity living in and around the biosphere reserve and critically depend on the reserve for livelihoods (Avibase, 2014; EBI, 2016). This study was designed to evaluate the impact of human activities in wildlife at Yayu biosphere reserve.

MATERIALS AND METHODS

Description of study area

The study was conducted in the Yayu biosphere reserve of south western Ethiopia. It encompasses Hurumu, Yayu, Chora, Nopha, Alge Sachi and Doreni districts, in Illu Abba Bora Zone (8°00′42″ to 8°44′23″ N and 35°20′31″ to 36°18′20″ E) (Figure 1). The biosphere reserve includes eastern Afromontane biodiversity hotspot and important bird areas of international significance and one of remnant montane rainforest fragments with wild Coffee (*Coffea arabica)* populations in the world. The area has an economic strategy that focuses on the environment as an economic driver. Five kebeles namely Witaetia, Achebo, Bondewo, Wabo and Geji located inside Yayu biosphere reserve were incorporated in this project.

The area forms the dispersal area for agriculture and most conducive to livestock grazing, wild animal conservation and tourism. The site covers a total area of 167,021 ha of biodiversity hotspots that has three management zones namely, core zone with (16.6%), buffer zone (12.9%) and transitional zone (70.5%) hectare area (Table 1).

It is special places for harmonious integration of people and nature testing interdisciplinary approaches to understanding and managing changes and interactions between social and ecological systems, including conflict prevention and management of biodiversity. Geba is the biggest river in the area and the great majority of its tributaries drain to the biosphere reserve.

Data collection

Information on the impact of human activities to wild animal threatening factors in Yayu Biosphere Reserve was collected from each kebele of the resident's or local community. This was followed by a deeper inquiring of the opinions of the biosphere reserves rangers on magnitude of each of the threat factors that shade light on their biosphere reserve area using a brief questionnaire. Five kebeles namely Witaetia, Achebo, Bondewo, Wabo, Geji located inside Yayu biosphere reserve hotspots were incorporated in this study. The Yayu Biosphere Reserve field officers information through the questionnaire was considered as knowledgeable in

Table 1. List of zonation for Yayu biosphere reserve.

Zonation of Yayu biosphere reserve in hectare	Area (ha)	Percentage of area
Core Zone	27,733	16.6
Buffer Zone	21,552	12.9
Transition Zone	117,736	70.5
Biosphere Reserve- Total	167,021	100.00

view of their involvement in protected area management over time. Key threats factors were identified from an initial preliminary survey. The officers from each kebele were asked, independent of each other, to rank from one (lowest threat level) to five (highest threat level) from the sorted key factors. At each site of the buffer zone field officers were provided ranks for the threat factors under which they served. Scoring for each threat factor on ordinal scale by field officers was assumed to be adequate for the purpose of assessing status and threat index of each hotspot area. Information were collected on wild animal threats from the five kebeles based on responses to a standardized questionnaire to 100 local people, 5 kebele managers randomly throughout the surveyed hotspot area.

Methods

The basic procedure involves establishing survey stations randomly throughout the various five selected buffer zone of the biosphere reserve. Semi-structured questionnaires were administered to 20 farmers in each of the selected communities who lived in and near to the biosphere reserve. A total of 100 farmers were interviewed with the help of local translator. They were purposively interviewed in different sections of the study area. Group discussion and interview were also made with the Yayu biosphere reserve field officer and rangers who have long experience in the biosphere reserve to collect information regarding anthropogenic factors disturbed wild animals in Yayu biosphere reserve.

Statistical analysis

Statistical analyses were undertaken in SPSS (Version 20) software. Chi-square goodness of fit test and Chi-square cross-tabulation were used to test for differences in responses and relationships among the responses. One-way ANOVA and the post-hoc Tukey test was used to test the differences in the mean quiz scores marks attained among the different groups of farmers. According to Kiringe and Okello (2007) a tally of the threat factors mentioned for each selected buffer zone of the biosphere was computed, and the proportion of the sum of the threat factors in each buffer zone of the total (identified by preliminary survey) was considered a measure of the sites of the biosphere reserve susceptibility index (PASI) to the threat factors. The following was calculated as indicators of how serious a threat factor was against wild animal within the Yayu biosphere reserve, and vulnerability of biosphere reserve to these threats: Mean score of each threat factor = (Sum of all the scores for that particular threat factor) / (the total number of respondents). Relative threat factor severity index, RTFSI = (The mean score for a particular threat factor) / (The maximum possible score). Biosphere reserve relative threatened index, BRRTI = (Total score of the threat factors from the interviewed officers of the biosphere reserve) / (Total responses). The relationship of each of the threat factors with the biosphere reserve relative threatened index (BRRTI) was determined by performing a non-parametric Spearman Rank Correlations (Zar, 1999) to determine key threat factors that influence the threat vulnerability of the areas. The analysis was done using SPSS (Version 20) software. Comparisons of buffer zone vulnerability in terms of dominant ecosystem types they have, and the predominant adjacent land use will be done by a non-parametric Kruskal-Wallis test followed by a Box- and -whisker Multiple Comparison Procedure (Zar, 1999).

RESULTS

Response of interviews (KAP) of local people

From the study, almost 79% of respondents were men while 21% were women. The recognition of gender roles in biodiversity management is an important step in the achievement of conservation and sustainable use of overall biological resources. It was observed that significant number of respondents had obtained informal education about (22%), secondary (15%), tertiary education (8%), very few had basic primary education (10%) and non-educated (45%). The occupational states of the farmers depend on farming (78%), coffee production (10%), apiculture or beekeeping (4%) and trading (6%). Their source of meat also suggested that majority (96%) of them use livestock meat and about 4% uses bush meat (Table 2). Response of the interview on KAP indicated that most farmers near Yayu biosphere reserve had limited skills for biodiversity management and conservation.

The study revealed that the highest ranking illegal activities observed in Yayu biosphere reserve with 75% as illegal entering the biosphere reserve, 65% fuelwood removal and charcoal production, 60% bush meat hunting, 45% livestock grazing, 40% logging for local use, 35% for fodder collection, 30% for uncontrolled land conversion to their farming activities and 25% for settlement on biosphere reserve territory (Table 3). These results revealed that livestock grazing, agricultural farming on biosphere reserve, fuelwood collection, fodder collection, fodder collection and logging are the main threats being faced in the biosphere reserve from the villages surrounding it. This is not surprising since most of these villagers own livestock and the only place where vegetation exists during the dry season is the biosphere reserve. Aside from these, fuelwood extraction and

Table 2. Some socio-demographic characteristics of farmer respondents in Yayu biosphere reserve.

Variable	Frequency	Percentage
Gender		
Male	79	79
Female	21	21
Educational background		
Primary	10	10
Secondary	15	15
Tertiary	8	8
Informal education	22	22
None educated	45	45
Occupation		
Farming	78	78
Trading	6	6
Coffee production	10	10
Apiculture/beekeeping	4	4
Source of meat		
Livestock	96	96
Bush meat	4	4

Multiple responses were recorded.

Table 3. Illegal activities in Yayu biosphere reserve as identified by YBR Staff officers (N = 20).

Illegal activities	Frequency	Percentage	Rank
Logging for local use	8	40	5th
Bush meat hunting	12	60	3rd
Fuelwood removal and charcoal production	13	65	2nd
Illegal entering	15	75	1st
Livestock grazing	9	45	4th
Settlement on biosphere reserve	5	25	8th
Agricultural farming	6	30	7th
Fodder collection	7	35	6th
Investment for organic fertilizer processing plant	5	25	8th
Commodity markets	5	25	8th
Illegal forest fire for Bee hive harvesting	5	25	8th
Charcoal	5	25	8th
Subsistence activities (gathering)	5	25	8th

charcoal production are prominent activities in the study areas because most of the inhabitants depend on fuelwood and charcoal as household energy sources. Deforestation due to collection of fire woods and charcoal, which is a consequence of indiscriminate logging, hinders the significant role that forests play at the global level in climatic change mitigation, oxygen production and carbon cycling. Significant amounts of nitrous oxide, carbon dioxide, and methane are released into the atmosphere as a result of human activities like logging, clearing and sometimes burning of forests during taking out of honey from hang beehives.

Threat factors that operate against biodiversity in Yayu Biosphere Reserves, their perceived threat index and prevalence

The Yayu Biosphere Reserve is faced by threat factors operating unsustainable use demand and exploitation of

Table 4. The respondents result to threat factors identified in Yaya biosphere reserve.

No.	Threat factor identified in Yayu biosphere reserves	Mean threat factor score (Mean ± SE)	Relative threat factor severity index (RTFSI)
1	Illegal killing of wild animal for their bush meat to the local /regional market (Tf 1)	2.3400 ± 0.15519	0.468
2	Wild animal poaching for international commercial purpose (Tf 2)	2.2200 ± 0.17031	0.444
3	Direct/indirect danger to biodiversity arising from the nation and intensity of human-wild animal conflict (Tf 3)	2.6100 ± 0.14695	0.522
4	Loss, conversion and degradation of wild animal migration and dispersal corridors important for the biosphere (Tf 4)	2.9800 ± 0.16635	0.596
5	Human encroachment in terms of their densities and distribution around the biosphere (Tf 5)	2.4500 ± 0.13210	0.49
6	Unsustainable use demand and exploitation of natural resource by the local communities surrounding the biosphere (Tf 6)	3.1600 ± 0.13686	0.632
7	Recent agricultural expansion and other incompatible land use changes to biodiversity requirements (Tf 7)	2.7600 ± 0.16213	0.552
8	Pollutants from other external sources of a biosphere that harm biodiversity directly or indirectly (Tf 8)	1.9200 ± 0.11342	0.384
9	Negative and persistent tourism impacts to the welfare of biodiversity and their habitats (Tf 9)	2.4000 ± 0.17408	0.48
10	Illegal cutting of trees and black market trade of timbers resulting in denudation of forest (Tf 10)	2.7600 ± 0.13190	0.552
11	Shortage of funds impairing the materialization of the long term visions and commitments of a biosphere based biodiversity conservation (Tf 11)	2.4800 ± 0.14459	0.496
12	Lack of integration at policy level that hampers the implementation of any new project in forestry sector (Tf 12)	2.3200 ± 0.12299	0.464
	Mean value (±SE)	2.533 ± 0.08501	0.51 ± 0.05781

natural resource by the local communities surrounding the biosphere at relatively higher threat factor severity (RTFSI) level was highest with 0.632 (Table 4). Loss, conversion and degradation of wild animal migration and dispersal corridors important for the biosphere (Tf4) with mean threat factor score of 2.9800 ± 0.16635 and 0.596 relative threat factor severity index, followed by Illegal cutting of trees and black market trade of timbers resulting in denudation of forest (Tf 10) with mean threat factor score of 2.7600 ± 0.13190 and 0.552 relative threat factor severity index; recent agricultural expansion and other incompatible land use changes to biodiversity requirements (Tf7) with mean threat factor score of 2.7600 ± 0.16213 that had a threat index of 0.552. The loss, direct/indirect danger to biodiversity arising from the nation and intensity of human-wild animal conflict (Tf3) with mean threat factor score of 2.6100 ± 0.14695 had a threat index of 0.522, while shortage of funds impairing the materialization of the long term visions and commitments of park based biodiversity conservation (Tf 11) with mean threat factor score of 2.4800 ± 0.14459 had a threat index of 0.496; human encroachment in terms of their densities and distribution around the biosphere (Tf5) with mean threat factor score of 2.4500 ± 0.13210 had a threat index of 0.49. Negative and persistent tourism impacts to the welfare of biodiversity and their habitats (Tf9) with mean threat factor score of 2.4000 ± 0.17408 had a threat index of 0.48. Unsustainable use, Illegal killing of wild animal for their bush meat to the local or regional market (Tf1) with mean threat factor score of 2.3400 ± 0.15519 had a threat index of 0.468; lack of integration at policy level that hampers the implementation of any new project in forestry sector (Tf12) with mean threat factor score of 2.3200 ± 0.12299 had a threat index of 0.464. Wild animal poaching for international commercial purpose (Tf2) with mean threat factor score of2.2200 ± 0.17031 had a threat index of 0.444; and pollutants from other external sources especially disturbance, the construction of infrastructures such as fertilizer plantation and expansion of road and electric power that harm biodiversity directly or indirectly (Tf8) with mean threat factor score of 1.9200 ± 0.11342 had a threat index 0.384 across Yayu biosphere reserve (Table 4) From Table 4, BRRTI can be estimated based on primary number of officers who rank the level of the twelve threat factors and divided to their number questions times 5 (12x5 =60). The

Table 5. Yayu biosphere reserve and the major threat factors against wild animal/biodiversity in and around them with Vulnerability Index (PAVI).

Buffer zone with in the Keble 1-5	BRRTI (rank)	Ecosystem type	Land use
Witaetia	0.333 (1st)	Forested montane	Agriculture
Achebo	0.316 (2nd)	Forested montane	Agriculture
Bondewo	0.333 (1st)	Agricultural land, wetland, grassland	Agriculture
Wabo	0.300 (3rd)	Swamp or wetland	Agriculture/near residents
Geji	0.333 (1st)	Settlement area and fragments of forest land	Agriculture

BRRTI = Total score of the 12 threat factors from the interviewed officers of a given biosphere reserve) / total responses (60).

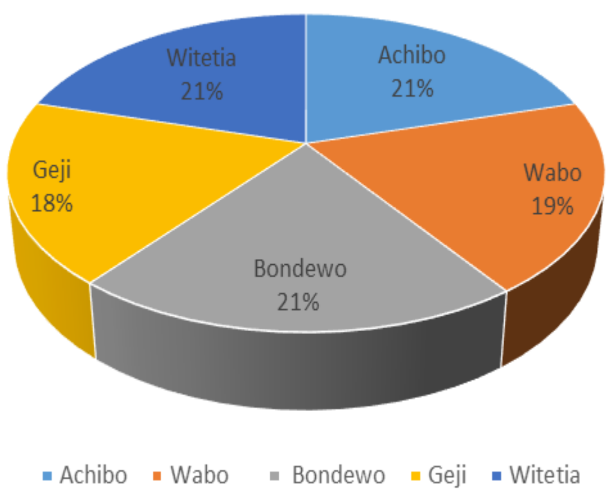

Figure 2. Percentage BRRTI of the selected of buffer zone within the Yayu biosphere reserve.

core of the biosphere reserve is a special area with outstanding natural beauty for conservation. Among the analyzed sites of Yayu biosphere reserve (core, buffer and transitional zone) had the 1st sites were (Witaetia, Bondewo and Geji) that scores with 0.333 relative threatened threat factors index. However, Achebo and Wabo were the 2nd and the 3rd with 0.316 and 0.300 relative threatened threat factors index respectively (Table 5).

About 21% biosphere reserve relative threatened index (BRRTI) were the highest observed in the buffer zone Achibo, Bondewo and Witaetia kebeles. While, Wabo and Geji were the least with relative threatened index (BRRTI) of 19 and 18% respectively (Figure 2).

One of the main challenges facing the biosphere reserve is extensive livestock grazing. The majority of agricultural lands are located near the biosphere reserve core, buffer and transitional zone between floodplains and a wetland, namely Witaetia, Bondewo and Geji. Agricultural intensification was also observed as the threat to forest in the Yayu biosphere reserve. The central premise of conservation planning is to make informed decisions about the limitations of current biosphere reserve systems and direct additional conservation action to ensure enduring biodiversity protection. Not only do conservation planners need to be aware of how biodiversity features are distributed, but they also require spatially explicit data on current biodiversity threats (that is, conservation-hostile land cover and land-uses), as well as data on the rate of land-cover transformation. Biodiversity conservation is more likely to endure if conservation initiatives consider the spatial requirements of other land-use sectors, avoiding, where possible, those areas that will experience a high probability of conversion in the future. Even within land-cover classes, the capacity and attitude of stakeholders are crucial to the success of conservation initiatives; enduring conservation goes beyond simply establishing a biophysical template.

DISCUSSION

It is evident that the Yayu biosphere reserve is a highly valuable ecosystem for biodiversity conservation. Besides the wild animal species, the availability of abundant wild coffee population makes the biosphere a keystone forest for the conservation of the genetic resources of coffee in the country. High diversity of *Coffea arabica* and other plant species makes the forest one of the most important biosphere reserve areas for the conservation of biodiversity in Ethiopia. According to Tadesse et al. (2009) there are over 450 higher plants, 50 mammals, 30 birds, and 20 amphibian species are found within Yayu biosphere reserve. The biosphere reserve relative threatened index indicates with maximum 21% and minimum 18%. Regionally, in addition to being hotspots of biodiversity that is also highly endangered (Birdlife International, 2012). Globally, natural habitats and species are declining by rate of 0.5 and 1.5% per year. Almost 12% birds, 25% mammals and 32% amphibians are threatened with extinction in the next century (IUCN, 2012).

In the present study, both survey and respondent data indicates that the impact of human activities of wild animal threats and their relative severity was prominent on Yayu biosphere reserve. The impact of human activities on wildlife at Yayu biosphere reserve with relative threatened index (BRRTI) were observed with 0.632 the highest one that helps in order to take conservation management action plan. The Yayu Biosphere Reserve transition area is found adjacent to the buffer zone and it is composed of agricultural land, wetland, grassland, settlement area and fragments of forest land. All the controlling unit core, buffer and transition in the biosphere reserve are connecting; but there are five core areas. About 154, 300 permanent residents live in the biosphere reserve and mainly rely on agriculture. Regarding the socioeconomic status and land use pattern of the residents of Yayu Biosphere Reserve depends on agriculture. Since, the major occupation in the area is agriculture that engages over 90% of the labor force which could impact on the wildlife of the biosphere reserve. The agricultural practice in the area is mainly smallholder subsistence farming. For more than 60% of the population, coffee production, processing and marketing are the major sources of employment (Tadesse, 2003; Fite, 2008).

Previous reports indicate that the total amount of land used for crop production in the district is 11,903 ha and the area under semi-forest coffee and garden coffee production is about 10,188 ha and the average holding size in the district is 2.5 ha. The Yayu biosphere reserve is known for its high plant species diversity, a keystone wild coffee forest ecosystem for the conservation of the genetic resources in the country, over 450 plant species were identified so far in the forest. However, in the last 30 years alone the southwest montane forest of Ethiopia has lost 60% of its forest cover. The most apparent reasons are undergrowth clearing for intensification and expansion of agriculture and extensive cutting of timber and wood for construction and fuel among others (Tadesse, 2003). The finding of this research also revealed that, the majority of the people in study areas depend on forest and forest products. The forest of Yayu biosphere reserve is relatively intact and provides a full range of potential resources which are the basis for the community's livelihoods. The designation as a biosphere reserve is expected to enhance ecologically sound and traditional agriculture to foster ecotourism and to create new jobs in small businesses such as coffee, bee-keeping, spices and horticulture activities. Direct threats to biodiversity in Yayu biosphere reserve, such as illegal bush meat hunting, poaching of large mammals, and human-wildlife conflicts, were perceived by biosphere reserve officers as being greater than indirect threats. However, analysis of the relationship between relative threat severity and biosphere reserve relative vulnerability revealed that indirect threats such as human and agriculture encroachment, tourism impacts and pollution were the most serious. Generally, direct threats will more strongly influence perceptions of the severity of threats than indirect threats but the effects of the latter are more long-term. Whereas direct threats may harm biodiversity alone, indirect threats affect both biota and their habitats.

The core zone of Yayu Biosphere is kept absolutely undisturbed. It must contain suitable habitat for numerous plant and animal species, including higher order predators and may contain centers of endemism. Core areas often conserve the wild relatives of economic species and also represent important genetic reservoirs of exceptional scientific interest (UNESCO, 2013). A core zone secures legal protection and management and research activities that do not affect natural processes and wildlife are allowed. The core zone is to be kept free from all human pressures external to the system. In the buffer zone which affixes core zone uses and activities are managed in ways that protect the core zone. These uses and activities include restoration, demonstration sites for enhancing value addition to the resources, limited recreation, tourism, fishing and grazing, which are permitted to reduce its effect on core zone. Research and educational activities are to be encouraged in the core zone of the Yayu Biosphere Reserve. Human activities, if natural within biosphere reserve, are likely to be permitted to continue if these do not adversely affect the ecological diversity.

The critical cross cutting issues of the impact of human activities in wild animals at Yayu biosphere reserve with relative threatened index (BRRTI) were the highest observed in the buffer zone this indicates that they could not to get sufficient space for feeding and copulating due to human pressure. With regard to 12 threat factors identified in the Yayu biosphere reserve, five (unsustainable demand and exploitation of biodiversity resource by the local communities surrounding the biosphere reserve; loss, conversion and degradation of wild animal migration and dispersal corridors important for the biosphere reserve; recent agricultural expansion and other incompatible land use changes to biodiversity requirements; illegal cutting of trees and black market trade of timbers resulting in denudation of native forest; direct or indirect vulnerability to biodiversity arising from the nation and intensity of human-wild animal conflict related to resource utilization). These results correspond with the findings of other studies (Islam and Sato, 2012; Muhammed et al., 2008; Marcovchik-Nicholis et al., 2008; Chowdhury et al., 2014) argued that habitat loss and fragmentation due to residents live in the biosphere reserve and mainly rely on agricultural development may have the most serious consequences to wildlife. Other than agricultural expansion, local drivers such as large-scale investments on coffee and tea plantations, Yayu fertilizer manufacturing plant, road expansion, logging, firewood and charcoal production have been significant drivers of deforestation and overexploitation of woody species of the biosphere. Corruption is a common problem for the forest cutting and selling of trees by timber traders and smugglers and killing of animals by poachers with the direct cooperation of forest officials through bribery, embezzlement and misuse of administrative power.

FUTURE DIRECTIONS AND CONCLUSIONS

Human activity, pressure, threats and their relative severity to wild animal in Yayu Biosphere Reserve are of concern to conservation for several reasons. They can deplete wild animal population sizes; hinder the recovery of rare species; necessitate management actions that often impact the environment; act on their own or in concert with other drivers and be the ultimate cause of species extinction. Ethiopia is rich in biodiversity the reckless destruction of its fauna and floras which necessitated formal intervention to protect the environment still continues today. Future studies of the complex interactions that occur between human activities, environmental change will promote healthy ecosystems and help protect biological diversity. Here, we outline what we see as the most critical challenges and future directions for the study of threats in the wild animal conservation sciences. Protected areas such as national parks and biosphere reserves are the cornerstones of almost all national and international conservation strategies. They act as refuges for species and ecological processes that cannot survive in intensely succeeded sites and outlooks. Wild animal conservation must provide controlled and monitored user rights where tourism is non-existent for wild animal to be a credible land use in communal wild animal dispersal areas outside the biosphere reserve. Where tourism is well advanced, local community need to be empowered to benefit directly from it rather than made to accept regulatory proofs and handouts. The local community in and around the Yayu biosphere reserve believe that ecological problems and solutions are human problems and not simply biological problems. Biodiversity conservation in biosphere reserve has been threatened by mismanagement, lack of funds, other organization conflict, lack of biodiversity awareness, and lack of public participation. Conservation biologists can help engage local community in conservation efforts by striving to achieve three goals: Adjusting the public's perception of biodiversity, increasing public participation in biodiversity conservation, and encouraging ecotourism by tour packages to develop conservation and local. Furthermore, the government should see the human and environmental condition as one intricate system. Researchers also need to avoid homogenous research work on the conservation of biodiversity in biosphere reserve national parks and others.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Short Communication

New sighting record of white-tailed Lapwing *Vanellus leucurus* in Nawabganj Bird Sanctuary, Uttar Pradesh, India

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The white-tailed Lapwing, *Vanellus leucurus*, is a species of bird which is listed by International Union for Conservation of Nature (IUCN) as Least Concern, winter visitor to India and breed in Central Asia and Southern Russia. It is occasionally sighted in the western region of Maharashtra State, Gujarat, Rajasthan, India, but hardly ever documented. There is no record of its presence in the study area. In this note, the first sighting record of the white-tailed Lapwing at Nawabganj Bird Sanctuary in Uttar Pradesh was reported.

Key words: Winter visitor, Nawabganj Bird Sanctuary, Uttar Pradesh, *Vanellus leucurus.*

INTRODUCTION

The white-tailed Lapwing, *Vanellus leucurus*, is a species of bird which is listed by International Union for Conservation of Nature (IUCN) as Least Concern (ver 3.1). It is a medium-sized wader belonging to the family, Charadriidae, occurring singly, in pairs or in small groups (Urban et al., 1986; Grimmet et al., 2011; Message and Taylor, 2013). The species prefer to forage in short grassland within or near dry part of wetlands. It breeds in Baluchistan, winters in North-West subcontinent. More or less migratory populations breed in Russia and migrate in winter to northeast Africa, the Middle East and the Indian Subcontinent, and reappear in their breeding lands in March and April (del Hoyo et al., 1996; Hayman et al., 1986; Rasmussen and Anderton, 2012; Bird Life International, 2016; Sama, 2002). White-tailed Lapwing has large dark eyes, blackish bill, very long yellow legs and white tail lacking black band. Juvenile has dark sub terminal marks and pale fringes to feathers of the upperpart. Crown is mottled with dark brown (Grimmett et al., 2011). The habitat consists of freshwater marshes and marshy wetlands edges. They usually feed in shallow water by pecking at the surface and by foot dabbling.

In this note, the first sighting record of the white-tailed Lapwing at Nawabganj Bird Sanctuary in Uttar Pradesh

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Figure 1. A white-tailed Lapwing.

Figure 2. White-tailed Lapwing in pair.

was reported. Line Transect method was used for the observation and monitoring.

MATERIALS AND METHODS

This study was performed in Nawabganj Bird Sanctuary (NBS) from December 2017 to January 2018. Survey work was carried out during suitable time in winter morning (7:00 to 11:00 am, evening: 3:00 to 5:30 pm). Observations were made along line transects with the aid of 10 × 50 binoculars and Canon EOS 70D SLR camera. A line transect of 1 to 100 m was prepared and the birds were monitored on both sides of the transect by close end transect up to 2 km without stopping. The birds were identified using standard field guide books of Ali and Ripley (1995) and Grimmett et al. (2011).

RESULTS AND DISCUSSION

On 23rd December 2017 at 9:00 h, a white-tailed Lapwing was observed in the open short grasses foraging with Red-wattled Lapwing (*Vanelllus indicus*) and Indian Pond heron (*Ardeola grayii*) during bird monitoring near the Watch Tower in Nawabganj Bird Sanctuary, Unnao District in Uttar Pradesh, India. It was photographed for authorization of the identification (Figure 1). The habitat of the sanctuary consisted of short grasses and marshy areas. This species was previously not recorded in Nawabganj Bird Sanctuary, Unnao. Again, on 30th December 2017, two pairs of white-tailed Lapwing were sighted by the bird monitoring group (Figure 2).

It has been reported from various places in India, like Delhi (Urfi, 2003), Maharashtra Bhayandar and Naigaon (Lad and Patil, 2015), the Bharat Petroleum Corporation mangroves (Verma et al., 2004), Manor (Monga, 2001), Gondur Tank, Dhule District (Vyawahare, 1992), Nandurbar (Davidson, 1882) and a tank near Kalyan, Thane district (Abdulali, 1952). The white-tailed Lapwing is a winter visitor to India (Grimmet et al., 2011). It is a regularly observed bird in northern and central regions, but a rare species for western Maharashtra (Anand, 2003).

Conclusion

During the study, this species was seen with Red-wattled Lapwings (*V. indicus*) and other waders like Indian pond heron (*Ardeola grayii*) and Grey headed Lapwing (*Vanellus cinereous*). There is no previous record of sighting of this species from the Nawabganj Bird

Sanctuary. There could be various reasons why this species was scarcely reported in North India as single birds or in groups of two or four while this is gregarious in nature. This must be further studied. The sighting in Nawabganj Bird Sanctuary seems to be a domestic extension of range for the white-tailed Lapwing.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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