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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 doorstep, 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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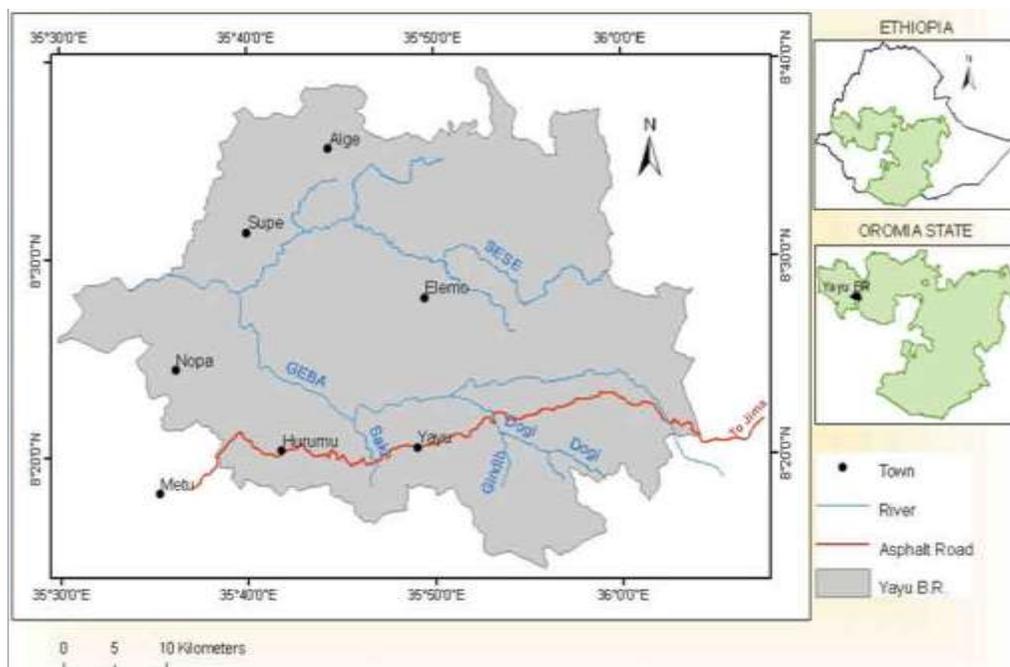


Figure 1. Map of Yayu Biosphere Reserve (Source: UNESCO, 2013).

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

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 Yaya 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 of 2.2200 ± 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 Yaya 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 (1 st)	Forested montane	Agriculture
Achebo	0.316 (2 nd)	Forested montane	Agriculture
Bondewo	0.333 (1 st)	Agricultural land, wetland, grassland	Agriculture
Wabo	0.300 (3 rd)	Swamp or wetland	Agriculture/near residents
Geji	0.333 (1 st)	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).

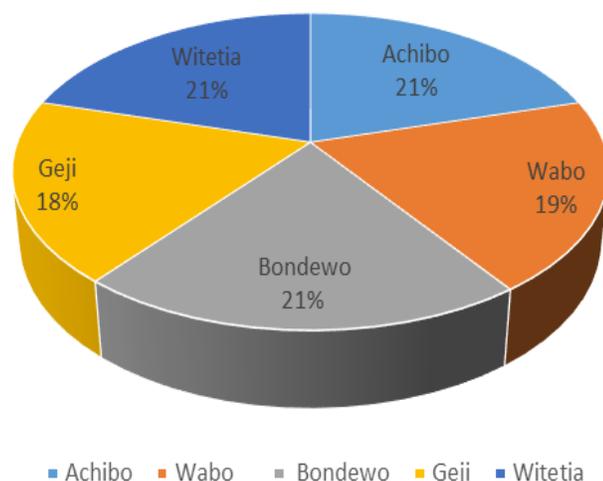


Figure 2. Percentage BRRTI of the selected of buffer zone within the Yayu biosphere reserve.

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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