ASSESSMENT OF HUMAN IMPACTS ON WOODY PLANT DIVERSITY IN YAYU BIOSPHERE RESERVE, SOUTHWESTERN ETHIOPIA

BY

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ASSESSMENT OF HUMAN IMPACTS ON WOODY PLANT DIVERSITY IN YAYU BIOSPHERE RESERVE, SOUTHWESTERN ETHIOPIA

By

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MSc. Thesis Research

Submitted to the Department of Natural Resource Management, School of Graduate Studies, Jimma University College of Agriculture and Veterinary Medicine, in Partial Fulfillment of the Requirement for the Degree of Masters of Natural Resource Management Specialization in Forest and Nature Conservation.

Major Advisor: Selamawit Negassa (Ph.D.)

Co-advisor: Dereje Bekele (MSc. Ass.Proffessor)

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I have incorporated the suggestions and modifications given during internal thesis defense and got the approval of by my advisers. Hence, I hereby kindly request the Department to allow me to summit my thesis for external defense.

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DEDICATION

I dedicate this thesis manuscript to my mother Meron Banti Aga, my wife Gadise Wagari Negara for nursing me with affection and love and for her dedicated partnership in the success of my life.

STATEMENT OF AUTHOR

I the undersigned, hereby declare that the thesis: - Assessment of Human Impacts on Woody Plant Diversity in Yayu Biosphere Reserve, South-Western Ethiopia was the outcome of my work and all sources of materials used have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for an MSc degree at Jimma University and is deposited at the University Library to be available to borrowers under the rules of the library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree. I concede copyright of the thesis in favor of the Jimma University, Collage of Agriculture and Veterinary Medicine.

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BIOGRAPHICAL SKETCH

Lalisa Bariso Hasan, the author was born on May 2, 1986 G.G. in Shonge kebele, Kondala Woreda, West Wollega Zone, and Oromia Region. He attended his elementary education at Shonge School in 1985 -1993E.C. and his junior secondary education at Begi secondary School in 1994-1996E.C.Then he joined Holeta ATVET College 1997-1999E.C and graduated with a Diploma in Natural Resource Management in 1999E.C. Soon after graduated he was first employed by Kondala Agricultural office and he served as Natural Resource Management experts at Kondala woreda Agricultural offices for three years (2000-2002). Again he joined Jimma University in 2003 and graduated with a BSc degree in Natural Resource Management on 28th June 2004. Again he served as Woreda Focal in Sustainable Land management project (SLMP) for four years (2006-2009). Then after, he joined Jimma University as a postgraduate student in the College of Agriculture and Veterinary medicine, Natural Resource management studies to pursue his MSc. Degree in Natural Resources Management (Forest and Nature Conservation Specialization) in 2010 E.C.

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LIST OF ACRONYMS

BR	Biosphere Reserve
DBH	Diameter at breast height
DF	Degree of freedom
DFD	Deforestation &Forest degradation
DHHSNYBR	Duration of households Stay near the Yayu biosphere reserve
DPSIR	Driver-Pressure-State-Impact-Response
ETB	Ethiopian Birr
FAO	Food and Agricultural Organization
HH	Households
HHD	High Human Disturbance
IUCN	International Union Conservation Nature
LHD	Low Human Disturbance
MHD	Medium Human Disturbance
MoEFCC	Ministry Environment, Forest and Climate Change
NGO's	Non-Governmental Organization
OFLP	Oromia Forest Landscape programme
PAs	Protected Areas
SPSS	Statistical Package for social science
UNESCO	United Nations Educational, Scientific, and Cultural Organization
VLHD	Very Low Human Disturbance
YBR	Yayu Biosphere Reserve

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ABSTRACT

Yayu Biosphere Reserve (YBR) is part of the Eastern Afromontane Biodiversity hotspot located in Illu Abbabor Zone, Oromia, Ethiopia. Understanding the patterns and intensity of anthropogenic impacts on habitats is important in the conservation of the Biosphere Reserve. However, the impacts of human disturbance on woody plant diversity and their relative severity was not well known. Hence, this study aimed to examines the impact of human disturbance on woody plant diversity in case of Yayu Biosphere Reserve, Oromia National Regional State South-western Ethiopia. Yayu district was purposively selected based on its forest potential, three representative Kebele were randomly selected, and households sample were selected by using the systematic random sampling techniques. A total of nine forest patches were designated to collect vegetation data. Three patches were designated as per zonations of Yayu Biosphere Reserve (core zone, buffer zone and transition zone). In each forest patches, five-line transects of 1km long were randomly placed parallel to each other. From those of the five-line transects, one line transect was randomly selected. A total of 28 quadrats were taken to assess vegetation diversity by measuring 20m × 20m, 5m×5m and 3m×3m for matured trees, sapling & seedling, respectively. A total of 145 representative households were selected to collect social survey data. One way ANOVA were used to analysis Quantitative data, and chi-square for social data analysis. The present findings pointed out that the main threats to the existing remnant forest patches in Yayu Biosphere Reserve were an anthropogenic disturbance; extraction of timber, fuel-wood Collection, forest land for agriculture; sandy soil extraction, livestock grazing, forest land for coffee plantation, and fire damage. There was high human interference in core zone of the Yayu Biosphere Reserve. This indicated that there is a modification of natural forest into coffee plantation by local community in study area. Medium and high human disturbance classes were characterized by low species diversity, and poor regeneration status whereas, very low and low human disturbance plots were characterized by high species diversity, and good regeneration status. Species richness and species abundance were significantly different among the all human disturbance classes and all Zonation of the Biosphere Reserve ($P<0.05$). The local community perception on forest conservation strategies indicated that 42.8% of the respondents perceived conservation management was done by the residents whereas, 28.9% was conserved with a collaboration of all stakeholders. Hence, this study has provided the first useful ecological information on the main human disturbance activities, effects of human disturbance on woody species diversity and community perception in the Yayu Biosphere Reserve that would serve as an input for management decisions. Therefore, special attention should be needed by all stakeholder to embrace participatory management by encouraging and supporting the formation of community forest association.

Keywords: *Human disturbance classes, woody species diversity, community perceptions.*

1. INTRODUCTION

1.1 Background and Justification

A protected area is a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values (IUCN, 2008). Ethiopia has designated many protected areas throughout the country that includes national parks, wildlife reserves, National Forest Priority Areas, Biosphere Reserves and community conservation areas (Oromia Forested Landscape Program, 2017). Biosphere Reserves are natural protected areas included in a global network organized by the (UNESCO) (Zarihun, 2018).

Biosphere Reserves have three interrelated zones that aim to fulfill three complementary and mutually reinforcing functions: The core area(s) comprises a strictly protected ecosystem that contributes to the conservation of landscapes, ecosystems, species and genetic variation (Mathevet *et al*., 2016; Zarihun, 2018). The buffer zone surrounds or adjoins the core areas, and is used for activities compatible with sound ecological practices that can reinforce scientific research, monitoring, training, and education. The transition area is the part of the reserve where the greatest activity is allowed, fostering economic and human development that is socio-culturally and ecologically sustainable (UNESCO, 2017).

In the same manner, Ethiopia has four internationally recognized sites namely Kafa biosphere reserves, nominated in 2010, Yayu Biosphere Reserves nominated in 2010, Sheka Biosphere Reserves, nominated in 2012 and Lake Tana Biosphere Reserves nominated in 2015). The country has diverse flora and fauna most of them are endemic (Tesfu *et al*., 2016). 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 (Fekensa., *et al*., 2016).

Ethiopian natural forests are rapidly disappearing and today the remaining primary forest located mostly in the country's most inaccessible areas. The national deforestation rate is estimated at 140,900 ha annually, and forest deforestation converts the remaining natural forest patches to coffee forests or open woodland (Million *et al*., 2016). According to the U.N., 11.2% or about 12,296,000 ha^{-1} of Ethiopia is forested, though the percentage of natural forest is unclear (FAO, 2010). Threats to the Ethiopian forests are numerous as a result of rising population pressure, with widespread deforestation for new settlement and agricultural lands, as well as adverse urban development policies and uncontrolled private investment.

Yayu forest is the largest and most important forest for the conservation of the coffee genetic resources in the World (Tesfu *et al*., 2016). However, there is an accelerated reduction in its faunal and flora diversity including woody plant species as a result of man-made pressure and activities, such as uncontrolled hunting, habitat destruction for agricultural expansion, pressure by domestic animals and heavy encroachment by a human being (Tesfu *et al*., 2016).

Understanding the patterns and intensity of human disturbances is important in the development of management plans for protection or possible revival of such important systems (Shrestha *et al*., 2013). However, no research has been carried out to investigate the assessments of major human disturbances on the woody plant diversity, effects of the human disturbances on the woody plant diversity in Yayu Biosphere Reserve as well as on the perception of the local community toward the Biosphere Reserve on supporting the conservation strategies. Thus, this study was conducted to gathering baseline information on the impacts of the human disturbance on woody plant diversity in the Yayu Biosphere Reserve.

1.2. Statement of the problem

Almost 85% of the population in Ethiopia live in rural areas, and a large part of this population depends directly or indirectly on natural resources (Hailu *et al*., 2018). The ever-increasing human population combined with unwise land use and farming systems,

unsustainable forms of agricultural intensification, and catchment degradation has resulted in serious degradation of these important forest resources (Elena Angulo *et al*., 2016).

The major problems to Biosphere Reserve in Ethiopia originate from demographic pressure, settlement within the Biosphere Reserve or adjacent to them; deforestation, farmland expansion, grazing, and cutting a living tree, illegal encroachment by people, uncontrolled fire, soil erosion, and hunting (Negese, 2014); while conflicts between Biosphere Reserve management and local people, alien invasive species and change in fire regime are other problems of a Biosphere Reserve in the country.

Despite this fact, studies were conducted about this Biosphere Reserve (YBR) before they are very rare. Most of the studies conducted so far have concentrated on impacts of human use and implications for in situ conservation of wild Coffea arabica, Diversity of anurans in forest fragments as well as studies on the impacts of human activities on wildlife, genetic variability in Yayu coffee and different case studies were conducted, but they are not focused on the continuous state of forest due to anthropogenic activities in Yayu Biosphere Reserve (Tadesse, 2003; Tesfu *et al*, 2016; Tilahun & Abebe, 2018 & Masreshaw, 2018).

There is lack of baseline information for the major human disturbance activities on woody plant diversity, the effect of human disturbance on woody plant diversity, local community perceptions on conservation, target of the present research, that profoundly contribute to formulating development and management plans for woody plant species in the areas and conservation area for forest genetic resources. Therefore, very little is known about the complicated and multifaceted problems of managing the YBR, especially on the further impacts of the human activities within the different zonation of the Biosphere Reserve.

This requires a careful in-situ investigation on the matter of human disturbance effects on the woody plant diversity in the Yayu Biosphere Reserve and perception of the local community toward the Biosphere Reserve conservation, so as to overcome management problems of Yayu Biosphere Reserve, and also to address the social and livelihood constraints of the people residing within and around the Yayu Biosphere Reserve. The results from this study provide data, which form a basis for determining suitable conservation strategies and a regular monitoring program of the Yayu Biosphere Reserve.

1.3 Objective

1.3.1 General objective

The overall objective of the study was to assess the impact of human disturbance on woody plant diversity in Yayu Biosphere Reserve, Oromia Region South-western Ethiopia.

❖ Specific Objectives

1) To identify the major human disturbance on woody plant diversity in the Yayu Biosphere Reserve.
2) To determine the effects of human disturbance on woody plant diversity in the Yayu Biosphere Reserve.
3) To assess the perception of the local community towards the conservation strategies in the Yayu Biosphere Reserve.

❖ Research questions;

a) What is the main human disturbance activities on woody plant diversity in the Yayu Biosphere Reserve?
b) What is the effect of human disturbance on woody plant diversity in the Yayu Biosphere Reserve?
c) What are the perceptions and attitudes of people towards the existing conservation strategies in the Yayu Biosphere Reserve?

1.3.2 Significance of the Study

The result of this study provides an understanding of how major human disturbances can impacts the woody plant diversity, richness, evenness & abundances in the YBR area, as well as the perception and attitudes of local people towards conservation strategies. This study is essential for adding input on designing national policies, strategies, and regulations for involving communities in the management of the biosphere reserve. This study also helps Biosphere Reserve stakeholders to know the major human disturbances which impact biodiversity in the study area and hence to come up with strategies that bring more

awareness to communities. Such awareness can be created by conducting researches and generating empirical information that can clearly show the impacts and consequences of the problem on different aspects. By providing a clear picture and information on the status of major human disturbances and its impacts on woody plant diversity in the study areas, specifically, this study provided a basis to understand the magnitudes of major human disturbances on woody plant diversity in Yayu Biosphere Reserve areas to the country in general and study area in particular.

The study paved ways and directions for further research, extension and development schemes. In addition, the outcomes of this study identified areas of intervention for policymakers and other stakeholders such as Biosphere Reserve Managers, Natural resources management offices, forest & wildlife Enterprises, Ethiopian Biodiversity Institute (EBI), for different Non-Governmental Organization (NGOs) and environmentalists to address the effects of human disturbances on woody plant diversity in Yayu Biosphere Reserve.

1.3.3 Scope of the Study

The study was conducted in the Yayu Biosphere Reserve, Oromia Regional State South-western Ethiopia. This study was carried out to analyze the impacts of human disturbances on woody plant diversity in the YBR. The study emphasized in examining the current status of human disturbances in Biosphere Reserve areas, different local socio-economic activities, socio-cultural activities, ecological setting and population structure in the study site.

Moreover, it assessed different human disturbance activity as well as measured the effects of the human disturbances on woody plant diversity, Species richness, evenness, and abundance, to provide management recommendation for the Yayu Biosphere Reserve and as well as perceptions and attitudes of the local community was assessed, similarly, the change occurred on local socio-economic and impacts variation between household groups as a result of the Biosphere Reserve would be assessed.

2. LITERATURE REVIEWS

2.1. Impacts of human disturbances on biosphere reserve in Ethiopia

The capability of the Biosphere Reserve to maintain biodiversity is frequently significantly limited due to the fact they frequently continue to be vulnerable to anthropogenic influences. First, biodiversity in the Biosphere Reserve may be impacted with the aid of human exploitation of surroundings services (Millennium environment assessment, M.E.A., 2005).

Anthropogenic disturbances profoundly alter vegetation structure and diversity (Mligo, 2011; Muboko *et al.,* 2014). Mostly, the conservation strategies are an integral part of the upkeep and management of this area are facing different challenges, but the major one fundamental one is human population growth which leads to overexploitation, degradation of resources and lack of habitat (Dudgeon *et al*., 2006). The livelihoods and nicely-being of rural poor people are more vulnerable to the establishment of Biosphere Reserve mainly in developing countries because their livelihoods are dependent in particular on agriculture and at the to be had natural resources (Sunderlin *et al*., 2005).

In developing countries, the Biosphere Reserve is threatened by poverty, increasing human populations and political instability (bad governance) (Naughton-Treves *et al.,* 2005), leading to increasing conflicts and demand for natural resources (Vedeld *et al.* 2012). Human impacts such as fuel-wood collection, logging and road constructions, are all causing biodiversity loss (Newton *et al.,* 2009).

The forest coverage of Ethiopia was above 40% of the country's landmass at the start of the 20th century but currently decreased to 2.36% in (2000). But, these days because the Ministry of environments and forest stated that due to the numerous multifaceted natural useful resource conservation, reforestation and other associated activities executed for the duration of the past decade, Ethiopia's forest coverage has reached 15% (MoEFCC, 2013). This reported even if there is an increment of forest coverage in Ethiopia, but still, there is high pressure on the remaining natural forest in the country.

According to (FAO, 2015, Ethiopia's forest cover was about 12.4 million hectares which counted to (11.5%) including plantation forest and 8.8 million hectares of natural forest

were lost each year between (2010-2015) due to the impacts of human disturbances in the Biosphere Reserve.

2.2. The DPSIR framework model

The Driving force, Pressure, State, Impact, and Response (DPSIR) model has been followed by most of the European Community nations as the great manner to shape environmental records concerning particular environmental troubles and to expose existing causes, consequences, effective responses and developments and the dynamic relationships between these components (Niemeijer, D. and de Groot, R.S., 2008).

Indicators play a valuable role in terms of building the necessary knowledge, communication and awareness for integrated scientific, political and public input into effective decision-making processes for sustainability or other key societal objectives (McCool, S.F. and Stankey, G.H., 2004). According to Karageorgis *et al. (*2006), the components within the DPSIR framework are defined as follows:

Driving Forces: Driving forces are the factors that cause changes in the system. They can be social, economic or ecological and can have positive or negative influences on pressures. Examples of driving forces are the size of the human population, the use of resources, climatic change, the fishing sector, and the tourism sector.

Pressure: Pressures are the human activities that immediately have an effect on the system and are generated by the driving forces. They change in environmental quality and the number of natural resources, e.g., pollution, harvesting.

State: State is the situation of the system at a specific time and is represented by using hard and fast descriptors of system attribute that are affected by pressure. Examples of state descriptors could be the features or quality of water, sediment, species composition, habitat structure.

Impacts: Impacts are the effects on human health and/or ecosystems produced by a pressure. Common examples are disease occurrence and the absorption of pollutants in biological populations, and reduction in abundance or biodiversity.

Response: Responses are the efforts made through society a result of the changes established inside the impacts. As directed movements, responses typically take the shape of program activities, inclusive of the number of inspections done.

This framework is a functional analysis scheme for structuring the purpose-impact relationships in connection to natural resource management problems (Ness, B., 2010). The scheme helps to shape facts and makes it viable to become aware of critical relations as well as to develop an outline and understanding of a problem (Nebyou, 2010).

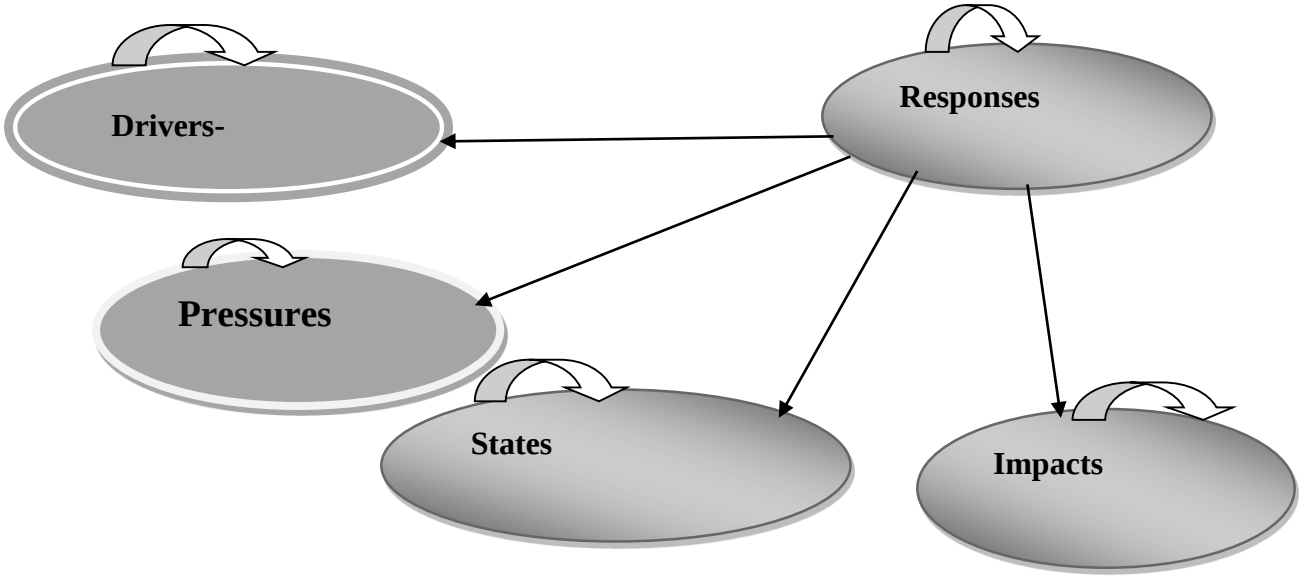


Figure a The DPSIR framework Model.

2.3. Driving forces of human disturbances in Biosphere Reserve

2.3.1. Agriculture

Poor agricultural practices associated with unfavorable socioeconomic conditions could create a vicious circle in which poor smallholder farmers are forced to use marginal lands, increasing deforestation and overall degradation. Agricultural activities are driving deforestation and forest degradation in several countries around the world – including Ethiopia.

There are several kinds of agriculture schemes and practices, which can be listed as drivers of deforestation and degradation (Tom Lavers, 2012). Grazing animals influence species

composition, alternate in biomass and distribution of biodiversity. Despite this, the overuse by grazing of the Biosphere Reserve could result in irreversible vegetation changes (Havstad *et al*., 2007). In Ethiopia Overgrazing results in reduced soil cover, increased erosion, reduced best and productiveness of variety sources, discount or elimination of the natural regeneration of woody species and desired forage species, bush encroachment in a few areas and loss of biodiversity (Eldridge *et al*., 2011).

Extensive agriculture, usually encroaching into the natural forest and pasture lands remain the main option of survival for this large portion of the population (Griffin *et al*., 2002). The area under cultivation can be used as a good proxy for the impact of agricultural expansion on forest cover since it excludes improvements in agricultural output due to intensification usage of modern inputs which are largely beyond the means of many poor rural farmers.

2.3.2. Conflicts over Resources

Conflict characterizes a relationship between two or more parties who might have conflicting goals, values, interests, or behaviors (Teferra & Beyene, 2014). In the case of natural resource management, the outcome of the competition and potential disagreement between two or more groups over the use of one or more scarce resources indicate conflict. Therefore, conflicts within biosphere reserve can be seen to be the result of diverse interests, goals, and ambitions that individuals or groups within legally established and isolated environments have, which all too often resulted in either positive or negative impact on the use-value of the resource in the area (Gillis *et al.*, 2001).

There are three categories of conflicts which are occurring in a Biosphere Reserve in Ethiopia, namely: (1) conflict between human and wild animals (2) conflict between Biosphere Reserve managers (scouts and staffs) and communities which live in and around Biosphere Reserve, and (3) conflict between different communities surrounding the Biosphere Reserve (Abebe and Bekele, 2018). Human-wildlife conflict happens throughout the globe but, developing countries are more vulnerable than developed counties (Rong, F., 2010).

The basic causes that have been suggested for the higher human-wildlife conflict in developing countries are poverty and the rapidly growing human populations and expanding settlements that cause habitat loss (Amaja *et al*., 2016). Resource use exclusion, an illegal activity made by local or external people (individually or in a group to access resources from the Biosphere Reserve), crop damage by wild animals are the causes of conflict between Biosphere Reserve managers and community (Vedeld *et al*.,2012).

2.4. Pressures on the Biosphere Reserve (P)

Overgrazing and poor land management further worsened the occurrence (Nebyou, 2010). In general, the direct pressures towards land degradation include; Land use area trend, Land use intensity trend, Crop management level, Deforestation, Over-exploitation of vegetation, Overgrazing, Industrial activities, Urbanization, Natural causes, Discharge of effluents, Washing out of pollutants and Airborne pollutants, rapidly increasing population, high per capita consumption of resources, imbalance of trade (Weldemariam, 2017).

2.5. Changes in the state of the Biosphere Reserve (S)

Ethiopian natural forests are rapidly disappearing and today the remaining primary forest located mostly in the country's most unreachable areas. The countrywide deforestation rate is estimated at 140,900 ha^{-1} yearly, and forest strengthening changes the residual natural forest covers to coffee forests or open woodland (Million *et al*., 2016). According to the U.N., 11.2% or about 12,296,000 ha^{-1} of Ethiopia is forested, though the percentage of natural forest is unclear (FAO, 2010).

Threats to the Ethiopian forests are many as a result of rising population pressure, with widespread deforestation for new settlement and agricultural lands, as well as adverse urban development policies and uncontrolled private assets. Forests especially those in the tropics serve as storehouses of biodiversity and consequently deforestation, fragmentation and degradation destroy biodiversity as a whole and habitat for migratory species including the endangered ones, some of which have still to be cataloged.

Tropical forests support about two-thirds of all known species and contain 65 percent of the world's 10, 000 endangered species (Myers and Mittermeier, 2000).

2.6. Impacts on the biosphere reserve (I)

Impacts are commonly the result of multiple stressors and effects on human health and/or ecosystems produced by pressure. Impacts related to land degradation are reduction in the abundance of biodiversity, decline in productivity, carbon storage loss, decline in water availability and quality, impact on ecosystem services and tourism (Tilman *et al*., 2011).

All these consequences, with wide variation in different systems, characteristics and practices throughout the world, may arise at site-specific level but can have impacts at local to global level to mean when land is degraded, wildlife, plants, and people suffer and can worsen the effects of poverty, and bring about hunger Degradation of land has serious consequences for food security. Many small scale farmers in areas of degraded land can only watch in disappointment as their soil grows less each year to feed their families (Godfray *et al*., 2010).

2.7. Responses to Biosphere Reserve threats (R)

Responses are the efforts made with the aid of society a result of the changes manifested in the impacts. As directed actions, responses normally take the shape of program sports, consisting of the range of inspections done. In the latest many years, a growing problem for the surroundings and sustainability has compelled many governments to continuously alter their land-use guidelines to balance more than one uses of land assets. These policies have caused changes in cropland and their spatial distribution (Lambin *et al*., 2014).

There are different environmental objectives incorporated into agri-environment measures; macroeconomic policies, training programs, and support for investments in agricultural and water holdings, protection of the environment in connection with agriculture and landscape conservation, support to improving the processing and marketing of agricultural products, conservation and rehabilitation, land policy and policy instruments, commitment to international conventions and monitoring and early warning systems (Lambin *et al*., 2014).

In addition to this, there are a few methods for decreasing deforestation and forest degradation. The reduction of population growth through promoting family planning is pivotal in reducing deforestation in developing countries.

Consequent to reduced population, an increase in per capita income will occur as a consequence of increased incomes and literacy rates which will reduce pressure on the remaining forests for new human settlement and land-use change (Sumit Chakravarty *et al.,* 2011).

Increasing the area of forest plantations by using vacant or unused lands and waste and marginal lands especially as roadside, along railway tracts, on contours, avenues, boundaries, and land not suited for agricultural production should have a net positive benefit. Planting trees outside forest areas will reduce pressure on forests for timber, fodder and fuel-wood needs. Moreover the deforested areas need to be reforested (Sumit Chakravarty *et al*, 2011).

Moreover, deforested areas need to be reforested. To develop an awareness of local people about the importance of conserving and managing Biosphere Reserve in Ethiopia environmental education programs should be given to the society (Otto *et al*, 2013) on continuous bases. Conservation education centers at each Biosphere Reserve that will help in raising awareness to the community should be established by Universities Research and Community Service in collaboration with biosphere reserve officials (Israel *et al*, 2005).

2.8. Woody plant diversity

The diversity of species in a specific area depends not only the number of species found, but also in their numbers. Environmentalists call the number of species in an area its richness, and the relative abundance of species its evenness (Kiran Gaunle, 2018). Biological diversity can be quantified in different ways. A diversity index is a mathematical measure of species diversity in a community.

The two main factors taken into account when measuring diversity are richness and evenness. Species number was defined by Fisher *et al.* (1943), which is simply the number of species found in a given community. Due to the implication that the exact number of species could be determined for a boundless community, the concept was later referred to as species richness index, evenness, on the other hand, refers to the degree to which dominance is distributed among the species in a community. Evenness is highest if all species in the community are equally represented. Species richness is a measure of the number of different

species in a given site and can be expressed in a mathematical index to compare diversity between sites. A richness index may simply coincide with the number of species present in a community, but may also be a function of the number of all the individuals in the community. The species richness of each community is simply the number of species present with at least one individual in a given area (Gotelli, N.J. and Colwell, R.K., 2001).

The interpretation of evenness is strictly dependent on the richness Frosini (2006). Species diversity is the product of species richness and evenness. Species diversity index provides information about species endemism, rarity, and commonness. Diversity indices also provide more information about community composition than simply species richness and relative abundances of different species (Frosini, 2006).

2.9. Factors affecting Woody plant diversity

Humans have long had a profound influence on forest ecosystems and their tree cover, and continue to do so (Schroth & Sinclair, 2003). Some activities have led to minor effects, while others have led to profound changes in the woody vegetation, or to permanent loss of tree cover (LongmanK & JeníkJ, 1987). Although the rise in human populations has caused obvious reductions in forest and tree cover, trees remain an important element of most human-dominated agricultural landscapes throughout the tropics.

As indicated by different studies, access to market and natural resource have a negative effect on woody diversity in the agricultural landscape (Wiersum, 1982). The socio-economic background of farmers is known to be the major factor that affects tree/shrub species diversity management (Rocheleau *et al*., 1988). Women may prefer fruit and fodder trees close to homesteads or men may prefer timber or woodlots away from the homestead; wealthy households may prefer monocultures or poor households may prefer multi strata gardens, to maintain diversity (Kalema, V. 2010).

Farmers with little access to resources, particularly land, may focus on the production of a few staple food crops, depending on their individual comparative advantage. In addition, farm size plays a role in the choice of tree species, arrangement, and density, as well as overall management practices of the system (Zebene, 2003).

Inappropriate land-use practices and tenure and the absence of local institutions for farm resource management brought about a rapid decline in tree cover and loss of biological diversity.

2.10. Attitudes of Local people towards Conservation

According to Karanth and Nepal (2012), sustainable and effective conservation activities are strongly influenced by the attitudes, perceptions, and impacts that local people have experienced from conservation activities. An understanding of the factors which influence people's attitudes and perception is the key features in planning, decision making and management of the biodiversity conservation goal. Understanding the perceptions and attitudes of local people provides guidance for policy and management policy towards conservation activities (Allendorf *et al*., 2012).

According to Røskaft *et al*., 2012), access to conservation-related benefits can positively influence local attitudes. Also (Gillingham, S. and Lee, P.C., 1999) revealed that, other factors such as government policy, lack of participation in decision making, protected staff or management intervention, and poor involvement of local people in planning conservation activities, influence negative perceptions. Local people especially those living in and adjacent to Biosphere Reserve have had a long relation with these areas, and their attitudes generally depend on the costs and benefits of Biosphere Reserve and the local dependency on natural resources (Kideghesho *et al*., 2007).

The needs and attitudes of these nearby communities should be considered in the management of the Biosphere Reserve to achieve long term survival of conservation goals. According to (Miller *et al*., 2011) the effective sustainable survival of Biosphere Reserve, especially in developing countries, would be threatened if the needs and aspiration of the local people are not considered (Upton *et al*, 2008).

3. MATERIALS AND METHODS

3.1. Description of the study area

3.1.1: Location

The study was conducted in the Yayu Biosphere Reserve Oromia Region South-Western Ethiopia. It encompasses Hurumu, Yayu, Chora, Nopha, Alge Sachi and Doreni districts, in Illu Abba Bora Zone. Yayu Biosphere Reserve (Figure 3) is located between 8°42'' to 8°44' 23'' N and 35°20'31'' to 36°18'20''E. The Biosphere Reserve includes eastern Afromontane biodiversity hotspot and important bird areas of international significance and one of the 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. The forest is characterized by rolling topography and it is dissected by small streams and two major rivers, Geba and Dogi. There is continuous forest cover along the rivers.

The land frequently changes from flat surface plateaus to very steep slopes and valley bottoms within a short distance. The elevation in the whole reserve ranges from 1,100 to 2,337 meters above sea level (Tadesse Weldemariam Gole, 2003). The forest type in the Biosphere Reserve is predominantly Afromontane rainforest and considered to be a transition between lowland and montane forest types (Tadesse Weldemariam Gole *et al.,* 2008). Three plant community types exist within the Biosphere Reserve including *Coffea arabica –Cassipourea malosana*, *Argomuellera macrophylla–Celtis africana,* and *Dracaena fragrans–Telclea noblis communities* (Tadesse Weldemariam Gole *et al.* 2008).

3.1.2 Climate and Rainfall

According to the climate data for ten years, obtained from National Meteorology Agency (2012), the mean annual temperature of the study area is 23.76 °C and the mean annual rainfall is 1,625 mm (Tilahun and Abebe, 2018). As it can be seen in the rainfall pattern is uni-modal and it reaches its highest between May and September (wet season) and its lowest between November and March (dry season) while there is a small amount of rainfall in April and October, although this shows variation year to year.

3.1.3 Socio-economic profile

Agriculture that holds both crop production and animal rearing is the major means of subsistence for the society in the study area. 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^{-1} 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. (Tesfu *et al*., 2016).

About 154, 300 permanent residents live in the Biosphere Reserve and mainly rely on agriculture. 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.

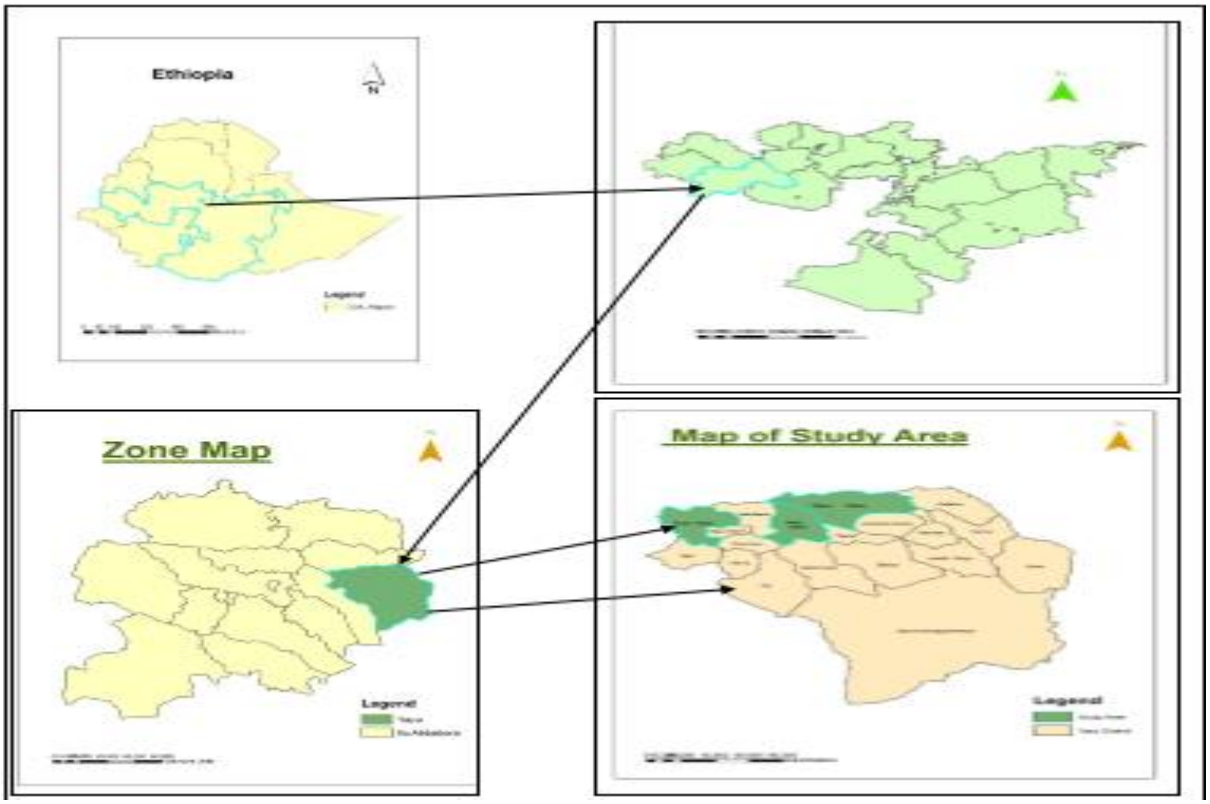


Figure 2 A Map of the Study area.

3.2 Methodology

3.2.1 Research Design

Both, quantitative and qualitative methods of data collection were used for this study. Quantitative method was used to identify major human impacts on woody plant diversity in the Yayu Biosphere Reserve and to assess effect of human disturbance on woody plant diversity. Qualitative method was used to investigate to perception of the local community towards conservation strategy.

3.2.2 Data Source

Both primary and secondary sources of data were used for the study. The primary data was gathered through a household's survey, focus groups discussion, key informants interviews, and direct field observation. The survey generated both qualitative and quantitative data about their socio-economic and demographic characteristics, aspects of participation and perception. Secondary data sources include published and unpublished report, books, journals, project reports, and maps.

3.3. Sampling techniques and method of data collection

3.3.1 Human disturbance assessment techniques

Anthropogenic disturbances originating from the use of the Yayu Biosphere Reserve by local communities along the boundary were assessed. Beforehand to the actual data collection, a preliminary assessment was done to identify the different types of disturbances encountered across the forest patches in Yayu Biosphere Reserve.

The levels of human disturbance by using an ordinal scale in per site per plots for the current study to classify human disturbance was assessed by assigning scores for each disturbance based on expert observation. A score of 1 to 3 were assigned to each anthropogenic factor. A score of 1 was considered to be a negligible or minimal human disturbance, 2 to moderate human disturbance and 3 to high human disturbance classes (Appendix 1). The overall disturbance for each site was calculated by summing the individual disturbance values of land use activities (Ten different activities in total).

Each of the ten activities was multiplied by a 1-3 intensity factor to calculate the overall human disturbance at each site, so the minimum disturbance score was 10 and the maximum disturbance score was 30. Scores ranging from 10 to 15 were identified as very low disturbed, 16 to 20 as low disturbed, and 21 to 25 as a medium disturbed 26 to 30 as high disturbed classes (Selamawit *et al*., 2017). This site classification was used to measure degree of human disturbance on woody plant diversity in Yayu Biosphere Reserve.

In this study, some degree of human disturbances activities in all patches were identified by using a certain indicator of human disturbances activities such as cut trees and poles were described as 'old cut' if there is any sign of blackening up of the stump and otherwise as 'fresh-cut' (Preston, 2011). Another evidence and indicators of human disturbance considered for this study was the presence of burnt trees and ground vegetation. These areas are described as "Fire damage". Another type of disturbance is an area cleared for pit sawing activities, with pitsaw platform in the area, or remains of such pieces.

These areas are described as "Pitsaw". Cut timber, planks or cut poles laying on the ground ready for transport are describes as "Timber/planks/poles". Evidence of crop cultivation (past or present) is described as "Cultivation", all humans used paths as "Footpath" and the well-established clearings within the forest as a consequence of human disturbance (usually short grassland, potentially previous settlement) are described as "Clearing".

3.3.2. Vegetation sampling techniques

In this study, a total of nine forest patches were designated to collect vegetation data. Three patches were designated as per zonations of Yayu Biosphere Reserve (core zone, buffer zone and transition zone) Core zone was considered as a little disturbed, buffer zone as moderately disturbed and transition zone as heavily disturbed. Accordingly, three forest patches were designated from each Kebeles and one transect line, was taken from each zonation's of the Yayu Biosphere Reserve.

In each forest patches, five-line transects of 1km long were randomly placed parallel to each other. From those of the five-line transects, one line transect was randomly selected. Sample plots with a dimension of 20m x 20m ($400m^2$) quadrates used for trees, and sub-plots of 5m x5 m ($25m^2$) for sapling and 3mx3m ($9m^2$) for seedling species at the center of the large

quadrant were taken as determined by (Kent and Coker, 1992; Lulekal *et al.*, 2008). The sampled Plots were assigned systematically at every 100m along the transect line. A total of 28 sample plots were taken from all zone along transect lines in the forest patches for vegetation diversity assessment. From each sample plots, data of trees/shrubs names, diameter at breast height (DBH) for those trees/shrubs with a diameter of 5 cm and above, the height of selected sample trees >2 m (small, medium, large) and location of the plots were collected.

3.3.3. Sample size determination techniques

Based on the feasibility of the Yayu Biosphere Reserves, members of the community in the total population of each villages the sample size of the respondents for this study determined by using (Yamane, T., 1967) sampling formula with 92 percent confidence level).

Yamane Formula.

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

Where n = sample size

N = total number of household of the Kebele

e= margin of error. $n = \frac{2077}{1+2077(0.08)^2}$ = n ≈2077/1+2077(0.0064) ≈14.2928 ≈2077/14.2928 ≈145.3179223 ≈ n ≈**145 HH**

Accordingly, 145 sample households were taken from a total population by using systematic random sampling techniques i.e.; 15 households from Wabo, 59 households from Geche, 71 households from Witate Kebeles, respectively.

3.3.4 Social Data Collection

Survey data were collected starting from February to March 2019. To collect the required information's both closed and open questions were included in the survey questionnaire and provided for sampled respondents. Multistage sampling was used, first, the district was purposively selected based on its forest coverage, and then three kebele were purposively

selected based on their proximity to Yayu Biosphere Reserves. Therefore, representative households were selected by using systematic random sampling techniques.

3.3.5 Methods of Data Collection

- **Questionnaire survey**

Both open-ended and closed-ended questions were used to collect the data for this research. The questionaries' administered to each respondent through enumerators by translating it's to the local language (Oromic) (Appendix: 3.1). The primary data were generated based on information from sampled households through a cross-sectional survey by using pre-tested structured questionaries' organized in a logical order of presentation. The survey generates qualitative, and quantitative data about demographic characteristics, aspects of participation, Biosphere Reserve resource use and dependence.

- **Key Informant Interviews**

In-depth key informant interviews were used with selected informants who have detail information about the Yayu Biosphere Reserve forest. Key informants contained (chairperson, kebele manager, DA, an elder from each kebele. The key informants were asked about the general information about the current and past situations of the Yayu Biosphere Reserve following (Keremane, 2017).

- **Focus group discussion**

Focus group discussion was used as an instrument to collect qualitative data in the study. Focus group discussion was selected from each sampled kebeles, then three focus group discussions were formed. Accordingly, a total of 10 participants in each focus group discussion participated (Appendix: 3.2). For each focus group discussion, written questions were administered to each member on the resource utilization related to Yayu Biosphere Reserves that were conducted following (schensul *et al*., 1999).

- **Field Observation**

During the data collection, field observation was used, hence I observed and taken notes about the environment like infrastructure, home gardens, yards and people's reactions to the overall interviewing situation against different questions, and discussion topics. The direct observation method was used to check up the clarity, and consistency of data collected from the study site. In general, observation in the current study has played a role in supporting the main data by generating useful information about the environment and people in the Yayu Biosphere Reserve. It was carried out with the guidance of the kebeles leader, including voluntary farmers, development agents (DA's), and the researcher.

In so doing, the researcher has taken notes on specific observations in advance. Disturbance on forest patches was described upon on-site observation together with the species affected in a Yayu Biosphere Reserve. It was used thematically to record the estimated disturbance size, cause, and quantify its impact on woody plant diversity.

3.4. Method of Data Analysis

3.4.1. Analysis of woody plant diversity

Species richness and abundance were calculated for each plots. Species richness was calculated by counting number of woody plant trees/shrubs species per plots whereas species abundance was calculated by counting each individual species. Shannon-Winner index for diversity, and species evenness were calculated based on Rahman *et al* (2011) using the following formula.

- **The Shannon-Winner index for diversity**, **H'** = - $\sum_{i=1}^{S}$(Pi $*$ lnPi)

Where **H'** = Index of species diversity,
S = number of species in community
Pi = No. of individual of one species/Total no. of Individuals in the sample (ni/N).

- ✓ $\boldsymbol{Species\ evenness(J)} = \frac{H'}{InS(Hmax).}$

- ✓ **Regeneration status analysis**

The regeneration status of woody species is summarized based on the total count of seedlings and saplings of each species across all plots. The regeneration status of the forest was categorized based on the criteria setted by (Dhaulkhandi *et al.*, 2008; Chauhan *et al.*, 2008).

1. „**Good** regeneration, if seedling is greater than sapling/young tree and mature tree/adult (seedling density > sapling density > mature tree/adults;

2. **„Fair"** regeneration, if seedling > or ≤ sapling ≤ mature tree;

3. „**Poor"** regeneration, if a species survives only in the sapling stage, but has no seedlings (even though saplings may be <, >, or = mature);

4. **None** "If a species is present only in an adult form, it is considered as not regenerating

5. „**New",** if a species has no mature, but only sapling and/ or seedling stages.

To determine regeneration status of a forest in Yayu Biosphere Reserve the following parameters were identified based on height classes. Accordingly, seedling, saplings and mature trees/shrubs were defined as plants with heights less than **1m**, **1-3m** and **greater than 3m**, respectively (Mammo Siraj and Kebin Zhang, 2018).

One way anova were computed to see significance difference between species richness and species abundance vs. among human disturbance classes, all zonations, and kebele in Yayu Biosphere Reserve. Multiple comparisons of Turkey's HSD were used to compare the mean difference between each groups (R version 3.6.2, R Development Core Team, 2019).

3.4.2. Method of Social data Analysis

The formal survey data were cleaned, coded then descriptive statistics (mean, standard deviation, frequency and percentages) were analyzed with the help of statistical package for social science (SPSS) version 20 software. The relationship between on forest resources and individual attitude questions were analyzed by using Pearson's chi-square tests (Agresti and Kateri, 2017).

4. RESULTS AND DISCUSSION

4.1. Major human disturbance on woody plant diversity in Yayu Biosphere Reserve

The major human disturbance activities in the study area were assessed and presented in (Table: 1). The category of human disturbance activities in the Yayu Biosphere Reserve was detected. Hence, based on the scores given the major human disturbance activities in the Yayu Biosphere Reserve were identified; accordingly, the major human disturbance activities detected in the core zone of the Biosphere Reserve were sandy soil extraction (12.3%), a land expansion for coffee plantation (14.3%), extraction of timber from the forest (13.3%), fuel-wood Collection (12.3%), fire damage during winter (8.5%), whereas the rest human disturbance activities were found in the buffer and transitional zone of the Biosphere Reserve as indicated in (Table 1).

Therefore, the present finding pointed out some of the human disturbance activities detected in Yayu Biosphere Reserves were converting the natural forest in to different land-use types. This indicated that there is a modification of natural forest into coffee plantation by local communities. In this case, even if the core zone of the Biosphere Reserve was protected legally based on the (UNESCO) principles, however there is high human pressure on the core zone of the Yayu Biosphere Reserve.

Thus, the current investigation argued that human effect influencing all zone of the forest classification, particularly the core zone of the Yayu Biosphere Reserve. Hence, upon this finding exact determination of forest demarcation will be needed for the sustainability of the Yayu Biosphere Reserve forest.

The current result is similar with the report of (Negese, 2014 and Victor K. Muposhi *et al*., 2016) Case of Maze National Park, in SNNPR in Gamo Gofa Zone**,** who reported that expansion of farmland and human activities around the Biosphere Reserve causes great management challenges in the country. Forest exploitation inside the Biosphere Reserves, and traditional farming activities close to the Biosphere Reserves might cause strong impacts on the Biosphere Reserve resources as reported by (Schloeder, 1996).

It is important to plan traditions in the outlook for the preservation of the Biosphere Reserve in cooperation with the local community (Lakew Birhanu, 2001). It is recognized that Biosphere Reserves management is successfully achieved only with the teamwork with local people (Balakrishnan and Ndholovu, 1992). Another result that corresponds with these findings (Weldemariam *et al*., 2016) argued that habitat loss and fragmentation of forest patches due to residents live in the Biosphere Reserve and mainly depend on agricultural development may have the most serious consequences to biodiversity.

Other than agricultural expansion, there is the presence of the local driver's force such as large scale investments on coffee and tea plantations, Yayu fertilizer manufacturing plant, road construction expansion, logging, firewood, and charcoal production have been the main drivers of deforestation and overexploitation of woody species of the Biosphere Reserve.

Table: 1 Major human disturbance activities in each zone of the Yayu Biosphere Reserve.

Major human disturbance Activities	**Core zone**		**Buffer zone**		**Transitional zone**	
	Score	%	Score	%	Score	%
Sandy soil extraction	13	12.3	0.0	0.0	0.0	0.0
Land for Coffee plantation	15	14.3	26	15.8	27	12.1
Extraction of the timber	14	13.3	22	13.4	27	12.1
Fuel-woody collection	13	12.3	24	14.6	27	12.1
Fire damage during winter	9	8.50	22	13.4	28	12.5
Agricultural expansion	0.00	0.00	22	13.4	30	13.4
Fertilizer industry	0.00	0.00	0.00	0.00	9	8.50
Electric pole distribution	0.00	0.00	12	7.30	27	12.1
Road construction	0.00	0.00	12	7.30	26	11.6
Grazing land in the forest	0.00	0.00	24	14.6	27	12.1

Note: 0.00: implies the absence of human activities in each zonation's of the YBR.

(A) Sandy soil extraction from buffer zone YBR (B) Sandy extraction from the core zone of the YBR.

(C) Fuel-woody extraction from buffer zone of YBR (D) Land for cultivation from the transional zone of the YBR.

(E) Land for coffee plantation in buffer zone (F) Livestock grazing in the transional zone

Figure 3 View of the landscape and some of the fragments forest in Biosphere Reserve.

4.2 Effects of human disturbance on woody species diversity in Yayu biosphere reserve

A total of 58 woody species (34 trees and 24 shrubs/liana species), belonging to 34 plant families, were recorded from the study area with 28 quadrats across all sites.

4.2.1 Woody Species diversity

Plant species diversity is mostly influenced by human impacts. Forests with low levels of disturbance has high species diversity compared to high disturbed forest. The Shannon - Wiener Diversity Index value in very low human disturbance classes was 3.23, in low human disturbance classes 3.10, in medium human disturbance classes 2.71, and in high human disturbance classes were 2.62 respectively (Table 2).

The results indicated that the value of diversity indices of woody species at very low human disturbance classes and low human disturbance classes were relatively higher than medium human disturbance classes and high human disturbance classes. The variation of Shannon-diversity index value in *VLHD* and *LHD* classes might be due to the difference in land-use types and degree of human disturbance risk in the area.

Besides, low human disturbance at very low human disturbance classes and low human disturbance classes as it is a less accessible site than medium human disturbance classes and high human disturbance classes could be another factor that generates a difference in woody species diversity. This result is consistent with the study of (Zegeye *et al*., 2011), who reported that a negative effect of site accessibility on woody species diversity.

The value of Shannon index diversity in *MHD* classes, slightly higher than in *HHD* classes. In *MHD* classes, farmers were conserving the forest for different purposes rather than in *HHD* classes. To maximize their coffee yield, farmers were managing the forest in such a way that favors the coffee plants. Due to this reason, farmers are conserving the forests on their own farmland hence the diversity of the woody species in this area was relatively high as compared with *HHD* classes.

Selective logging creates canopy openings that readily favor the germination and growth of light-demanding plant species, thus, leading to increased diversity and density of woody

plants. This result is in line with the results of (Tadesse Weldemariam Gole, 2003) who reported, semi-coffee forest conservation has fairly high plant species diversity and contributed to biodiversity conservation than other land use types like agriculture.

Forest disturbance influences species through alteration and fragmentation of forests, which is a serious concern in the management of tropical forests. This issue is supported by Liu & Brakenhielm (1996) who stated as a change in species diversity is often used as an indicator of anthropogenic or natural disturbances in an ecosystem. Similarly, Noble and Dirzo (1997) also reported that anthropogenic disturbances, such as logging or cutting trees, usually, result in an immediate decline in species diversity.

The present study pointed out there was a difference in species diversity among the all level of human disturbance classes. The current result is similar with result of (Fikiru Gamechu and Tefera Jegora, 2019) who reported that Shannon's diversity index value for adjacent natural forests and coffee farms was 3.07 and 2.13 respectively in Yayu Biosphere Reserve, South western Ethiopia. The highest value in the present study might be due to the different levels of protection and conservation programs in the study area (Table: 2). This indicated that the disturbance gradient from the Yayu Biosphere Reserve boundary into the inner sections of the Biosphere Reserve as reported by (Victor K. Muposhi *et al*., 2016).

Evenness or equitability value was (0.86 & 0.88) for *VLHD* & *LHD* classes showed that there is more or less balanced distribution of individuals of different species than (0.82 & 0.77) in *MHD* & *HHD* classes (Table: 2). On the other hand, the low evenness for *MHD* & *HHD* with comparing to that of *VLHD* & *LHD* classes indicated that there is an unbalanced representation of individuals of different species because of high human disturbance as well as site condition and species characteristics.

The finding is almost consistent with the result of (Getahun Yakob and Anteneh Fekadu, 2016, Hana Yasin *et al.,* 2018) who reported that Species evenness for Keja Araba natural forests and Tula natural forests in South West Ethiopia were 0.79 and 0.86, and the species evenness for the natural forest and coffee agro-forests were 0.95 and 0.81, at Belete Forest, Southwest Ethiopia respectively. The diversity and evenness indices imply the need to conserve the forests at *MHD* & *HHD* sites from human disturbance. In this case, findings

show a pattern of increasing or decreasing species diversity by changing the intensity of anthropogenic disturbances as reported by (Chinuwo *et al*., 2010).

The results of current study revealed that the variation of the woody species diversity among different level of human disturbances with high species diversity is in very low disturbed, low disturbed plots whereas, with low species, diversity in medium disturbed, high disturbed plots, and also include the result among the level of protection. This variation might be due to degree of disturbance by anthropogenic factors and Agro-ecological factors.

The species richness value in all human disturbance classes shown that a decrement in species richness against degree of human disturbance in the study area. This implies there was high species richness in very low human disturbance classes and low species richness in high human disturbance classes of the Yayu Biosphere Reserve. The reason why community two has the highest species richness is that there are fewer human disturbances in this classes. The current finding revealed that there was a significant difference in species richness against human disturbance classes ($F_{3, 23}=15.5$; $P<0.05$) (Table 3).

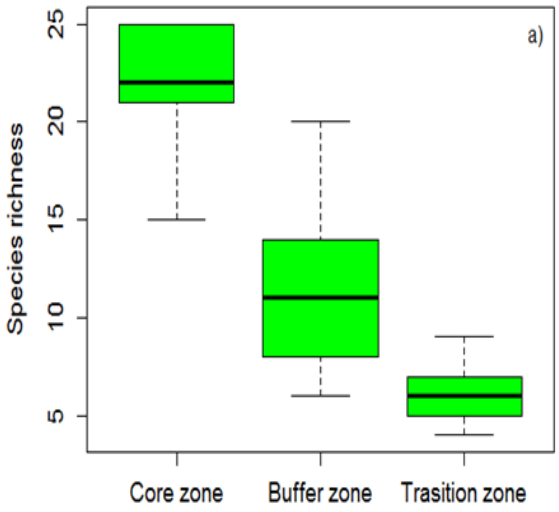
The difference in species richness along the different human disturbance classes might be due to the different anthropogenic factors in the study site. Besides this, different anthropogenic disturbances were the great factors that cause difference in species richness between all human disturbance classes in Yayu Biosphere Reserve. Therefore, this finding in line with the report of Zimudzi, (2013) who reported that variation in species richness among the different communities are often explained due to micro-site factors.

Means comparison between the human disturbance classes indicated that: there is a significant difference in species richness between each classes thus, Very low (mean = 20) human disturbance classes was statistically higher than a high human disturbance classes (mean=8) at ($P<0.05$). However, there is no significant difference between the rest human disturbance groups. Among all forest classes, higher species richness was recorded in the *VLHD* classes, whereas, small species richness was recorded in *HHD* classes.

This might due to minimum human interference which affects the species richness. The low human interference facilitates growth of different species in the forest as compared with

high human disturbance classes. Species richness vs. Kebele was significantly different (F2, 24=3.47; P<0.05) (Table 3). A mean comparison of Species richness was a significantly different between kebeles. There is a significant difference in species richness between Witate (mean=18) and Geche (mean=14) whereas, there is no significant difference in species richness between Witate and Wabo kebeles (Figure: 5). The difference in species richness between kebeles' might be due to knowledge variation on species diversity.

This implies Witate and Wabo kebele farmers have a positive attitude towards the indigenous and exotic species in their locality. The variation of attitudes between kebeles may affect the number of native woody species conserved in the farmer's field. The current result also showed that there is a significant variation in a species richness between all zonation of Yayu Biosphere Reserves (F2, 24=31; P<0.05) (Table 2). There was high species richness in core zone as compared with buffer zone and transitional zones of the Yayu Biosphere Reserves.



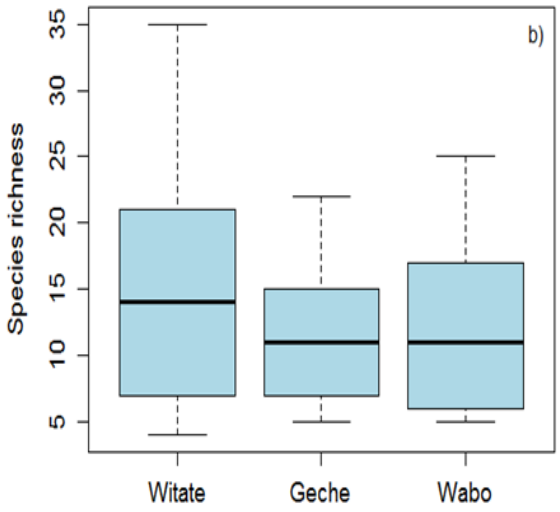


Figure 4: Species richness vs. all zonation of the BR and Figure 5: Species richness vs. all Kebele.

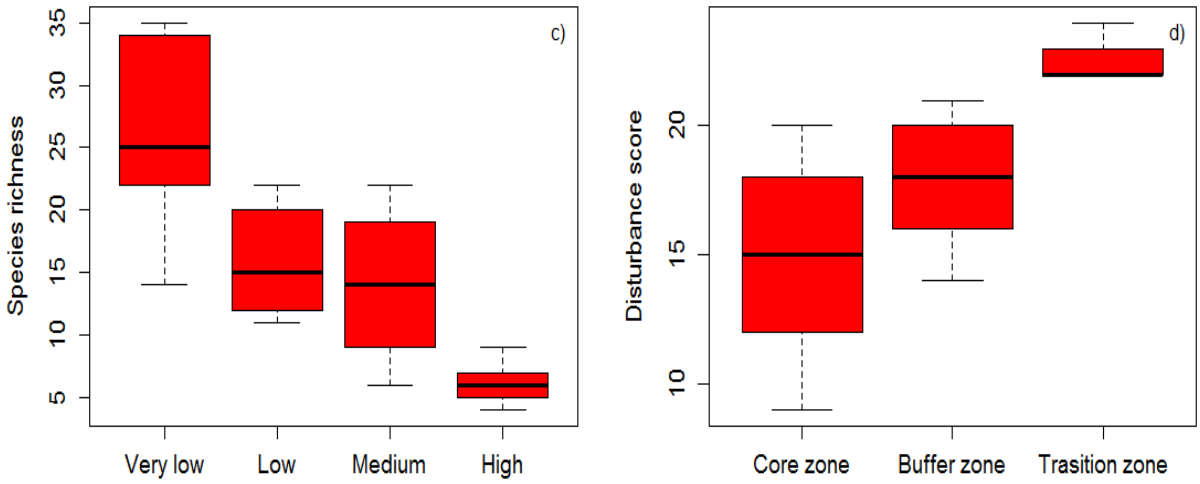


Figure: 6 Species richness vs. human disturbance and Figure: 7 Disturbance Score vs. all Zonation's.

4.2.3 Species abundance

The current result revealed that there was a significant difference in woody species abundance among all human disturbance classes ($F_{3, 23} = 18.62$; $P<0.05$). The species abundance density per hectare in all human disturbance classes were recorded in Very low human disturbance ($1903ha^{-1}$), low human disturbance ($827ha^{-1}$), medium human disturbance ($725ha^{-1}$), and in high human disturbance classes ($264ha^{-1}$) classes (Table: 2). The species abundance in all human disturbance classes showed that there is a decrement in species abundance with increasing human disturbance level in the Yayu Biosphere Reserve.

This implies there is high species abundance in low human disturbance classes whereas low species abundance in high human disturbance classes and vice versa. This might be due to human impacts and inappropriate utilization of forest resource in different land use types. Species abundance was significantly different among all zonations of Biosphere Reserves ($F_{2, 24}=3.98$ $P<0.05$). There was high species abundance in core zone (mean=66, $P<0.05$) as compared with transitional and buffer zone of the Biosphere Reserve. Species abundance vs. zonations of the Biosphere Reserve was significantly different ($F_{2, 24}=25$; $P<0.05$).

The species abundance was a significant difference among Kebeles in the study area (F2, 24=3.83; P<0.05) (Table: 3). A mean comparison of Species abundance was a significantly different between kebeles. There is a significant difference in species abundance between Wabo (mean=42) and Geche (mean=17) whereas, there is no significant difference in species abundance between Geche and Witate kebeles (Figure: 7).The result showed that the highest species abundance was recorded in Geche kebele whereas the lowest species abundance was recorded in Wabo kebele. The variation in species abundance between kebeles might be due to preference of farmers on particular trees species and shrubs based on its order of importance.

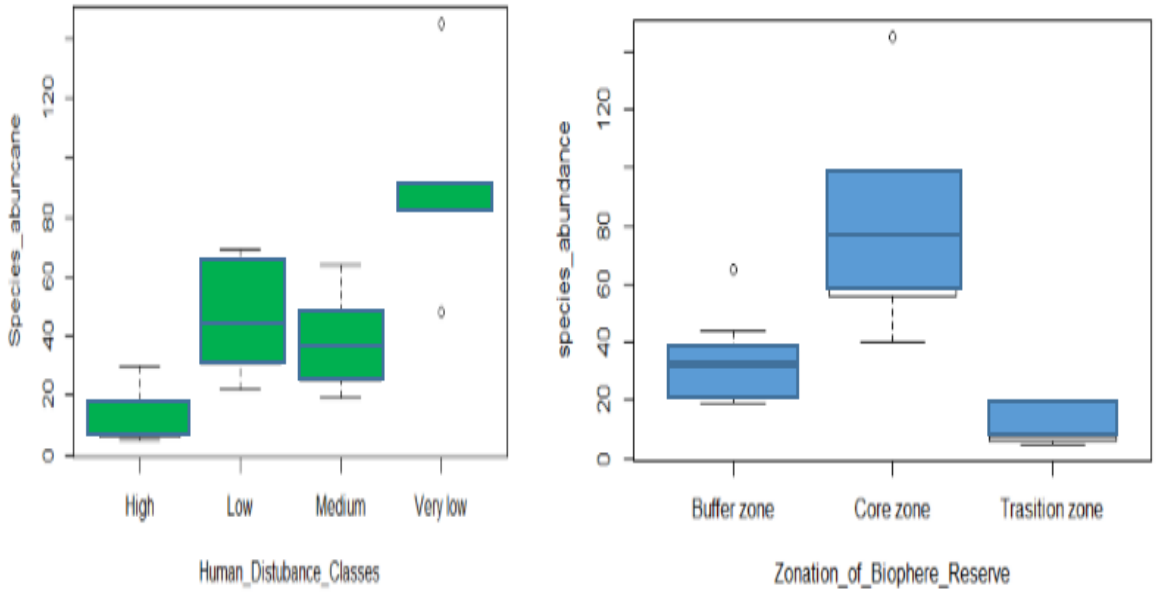


Figure: 8 Species abundance vs. all human disturbance classes and Figure: 9 Species abundance vs. all Zonation's of the Biosphere Reserve.

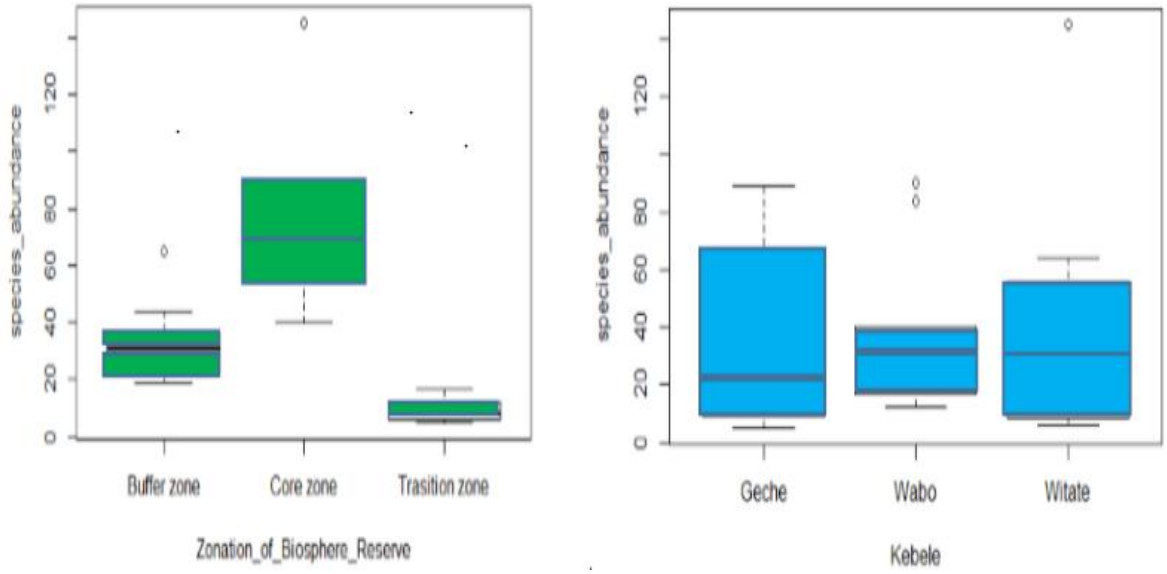


Figure: 10 Species abundance vs. all zonation of the Biosphere Reserve and Figure: 11 Species abundance vs. all kebeles in Yayu Biosphere Reserve.

Table: 2 Species diversity from all human disturbance classes in Yayu biosphere reserve.

Human Disturbance class	Total area	Species richness	Species abundance	Diversity Index Values	
				Shannon (H)	Evenness (J)
VLHD classes	0.28 ha^{-1}	42.00	1903 ha^{-1}	3.23	0.86
LHD classes	0.28 ha^{-1}	36.00	827 ha^{-1}	3.10	0.88
MHD classes	0.28 ha^{-1}	34.00	725 ha-1	2.71	0.77
HHD classes	0.28 ha^{-1}	24.00	264 ha^{-1}	2.62	0.82

Note: n = number of plots belonging to the category, *VLHD*: Very Low Human Disturbance *LHD*: Low human disturbance, *MHD*: Medium human disturbance & *HHD*: Heavy human disturbance Classes.

Table: 3 Mean values of species richness and species abundance versus Human disturbance classes, Zonation's and kebele in Yayu Biosphere Reserve.

Human Disturbance Classes					
Name of variable	VLHD	LHD	MHD	HHD	P-values
Species richness	26	16	14	6	**0.000*** **
Species abundance	253	228	106	31	**0.000*** **
Zonation of Biosphere Reserve					
	Core zone	Buffer zone	Transitional zone	P-values	
Species richness	24	12	6	**0.000*** **	
Species abundance	211	92	28	**0.000*** **	
Kebele					
	Wabo	Geche	Witate	P-values	
Species richness	11	7	14	**0.048** **	
Species abundance	53	169	122	**0.036** **	

Note: significant values in bold** & non-significance values in not bold).

The mean values of species richness and species abundance within kebele versus zones were showed a significant difference (Table: 3). There was a significant difference in species richness and species abundance between zones within kebeles. This implies that the species richness and species abundance was high in the core zone of the Yayu Biosphere Reserve in each kebeles as compared with buffer and transitional zones of the Biosphere Reserve. The highest species richness and abundance in the core zone might be due to the geographical location of the core zones since it was far apart from human settlements whereas transitional and buffer zones are more exposed for human disturbance.

Table 4 Mean values of species richness and species abundance of each kebele verses zonation of the Yayu Biosphere Reserve.

Kebele	Zonation of BR	Species richness	Species abundance
	Core	21	71
	Buffer	10	29
Wabo	Transition	7	15
	P-value	**0.003****	**0.014****
	Core	23	69
Geche	Buffer	11	35
	Transition	6	7
	P-value	**0.034****	**0.021****
	Core	26	88
Witate	Buffer	14	35
	Transition	6	7
	P-value	**0.014****	**0.034****

Note: significant values in bold** & non-significance values in not bold).

4.2.4 Regeneration status of woody species

The density values of seedling and sapling are considered as the regeneration potential of the species (Robi, 2016). The successful regeneration of a given forest requires the occurrence of a sufficient number of matured trees, saplings, and seedling in the population (Hanief *et al*., 2016). The total density of mature trees/shrubs, sapling, and seedling of the study plots in Very low human disturbance, low human disturbance, medium human disturbance & high human disturbance classes as described in Table (5) individual's ha^{-1} respectively.

The density of the species showed that seedling/ha^{-1} greater than both, sapling/young trees and mature trees/adults in *VLHD & LHD* classes whereas, seedling greater than a sapling, but less than a matured tree in *MHD & HHD* classes. In this study it has been observed that (42.9 & 46.8 % in *VLHD* & *LHD)* trees/shrubs species indicated "good" regeneration status, (40.9 & 23.5 % in *MHD* & *HHD*) showed "poor" regeneration condition.

These revealed that the distribution of seedling density was greater than both sapling and mature trees/shrubs in *VLHD* & *LHD* classes and seedling greater than a sapling, but less than a matured tree in *MHD* & *HHD* classes. Such conditions might have been occurred due to existing human disturbance in the study site like overgrazing, firewood collection, and poor biotic potential of tree species. Results of the present study indicated that the level of disturbance does not have a uniform effect on natural regeneration expressed in terms of seedling, sapling & matured tree density in all human disturbance classes.

As far as the regeneration status of each species is concerned and based on the categories used by Dhaulkhadi *et al*. (2008) and Chauhan *et al*. (2008); out of the 42 & 36 wood species in *VLHD* & *LHD* classes, 28.5% (12 in numbers) and 38.9% (14 in numbers) tree species achieved good regeneration and out of the 34 & 24 wood species in *MHD & HHD* classes, 47 % (16 in numbers) and 83.3% (20 in numbers) tree species had poor regeneration. This result is similar with the report of Hana Yasin *et al*., (2018) who reported that, no regeneration of certain species were recorded both under the natural forest and coffee agro-forest at Belete Forest, Southwest Ethiopia.

The reason for the low-density value of seedling and sapling in *MHD* & *HHD* classes might be attributed due to excessive disturbance, variable conditions for regeneration, and over-exploitation of some species. This finding was less than (Siraj, 2018) reported, the total density of matured trees/shrubs, sapling, and seedling of the study plots were 757.64 (52%), 827.o8 (25%) and 1743.75 (52%) individual ha^{-1} respectively.

The number of seedling/ha^{-1} was recorded from all human disturbance classes that were statistically significantly different ($P<0.05$), but no significant difference under a number of the sapling and matured tree density/ha^{-1} in all human disturbance classes ($P<0.05$).

The highest seedling/ha^{-1} were recorded in Very low human disturbance classes and the lowest seedling/ha^{-1} were recorded in high human disturbance classes. This variation might be due to different degree of human disturbance in study site.

Table: 5 Number of seedling densities / ha^{-1}, sapling densities /ha^{-1} and tree matured densities / ha^{-1} in the low, medium & high human disturbance classes in Yayu Biosphere Reserve forest.

Growth stage	**VLHD**		**LHD**		**MHD**		**HHD**		**(HD)**
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**P-value**
Seedling	700	42.9	386	46.8	389	40.9	93	23.5	**0.0048****
Sapling	254	15.6	121	14.7	125	13.1	86	21.5	0.0911
Matured tree	674	41.5	318	38.5	436	46.0	228	55.0	0.0982

Note: *VLHD*: Very Low Human Disturbance, *LHD:* Low human disturbance, *MHD*: Medium human disturbance, *HHD:* High human disturbance Classes.

The regeneration status of woody species diversity in Yayu Biosphere Reserve were a significant difference in each kebeles and zonation of Biosphere Reserve (Table: 6). There was a significant difference in seedling, sapling and matured tree density per hectare in Geche and Witate kebele against all zones of Yayu Biosphere Reserves whereas, seedling and sapling were significant difference in Wabo kebele versus zonation however, there was no significant difference in matured tree per hectare in Wabo kebeles.

Table 6 Mean value of Seedling/ha^{-1}, sampling/ha^{-1} and matured trees/ha^{-1} of each kebele verses zonation of the Yayu Biosphere Reserve.

Kebele	Zonation of BR	Seedling	Sapling	Matured Tree
	Core	22	12	89
Wabo	Buffer	9	8	54
	Transition	3	3	47
	P-value	**0.045****	**0.030****	0.380
	Core	21	22	51
Geche	Buffer	5	10	23
	Transition	1	5	15
	P-value	**0.048****	**0.015****	**0.014****
	Core	64	21	56
Witate	Buffer	4	10	37
	Transition	6	4	8
	P-value	**0.000*****	**0.013****	**0.043****

Note: significant values in bold & non-significance values in not bold).

4.3. Demographic and Socio Economic Characteristics of the Respondents in Yayu Biosphere Reserve.

The household characteristics of the study area are presented in (Table 7). The researcher interviewed members of both genders to get a more representative sample. Male respondents (76.6%) were twice as many as the female respondents (23.4%). Less than half of the respondents (37.9%) were between 30 and 39 years old age.

Those between 40-49 and 50-59 years of age accounted for 39.3% and 19.3% of the individuals interviewed. Such age classification was important in identifying the detailed information on management challenges of the Yayu Biosphere Reserve. Findings suggest that most of the people living near the forest are young & middle-age. The members of the local community had different levels of education (Table: 7) summarizes their education levels.

An examination of (Table: 6) reveals that most of the people who were interviewed had relatively primary levels of education (62.8%). Individuals with no formal education accounted for 31.7% of the respondents, 5.5% had only secondary education.

As an asked the community members to state how long they had lived around the forest. Their responses are summarized in (Table: 7) reveals that up to two-thirds of the people in the community had lived in their current homes for more than 20 years and less than 25 years. This leads to the conclusion that most of the respondents were probably born and have spent all their lives in their present homes near the Yayu Biosphere Reserve. Therefore, the respondents are likely to be familiar with the forest, the resources derived from it and the challenges facing the forest. Further respondents (29.7 %) have a family size of 5 and (24.1%) have a family size of 6.

Such a large family size with small landholdings will increase the demand for more resources. As a result, communities have been imposing maximum pressure on the Yayu Biosphere Reserve. The majority of respondents had a landholding more than 1 ha^{-1} (46.9%); only 31% have a land size greater than 2 ha^{-1}, 12.4% greater than 2.5 ha^{-1} and 9.7% were 0-1 ha^{-1} land.

Regarding the marital status majority of respondents were married (92.6%), 2.7% were single, 2% of respondents were a widow and 2% of the community member of the respondents were categorized under divorced.

Table 7: Major Demographic and socio-economic characteristics of the households in Yayu Biosphere Reserve.

Variables	Category	Frequency (%)*	Variables	Category	Frequency (%)*
Gender	Male	111(76.6%)	**Duration of HH Stay**	5-10 yrs	10(6.9%)
	Female	34 (23.4%)		11-15yrs	21(14.9%)
	30-39yrs	55(37.9%)		16-20yrs	42(28.9%)
Age	40-49yrs	57(39.3%)		21-25yrs	54(37.2%)
	50-59yrs	28(19.3%)		>25 yrs	18(12.1%)
	60-70yrs	5 (3.40%)	**Family size**	1-4.00	35(24.1%)
Education:	None educated	46 (31.7%)		4-5.00	22(15.2%)
	Primary education	91 (62.8%)		5-6.00	43(29.7%)
	Secondary education	8 (5.50%)		6-7.00	35(24.2%)
	And above	0.00(%)		7-8.00	10(6.8%)
Land size	0-1ha	14(9.7%)	**Marital status**	Single	4(2.7%)
	1-1.5ha	68(46.9)		Married	137(92.6)
	2-2.5ha	45(31%)		widow	2(1.4%)
	>2.5ha	18 (12.4)		Divorced	2(1.4%)
Total		**145**	**100%**		

Note: Parenthesis (%)*=number of frequency percentage.

4.4 Local community Perceptions in Yayu Biosphere Reserve

The third objective of the study was to decide the community's perception of the helps the conservation techniques inside the Yayu Biosphere Reserve. These perceptions are vital because they affect the community's willingness to take participate in the conservation of the forest. The community individuals had been asked to state who they believed become purported to conserve or control the forest.

Among the six perceptions, four perception questions differed statistically significant with all independent variables described in (Table: 8). Gender was statistically significant in almost all (4 out of 6) of the perceptions statements. Age, education, and duration of household stay near the Yayu Biosphere Reserve were also statistically significant in some perceptions (Table: 8). Other independent variables such as religion, marital status, occupation, land size and household size of the participants were not significantly different in any perception questions, they will therefore not be included in the further tests.

Table: 8 Significance level of chi-square tests from six perceptions tested with gender, age, education and duration of participants stay near the Yayu Biosphere Reserve.

Perceptions	1.Age	2.Gender	3.Education	DHHSNYBR
	P. Value	P. Value	P. Value	P. Value
Who Should Conserve Yayu Biosphere Reserve	0.041**	0.044**	0.048**	0.04
Awareness of importance of the YBR	**0.289**	**0.479**	**0.759**	**0.899**
Conservation knowledge of the HHs in YBR	0.005**	0.014**	0.013**	0.027
Awareness about the conservation programs in YBR	0.005**	0.041**	0.031**	0.03
Current situation of Yayu Biosphere Reserve	0.004**	0.032**	0.041**	0.04
Overall view of YBR (satisfied / unsatisfied)	**0.048**	**0.273**	**0.904**	**0.702**

Note: Implies significant values in bold** & implies non-significance values in not bold): DHHSNYBR: Duration of households Stay near the Yayu Biosphere Reserve.

4.4.1 Perception on who should conserve Yayu Biosphere Reserves?

An examination of (Figure: 12) reveals the respondents‟ views on who should be in the responsibility of conserving the forest. 62 respondents (42.8%) were of the view that residents should take charge of conserving the forest. 42 respondents (28.9%) believed that all stakeholders should be involved in conservation, 24 respondents (16.6%) were governmental parties involved in Yayu Biosphere Reserve conservation. only 6.9% and 2% of respondents felt that the role of conservation should be left to the local authority and done by the Non-Governmental Organizations.

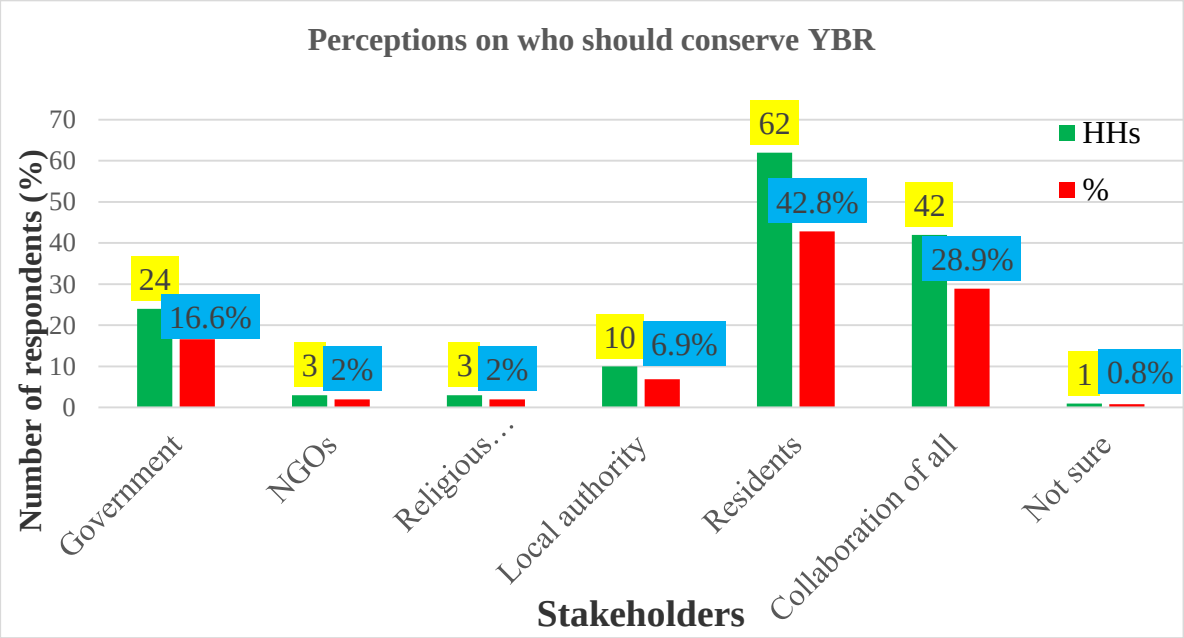


Figure: 12 Respondents' view on who should conserve Yayu biosphere reserve.

One respondent (0.8%) was of the view that he was not sure about who should have the accountability of maintaining the Yayu Biosphere Reserve. Statically there is highly significantly differed between a dependent variable and independent variable in YBR groups who should conserve the Biosphere Reserve point of views more than a half percent of the male respondent was of the view that residents should take charge of conserving the forest than female respondents (χ^2 =9.66, DF = 1, P<0.05; Table: 8, Figure: 12).

Figure: 8 shows that 42.8% of respondents thought that the residents had the accountability of conserving the forest. This shows that approximately half of the community members are willing to involve in conservation activities. (Figure: 12) also shows that 28.9% of respondents felt that all stakeholders should participate in conserving the forest and only 16.6% and 6.9% of respondents were of the view that only forest officers or governmental organizations and local authorities should be tasked with the role of conserving the forest. One respondent (0.8%) was of the view that he was not sure about who should have the responsibility of conserving the Yayu Biosphere Reserve.

These findings suggest that the local community is willing to take part in conserving the forest if the local people are involved. The current result is similar with report of Tesfaye (2017) who reported that most of the respondents were aware of the conservation of Chilimo-Gaji forest, and more than half agreed with the necessity for conserving the forest. It is important for the communities that exploit forest resources to be involved in conservation as reported by (Areole, 1991).

4.4.2 Conservation knowledge of the participants on support conservation strategies in Yayu Biosphere Reserve:

More than half of the members answered that they know the conservation activities from Yayu Biosphere Reserve. A much higher frequency of female participants answered that they do not know any of the conservation activities than male participants ($\chi^2 = 6.60$, DF = 1, $P<0.05$, Table: 8, Figure: 13). Male participants knew the human impacts on the Yayu Biosphere Reserve better than females, probably due to the better education and knowledge about conservation activities.

Garekae *et al.,* 2016 also suggested that women were important for the conservation of the Biosphere Reserve and required special efforts to target women in conservation activities. It is strongly recommended for targeting women for conservation activities together with well-trained women staff. Extension programs should also plan to listen to local people together with information sharing.

Conservation knowledge's also significantly differed between different age groups whereas middle-age people had more knowledge than other age groups (χ^2 =9.44, DF = 3, P<0.05; Table: 8, Figure: 13). Male participants said that they knew more conservation activities than females. This can be because most of the extension programs are focused on male participants. The present study found that the middle male age group people (40-49 years of age) were the most targeted group for the extension programs. This can be because the middle age group people are mostly males and the leader of the family. Participants described that Yayu Biosphere Reserve is protected not only for nature, biodiversity, and tourism but also for their cultures and traditions.

This findings similar with the (Htun *et al.* 2012) who reported that, conservation activities described by the participants include extension programs, patrolling, and prohibition for logging, hunting, orchids and forest fire protection. The finding from the current study suggests that conservation education programs should also include all households, younger generation and women in Yayu Biosphere Reserve.

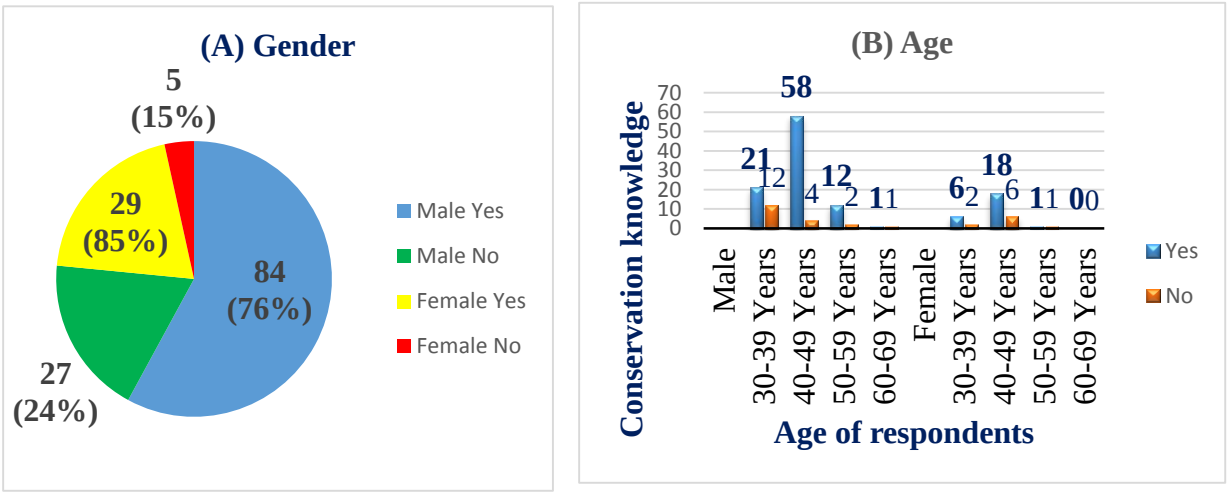


Figure: 13 Differences in conservation knowledge in relation to A & B) Gender and Age.

4.4.3 Awareness about the conservation programs in biosphere reserve

The respondents were asked to indicate which programs they knew were being done to conserve the forest. They were required to choose between two options, which were, planting trees and protection operations.

They could also state other programs in addition to these two. (Table: 9) shows how the community members responded on conservation programs.

Table: 9 Known conservation programs being done in Yayu Biosphere Reserve.

Program	Frequency	Percent
Planting new trees	107	73.8%
Protection operations	38	26.2%
Others	0	0.0%
Total	**145**	**100%**

As the results in (Table: 9) indicate, the community members are only aware of the two approaches, namely; planting new trees and protection operations. More people were aware of the tree planting strategy (73.8%) compared to the protection operations (26.2%). More than half of the participants answered that they know only one conservation program being done in a Biosphere Reserve.

A much higher frequency of female participants answered that they do not know any of the conservation programs than male participants ($\chi^2 = 4.71$, DF = 1, $P<0.05$; Table: 8). Known Conservation programs also significantly differed between different age groups whereas middle-aged people had more knowledge than other age groups ($\chi^2 = 18.79$, DF = 3, $P<0.05$; Table: 8). Secondary and above-educated people said more known conservation programs for Yayu Biosphere Reserve was the second most important factor for the sustainability of the Yayu Biosphere Reserve. Approximately, one third of none educated people did not have any answer ($\chi^2 = 6.71$, DF = 2, $P<0.05$; Table: 8).

The educated respondents have strongly supported by the Biosphere Reserve conservation approach. This finding is in line with report of (Jianying Xu, Liding Chen and Yihe Lu, Bojie Fu, 2005) who reported that respondents with higher education level expressed an objective opinion about the Reserve: it brought both benefits and losses. They perceived more benefits because they had better environmental awareness and advantages in the Biosphere Reserve.

Known Conservation programs also significantly differed between different duration of HHs stay near the Yayu Biosphere Reserve groups whereas the household who stay last years (> 25) had more known conservation programs than other duration of HHs stay near the BR groups, because of the respondents were inhabitants along period of time in and around the areas are likely to be familiar with the forest, the incomes derived from it and the challenges facing the forest (χ^2 =9.24, DF = 4, P<0.05; Table: 8). The findings in (Table: 8) show that the local community is only aware of two forms of conservation measures that are being implemented in Yayu Biosphere Reserve namely; planting trees and protection operations. This leads to the conclusion that the local community is not well-informed about all the conservation programs being undertaken.

The current result is similar with report of Tesfaye (2017) who reported that most of the respondents were aware of the conservation of Chilimo-Gaji forest, and more than half agreed with the necessity for conserving the forest. At the same time, these findings suggested that there is a need to educate the public more about different conservation programs that carry out in the Biosphere Reserve.

4.4.4 Local community Perception on current situation of Yayu biosphere reserve.

Participants were also asked whether the situation of Yayu Biosphere Reserve is presently better or worse than in the past. The majority of the participant said people's actions (logging, hunting, conversion of forest land into coffee, cultivated land, and expansion of any investment, as well as sandy soil extraction by user groups in the core zone of the Biosphere Reserve, makes Yayu Biosphere Reserve become worse. Significant differences were found between different education levels.

Secondary and above-educated people pointed out the ineffectiveness of management and land expansion for the coffee plantation inside the Biosphere Reserve is the second important factor making Yayu Biosphere Reserve be worse. Another factor making Yayu Biosphere Reserve worse is the lack of sufficient compensation for their resources which lost during the forest boundary demarcation. Primary educated people described a lack of support for local people as the second most important factor to cause a worse situation for Yayu Biosphere Reserve (χ^2 = 13.67, DF = 2, P<0.05; Table: 8).

Known current situation of the Yayu Biosphere Reserve also significantly between different duration of household stays in the Yayu Biosphere Reserve groups whereas the households who stay last years (>25) had a more known current situation of the YBR than other duration of household stay in the Yayu Biosphere Reserve groups, because of the household were a life a long period of time in and around the areas are likely to be well known with the forest, improved their livelihood derived from it and the challenges facing the forest (χ^2 = 26.12, df = 4, P<0.05; Table: 8).

Most of the participants mentioned that Yayu Biosphere Reserve is becoming worse nowadays than it used to be in the past. According to them, the major driver is human actions. Senavirathna *et al.* (2014) found that poaching, unsustainable forest harvesting, as well as lack of community participation are threatening the Biosphere Reserve. Participants from the current study believed that because of the increasing human population and fewer job opportunities, there are more hunting, shifting cultivation, and more logging all of which are destroying the Biosphere Reserve. No support from the government for their survival is a major concern by participants.

Secondary and above-educated people claimed that ineffective management for Biosphere Reserve is a major concern. The attitudes of the local communities toward the Yayu Biosphere Reserve in all selected kebeles were almost the same. They need to live harmoniously with the conservation area, by utilizing the Biosphere Reserve resources as a free grazing land for their livestock, forest land for coffee plantation, extraction of the timber, farmland and fuel wood collection site. The challenge remain to determine how many benefits will be enough to change the negative perceptions of local people towards conservation. Therefore, the need for the involvement and participation of the key stakeholders, such as local people, is important in achieving conservation strategies. According to Garekae *et al.* (2016) and Allendorf (2013) also reported that biodiversity loss is related to a lack of proper management. The current study suggested that it is important to improving participatory forest management approaches than assign a sufficient number of guards and necessary to provide basic facilities for the Biosphere Reserve staff for the successful conservation Yayu Biosphere Reserve.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions:

Human-induced disturbances are the main causes of changes in forest structure and composition, and the extent of these effects is dependent on the type and severity of the disturbances. The main human disturbance activities identified in the Yayu Biosphere Reserve were an illegal farming, free grazing, sandy soil extraction, deforestation, extraction of forest resources, and forest fire. The current finding indicated that there was high human interference in core zone of the Yayu Biosphere Reserve. This point out that there is a conversion of natural forest into different land use types by local community in study site.

Very low & Low human disturbance classes have higher species diversity and regeneration of woody species than medium and high human disturbance classes. The diversity and evenness directories indicate the need to give attention to reducing disturbance impact as a result of overexploitation of the natural forest in the area. The DBH class distributions show that some species are in poor regeneration status due to human disturbance. These variations between classes occurred because of the existence of heterogeneity in site characteristics and the extent of different anthropogenic factors.

The DBH and height class distributions show that some species are in poor regeneration status due to human disturbance. Influence of coffee expansion on the overall forest condition is somewhat controversial; on one hand, it plays a positive role in maintaining large areas covered by forest, however, on the other hand, through the modification of the natural forest for coffee production enhancement, it endangered the associated plant species and hence biodiversity, suggesting that a balance mechanism shall be required.

In this study, it has been observed that (42.9 & 46.8 % and 40.9 & 23.5 %) trees/shrubs species in all classes. This figure indicating good regeneration status in very low & low human disturbance classes & poor regeneration status in medium & high human disturbance classes respectively. These showed that the distribution of seedling density was greater than both sapling and mature trees/shrubs and seedling greater than a sapling, but less than a matured tree in medium & high human disturbance classes.

Regarding community perception towards conservation strategy, three accommodations of the respondents were of the view that conservation should be done by the residents and by a collaboration of all the stakeholders. This finding is very important for the government because it shows that the community is aware of its role in conservation and is willing to be involved in the efforts to conserve in the Yayu Biosphere Reserve.

The local community is not well-informed about all the conservation programs being undertaken in Yayu Biosphere Reserve. Information level on conservation strategy is not uniformly distributed within the social categories and vary by level of education, gender and age groups (people with a higher level of education are better informed than other categories).

The most common demand described by participants was to fulfill the daily basic needs. These basic requirements were most important for participants from inside the Yayu Biosphere Reserve. It is, therefore, important to understand the needs of local people which can be useful in encouraging them to be more supportive of conservation strategies. For conservation plans to succeed, the views of the local community should be considered and more so be fully involved in the process of conservation for them to feel a touch of ownership and sustain conservation.

5.2. Recommendations:

Based on the results the following recommendations are put forward/suggested to be effective in Yayu Biosphere Reserve management practice:

- Incentives should be given to the local community around the Biosphere Reserve to encourage local farmers to participate in conservation.
- Efforts should be made to provide the local communities with alternative sources of energy in order to reduce fuel-wood problems or scarcity, individual households have to be encouraged to grow their own on-farm trees at least for their daily fuel-wood consumption.
- Alternatives for fuel-wood usage should be developed (electricity, less energy-consuming stove, biofuel, solar energy), awareness should be created

about different conservation programs that carry out in the Yayu Biosphere Reserve.

- Priority needs to be given for conservation of low diversity, poor regeneration, none regeneration in medium and high human disturbance classes in study area.
- Biosphere Reserve and people relationships need to be improved, conservation education programs should also include all households, the younger generation, and women in the Yayu Biosphere Reserve. Job opportunities for local people should be created (small scale businesses) and Women targeted conservation programs need to be developed and implemented.
- The agriculture sector package should be implemented as a strategic option for conservation and sustainable use of remaining natural forests according to the climate-resilient green economic policy under implementation.
- Generally, good governance, continuous monitoring, and evaluation of Biosphere Reserve management activities at different levels (national, regional, and local levels) are crucial for positive outcomes and for the reduction of human disturbance related problems.

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7. APPENDIX

Appendix Table 1 Method used to assess habitat disturbance of forest sites (Hruby 2004 as modified by Mereta *et al.* 2013). A score of 1 was awarded for no or minimal disturbance, 2 for moderate disturbance and 3 for high disturbance. Ten different disturbance criteria w were included.

Disturbance		**Score=1**	**Score =2**	**Score=3**
Habitat alteration	-Grazing vegetation removal	-Minimal grazing with < 10% Vegetation removal	-Moderate grazing with 10-50% Vegetation removal	-Intensive grazing with > 50% Vegetation removal
	-Fire damage in forest	-Minimal fire damage at > 50 m from the forest	-Moderate Fire damage at < 50 m but not in the forest	-Intensive Fire damage in Forest or > 50% tree removal
	-Fuel-woody collection	-Minimal fuel-woody collection With < 10% Vegetation removal	-Moderate Fuel-woody collection with 10-50% Vegetation removal	-Intensive fuel-collection with >50% Vegetation removal
	-Extraction of the timber	-Minimal extraction of the timber with < 10% tree removal	-Moderate extraction of the timber with 10-50% tree removal	-Intensive extraction of the Timber with > 50% tree removal
	-Sandy soil extraction	-Minimal Sandy soil extraction > 50 m from the forest	-Moderate Sandy soil extraction Ex. in or< 50 m from F.	-Intensive Sandy soil extraction in the Forest.
Land use	-Crops cultivation	-Minimal Crops cultivation at > 50 m from the forest	-Moderate Crops cultivation at < 50 m from the forest	-Intensive Crops cultivation in the forest
	-Coffee Plantation	- Minimal Coffee Plantation at > 50 m from the forest	-Moderate Coffee Plantation at < 50 m from the forest	-Intensive Coffee Plantation in the forest
Infrastructure	-Road construction	-Minimal Road construction at > 50 m from the forest	-Moderate road construction < 50 m from the forest	-Intensive road construction in < 50 m from the forest
	-fertilizer processing	-Minimal Fertilizer processing at > 50 m from the forest	-Moderate fertilizer processing < 50 m from the forest	-Intensive fertilizer processing < 50 m from the forest
	-Electrical pole distribution	-Electrical pole distribution at > 50 m from the forest	-Moderate Electrical pole distribution < 50 m from the forest	-Intensive Electrical pole distribution < 50 m from the forest

Appendix Table 2 Woody species diversity recorded format 2011

***Table 7.2.1*: Woody plant species were recorded from Very low Disturbances classes' in Yayu**

Biosphere Reserve Study site: Region: **Oromia** Zone: **Illubabor** District: **Yayu,** Kebele:

No	**Local name (A/Oromo)**	**Scientific name**	**Family Name**	**No.**	**G/F**
1.	Abbayyii	Maesa lanceolata Forssk.	Myrsinaceae	10	Shrubs
2.	Abiraangoo	Oxyanthus speciosus	Rubiaceae	22	Shrubs
3.	Akuukkuu	Flacourtia indica (Burm. F)	Flacourtaceae	1	Trees
4.	Baddeessaa	Sysygium guineense (Willd.)	Myrtaceae	1	Trees
5.	Baggee	Combretum paniculatum	Menispermaceae	4	Shrubs
6.	Bosoqa	Sapium ellipticum (Krauss) P	Euphorbiaceae	5	Trees
7.	Buruurii	Psychotria orophila Petit	Rubiaceae	12	Trees
8.	Cayii	Celtis africana Burm.f.	Ulmaceae	15	Trees
9.	Birbirsa	Podocarpus falcatus (Thunb.	Podocarpaceae	2	Tress
10.	Dambii	Ficus thonningii Blume.	Moraceae	2	Trees
11.	Dhama'ee	Nuxia congesta	Loganiaceae	12	Shrubs
12.	Dhummuugaa	Justicia schimperiana	Acanthaceae	6	Shrubs
13.	Diiboo	Rothmania urcelliformis	Rubiaceae	15	Shrubs
14.	Doophoo	Landolphia buchananni	Apocynaceae	53	Trees
15.	Eebicha	Vernonia amygdalina	Asteraceae	1	Shrubs
16.	Gagamaa	Olea copensis ssp mororpa	Olea	4	Trees
17.	Gatamaa	Schefflera abyssinica	Araliaceae	5	Trees
18.	Hadheessa	Teclea nobilis Del.	Rutaceae	2	Trees
19.	Halalee	Byttneria catalpitiolata	Sterculiaceae	10	shrubs
20.	Hincinnii	Pavonia urens Cav.	Malvaceae	40	Shrubs
21.	Kombolcha	Maytenus arbutifolia (A.Rich)	Celastraceae	6	Shrubs
22.	Lolchiisaa	Berseama abyssinica Fresen.	Melianthaceae	4	Shrubs
23.	Lookoo Adii	Diosporyus abysssinica	Ebenaceae	27	Trees
24.	Lookoo Gurracha	Diosporyus abyssinica	Ebenaceae	25	Trees
25.	Muka Foonii	Clutia abyssinica Jaub.	Euphorbiaceae	8	Shrubs
26.	Qacamaa	Myrsina africana	Myrsinaceae	1	Shrubs
27.	Qolaatii	Mimusops kummel A. DC.	Sapotaceae	4	Trees

28.	Saacoo	Agave sisalana Perr.	Agavaceae	20	shrubs
29.	Sarxee	Dracaena steudneri	Dracaenaceae	3	Shrubs
30.	Si'oo	Allophylus abyssinicus	Sapindaceae	4	Tress
31.	Soolee	Pittosporum viridiflorum	Pittosporaceae	47	Shrubs
32.	Sootalloo	Millettia ferruginea	Fabaceae	19	Trees
33.	Ulaagaa	Ehretia cymosa Thonn.	boraginaceae	6	Shrubs
34.	Ulmaayyii	Clausena anisata (Wild.) Ben	Rutaceae	24	Shrubs
35.	Urgeessaa	Premna schimperi Engl.	Lamiaceae	1	Shrubs
36.	Waddessa	Cordia africana Lam.	Boraginaceae	8	Trees
37.	Somboo	Ekebergia capensis Sparrm.	Meliaceae	4	Trees
38.	Qararoo	Pouteria adolfi friederici	Sapotaceae	4	Trees
39.	Agamsa	Carissa edulis (Forsk.) Vahl.	Apocyanaceae	2	Shrubs
40.	Hidda Gafarsaa	Paullinia pinnate L.	Sapindaceae	2	Shrubs
41.	Hambaabbeessa	Albizia gummifera (J.F.Gumel.)	Fabaceae	4	Trees
42.	Xaaxessaa	Rhus ruspolii Engl.	Anacardaceae	1	Shrubs

7.2 Woody species diversity recorded format 2011

***Table 7.2.1*: Woody plant species were recorded in <u>low Disturbances</u> classes** in Yayu Biosphere Reserve Study site: Region: **<u>Oromia</u>** Zone: **<u>Illubabor</u>** District: **Yayu,** Kebele:

No	**Local name (A/Oromo)**	**Scientific name**	**Family Name**	**No.**	**G/F**
1.	Abbayyii	Maesa lanceolata Forssk.	Myrsinaceae	10	Shrubs
2.	Abiraangoo	Oxyanthus speciosus	Rubiaceae	21	Shrubs
3.	Baddeessaa	Sysygium guineense (Willd.)	Myrtaceae	1	Trees
4.	Baggee	Combretum paniculatum	Menispermaceae	2	Shrubs
5.	Bosoqa	Sapium ellipticum (Krauss) P	Euphorbiaceae	3	Trees
6.	Buruurii	Psychotria orophila Petit	Rubiaceae	15	Trees
7.	Cayii	Celtis africana Burm.f.	Ulmaceae	16	Trees
8.	Birbirsa	Podocarpus falcatus (Thunb.	Podocarpaceae	35	Tress
9.	Dambii	Ficus thonningii Blume.	Moraceae	3	Trees
10.	Dhama'ee	Nuxia congesta	Loganiaceae	10	Shrubs
11.	Dhummuugaa	Justicia schimperiana	Acanthaceae	65	Shrubs

12.	Diiboo	Rothmania urcelliformis	Rubiaceae	1	Shrubs
13.	Doophoo	Landolphia buchananni	Apocynaceae	11	Trees
14.	Eebicha	Vernonia amygdalina	Asteraceae	1	Shrubs
15.	Gagamaa	Olea copensis ssp mororpa	Olea	14	Trees
16.	Gatamaa	Schefflera abyssinica	Araliaceae	5	Trees
17.	Hadheessa	Teclea nobilis Del.	Rutaceae	33	Trees
18.	Halalee	Byttneria catalpitiolata	Sterculiaceae	60	Shrubs
19.	Hincinnii	Pavonia urens Cav.	Malvaceae	5	Shrubs
20.	Kombolcha	Maytenus arbutifolia (A.Rich)	Celastraceae	73	Shrubs
21.	Lolchiisaa	Berseama abyssinica Fresen.	Melianthaceae	10	Shrubs
22.	Lookoo Adii	Diosporyus abysssinica	Ebenaceae	33	Trees
23.	Lookoo Gurracha	Diosporyus abyssinica	Ebenaceae	11	Trees
24.	Muka Foonii	Clutia abyssinica Jaub.	Euphorbiaceae	1	Shrubs
25.	Qacamaa	Myrsina africana	Myrsinaceae	6	Shrubs
26.	Qolaatii	Mimusops kummel A. DC.	Sapotaceae	2	Trees
27.	Saacoo	Agave sisalana Perr.	Agavaceae	6	Shrubs
28.	Sarxee	Dracaena steudneri	Dracaenaceae	56	Shrubs
29.	Si'oo	Allophylus abyssinicus	Sapindaceae	2	Tress
30.	Soolee	Pittosporum viridiflorum	Pittosporaceae	3	Shrubs
31.	Sootalloo	Millettia ferruginea	Fabaceae	24	Trees
32.	Ulaagaa	Ehretia cymosa Thonn.	boraginaceae	13	Shrubs
33.	Ulmaayyii	Clausena anisata (Wild.) Ben	Rutaceae	18	Shrubs
34.	Waddessa	Cordia africana Lam.	Boraginaceae	2	Trees
35.	Somboo	Ekebergia capensis Sparrm.	Meliaceae	2	Trees
36.	Qararoo	Pouteria adolfi friederici	Sapotaceae	2	Trees

Appendix Table 3 Woody plant species were recorded from **Medium Human Disturbance classes** in Yayu Biosphere Reserve.

Study site: Region: **Oromia** Zone: **Illubabor** District: **Yayu,** Kebele, Altitude/Elevation.

No	**Local name (A/Oromo)**	**Scientific name**	**Family Name**	**No.**	**G/FF**
1.	Xaaxessaa	Rhus ruspolii Engl.	Anacardaceae	1	Shrubs
2.	Lookoo Adii	Diosporyus abysssinica	Ebenaceae	2	Trees
3.	Bosoqa	Sapium ellipticum (Krauss) P	Euphorbiaceous	1	Trees
4.	Cayii	Celtis africana Burm.f.	Ulmaceae	8	Trees
5.	Birbirsa	Podocarpus falcatus (Thunb.	Podocarpaceae	1	Trees
6.	Walensuu	Erythrina brucei Schweinf.	Fabaceae	5	Trees
7.	Deeqqoo Qalamee	Girardina diversifolia (Link)	Urticaceae	2	Trees
8.	Dhoqonuu	Grewia ferruginea A. Rich.	Tiliaceae	4	Trees
9.	Diiboo	Rothmania urcelliformis	Rubiaceae	2	Trees
10.	Gagamaa	Olea copensis ssp mororpa	Olea	1	Trees
11.	Gatamaa	Schefflera abyssinica (Hochst.	Araliaceae	1	Tress
12.	Gur-sadee	Lepidotrichilia volkensis	Meliaceae	1	Trees
13.	Halalee	Byttneria catalpitiolata	Sterculiaceae	28	Shrubs
14.	Hambaabbeessa	Albizia gummifera	Fabaceae	1	Trees
15.	Dhama'ee	Nuxia congesta	Loganiaceae	2	Shrubs
16.	Harbuu	Ficus sycomorus	Moraceae	4	Trees
17.	Ambaltaa	Entada abyssinica Steud.	Fabaceae	1	Trees
18.	Kombolcha	Maytenus arbutifolia (A.Rich.)	Celastraceae	5	Shrubs
19.	Lolchiisaa	Berseama abyssinica Fresen.	Melianthaceae	1	Shrubs
20.	Lookoo	Diosporyus abysssinica	Ebenaceae	9	Trees
21.	Dodota	Acacia sp.	Fabaceae	1	Trees
22.	Sokorruu	Acanthus eminence C.B. Blake	Acanthaceae	1	Shrubs
23.	Agamsa	Carissa edulis (Forsk.) Vahl.	Apocyanaceae	4	Shrubs
24.	Buruurii	Psychotria orophila Petit	Rubiaceae	1	trees
25.	Qaawoo	Gouania longispicta	Rhamnaceae	2	Trees
26.	Qararoo	Pouteria adolfi friederici	Sapotaceae	1	Trees
27.	Qolaatii	Mimusops kummel A. DC.	Sapotaceae	1	Trees

28.	Saacoo	Agave sisalana Perr.	Agavaceae	4	Shrubs
29.	Sarxee	Dracaena steudneri	Dracaenaceae	24	Shrubs
30.	Somboo	Ekebergia capensis Sparrm.	Meliaceae	10	Trees
31.	Ulmaayyii	Clausena anisata (Wild.) Ben	Rutaceae	2	Shrubs
32.	Sootalloo	Millettia ferruginea (Hochst.)	Fabaceae	7	Trees
33.	Waddessa	Cordia africana Lam.	Boraginaceae	3	Trees
34.	Ulaagaa	Ehretia cymosa Thonn.	boraginaceae	3	Shrubs

* Growth form: T= Trees, S= Shrubs, T/S = Tree/Shrubs.

Appendix Table 4 Woody plant species were recorded from **High human disturbance classes** in Yayu Biosphere Reserve.

Study site: Region: **Oromia** Zone: **Illubabor** District: **Yayu,** Kebele: _____

Name of data Collector: _____Date (day/month/year) ____/___/2019 Line/Transect: _____ Plot No: _____ GPS reading; Longitude (X): _____ Latitude (Y): _____ Altitude/Elevation.

No	**Local name (A/Oromo)**	**Scientific name**	**Family Name**	**No.**	**G/FF**
1.	Bosoqa	Sapium ellipticum (Krauss) P	Euphorbiaceae	1	Trees
2.	Buruurii	Psychotria orophila Petit	Rubiaceae	1	Trees
3.	Walensuu	Erythrina brucei Schweinf.	Fabaceae	2	Trees
4.	Dhama'ee	Nuxia congesta	Loganiaceae	2	shrubs
5.	Gagamaa	Olea copensis ssp mororpa	Olea	1	Trees
6.	Gambeelaa	Gardenia ternifolia Schumach.	Rubiaceae	1	shrubs
7.	Hadheessa	Teclea nobilis Del.	Rutaceae	7	Trees
8.	Halalee	Byttneria catalpitiolata	Sterculiaceae	2	shrubs
9.	Harbuu	Ficus sycomorus	Moraceae	3	Trees
10.	Hoomii	Prunus africana (Hook. F.)	Rosaceae	2	Trees
11.	Laaftoo	Acacia abyssinica Hochst.	Fabaceae	2	Trees
12.	Lookoo	Diosporyus abysssinica	Ebenaceae	1	Trees
13.	Makkanniisa	Croton macrostachyus Del.	Euphorbiaceae	1	Trees
14.	Mieessaa	Euclea racimosa L.	Ebenaceae	5	Trees
15.	Lookoo Gurracha	Diosporyus abyssinica	Ebenaceae	1	Trees

16.	Qolaatii	Mimusops kummel A. DC.	Sapotaceae	1	Trees
17.	Saacoo	Agave sisalana Perr.	Agavaceae	4	shrubs
18.	Si'oo	Allophylus abyssinicus	Sapindaceae	2	Trees
19.	Somboo	Ekebergia capensis Sparrm.	Meliaceae	1	Trees
20.	Sootalloo	Millettia ferruginea (Hochst.)	Fabaceae	2	Trees
21.	Turungoo	Citrus grandis (L.)	Rutaceae	1	shrubs
22.	Ulmaayyii	Clausena anisata (Wild.) Benth	Rutaceae	2	shrubs
23.	Urgeessaa	Premna schimperi Engl.	Lamiaceae	1	shrubs
24.	Waddessa	Cordia africana Lam.	Boraginaceae	2	Trees

Table: 4 ANOVA table for biological diversity parameters.

*Name of Variables	Sum Square	Mean Square	DF	F-value	P-value
Species Abundance Vs. Human Disturbance	21389	7130	3	18.62	**0.000*** **
	8814	383	23		
Species Richness Vs. Human Disturbance	1346.0	448.7	3	15.5	**0.000*** **
	665.6	28.9	23		
Specie Abundance Vs. Zonation's	1209	604.3	2	25.3	**0.000** **
	3640	151.7	24		
Species Richness Vs. Zonation's	18.7	9.330	2	30.9	**0.000** **
	1698.0	70.75	24		
Species Abundance Vs. Kebeles	7852	3925	2	3.83	**0.036** **
	24620	1025	24		
Species Richness Vs. Kebeles	208	104	2	3.47	**0.048** **
	719	30	24		
Seedling Vs. Human Disturbance	1193	397.6	2	5.613	**0.0048** **
	1629	70.8	24		
Sapling Vs. Human Disturbance	142.0	47.34	2	2.43	0.0911
	448.1	448.1	24	19.48	

Matured Trees Vs. Human Disturbance	724.1	241.4	2	2.358	0.098
	2353.9	2353.9	24	102.3	

Note: significant values in bold & non-significance values in not bold): ***; highly significance values & **; significance values.

Note: significant values in bold & non-significance values in not bold): ***; highly significance values & **; significance values.

Appendix Table 5 ANOVA table for Species richness and Species abundance of each Kebele verses zonation of the Yayu Biosphere Reserve.

	Zonation	Species richnes.	**Sum Square**	**DF**	**Mean Square**	**F-value**	**P-value**
	core		360.222	2	180.111	17.430	**.003**
Wabo	Buffer		62.000	6	10.333		
	Transition	**Total**	**422.222**	**8**			
		Species Abund.	5180.667	2	2592	9.378	**.014**
			1657.333	6	276		
		Total	**6838.000**	**8**			
Geche		Species richn.	492.667	2	246.33	6.228	**.034**
			237.333	6	39.556		
		Total	**730.000**	**8**			
		Species Abund	5716.667	2	2858.33	7.891	**.021**
			2173.333	6	362.222		
		Total	**7890.000**	**8**			
Witate		Species richn.	626.889	2	313.444	9.466	**.014**
			198.667	6	33.111		
		Total	**825.556**	**8**			
		Species Abund	10300.222	2	5150.111	6.222	**.034**
			4966.000	6	827.667		
		Total	**15266.222**	**8**			

Note: significant values in bold & non-significance values in not bold): ***; highly significance values & **; significance values. BR: Biosphere Reserve.

Appendix Table 6 ANOVA table for Seedling/ha-1, sampling/ha-1 and matured trees/ha-1 of each kebele verses zonation of the Yayu Biosphere Reserve.

	Zonation	**Species variable**	**Sum Square**	**DF**	**Mean Square**	**F-value**	**P-value**
	core	Seedling	583	2	291	5.45	**0.045**
Wabo	Buffer		321	6	53		
	Transition	**Total**	904	8			
	core	sapling	132	2	66	6.65	**0.030**
	Buffer		59	6	10		
	Transition	**Total**	191	8			
	core	Matured Trees	403	2	201	1.1	0.38
	Buffer		1059	6	176		
	Transition	**Total**	1462	8			
Geche	core	Seedling	672	2	336	2.44	**0.048**
	Buffer		384	6	64		
	Transition	**Total**	1056	8			
	core	sapling	444	2	222	9.25	**0.015**
	Buffer		144	6	24		
	Transition	**Total**	588	8	246		
	core	Matured Trees	2130	2	144	0.095	**0.014**
	Buffer		683	6	1523		
	Transition	**Total**	2814	8			
	core	Seedling	7028	2	3514	315	**0.000**
	Buffer		67	6	11		
Witate	Transition	**Total**	7095	8	3525		
	core	sapling	475	2	237	2.88	**0.013**
	Buffer		494	6	82		

	Transition	**Total**	969	8	319		
	core	Matured Trees	3397	2	1698	5.58	**0.043**
	Buffer		1826	6	3004		
	Transition	**Total**	5223	8	4702		

Note: significant values in bold & non-significance values in not bold): ***; highly significance values & **; significance values. BR: Biosphere Reserve.

7.3 Household Questionnaires in Yayu Biosphere Reserve

My Name is Lalisa Bariso Hasan I am a master student, studying Natural Resource Management at the Jimma University College of Agriculture and Veterinary Medicine, Specialization in Forest and Nature Conservation. The aim of my study is to acquire knowledge about the perception of local people living near the Yayu Biosphere Reserve.

This study is important both for the conservation of biodiversity and the local people who is dependent on the Yayu Biosphere Reserve. I hope you would like to give me some time to answer my questions. Feel free to answer my questions, I will not show your identity in my thesis. I just want to know your opinion and your knowledge for my study.

Thank you so much for your kind participation!

Date & Time…….....

Village Name……..…….

GPS position……

Demographic Information

1. Name of respondents_____
2. Age: 30–40 ( ) 41–50 ( ) 51–60 ( ) 61–70 ( )

(3) Gender_____Female ( ) Male ( )

(4) What is your religion? _____

(4) What is your ethnicity/ community? _____ _____

(5) Marital status -Single ( ) Married ( ) Widow (HWAW) ( ) Divorced (Kan hiike) ( )

(6) Education - None ( ) - Primary ( ) - Secondary ( ) - Other (specify) ( )

(7) What is your occupation (jobs)? _____

(8) How many people are living in your household? _____

Age_____Sex_____Occupation_____Education

Relation_____

(9) Household Activity and Income

Activity Income in Year

-Agriculture -Hunting Business

-Fishing -Employment

Tour Guide (Bird Watching Tour) Other (specify) _____

(10) Do you own land? Yes ( ) No ( )

(11) If yes, how big is your land? _____Ac/Ha

(12) What kind of crops do you mainly grow?

_____

(13) What was the average production (kg) last season? _____

(14) How long have you been living in this village? Years 5-10, 10-15, 15-20, over 20 years

(15) What happened to you when the Yayu Biosphere Reserve was established?

_____

Benefit from the Biosphere Reserve

(16) Do you ever go into the Biosphere Reserve? Yes ( ) No ( )

(a) If yes, could you tell me why do you go there? Hunting ( ) Fuel wood collections ( ) Collection of Non-wood forest products ( ) Grazing ( ) Water ( ) others (specify) _____

(b) Which part of the Biosphere Reserve do you usually go? Inside (a) near (b) (c) How far is it? _____

(17) How many times do you go per month? _____times

(18) How long does it take to go into Yayu Biosphere Reserve? _____Hours

(19) Have you ever sleep in the Yayu Biosphere Reserve? Yes ( ) No ( )

(20) Do you benefit from the tourism activities of this Biosphere Reserve? Yes ( ) No ( )

If, Yes…. Please specify in which way - Selling Handicraft (Labor) ( )-Selling forest products ( ) Tour guide/porter ()-Others (specify) ( )

_____

(21) What is your income from this business per month? _____ ETB

ii. Human impacts and problems of park management

(22) Is there any resources that you have been prevented from the biosphere reserve?

Yes/No. If yes, what type of the resource? And mention and describe the reasons.

_____ (23)

below are activities that degrade Yayu forest; use the key to fill the table.

Frequency, 1= Always 2= Rarely, 3= Never Status,

1= Legal, 2= Illegal Effects, 1= Very Destructive, 2= Destructive, 3= Less Destructive.

Key	Logging	Grazing	Fire-wood collection	Herbs Collection	Charcoal burning	browsing	Trampling	beekeeping	cultivation
Frequency									
Status									
Effects									

(24) Which do you think is the most serious problem with regarding to biosphere protection?

No Item tick rank by whom

No	Item	tick	rank	by whom
1	Human encroachment			
2	Expansion of farmland			
3	Livestock grazing			
4	Settlements			
5	Uncontrolled Fire			
6	Illegal Hunting			

7	Cutting living trees			
8	Construction roads			
9	Disturbances forms			
10	others			

(25) Does biosphere reserve management need external support? -Strongly need ( ) -Fairly need ( ), Need () -Do not need ( )

For the question above the answer strongly need, what type of support?

(26) Do you participate on illegal tree cutting? Yes/No. If No which community? And what type of trees they hunt?

Perceptions

(27) Do you know what the main purpose of the Yayu Biosphere Reserve is?

- Nature protection/biodiversity conservation ( )-Tourism ( )-Watershed ( )-Don't know ( ) - Other (specify) ( ) _____

(28) Do you think that the Yayu Biosphere Reserve is necessary for the conservation of remaining natural resources? Yes ( ) No ( ) don't know ( )

(29) Do you think local people get any advantages from the existence of the Yayu Biosphere Reserve? Yes ( ) No ( ) don't know ( )

(30) Do you rely to some extent on resources located within the park boundary? Yes ( ) No ( )

If yes, please rate the following resources according to their value to you.

Least Value & **Most Value:** Timber 1 2 3 4 5 Pasture 1 2 3 4 5 Wild Animals 1 2 3 4 5 Water 1 2 3 4 5 Other 1 2 3 4 5

(31) Have you heard about the conservation activities within the Biosphere Reserve? Yes ( ) No ()

If yes, please describe some activities

_____

(32) Are you involved in some way in conservation activities of the Yayu Biosphere Reserve?

Yes ( ) No ( )

If yes, please describe in what way you involved in conservation activities?

_____

(33) Do you have knowledge about the protected species in Yayu Biosphere Reserve? Yes ( ) No ( )

If Yes, Can you tell me some rare species you know in Yayu Biosphere Reserve? –Animals ( ) – Birds ( ) -Medicinal Plants Orchids ( )–Others (specify) ( )

(34) Do you think that local people take full advantage of the area's economic potential related to tourism? -No, definitely not ( ) -No, not really ( ) -Do not know ( ) -Yes to some extent ( )-Yes definitely ( )

(35) What is your overall view of the Yayu Biosphere Reserve? - Not all satisfied ( )-Somewhat dissatisfied ( ) -Neutral / Do not know ( )-Somewhat satisfied ( )-Very satisfied ( )

(36) How do you think of the situations of Yayu Biosphere Reserve in the past and now?

Better ( ) Similar ( ) Worse ( ) don't know ( ) Why? _____

(37) Please indicate the level regarding your

	(Low)	(R. low)	(Neutral/don't 'know)	(R. High)	(High)
Awareness of the importance of YBR	1	2	3	4	5
Knowledge about the rare species	1	2	3	4	5
Observing the changing climate	1	2	3	4	5
Concern regarding environmental issues	1	2	3	4	5
Understanding the laws and regulations	1	2	3	4	5
Participation in conservation activities	1	2	3	4	5
Impacts on the biodiversity in the BR	1	2	3	4	5
Others (specify)	1	2	3	4	5

(38) Could you tell me what kind of impacts do local people have on the biosphere Reserve in the PAs? _____

(40) What possible changes could be made to improve the overall effectiveness of YBR in nature conservation? _____

(41) Do you think that any infrastructure which used by the local communities impacts on the Yayu biosphere reserve? By what means? _____

(42) Do you think that any expansion of investment in the protected areas which carried out by another bodies impacts on the Yayu biosphere reserve? Low ( ) medium ( ) high ( ) don't know ( ), others specify ( ) _____

(43) According to you, who is/are among the following, is/are supposed to conserve or manage Yayu forest? Use a tick Government Forest department ( ), NGOs ( ), Religious Institutions ( ), local authority ( ), residents (), Collaboration of all ( ), not sure ( ) others ( ).

(44) Do you think the forest is stable in terms of resource richness? Use a tick 1=strongly agree ( ), 2= agree ( ), 3=disagree ( ), 4=strongly disagree ( ).

(45) Do you think that land expansion for agriculture is negative effect on woody plant diversity in Yayu biosphere reserve? Yes ( )/ no ( ) if yes by what extent?

- Do you have any questions about my study?

Thank you!!!!!

1. **Checklist of questions for Key informants and focus group discussion interviews**

Expert/person Interviewed: _____ Interview completed by_____ Date: _____

My name is Lalisa Bariso Hasan MSc fellow at Jimma University. The purpose in meeting with you today is to learn about your thoughts, feelings, and experiences with regard to ''Impacts of human disturbances on protected areas: The Case of Yayu Biosphere Reserve, South-Western Ethiopia". Your contribution has a vital role in the success of the study. Your participation in this interview is totally voluntary. I would like to assure you that the information that you are giving used only for this study and honestly there is no any risk to you. Are you willing to answer the questions?

What is the extent of community in resource use in the Yayu biosphere reserve?

How do you evaluate the current socioeconomic strength of the local people in times of income and education?

Does low-level of income and education limits on the use of biosphere resource?

Do you think the presence of the biosphere reserve close to your area benefited the community?

In what way and what benefits have been realized up until now?

Do you think that local people and livestock affect woody plant diversity?

What do you think are the factors that promote local people to use biosphere resource?

What is the extent of tangible socio and economic benefit that the community member receives as individually and group?

To increases the local community benefits and at the same time securing the biosphere, what should be done?

A. by the local community

B. by conservationists

In order to bring sustainable development for both the biosphere reserve and the local community, what do you suggest?

Biosphere reserve dependents livelihood condition and perception.

What type of resource do you use from the biosphere reserve?

What is the major benefit do you get from the biosphere reserve?

Are you satisfied by gazing the area in to the biosphere reserve? What challenges do you get from demarcation of the area in to biosphere reserve? What solution do you propose?

Have traditional hunters in your community? What type of animal they hunt?

Do you practice your livestock grazing in the biosphere reserve? Why?

Do you believe accidental fire occurs in the biosphere reserve? When? By whom?