Bio-resource Conservation and Land Use in Ethiopia

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Abstract

Human are dependent on biological systems and processes for sustenance, health, well-being and enjoyment of life. Many people depend on biodiversity and other natural resources for their livelihoods. Ethiopia is one of the world's rich biodiversity countries and it deserves attention regionally and globally. It has a very diverse set of ecosystems ranging from humid forest and extensive wetlands to the desert of the Afar depression. Ethiopia is one of the twelve known ancient countries for crop plant diversities in the world and has valuable reserves of crop genetic diversity, of which 11 cultivated crops have their centre of diversity in the country. The extensive and unique conditions in the highlands of the country have contributed to the presence of a large number of endemic species. This is due to the variation in climate, topography and vegetation. Environment Planning has focused on biodiversity conservation in response to local government interest and concern about the extensive clearing of native vegetation in Ethiopia. Ethiopia covers an area of 1,127,127 km², of which water area covers 7,444km² and land area 1,119,683km², with a topographic diversity encompassing high and rugged mountains, flat-topped plateau, deep gorges with river, and rolling plains. Nearly half of the total land (41%) is non arable land, which includes forest, mountains, roads, cities, etc. and about 43% of the total land area is arable that includes temporary crop, permanent crop, pasture, and fallow land. Since the recent past, protected areas coverage is increasing in which 15% of the land is covered by national parks, wildlife sanctuaries and reserves, controlled and open hunting areas and community conservation and about 1% of land shares water surface. Biodiversity conservation and land use is a significant issue for Ethiopia and overview of the main legislation, policies and responsibilities is presented to establish biodiversity as a relevant consideration in land use planning.

1. Introduction

Ethiopia is known for its rich biodiversity. Environment Planning has focused on biodiversity conservation in response to local government interest and concern about the extensive clearing of native vegetation in Ethiopia. Biological diversity, or biodiversity, is a term used to describe the variety of nature. Biodiversity covers marine, terrestrial, subterranean and aquatic life and implies a highly complex system of interacting entities that occur over a range of temporal and geographic (from local to global) scales (DEC, 2006). The National Strategy for the Conservation of Ethiopia's Biological Diversity defines biodiversity as: 'The variety of life forms - the different plants, animals and micro-organisms, the genes they contain, and the ecosystems they form. It is usually considered at three levels: genetic diversity, species diversity, and ecosystem diversity' (DEST, 1996).

Biodiversity conservation is a significant issue for Ethiopia and overview of the main legislation, policies and responsibilities is presented to establish biodiversity as a relevant consideration in land use planning. The efforts have been made by the government to achieve effective biodiversity conservation outcomes through land use planning.

2. Biodiversity

2.1. Biodiversity and natural areas

The three levels of biodiversity-genes, species and ecosystems are interrelated and interdependent. A population of a species is dependent on the genetic variation within it and its ecosystem for survival and an ecosystem are dependent on the full variety of species that comprise it (Williams et al., 2001). Biodiversity increases when new genetic variation is produced, a new species evolves or an ecosystem forms; and it decreases when the genetic variation within a species decreases, a species becomes extinct or an ecosystem is lost (DEST, 1996).

2.2. Biodiversity benefits

Human are dependent on biological systems and processes for sustenance, health, well-being and enjoyment of life. Many

people depend on biodiversity and other natural resources for their livelihoods. Outside the main population centres, most income is derived from agriculture, pastoralism, forestry and mining (Gole, 2006). These industries depend on biodiversity and other natural resources for long-term sustainability.

People living in cities also depend on biodiversity for their well-being. Natural areas provide the following benefits to the community:

• Ecosystem services - maintaining air quality, soil fertility and water quality;

• Natural resources - providing food, medicines and industrial products;

• Education and research - providing opportunities to learn and appreciate nature;

• Spaces for recreation and interaction with nature - maintaining physical and psychological well-being;

• Cultural identity and spirituality - maintaining human connections with nature.

Biodiversity also has intrinsic value, and many people believe that the present generation has a moral obligation to ensure that the diversity of life on Earth is sustained so that a healthy, life-supporting planet is provided for future generations. Biodiversity is contained and conserved within natural areas. The term 'natural area' is used to describe any physical area that contains native species or ecological communities in a relatively natural state and hence contains biodiversity (Del Marco et al., 2004). Natural areas can be areas of native vegetation, vegetated or open wetlands (lakes, swamps) or waterways (rivers, streams, creeks and estuaries), springs, rocky outcrops, bare ground, caves, coastal dunes or cliffs. Natural areas are areas that have been naturally colonized by living organisms indigenous to that area, and so do not include rehabilitated areas because they do not contain the same level of biodiversity as a natural community that would have once been present in that area (Del Marco et al., 2004).

2.3. Ethiopia's biodiversity

Ethiopia is one of the world's rich biodiversity countries and it deserves attention regionally and globally. It has a very diverse set of ecosystems ranging from humid forest and extensive wetlands to the desert of the Afar depression. This is due to the variation in climate, topography and vegetation. As indicated by Edwards (1991), Ethiopia is one of the twelve known ancient countries for crop plant diversities in the world and has valuable reserves of crop genetic diversity, of which 11 cultivated crops have their centre of diversity in the country. The extensive and unique conditions in the highlands of the country have contributed to the presence of a large number of endemic species.

The flora of Ethiopia is very diverse with an estimated number between 6,500 and 7,000 species of higher plants, of which about 15% are endemic. It has been said that Ethiopia is the fifth largest floral country in tropical Africa.

2.4. Ecosystem diversity in Ethiopia

Ethiopia with its geographical position, between 3° and 15°N latitude and 33° and 48°E longitude covers a land area of 1,127,127 km². The Great Rift Valley cuts diagonally across the country from Red sea to Kenya, creating a vast depression. The width of this valley are about 80 kilometers. It is a country of great geographical and climatic diversity

2.5. Major ecosystems of Ethiopia

• Afroalpine and sub-afroalpine Ecosystem

• Dry Evergreen Montane Forest and Grassland complex

• Moist Evergreen Montane Forest Ecosystem

• Acacia-Commiphora Woodland Ecosystem

• Combretum-Terminalia Woodland Ecosystem

• Lowland, Semi-evergreen Forest Ecosystem

• Desert and Semi desert Scrubland Ecosystem

• Aquatic Ecosystem

2.6. Field crop resource genetic diversity

Ethiopia is known to be a center of origin and diversity for many cultivated crop plants. It is a primary gene center for field crops such as Niger seed (*Gastonia abyssinica*), Tef (*Eragrostis tef*) and Ethiopian mustard (*Brassica carinata*) and a secondary gene center for crops such as Durum wheat, Barley, Sorghum, Finger millet, Linseed, Sesame, Safflower, Faba bean, Field pea, Chickpea, Lentil, Cowpea, Fenugreek and Grasspea.

2.7. Land clearing in Ethiopia

Removal of native vegetation, both historic and current, is a major threatening process affecting biodiversity in Ethiopia. It includes the traditional concept of clearing, but also involves other substantial damage to native vegetation (e.g. burning, overgrazing, and draining or flooding of land) which results in the removal of at least some native vegetation, and can result in degradation or loss of whole ecosystems (EPA, 2007). The loss of habitat area through clearing is currently the primary cause of declines in species and populations worldwide (Millennium Ecosystem Assessment, 2005).

Removal of native vegetation has obvious environmental implications, but it also has significant social and economic implications. Continued clearing will result in loss of biodiversity and extinctions, with fragmented habitats becoming more susceptible to climate change, disease, and invasion by weeds and introduced animals (EPA, 2007). Salinisation of land and inland waters, altered water regimes, soil erosion, eutrophication and increased greenhouse gas emissions are all direct consequences of clearing native vegetation (EPA, 2007).

Land clearing destroys biodiversity, resulting in the direct loss of plant and animal species and destruction of habitat.

Removal of large areas of native vegetation fragments the landscape, leaving behind small and unconnected remnants. Habitat fragmentation and associated degradation due to 'edge effects' (such as weed invasion) reduces habitat for individual species and isolates the species that live in an area. The ability of native animals and plants to disperse across landscapes is affected, as is the ability of populations to re-colonize areas after disturbance or mortality (Del Marco et al., 2004). This generally results in the continuing loss of species long after land is initially cleared (Gole, 2006).

2.8. Threats to floral biodiversity in Ethiopia

In Ethiopia, biodiversity and other natural resources are under threat from broad-scale threatening processes, including:

- Clearing and fragmentation
- Dieback caused by *Phytophthora* root fungus;
- Dryland salinity
- Altered hydrology
- Invasions by weeds and feral animals
- Inappropriate fire regimes and
- Climate change

At large scales, these events and processes may threaten whole vegetation types, remnants or populations of species; at small scales, microhabitats and small populations may be threatened (Gole, 2006). Some of these threats (e.g. weed invasion) can be controlled, but other factors (e.g. climate change) exist outside the realm of the land manager's control (Del Marco et al., 2004). Threats to biodiversity not only come from biological and physical processes, but also from institutional issues. Foremost amongst these problems is the failure to adequately value biodiversity in decision-making, and this is exacerbated by shortcomings in knowledge of biodiversity and the lack of commitment and capacity to manage ongoing threats (EPA, 2007)

2.9. Community based in situ conservation initiative

A project entitled 'A Dynamic Farmer Based Approach to the Conservation of Ethiopia's Plant Genetic Resources'. This community-based *in situ* conservation project is designated to link farming communities and their varieties with the existing formal genetic resources conservation efforts of the IBCR by means of establishing community gene banks. Conservation at the farm level allows for continuing farmer selection, interaction with the environment and gene exchange with the wild species so that evolution of landraces may continue.

In this project, twelve on-farm *in situ* conservation sites and community gene banks have been established for farmers' varieties in six agro-ecological regions. Farmer Conservator Associations have been formed for each *in situ* conservation site. Agro-morphological, nutritional, biochemical and ethno botanical studies were conducted on some of the crop species under *in situ* conservation.

Crop germplasm samples originally collected from the *in situ* sites and maintained at the gene bank were also restored at their respective sites. Indigenous knowledge of the farmers on their crop cultivars such as methods of selection, cultivation and use of different crops and cultivars, women's knowledge and role, seed exchange and movement were surveyed and documented.

- Ethiopia's immense biodiversity wealth be conserved, sustainably utilized

- Ethiopia is a Party to the Convention on Biological Diversity (CBD), that the Convention requires Legislation on ABS

Ethiopia has agreed to, and arctic of the African Model Law on:

- Access and Benefit-sharing;
- Community Rights;
- Farmers' Rights;
- Plant Breeders Rights;

- Ethiopia's diverse and rich Community Knowledge (CK) associated with genetic resources (GR) be conserved

- It is, therefore, necessary to determine by law the access to, and benefit-sharing from, genetic resources and associated community knowledge

- This is, therefore, to approve the right of communities over their GR and associated CK

- This Proclamation has seven Parts and 38 Articles

2.10. Existing land use in Ethiopia

Three different types of land use that exists in Ethiopia is arable land – land cultivated for crops like wheat, maize and rice, replanted after each harvest; permanent crops –land cultivated for crops like citrus, coffee and rubber that are not replanted after each harvest (Table 1). It includes flowering shrubs, fruit trees, nut trees, and vines, but excluded land under trees grown for wood and timber. Other- any land not arable or under permanent crops include permanent meadows and pastures, forests and woodlands, built-on areas, road, barren lands etc. The area under these land use include 13.19% arable land, 1.01% permanent crops and 85.8% others (forest area 12.4% and other land 72.6%). In Ethiopia, In Ethiopia, rangelands support 9.8 million (pastoral and agro-pastoral communities). There are 29 ethnic groups in 7 regions, 21 zones and 124 districts. Of the 9.8 million,

Land particulars	Area (1000 ha)	
	1990-2000	2000-2009
Land area	100,000	100,000
Arable land	9,956.13	12,185.10
Permanent	587.63	801.70
Forest area	14,197.63	13,070.50

5.5 millions are pastorals; 3.1 millions are agro-pastorals and 1.2 million urban dwellers. Of the 5.5 million pastoral people, majority are of marginal livelihood condition and rely on aid for survival. Only 1.5 million earn good revenue. Labour force is 97% illiterate. Nowadays, pastoralists can no longer live and need for alternate livelihood. The current livestock population is 25% of human. Land use or land cover change plays import role in climate change at global as well as regional and local level.

Range land degradation is serious global environmental issues today in Ethiopia. More than 250 million peoples are directly affected through this and some 1 billion people in over 100 countries are at risk (Adger et. al., 2000) (Table 2).
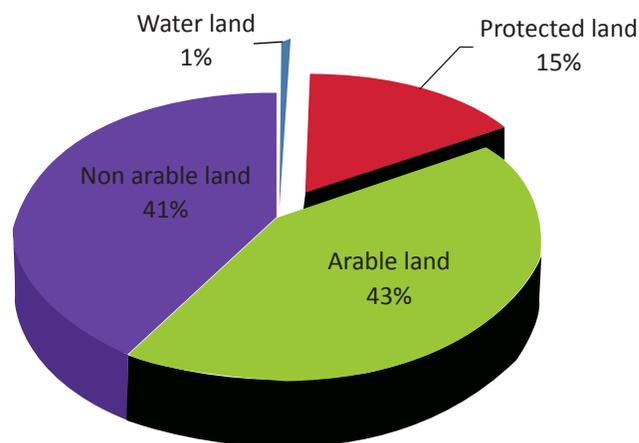
Table: 2. Distribution (%) of agriculture and arable land during different year

Land particulars	1994	1999	2004	2009
Agriculture land (% of area)	30.47	30.68	33.10	34.99
Arable land (% of land area)	9.93	10.0	12.36	13.95
Arable land (ha persons-1)	0.18	0.16	0.17	0.17
Agriculture irrigated land (% of total agricultural land)			0.37	0.49
Permanent cropland (% of area)	0.54	0.68	0.74	1.04

2.11. Trends in Land Use Coverage in Ethiopia

2.11.1. Land Cover

Ethiopia covers an area of 1,127,127km^2, of which water area covers 7,444km^2 and land area 1,119,683km^2, with a topographic diversity encompassing high and rugged mountains, flat-topped plateau, deep gorges with river, and rolling plains (Anonymous, 2010) (Figure 1).

Nearly half of the total land (41%) is non arable land, which includes forest, mountains, roads, cities, etc. and about 43% of the total land area is arable that includes temporary crop, permanent crop, pasture, and fallow land. Since the recent past, protected areas coverage is increasing in which 15% of the land is covered by national parks, wildlife sanctuaries and reserves, controlled and open hunting areas and community conservation and about 1% of land shares water surface

Land use refers to activities – such as growing crops, raising livestock or cultivating fish – carried out on the land making up the holding with the intention of obtaining products and/or benefits. Land use should be distinguished from "land cover", the later being description of the physical characteristics of

Figure 1: Distribution of land cover surface area in km^2 source CSA Land Use

the land, such as grassland or forest.

Land use is the function of land what it is used for. It is a description of how people utilize the land, manipulation of natural ecosystem in order to obtain benefits, which could be material benefits or products (e.g cereals production, livestock purpose) and immaterial benefits (erosion prevention) and socio economic activity (inputs, managements and out puts). Land use information can be used to study food security at national, regional and global levels, to develop solution for natural resource management issue such as salinity, water quality, and deforestation and for planning and policy formulation. Land use directly affects land and triggers process such as land degradation, desertification and loss of biodiversity.

2.11.2. Protected area coverage

From the total land area coverage of the country PA shares about 15% only. It includes national parks, sanctuaries, controlled hunting, open hunting, wildlife reserves and community conservation areas. A National Park is a reserve of natural or semi natural land, declared or owned by a government, set aside for animal safety and/ or human recreation and enjoyment, and protected from most development activities.

2.11.3. Agricultural land area in rural sedentary private holdings

Land plays a critical role in the production of food crops. The expansion of agriculture and intensive exploitation of land by human beings with the aspiration of increasing the volume of crop production impacts directly or indirectly on land. Changes taking place in agriculture are drastically shaping land use patterns and holding sizes. From agricultural point of view, land is an indispensable factor for production of crops, raising of livestock and other ancillary agricultural activities. There is no universally accepted standard of land use classification. According to the FAO recommendations for the purpose of

agricultural census, the total land use is categorized into six main land use types, which are land under temporary crops, land under permanent crops, grazing land, fallow land, forest or other wood land, and land for other purposes.

The trend of crop area (temporary and permanent crop area in hectare) is increasing. Thus, due to the ever-increasing of crop area coverage, grazing land and wood lands have been declining and this in turn brings negative impact on biological diversity, and maintenance of the ecological integrity who have actively participated in this process fully acknowledge that the information provided herein is spatially and temporally bounded. That is with new and updated information; the interpretive scope of indicator species will also gain value.

To make use of existing data held by various organizations efficiently and facilitate further development of successful and sustainable biodiversity indicators in the future, there is a vital need to establish a centralized biodiversity database management system. This helps to sustainably produce and update biodiversity indicators. It is thus hoped that this work will prompt and give impetus to other stakeholders involved in biodiversity conservation and charged with responsibilities of reporting on progress of international conventions to frame their mind for responsible actions towards mainstreaming the issue of biodiversity indicators in the country.

2.11.4. Role of land use planning in biodiversity conservation

Land use planning has an important role in achieving biodiversity conservation outcomes in Ethiopia. As outlined in, extensive areas of native vegetation exist outside the formal conservation reserve system – areas referred to as 'off-reserve'. Biodiversity conservation involves the retention, protection and management of natural areas in reserves and off-reserves, affecting both public and private land. The land use planning system can achieve conservation outcomes through the identification and protection of natural areas with significant biodiversity values, by directing development away from natural areas, and by controlling the impacts of land uses on these areas. These issues are further explored opportunities to address biodiversity conservation through land use planning at the local government level.

2.12. National strategy for biodiversity conservation

The National Strategy for the Conservation of Ethiopia's Biological Diversity (the National Strategy) is the primary policy for the conservation of Australia's biodiversity. It has been prepared in response to Article 6 of the Convention on Biological Diversity, which obliges all parties to develop and implement a National Biodiversity Strategy and Action Plans. Key components of the National Strategy include: 1) conservation of biodiversity across 2) integrating biodiversity conservation and NRM; 3) managing threatening processes; 4) improving knowledge; 5) involving the community.

The National Strategy adopts several principles as a basis for its objectives and actions, including:

• Biodiversity is best conserved in-situ (in its natural state);

• The causes of significant loss of biodiversity should be anticipated, prevented and managed;

• Lack of full knowledge should not be an excuse for postponing action to conserve biodiversity; and

Biological resources grouped into:

• That affect agriculture, such as cultivated plants, pollinators, and pests;

• Those that are sources of scientific inputs, such as agricultural plant varieties (and their wild relatives)

• Those that provide genetic resources; and

• Those that provide natural goods and services, such as wildlife, fish, and scenic beauty

Biological resources are fundamental to:

• Agriculture

• Livestock

• Logging

• Export earning

• Medicinal resource, and

• Provides free of charge services

Services include:

• Clean water

• Pure air

• Soil formation and protection

• Pollination

• Crop pest control and

• The provision of foods, fuel, fibres and drugs

3. Conclusion

Ethiopia has a very diverse set of ecosystems ranging from humid forest and extensive wetlands to the desert of the Afar depression. Ethiopia is one of the twelve known ancient countries for crop plant diversities in the world of which 11 cultivated crops have their centre of diversity in the country. Ethiopia covers an area of 1,127,127 km^2, of which water area covers 7,444 km^2 and land area 1,119,683 km^2, with a topographic diversity encompassing high and rugged mountains, flat-topped plateau, deep gorges with river, and rolling plains.

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