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Review

Review on distribution, importance, threats and consequences of wetland degradation in Ethiopia

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Wetlands are the ecosystems that are found on the interface between land and water. It is also areas of marsh, ponds and swamps, whether natural or artificial, permanent or temporary, with water, that is static or flowing, fresh, brackish or salty, including areas of marine water, the depth of which at low tide, does not exceed six meters. Although, wetlands by nature are dynamic ecosystems, anthropogenic activities continuously changing the land uses in and around wetlands speed up the ecological changes in wetlands. Ethiopia exhibits a wide range of geologic formations and climatic conditions which create numerous wetland ecosystems including 12 rivers, eight major lakes and many swamps and floodplains. It is found on every agro-ecological zones from alpine (high mountains) to desert ecosystem in the low-lying regions and across all traditional climatic zones. Riverine wetlands are other common types of wetlands throughout the country. Based on scattered information, the total wetlands coverage of Ethiopia is approximately 2% (22,600 km^2). This, wetlands provide natural resources and services for humanity. They are a source of food, tourism, cultural resources, flood control and improved water quality. They are also important for biodiversity and wildlife conservation. However, there are numerous threats to wetlands in developing countries including Ethiopia. Ethiopian wetlands are increasingly being lost or altered by unregulated over utilization, including water diversion for agricultural intensification, urbanization, dam construction, population pressures, food shortages, increased drainage and cultivation, collection of sedges and reeds for roofing and housing. The consequences of wetland loss and degradation in Ethiopia are enormous and directly affecting the livelihood base of rural communities. The change of wetlands has created numerous problems including decrease and extinction of wild flora and fauna, loss of natural soil nutrients, water reservoirs and of their subsequent benefits. They have affected various traditional occupations, socioeconomic conditions and cultural activities. Therefore, it needs intensive research and development works by different stakeholders and needs policy attention from the government to provide enabling environment for sustainable wetland management.

Key words: Wetland loss, drainage and cultivation, types of wetlands, threats to wetlands.

INTRODUCTION

Wetlands are ecosystems or units of the landscape that are found on the interface between land and water. While water is a major factor of wetland definition (Ramsar Convention Bureau, 1997), soils, vegetation and animal life also contribute to their unique characteristics (Koetze, 1996; Howard, 1995; Roggeri, 1995). As a result, it has proved difficult to define wetlands, and over 50 definitions exist. That used by the Ramsar Convention (1997: 2) is

as follows: “areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water with the depth of which at low tide, does not exceed six meters”. Wetlands are also areas of marsh, ponds and swamps, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty, including areas of marine water, the depth of which at low tide does not exceed six meters (Sivaperuman and Jayson, 2000; Kafle, 2006). Water is the most determinantal component that distinguishes wetlands from other ecosystems. It also controls the processes, interactions and functioning of the other biotic and biotic components of the ecosystems (Schot and Winter, 2006; Hughes and Hughes, 1992).

Although, wetlands by nature are dynamic ecosystems, anthropogenic activities continuously changing the land uses in and around wetlands speed up the ecological changes in wetlands. Drainage for agriculture is responsible for the largest extent of wetland losses worldwide (Schot and Winter, 2006; OECD, 1996; Roggeri, 1995). Estimates show that about 50% of the global wetlands have been lost since 1900. Since 1950s, tropical and sub-tropical wetlands particularly swamp forests and mangroves have also been rapidly disappearing. The largest losses were recorded in the industrialized world (Finlayson and Davidson, 1999). However, the limited documented information on wetland loss in developing countries like Ethiopia leaves us with little to say. Multiple authors suggest that more information should be published to improve wetlands management and protection in Ethiopia (Abunie, 2003; Wonderfrash, 2003; Hailu, 2003; Woldu and Yeshitela, 2003; Desta, 2003; Vogt et al., 2006; McHugh et al., 2007). The authors confirmed that inadequate information is a common problem in lesser developed nations, causing issues in the evaluation of current and changing environmental conditions, and eventually leading to a lack of decision making or uninformed decision making. This lack of information becomes crucial, as wetlands play a vital role in the livelihoods of many people in developing nations via a variety of environmental services and socioeconomic benefits (Millenium Ecosystem Assessment, 2005; Dixon, 2008). Therefore, the main target of this critical review is to compile limited information on wetland distribution, importance, threats and consequences of wetlands degradation in Ethiopia.

Distribution and extent of wetlands in Ethiopia

Ethiopia exhibits a wide range of geologic formations and climatic conditions which create numerous wetland ecosystems including 12 rivers, eight major lakes, and many swamps and flood plains (Abunje, 2003) (Figure 1). It was found on every agro-ecological zones from alpine (high mountains) to desert ecosystem in the low-lying regions and across all traditional climatic zones (Wood, 2001). Except coastal wetlands, all the other wetland types are found in Ethiopia which consists of flood plains, lakes, swamps/marshes, swamp forests and human made wetlands. The widely recognized wetland types are however, swamps and marshes, which together account for about 0.16% of the country’s total area (EPA, 2004). There are several important swamp areas in the country. Lakes are also the widely distributed types of wetlands in Ethiopia both on highlands and lowland parts of the country with the largest concentration in the great East African Rift valley system (Hughes and Hughes, 1992; EPA, 2004; Leykun, 2003). Similarly, riverine wetlands are other common types of wetlands throughout the country. Such wetlands are particularly extensive in the flood plains of Aawsh, Abay, Baro, Gibe, Wabe Shebelle and Dawa Rivers (Getachew, 2004). Detailed inventory of the wetland resource base of Ethiopia is not carried out yet. However, based on scattered information, the total wetlands coverage of Ethiopia is approximately 2% (22,600 km^2) of the country’s total surface area (EWNRA, 2008). However, Tesfaye (1990) estimated that Ethiopian wetlands covered an area of 13,699 km^2 or 1.14% of the country’s land surface. There are 58 major lakes and marshes and a total of 77 wetlands in Ethiopia. However, Wonderfrash (2003) maintains that Ethiopia is “endowed with an array of wetlands too numerous to be counted”. He further comments that Ethiopia is often referred to as the “water tower of northeast Africa,” as Ethiopia spans an entire watershed area between the Mediterranean Sea and the Indian Ocean. Ethiopian wetlands can be broadly grouped into four major categories based on ecological zones, hydrological functions, geomorphologic formations and climatic conditions. These categories interlink to form four major biomes, which also describe climatic conditions in Ethiopia. These biomes are the Afro-tropical Highlands, the Somali Masai, the Sudan-Guinea and the Sahelian Transition Zone groups (Tilahun et al., 1996) (Figure 2).

Importance of wetlands

Wetlands are important resource in sub-Saharan Africa including Ethiopia that sustains rural livelihoods, particularly in areas with low or unpredictable rainfall, land scarcity or where uplands have poor soil

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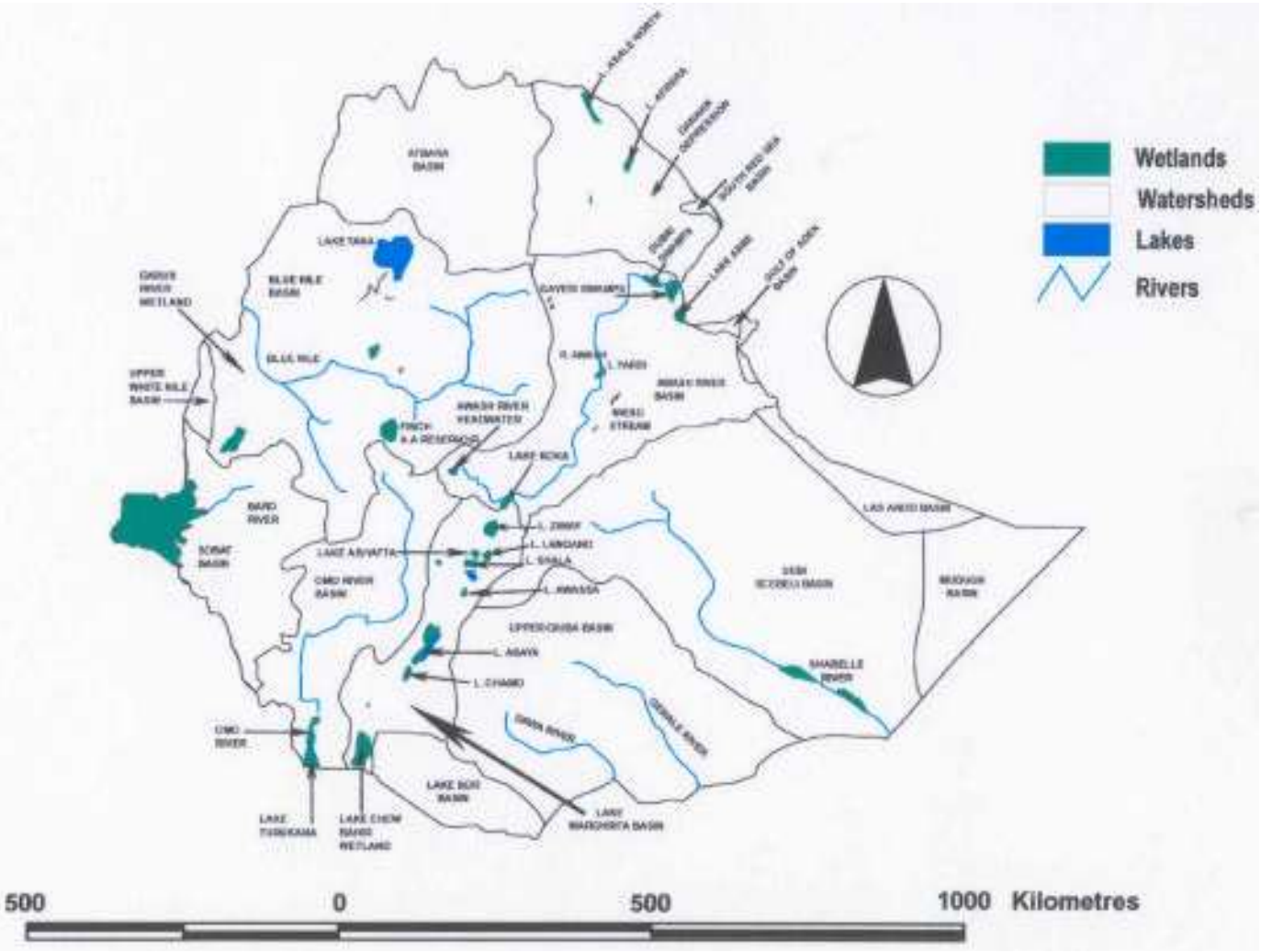

Figure 1. Lakes, rivers and wetlands of Ethiopia (Source: Abebe and Geheb, 2003).

characteristics and thus low potentials for agriculture (Dixon and Wood, 2002; 2003). Wetlands provide natural resources and services for humanity. They are a source of food, tourism, cultural resources, flood control and improved water quality. They are also important to biodiversity and wildlife conservation (Desta, 2003). As noted earlier by Hailu (2003), wetlands play a crucial role in the well-being of citizens in lesser developed nations, with Ethiopia being no exception. According to Hailu (2003), wetlands are used virtually by all households in the Western Wellaga and Illubabor zones in Ethiopia directly or indirectly. The main uses are social/ceremonial reeds, medicinal plants, thatching reeds used for housing construction and granary roofing, domestic water supplies, dry season grazing land, water for livestock, temporary crop-guarding huts of reeds, cultivation and craft materials. Dixon (2008), noted that cheffe (Cyperus latifolius) is the dense reed vegetation used for roofing, craft material, fodder for cattle, and as a marketable commodity in a range of ceremonies and celebrations in Ethiopia. Furthermore, minor uses such as establishing coffee and tree nurseries on wetland fringes, clay collection for pottery, and use of wetland tree bark for making ropes were also noted. The indirect uses of wetlands are due to their hydrological and ecological functions, which support various economic activities, life support systems and human welfare. This includes ground water recharge, flood control, nutrient cycling, erosion control and sediment traps, climate regulation, stream flow moderation, water filtration and purification, plant and fish products, biodiversity, wildlife habitat for migratory wildlife and pest control (Dugan, 1990, McHugh et al., 2007). According to Abebe and Geheb (2003), wetlands also support crop production, fishing and sources of medical plants among others. Ecologically, wetlands are instrumental in water storage, filtration and supply, flood control; perform sediment, nutrient and toxins retention functions and habitats for biodiversity of

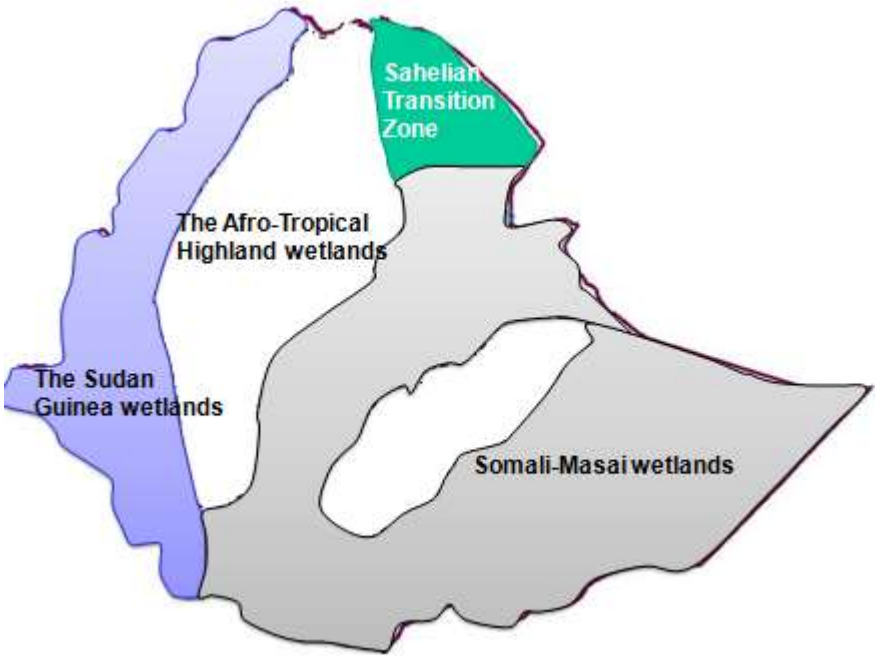

Figure 2. Categories of wetlands by biomes (Source: Abebe and Geheb, 2003).

both flora and found (Abebe and Geheb, 2003)

Their ecosystems support both aquatic and terrestrial biodiversity, such as migratory birds, wildlife, fishery resources and aquatic and terrestrial vegetation. These ecosystems serve as wintering grounds and maintenance stations for a large number of terrestrial and aquatic birds. Thirty-five fish species and ninety-four mammal species are recorded from the Ethiopian Rift lakes, of which six are endemic (Tesfaye, 1990).

Growing threats to wetland ecosystem

The most common threats of wetlands are the result of a combination of social, economic and climatic factors, which have increased pressure on the natural resources in Ethiopian wetlands. Another constraint to the judicious use of African wetlands is lack of knowledge by planners and natural resource managers of the benefits that they provide and techniques by which they can be utilized in a sustainable manner (Jogo and Hassan, 2010). This has caused the degradation of watersheds, increased soil erosion, decreased water quality and caused immeasurable loss to biological diversity (Tesfaye, 1990). For instance, in the Lake Alemaya catchment which is located at the eastern part of Ethiopia, has been degraded due to soil erosion which is caused by the intense rainfall, steep topography, and poor vegetation cover coupled with cultivation of steep lands, and inadequate conservation practices. Sediment from the catchment has affected the storage capacity of Lake Alemaya (Muleta et al., 2005). The loss of these wetlands is devastating to several endemic species and particularly to wetland dependent species. Wetlands are the most productive ecosystems on the earth, they are also the most threatened and the most fragile component of the ecosystems susceptible to changes. There are a number of environmental and anthropogenic driving factors of hydrological changes in wetlands that obscure the residence, input and output of water (Hughes and Hughes, 1992). Wetlands loss, destruction and alteration have been and are still seen as an advanced mode of development, even at the government level (Abebe and Geheb, 2003). Wetland loss is evident wherever major developments like dams, irrigation schemes and conversion projects are present in the developing world. While most of the threats that wetlands face result from their misuse, many are also related to unsustainable resource extraction. Another important reason for their vulnerability is the fact that they are dynamic systems undergoing continual change (Barbier et al., 1996). As a result, many wetlands are temporary features that disappear, reappear and re-create themselves over time (Barbier et al., 1996).

A large number of wetlands in Ethiopia are considered vulnerable zones and some of the most exploited, mismanaged and lost their regenerating capacity (Alemayehu, 2006). Ethiopian wetlands are increasingly being lost or altered by unregulated over utilization, including water diversion for agricultural intensification, urbanization, dam construction, population pressures, food shortages, increased drainage and cultivation, collection of sedges and reeds for roofing and housing,

extraction of clay materials for brick making, pollution and other anthropogenic interventions (Abebe and Geheb, 2003; Wood 2003, Mulugeta, 2004; Melaku et al., 2012; Getachew et al., 2012). Kumsa (2015) noted that the most serious threats to Jarmet wetland in the western region are unsustainable use of wetland resources through overgrazing, over cultivation, over abstraction of water for domestic use, agriculture and improper use of forest practices, establishment of new human and livestock settlements in wetland areas, cutting and burning of aquatic and other vegetation for housing and commercial activities like charcoal and fire wood, lack of an operational national wetland policy and cross cutting sectorial policies, limited funds where by wetland management institutions, lack adequate and continuous fund personnel for monitoring, management, and research and community awareness, lack of community participations in management of various wetland resources in the district. Generally, conversions of wetlands, agricultural encroachment, demographic pressures, over grazing and climate change are the major factors threatening wetlands. The major factor limiting the availability of resources of wetlands in Ethiopia is extensive farming which has increased largely over the past century in the Western Wellaga and Illubador Zones (Dixon et al., 2008). Wetland cultivation in these zones may date as far back as the mid-19th century, and possibly centuries earlier (2008). During this time period, cultivation extended beyond the use of wetland margins which include much larger wetland areas was completely drained and cultivated. Mulugeta (2004) also maintains that cultivation of wetlands has existed for at least eight decades, with an average cultivation of 23% of the total wetland area. Complete drainage of wetlands in the mentioned region leads to many issues regarding to the local collection of sedges and reeds for roofing and housing, as only the rich can afford alternative building supplies. Today, wetland cultivation provides between 10 and 20% of the annual food needs of the region, but can be as high as 100% during the summer months in some areas (Dixon and Wood, 2008). Coffee production in the early 1900's also placed pressure on starting further wetland cultivation, as more uplands were being used for its cultivation, making it necessary to expand into new portions of habitats (Hailu 2003). This expansion was largely due to a food shortage because of drought conditions (Hailu, 2003; Dixon et al., 2008). According to Hailu (2003), roughly 20% of the Illubabor Zone wetlands were cultivated between 1986 and 1998, increasing drastically in 1999 to 35% or 7,100 hectares of the wetland area. Some of this might be accounted for by increased government pressure from 1974-1991 as food-sufficiency targets were set for the region, and those unwilling to cultivate their wetland plots risked losing them to those who were willing to do so (Dixon et al., 2008). In addition, over 100,000 people were moved to the region by a government decision during a famine in 1984 (Dixon et al., 2008). In 1999, the government increased their pressure on farmers to cultivate wetlands in order to compensate for more drought-induced food shortages (Dixon et al., 2008). Eucalyptus, banana, sugarcane, and 'chatt' cultivation on the edges of wetlands, and teff cropping in wetlands, has been identified as a threat to the survival of these areas. Farmers are of the opinion that the cultivation of these crops and trees on the wetland edge is responsible for their drying out. Grazing by domestic stock has also been identified as a threat to wetlands. When grazing follows continuous cultivation, wetlands easily become degraded and lose their natural characteristics. Livestock trample the soil and compact it and their grazing destroys natural vegetation. They erode drainage channels leading to gullies and increase water outflow. These effects often result in the complete degradation of wetlands by reducing the water table and by changing the original vegetation (Afework et al., 2003). Moreover, sand mining; mineral salt extraction and other development intervention like soda ash factory are other threats of wetland management (Gemechu, 2010)

The incidental and intentional introduction of invasive alien species is another emerging issue severely affecting the wetlands of the country. Some of the world's worst invasive species, which are threatening Ethiopia's wetlands, include *Mimosa pigra* in the Baro-Akobo Basin, and *Eichhornia crassipes* in Koka and Abasamuael reservoirs and in Baro-Akobo Basin. *M. pigra* is aggressively invading wetlands and other areas in the Baro-Akobo Basin, threatening fishing, grazing and other agricultural activities by forming impenetrable thickets and hindering movements of humans and animals, and destroying and replacing natural biodiversity. *E crassipes* disrupts hydropower generation (e.g., Koka dam), increases siltation and evapotranspiration, reduces fish stocks, impairs water transport and fishing activities, and reduce water quality (Dereje, 2003).

According to EPA (2004) report, most of the wetlands' ecosystems in Ethiopia are severely degraded and most of the floristic and faunistic species are endangered mainly for two reasons. Firstly, land use does not take wetlands conservation into account while they are under pressure by the farming population which is in dire need of land for pasture and crop farming. Humans usually and very dramatically accelerate natural processes often unintentionally but usually in the course of activities like agriculture, industry and urban development. These activities can involve anything from drainage and diverting water, to dredging and loading water sources with toxic chemicals. For instant, Lake Hawassa in the southern region of Ethiopia is being degraded as a result of unmanaged and harmful human activities in the catchment. Land use and modification, toxic industrial discharge and activities associated with urbanization are the major causes of this degradation. Another most destructive activities could be mining (Williams, 1990)

which permanently destroys the substrate and prevents the natural restoration of a site. Wetlands whose biotic balance has been disturbed can often recover. The situation is aggravated by the fact that wetlands are considered as either state property or a property belonging to no one. The second reason is that people in the wetland vicinities (in lowland areas) devegetate herbaceous vegetation to avoid the harboring of mosquito flies and snakes. Because of these and related actions, most of the wetlands are seriously denuded, except those situated in remote areas.

Furthermore, wetlands are usually considered as wastelands and are thought of as nuisance to human development (Dixon and Wood, 2003; Schot, 1999; OECD, 1996; Roggeri, 1995). This view has led to considerable conversion of wetlands, which has usually been seen as a progressive public-spirited endeavor believed to enhance the health and welfare of society, alleviate flooding, improve sanitation and land reclamation. Moreover, the underlying causes of wetland loss are that they are assumed to be less important than other priorities or tend to be regarded as free goods. This is due to the absence of a proper guiding policy and an accountable institution for addressing problems associated with wetland degradation. The lack of any strategic planning and capacity for wetland management programmes and sustainable uses are other impediments (Leykun, 2003). Currently, some wetlands are at the edge of extinction. The situation of Lake Haramaya in the east wetland exhibits this reality. The resources and the lake disappeared for reason they cannot comprehend. Many lakes of Great Rift Valley are also similarly exposed to severe degradation. The dangers would refer to Ziway, and Abijiata wetlands where currently human actions related to resources extraction are being maximized beyond the resources rejuvenating capacity. In Ethiopia, wetlands are often considered as wastelands and are thought of as obstacles to agricultural development, human and animal health associated with nuisances and calamities such as floods, diseases like malaria and schistosomiasis (Legesse, 2007)

Consequences of wetland loss and degradation in Ethiopia

Alterations of the hydrological regime of wetlands have significant physical, chemical and biological effects that can have significant ecological and socio-economic implications at wider scale. On the other hand, presence of water is the main obstacle to human when wetlands have to be transformed into other form of land use (OECD, 1996; Roggeri, 1995).

The consequences of wetland loss and degradation in Ethiopia are enormous and directly affecting the livelihood base of rural communities. The change of wetlands has created numerous problems including decrease and extinction of wild flora and fauna, loss of natural soil nutrients, water reservoirs and of their subsequent benefits. They have affected various traditional occupations, socioeconomic conditions and cultural activities (Kumsa, 2015). Wetland conversion often results in water depletion, the displacement of populations, the destruction of traditional production systems, habitat degradation, salinization, increase of waterborne diseases and other adverse ecological impacts (WCED, 1987). Wetland dependent communities in different parts of Ethiopia survive by the virtue of wetland resources such as fisheries, dry season food crops, raw materials for construction, water, feed for animals, medicinal plants, income from sale of the products including handicrafts, etc. Thus at community level, the significance of wetlands in poverty reduction and ensuring food security is immense. Wetlands stand first when communities consider their problems of dry season when shortage of water and forage threatens the lives of their livestock, major asset next to land in agricultural areas and may be asset number one in pastoral communities. Wetlands save lives in dry seasons and are thereby the backbone of rural livelihoods for millions. Therefore, considering the impact on the local community from the loss of wetlands such as Haromaya/Alemaya, weakening of wetlands such as Abijata and Cheffa may suffice to understand the role of wetlands in community livelihood.

Losses of communal resources collected from the wetlands, water, dry season pasture, declining of food crop production are a few to mention (Dixon and Wood, 2003). Pollution of habitat and over fishing of selected species is among the biggest concern in the Ethiopian lakes. Wassie et al. (2012) noted that selective fishing in Lake Tana caused a 75% decline in Labeobarbus species during 1990s. Excessive water abstraction from wetlands and erosion and sedimentation are other serious threats. Ghermandi et al., (2008) found out excessive abstraction of water from Lake Alemaya, South-eastern Ethiopia caused complete drying up of the lake by the year 2004, 12 years earlier than the predicted time. Recently, there are increasing treats to the valley bottom wetlands of South-west Ethiopia which mainly arisen from expansion of drainage and cultivation (Dixon and Wood, 2003).

The complete drainage of wetlands in Illubabor Zones, south west Ethiopia has led to a number of ecological and economic problems. Some of these are immediate and clearly linked to drainage, such as the scarcity of thatching reeds, vegetation change, lowered water tables, reduced accessibility and provides unsafe water (Wood, 1996). This unsafe water may lead to even greater issues such as ill health among the entire family, which in turn affects farming and other domestic and economic activities, reducing food security and lowering economic well-being (Wood, 2003). Other problems are more complex and long-term, such as declining

agricultural productivity, reduced availability of land for 'hungry season' crops, increased fluctuations in stream flow, reduced water quality and downstream hydrological impacts. Loss of wetlands may also decrease biodiversity such as birds and other wildlife (Idris et al., 2001).

Wetland loss also aggravates climatic disturbances by increasing carbon build up in the atmosphere. As Ethiopia is prone to desertification and recurrent drought, the effects of wetland loss could be more visible in complicating the situation locally. It can also affect hydrological cycle or rainfall patterns. Rivers and streams may lose their strength. This will create shortage of water and narrow opportunities for irrigation based agriculture. Wetlands play a vital role in the carbon cycle and wetland loss may have impacts which encourage global warming and climate change (Shimeles and Geremew, 2008).

CONCLUSION AND RECOMMENDATION

In conclusion, wetlands have been ranked amongst the most productive and highly deteriorated and biologically threatened ecosystem in Ethiopia. Wetlands by nature are dynamic ecosystems, anthropogenic activities continuously changing the land uses in and around wetlands and speed up the ecological changes in wetlands. The primary direct causes of wetland degradation in Ethiopia includes drainage for agriculture, over grazing, degradation of catchments, over harvesting of their resources, settlement and urban expansion, pollution, tree plantation and invasion of alien species. The common threats to all wetlands of Ethiopia are: Weak institutional set up for management, over utilization of wetland resources, Lack of awareness, information and research on wetlands; poverty, the lack of livelihood alternatives for farmers, poor agricultural technology and productivity; the delicate arid and semi-arid environment surrounding the lakes, associated low and erratic rainfall and the threat of high human population pressure. Thus, wetland threats and losses are directly affecting the livelihood base of rural communities. Losses of communal resources collected from the wetlands, water, dry season pasture, declining of food crop production are a few to mention. Therefore, it deserves intensive research works, providing different livelihood improvement programs for small scale farmers around wetlands and needs policy attention from the government side to provide enabling environment for sustainable wetland management. Moreover, awareness creation campaign should be promoted by both government and nongovernmental organization in order to minimize over resource extraction that could be conducted by investors or private sectors and small holder farmers.

CONFLICTS OF INTERESTS

The authors have not declared any conflict of interests.

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