

Review

Wetland ecosystems in Ethiopia and their implications in ecotourism and biodiversity conservation

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Wetlands are ecosystems in which water covers the land. They provide economical, ecological, societal and recreational benefits to humans. Although complete documentation is lacking, wetlands make a significant part of Ethiopia covering an area of 13,700 km². Wetlands with a great potential for ecotourism development in the country include the rift valley lakes, the floodplains in Gambella, the Awash River Gorge with spectacular waterfalls, the Lake Tana and the Lake Ashenge, the Wenchi Crater Lake and the Wetlands in Sheko district are among others. Similarly, the Wetlands of Ethiopia are home to various aquatic biodiversity. Some of the biodiversity potential areas are the Cheffa Wetland and Lake Tana basin in the North, the rift valley lakes namely, Lake Zeway, Abaya and Chamo, and the Baro River and the Dabus Wetland in the Western Ethiopia. However, the wetlands in the country are impacted by a combination of social, economic, development related and climatic factors that lead to their destruction. Correspondingly, the wetlands holding a considerable biodiversity potential in the country lack adequate management. To address the challenges and enhance the wetland's role in ecotourism and biodiversity, a sustainable form of wetland resource use should be developed. As a result, integrating wetlands with ecotourism and developing as livelihood option for local communities is important for sustainable conservation of wetlands. Awareness rising, empowering stakeholders involved in wetland resource conservation, enhancing stakeholders' participation, undertaking the restoration of degraded wetlands and promoting scientific studies on wetlands of the country are crucial to conserve wetlands and at the same time promote their ecotourism and biodiversity importance. Moreover, implementing the integrated wetland resource management approach and addressing policy, management and coordination issues that arise on wetland resource conservation aids to promote the significance of wetlands in ecotourism and biodiversity conservation in Ethiopia.

Key words: Wetlands, ecotourism, biodiversity conservation, implication, Ethiopia.

INTRODUCTION

Wetlands and their roles

Wetlands are "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 the depth of which at low tide does not exceed six meters" (Secretariat of the Ramsar Convention, 2013). They are ecosystems found bordering land and water (Abebe, 2003). In wetland ecosystems, water covers the land, or is at or near the

surface of land (Abebe, 2003; Abunie, 2003). As wetlands are characterized by the feature whereby water plays a dominant role in regulating the environment, they have numerous roles in the livelihood of communities (Chakravarty, 2016; World Bank, 2013).

Wetlands are commonly used as areas of agricultural and grazing lands, in addition to their various benefits (Tulu and Desta, 2015). They support human wellbeing by offering food, fodder, fiber, fuel wood, timber and non-timber forest products (Amsalu and Addisu, 2014). They provide construction materials, energy resources such as peat and plant matter, transport services, herbal medicines and renewable freshwater for human use (Secretariat of the Ramsar Convention, 2013). Fish obtained from wetlands is an important source of animal protein for many developing economies (World Bank, 2013). These tangible and intangible diverse resources and products of wetlands historically provided a source of income and livelihood opportunities for human beings (Lamsal et al., 2015). Wetlands also play an essential role in the ecological condition of the environment (IWMI, 2006). They are important in maintaining natural cycles, water purification, climate regulation, flood regulation and coastal protection (World Bank, 2013; Lamsal et al., 2015). They provide the water and primary productivity upon which innumerable plant and animal species depend for their survival (Chakravarty, 2016; Secretariat of the Ramsar Convention, 2013). Where wetlands have healthy biodiversity, they provide essential services to our communities and to the environment providing recreational, cultural and spiritual benefits, acting as spawning and nursery grounds for fish and providing a refuge for animals in times of drought (Commonwealth of Australia, 2016).

Wetlands are considered one of the most productive environments in the world (Dubeau et al., 2017). They are places for wide range of biodiversity including concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species (Commonwealth of Australia, 2016; Babu, 2015; Johnson, 2013). They are also crucial storehouses of plant genetic material (Blumenfeld et al., 2009; World Bank, 2013). Due to their vast biological diversity and ecosystem features, wetlands are destinations for recreational and ecotourism opportunities (Chance, 2006; IWMI, 2006; Jafari, 2009; Brooks et al., 2011). Where wetlands are developed as ecotourism sites, they provide enormous advantages for Lamsal et al., 2015). The potentiality of the wetlands to rural communities by creating employment (Secretariat of the Ramsar Convention, 2013; World Bank, 2013; become an active recreation facility such as an

ecotourism park also brings necessary benefits for the wetland itself (Chakravarty, 2016).

Wetland ecosystems of Ethiopia

No complete documentation and studies of wetlands have been made in Ethiopia. It is estimated that there are 77 wetlands in Ethiopia including lakes that cover an area of 13,700 km², which is about 1.14 percent of the country's landmass (Karlsson, 2015). Different estimates also indicate that the total area of wetlands in Ethiopia may exceed 2% of the country's surface area (22,500 km²) (Mengistou, 2006). Variation in the geological formation and climatic conditions has endowed Ethiopia with different types of water resources and wetland ecosystems, including twelve river basins, eight major lakes and many swamps and floodplains (Tulu and Desta, 2015; USAID, 2008). The total annual volume of runoff water is about 110 billion cubic meters (USAID, 2008). The wetlands of Ethiopia vary in attributes such as size, type and location, and they represent a substantial micro-environment in many parts of the country (Endalew, 2015). Various forms of wetlands are found to exist in Ethiopia except the coastal and marine-related wetlands and extensive swamp-forest complexes (Dixon and Wood, 2001). They include alpine formations, riverine, lacustrine, palustrine and floodplain wetlands (Abebe, 2003).

Wetlands in Ethiopia are also usually determined as land covered by shallow water encompassing lakes, rivers, swamps, marshes, floodplains, natural or artificial ponds, high mountain lakes and human made wetlands (Tulu and Desta, 2015; Abunie, 2003). The wetland resources of Ethiopia are distributed in the central highlands, rift valley areas and mainly in the southwest borders of the country (Figure 1). They provide with various benefits to local communities. These include, of food crops through agriculture by draining and recession, important sites for dry season grazing, resource extraction, raw materials, papyrus supply, fish harvesting, source of medicinal plants and sites for tourist attraction and various traditional ceremonies (Mengesha, 2017; Tessema et al., 2015). Since they provide fresh water for drinking and household use, for livestock and for irrigation purpose, they are crucial in the life of rural peoples (Young, 2012; Chance, 2006). These wetlands also function as flood and erosion control and water purifiers, which are among the ecological values of wetlands and are affected when wetlands are unsustainably used (Karlsson, 2015; Ali, 2007). Wetlands

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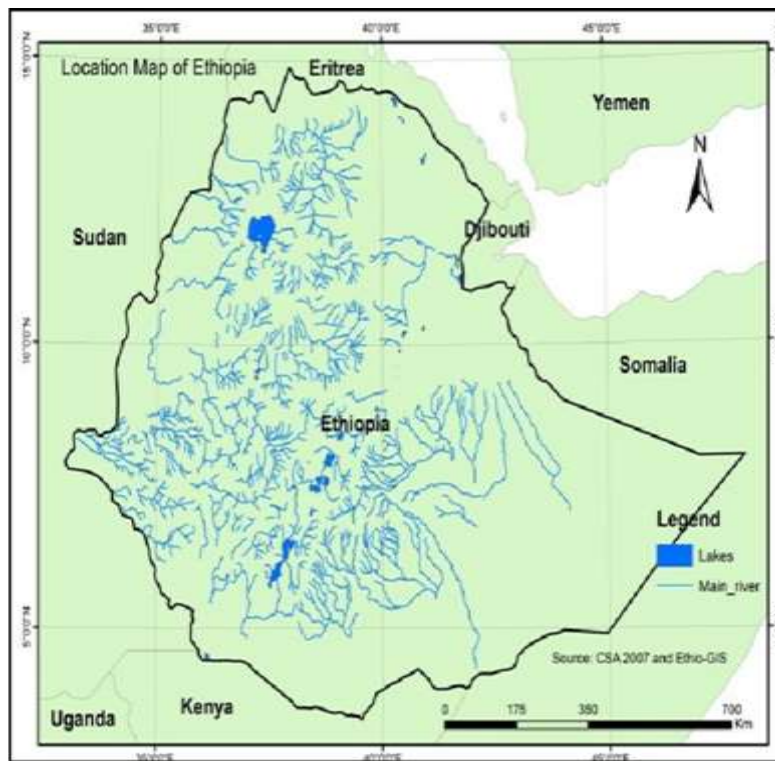


Figure 1. Map of Ethiopia showing lakes, rivers and associated wetlands (Tulu and Desta, 2015).

in Ethiopia have important ecological processes that link the highlands with lowlands. The major river basins comprise the Takeze, Baro-Akobo and Abbai (Young, 2012). They are found in the highlands of Ethiopia and provide water for people, livestock, wildlife and riparian vegetation in the lowlands (United Nations Development Program Global Environment Facility, 2008). As a result, the people, livestock, wildlife and riparian vegetation in the lowlands are dependent on the good management and protection of the watersheds in the highlands (Young, 2012).

The wetlands of Ethiopia support high population of mammals, birds (including transcontinental migratory species), reptiles, amphibians, fishes and invertebrate species. They also ameliorate climatic changes and global warming through carbon sequestration (Babu, 2015; Endalew, 2015). In Ethiopia, wetland ecosystems have a great potential in ecotourism and biodiversity conservation activities (Mengesha, 2017). Conversely, there are increasing challenges that affect the contribution of these wetlands to ecotourism development and biodiversity conservation (Gebreslassie et al., 2014; Abebe et al., 2014). However, the role of wetland resources in ecotourism and biodiversity conservation and the different challenges that affect their contribution

have not been discussed in detail due to the scarcity of adequate information and studies related to them (Bezabih and Mosissa, 2017). Some wetlands with many sources of attractions and recreation values are impacted due to conversion of the natural ecosystem into other land uses and illegal over-exploitation (Mesfin, 2011). Moreover, there are information gaps in relating wetland ecosystems with ecotourism and biodiversity conservation than relating with socioeconomic values and development (IWMI, 2006; Mesfin, 2011; Shewit, et al., 2017). This inadequate information affects the overall decision in utilizing and managing wetland ecosystems (Bezabih and Mosissa, 2017). Hence, the main objective of this paper is to review the ecotourism and biodiversity importance of Ethiopian wetlands, challenges affecting these wetlands and their values, and to provide solutions in relation to wetland based ecotourism and biodiversity conservation activities in Ethiopia.

Why wetland ecotourism should be encouraged in Ethiopia?

Wetland ecosystems have importance in conservation and sustainable development of the country (Lamsal et

al., 2015; Secretariat of the Nile Basin Initiative, 2013). This is due to their possession of enormous biological diversity, contribution to the socioeconomic aspect of communities and provision of various ecosystem services (Nikolić et al., 2009; Bezabih and Mosissa, 2017; Brooks et al., 2011). Wetland resources play an indispensable role in the livelihood of the poor particularly in developing countries like Ethiopia (Lamsal et al., 2015). Different natural resources and services are obtained from wetlands to meet the human needs.

The major advantages obtained from wetlands include food and cultural resources while the minor benefits include establishing coffee and tree nurseries on wetland fringes, clay collection for pottery and use of wetland tree bark for making ropes (Bezabih and Mosissa, 2017; Mengesha, 2017). In addition, flood control, improved water quality and tourism are services commonly obtained from wetlands in Ethiopia (Bezabih and Mosissa, 2017). However, the wetland ecosystems in Ethiopia are being affected in variety of ways because of the unregulated and unlimited human encroachments for activities such as farming, grazing and deforestation (Abunie, 2003; Kumsa, 2015; Bezabih and Mosissa, 2017). This unsustainable form of wetland resources use is leading to disappearance of biodiversity, dried up of wetland resources and destruction of wetland ecosystems in Ethiopia (Tewabe, 2014). Moreover, pressures of extensive fishery, deforestation and the related flow of sediments to wetlands are challenging the proper ecological functioning of the lake based wetland ecosystems. This has been evidenced in Lake Chamo wherein the lake has shrunk by 14.42% (50.12 sq. km) of the lake surface area in the last 45 years (Hailemicael and Raju, 2011). Currently, with rapid population growth and economic development, degradation of wetland ecosystems in the country increases with time (Babu and Teferi, 2015). The main threat to wetlands, particularly for those close to or in urban settlements, is development. Development affects the wetland resources through the filling in and building over of the wetland area or whereby development and industry nearby use wetlands so much that the wetland water table dries out (Chance, 2006).

Similarly, the rift valley lakes and wetlands of Ethiopia which are centers for socio-economic development suffer from excessive extractions and intractable human interactions with nature. As a result, these extensive development activities in the wetlands led to significant changes in their states (Abera, 2016; Akele, 2011). Many wetlands in Ethiopia are being affected due to over-extraction of wetland resources beyond their rejuvenating capacity by the surrounding societies. This ongoing process to meet the livelihood and development needs affects the wetland ecosystems and their function in many parts of the country (Tessema et al., 2015). Wetlands ecosystems entertain multiple natural functions and processes. The functions performed in wetland

ecosystems vary in degree, time and ways. Similar to other ecosystems, their functions are fulfilled in an interactive way (Sfougaris et al., 2009). To promote the functions of wetlands, a sustainable way to maintain the physio-chemical condition of wetlands is required. Monitoring and giving due care to the physico-chemical conditions of wetlands is crucial as it contributes to address the gaps in wetland assessment, the problems associated with wetlands and to promote sustainable wetland management (Yimer and Mengistou, 2009). Similarly, to increase the value of wetlands to local community and to preserve the wetland based environment in adequate manner, a more sustainable form of wetland resource use, such as ecotourism, should be developed (Temesgen, 2015; Lemenih et al., 2009).

Ecotourism development enhances the maintenance of the physico-chemical conditions of the wetland resources, and this leads to the wetland based ecotourism attraction remain attractive to tourists (Regis, 2004). Ecotourism also promotes the conservation of natural areas (wetland resources) at the same time improves the livelihood of communities when conscientiously followed, and therefore ecotourism that gives a due emphasis to the conservation of wetlands in Ethiopia should be launched to enhance their values (Temesgen, 2015; Lemenih et al., 2009). The sustainable existence of wetlands can be affirmed when they cope with stresses and shocks, and recover from strains, which enables them to improve their capabilities in the future. The involvement of local communities with their traditional knowledge, skills and practices can help wetland resource conservation while meeting their daily requirements (Lamsal et al., 2015). This indicates the necessity of community based wetland conservation through the active participation of local peoples. As a result, ecotourism which is a responsible and participatory form of tourism is valuable to enhance the preservation of wetlands and contribute to the welfare of local communities (Menbere and Menbere, 2017).

ECO-TOURISM OF WETLANDS

Wetlands as ecotourism potential sites in Ethiopia

The importance of wetland resources in Ethiopia goes beyond their relevance as a shelter for several endangered fauna and flora species, but they are vital components in the national and global ecosystems and economies. Wetlands are exceptional habitats favored by endemic birds and are endowed with variety of natural attractions offering immense potential for ecotourism development in Ethiopia (Abera, 2016; Amsalu and Addisu, 2014). In Ethiopia, the wetland resources based ecotourism opportunities are dispersed throughout the



Figure 2. Tis Abay (McCartney et al., 2010).

country. Important places with ecotourism potentials include the rift valley lakes for resort-like accommodations, water-based ecotourism activities and bird watching, the wetlands and floodplains found in Gambella National Park, the waterfalls, springs and dam in Sheko district and the hot springs and the Awash River Gorge with spectacular waterfalls in the Awash National Park are among others (Dejene et al., 2014; Shale et al., 2014; Ministry of Culture and Tourism, 2012; Yilma et al., 2016). The lakes in the Afar Depression such as Lake Afrera, Lake Asale and Dallol Depression are also essential ecotourism potentials that should be preserved in proper manner (Michael, 2012).

The central rift valley region comprises different wetland resources akin to the Lake Zeway and Lake Hawassa, both of which have a huge potential for ecotourism development. Lake Zeway is characterized by hot weathered climate and is an ideal place of fishing, boating, bird watching, water transportation for island and monastery tours. The lake is also known by several islands of which Tullu Guddo, with its historical monastery of Debre-Tsion Mariam and Zayé ethnic group is the main and the popular one. Tullu Guddo is accessible by boat both from Eastern shore and Western shore (Zeway town) (Bayou and Bedane, 2014). Lake Hawassa also provides an ideal spot for ecotourism activities such as fishing, bird watching and boating (Suryabagavan, et al., 2015). The Lake Tana and the Lake Ashenge, are important ecotourism destinations with various tourist attractions in Northern Ethiopia. The majority of attractions in the Lake Tana Region are related to cultural resources including churches and monasteries on the islands and peninsulas on the Lake. The area also holds Tis Isat falls (Figure 2), natural (church) forest with indigenous tree species (including shade-growing organic coffee), wildlife such as the

hippopotamus, papyrus bed wetlands, important bird areas of key global species and the Bahir Dar Blue Nile River Millennium Park (BDBNRMP) (Heide, 2012).

Due to its importance as nesting, breeding, roosting and feeding sites for globally threatened and migratory birds, the Lake Tana area provides a crucial economical, ecological and recreational opportunities (Goshu and Aynalem, 2017; Environmental protection Authority, 2003). Similarly, the Lake Ashenge has also unique features vital for ecotourism development. The area includes the globally threatened and congregatory bird species which are supported at a regular base (Thrymbakam and Saini, 2014). As an important bird attraction site, the lake holds Afrotropical highland biome species including the endemic *Serinus nigriceps*, *Columba albitorques*, *Onychognathus albirostris* and *Corvus crassirostris*. Other species include *Bubo capensis*, and the Sudan–Guinea savanna biome species such as *Turdoides tenebrosus* (EWNHS, 1996a).

Evidences of wetland based ecotourism practices in Ethiopia

In Ethiopia, though not adequate, there is a practice of using wetlands for ecotourism activities. The astonishing Wenchi Crater Lake is a major wetland based ecotourism site; managed, governed and conserved by local peoples (Figure 3). The communities also obtain income through involvement in different ecotourism based activities. The potential attractions commonly visited in this wetland resource includes the fauna and flora around the lake, the stunning landscape, the Cherkos Orthodox church in the middle of the lake and the hot springs in the area (Shale et al., 2014; Ketema, 2015a). Although not community based, the Wondo Genet wetland ecosystem



Figure 3. Wenchi Crater Lake and community based ecotourism site (Photo by authors, 2017).

and associated forest provides nature-based recreation service to different users from local visitors to international tourists (Ali, 2007).

Ecotourism facilities that are in practice in the country also include the Bishangari and Wenev Lodges which are pioneers of eco-tourism facilities in Ethiopia, and are settled in the tranquil enclave of pristine forest of Eastern Shore of Langanu (Bayou and Bedane, 2014). Due to its importance for swimming, availability of accommodation services and existence of hotels like (Bekele Molla, Wabe Shebele and Abule Basuma Resort), the Lake Langanu is such a big ecotourism center in the rift valley area that needs to be developed in a sustainable manner. Visitors can camp, water ski, sail and swim or bask in the blazing sun on the sandy beaches of the lake (Bayou and Bedane, 2014). Developing community based ecotourism in and around wetland resources enhances the conservation attitude of communities, improves the community's livelihood, strengthens their sense of ownership and leads to community empowerment as observed in Wenchi Crater Lake in Ethiopia (Ketema, 2015b). Although there are other wetland based ecotourism practices known to occur in the country, they lack adequate studies to compile their potentials, values and challenges in sufficient manner.

BIODIVERSITY IMPORTANCE OF ETHIOPIAN WETLANDS

Wetlands as biodiversity conservation devices in Ethiopia

Wetlands are characterized by a life support system and immense biodiversity due to their hydrological and ecological functions (Bezabih and Mosissa, 2017). The

wetlands of Ethiopia are prominent shelters of aquatic and terrestrial biodiversity such as endemic fishes, birds and lower invertebrates (Babu, 2015). Nationally, there are 73 Important Bird Areas (IBAs) of which 30 of these sites comprise wetlands, while the rest represent other forms of ecosystems. These wetlands are habitats for innumerable organisms including birds. The wetlands and flood plains of west Ethiopia serve as the second largest mammal migration zone on the continent between Ethiopia and South Sudan. Almost one million white-eared kobs migrate between the two countries to take advantage of the vast grassland areas and flood plains (Ministry of Culture and Tourism, 2012).

However, the change and threat to the wetlands has created numerous problems including decline and extinction of wild flora and fauna, loss of natural soil nutrients, shrinking of water level and the associated reduction of their benefits in the country (Bezabih and Mosissa, 2017). The lake based wetlands which are covered with water earlier are now converted to grazing ground, farm land, salt lick places and sites to dig a special type of clay in some lakes (Hailemicael and Raju, 2011). There have also been indications wherein some indispensable species were disappeared and others are reduced in number due to the degradation of wetlands in Ethiopia. The loss of wetlands is devastating to several endemic species particularly to wetland dependent species (Babu, 2015). Generally, the consequences of wetland loss and degradation in Ethiopia are enormous and directly affecting the livelihood base of rural communities, the wetlands themselves and biodiversity they support and their sustainable existence. The following wetlands from the northern, central, southern and western Ethiopia incorporated here are mainly based on their involvement in legal conservation system and their role in supporting high biodiversity in Ethiopia.

Northern wetlands

Cheffa, Geray, and other Wetlands and hot springs in Eastern Amhara Region

Among the northern wetlands, the Cheffa wetland is known to possess high amount of biodiversity including the two fish families (Cyprinidae and Clariidae), comprising four genera (*Gara*, *Clarias*, *Labeo* and *Labeobarbus*) and five fish species (*Gara dembecha*, *Clarias gariepinus*, *Labeobarbus intermedius*, *Labeobarbus nedgia* and *Labeo horie*). Though the fish diversity in Cheffa is lower compared to other studied wetlands in Ethiopia, its significance in fish diversity is still relatively higher. Beside the fish resources, other vertebrates are also found to exist in and around Cheffa wetland. These include the Nile monitor (*Varanus niloticus*), snakes and various bird species. The different bird species that are commonly observed in the area include cattle egrets (*Bulbulcus ibis*), Egyptian goose (*Alopochen aegyptiaca*), grey heron (*Ardea cinerea*), hadada ibis (*Bostrychia hagedash*), sacred ibis (*Threskiornis aethiopicus*), yellow-billed duck (*Anas undulata*), African jacana (*Actophilornis africana*) and great white pelican (*Pelecanus onocrotalus*) (Tessema et al., 2015). Similarly, the wetland of Geray also holds significant forms of biodiversity. But, problems such as floating of macrophytes and wetland shrinkage reduce the biofiltering role of its wetland habitat. In addition, poor land use, intensive agricultural activities, deforestation, habitat degradation and the resulted soil erosion in and around the wetland basin induce sedimentation that results in reduction of the water storage capacity of this wetland (Endalew, 2015).

The other wetland ecosystems in this part of the country include the wetlands and the hot springs in the Eastern Amhara Region. These areas have high potentials for avian diversity. According to Derso et al. (2015), a total of 2484 birds belonging to 56 species have been recorded at different sites in the area. The frequently recorded and abundant bird species of the area are black-headed oriole (*Oriolus larvatus*), spur-winged lapwing (*Vanellus spinosus*), spectacled weaver (*Places ocellaris*) and yellow wagtail (*Motacilla flava*). Despite the values of the area in biodiversity, human activities undertaken on the water body as well as in the surrounding area are creating serious challenges to the diversity of birds, wetland habitats and quality of wetland water as a whole (Derso et al., 2015). Hence, appropriate and immediate action should be put in place.

Lake Tana Basin

Lake Tana Basin is one of the 73 Important Bird Areas in Ethiopia that possesses globally threatened species such as wattled crane (*Bugeranus carunculatus*), lesser flamingo (*Phoeniconaias minor*), rouget's rail (*Rougetius*

rougetti), pallid harrier (*Circus macrourus*) and greater spotted eagle (*Aquila clanga*) (Aynalem and Bekele, 2008). It is the largest lake of Ethiopia with a surface area of 3156 km² and with a maximum depth of 14 m. As located at an elevation of 1840 masl, it is also the highest lake in Africa. Lake Tana Basin is the main source of the Blue Nile that drains a long way through Khartoum in Sudan to the Mediterranean Sea. The wetlands around the Lake have significant values for conservation of endemic fish diversity and various waterbird species.

The Lake Tana Region is an important roosting site for migratory bird species such as the common crane (*Grus grus*), northern shoveller (*Anas clypeata*), northern pintail (*Anas acuta*), black-tailed godwit (*Limosa limosa*) and ruff (*Philomachus pugnax*). It also provides favorable habitats for various endangered and endemic bird species including, the wattled ibis (*Bostrychia carunculata*), white-collared pigeon (*Columba albitorques*), black-winged lovebird (*Agapornis taranta*), white-cheeked turaco (*Tauraco leucotis*), pallid harrier (*Circus macrourus*) and black-crowned crane (*Balearica pavonina*) (Aynalem, and Bekele, 2009). The Lake Tana Region provides various benefits from local and national to international levels. It is a place of rich biodiversity with endemic fauna and flora; a place of extensive and pristine wetlands; a site to cultural and archaeological resources and is a potential for ecotourism attractions. However, the interacting environmental problems notably deforestation, erosion, sedimentation, water level reduction, erratic rainfall, excessive flooding of the wetlands, competition of water resources, pollution and the introduction of alien species are affecting the area (Dejen, 2003).

Central Wetlands and Rift Valley Lakes

The Ethiopian rift valley runs from Eritrea in the northeast to Lake Turkana on the Kenya border in the southwest. The Central Ethiopian rift valley is characterized by a chain of lakes and wetlands with unique hydrological and ecological features. The wetlands and lakes of this area serve as wintering and stopover sites for many bird species of the Sub-Saharan and Palearctic origin (Ethiopian Wildlife and Natural History Society, 1996b). The lakes and surrounding wetlands are also well-known for biodiversity including different endemic birds and wild animals. Congruent to this, about 50% of the bird species in Ethiopia have been recorded in this rift valley area. However, the human intervention and intensive use of the wetlands for various purposes are provoking the deterioration of these wetland resources (Alemayehu et al., 2006).

Abijatta-Shalla Lakes

The role of Abijatta-Shalla Lakes in biodiversity

conservation is so great due to the productivity of their wetlands, and evidences from well documented taxonomic groups of bird species in the area. The lakes were also serving as fishing places in the past, but currently this activity is rarely reported. Abijatta-Shalla Lakes and associated wetlands are among the highest wetland bird diversity sites in Ethiopia (Getaneh et al., 2015). Various studies of bird species specifically in the Abijatta-Shalla Lakes and on their associated wetlands indicated the presence of 136 (30%) wetland bird species (of which 106 species are wetland specialist and 30 species are wetland generalist) including migrant groups. These lakes are also home for the nearly threatened bird species such as lesser flamingo (*Phoeniconaios minor*), and for the vulnerable bird species such as wattled crane (*Grus carunculatus*) and ferruginous duck (*Aythya nyroca*) (Almaw, 2012).

The great relevance of Abijatta and Shalla Lakes and their wetlands for bird diversity particularly, for great white pelicans and greater and lesser flamingoes has been related to the existence of islands within these lakes that are used as reproduction sites by various birds including pelicans. Correspondingly, the parts of the lakes in particular to the Lake Abijata which is more productive are used as their feeding places. As a result, these lakes serve as the major feeding ground for aquatic and terrestrial birds including both migratory and resident ones. Flamingos and white pelicans are among the commonly observed waterbirds that depend on these lakes and on their wetlands (Getaneh et al., 2015).

Lake Zeway and Lake Langanu

The wetlands of Lake Zeway are sites for biodiversity conservation while the wetlands of Lake Langanu are tourist attraction places (Unbushe, 2013). Lake Zeway supports a considerable aquatic and terrestrial biodiversity including birds and fishes. Its ecosystem serves as a breeding and wintering ground and as a migration stopover habitat for several resident and migratory waterbird species (EWNHS, 1996b). The shores of the Lake Zeway are marshy, shaded by bulrush, sycamores and reeds that provide a feeding ground for aquatic birds. Some of the waterbirds frequently observed in the lake are marabou stork (*Leptoptilos crumenifer*), great white pelican (*Pelecanus onocrotalus*), striated heron (*Butorides striata*), grey heron (*Ardea cinerea*), African darter (*Anhinga rufa*) and reed cormorant (*Microcarbo africanus*). Apart from aquatic birds, the lake is also a site for a large quantity of fish, amphibians and hippos (Bayou and Bedane, 2014). Unlike Lake Zeway, Lake Langanu is less productive. The western side of the lake is covered with a thin acacia tree while the eastern shore is covered by pristine dense forest patches. Usually Lake Langanu is considered as

an important place for big potential tourism development than biodiversity conservation (Bayou and Bedane, 2014).

Lake Hawassa

Diversity of endemic birds is observed in and around Lake Hawassa. The main groups of avian biodiversity in the areas include marabou stork (*Leptoptilos crumenifer*), great white pelican (*Pelecanus onocrotalus*), Egyptian goose (*Alopochen aegyptiaca*), wattled ibis (*Bostrychia carunculata*) and white stork (*Ciconia ciconia*). The lake and its associated wetlands are also habitats for mammals like hippopotamus and for fishes such as barb (*Barbus intermedius*), the African catfish (*Clarias gariepinus*) and tilapia (*Oreochromis niloticus*) (IBC, 2005; Suryabhagavan et al., 2015). The wetland of Lake Hawassa is extensive possessing abundant aquatic vegetation. As the lake is highly endowed with the views of birds, mammals, fishes, invertebrates and plants, it serves as an important destination for biodiversity conservation (Suryabhagavan et al., 2015).

Southern Wetlands

Southern Rift Valley Lakes: Abaya and Chamo

Wetlands of the southern rift valley lakes support a great deal of flora and fauna including endemic bird species (Figure 4). They also hold useful non-cultivated plant species such as *Discorea*, *Erythrocarpus*, *Celtis tokka*, *Tamarindus indica*, *Ficus sur*, *Carissa spinarum*, *Cordia africana*, *Gardenia ternifolia*, *Citrus auriantifolia* and *Ipomoea aquatic*. The wetlands of Abaya and Chamo Lakes provide a range of ecological and economic importance to people in the surrounding area. The wetland vegetation support wildlife being an important nesting and feeding areas for hundreds of wetland birds and hippopotamus, and serving as a spawning areas for crocodiles (Unbushe, 2013).

Lake Chew Bahir

Lake Chew Bahir is located at the end of the Ethiopian section of the Great Rift Valley. Due to its water level fluctuation, Lake Chew Bahir has a variable feature from swamp to shallow open water with a maximum depth of 7.5 m and with an area of 2,000 km². The water of Chew Bahir is also highly saline as a result, there is a variation in supporting life in different parts of the lake. The flora diversity of the area includes *Sporobolus consimilis*, *Sporobolus spicatu* and *Cyperus* species of grasses, and *Echinochloa*, *Cyperus* and *Nymphaea* species of tall



Figure 4. Faunal resources of Lake Chamo (Hailemicael and Raju, 2011).

plants (EWNHS, 1996a). The area also commonly possesses diverse fauna species such as birds, mammals, amphibians and snails.

Among the birds, African open bill (*Anastomus lamelligerus*), gull-billed tern (*Sterna nilotica*), fulvous whistling duck (*Dendrocygna bicolor*), allen's gallinule (*Porphyrio alleni*), kittlitz's plover (*Charadrius pecuarius*), pink-breasted lark (*Mirafra poecilosterna*), scaly chatterer (*Turdoides aylmeri*), pygmy batis (*Batis perkeo*), hunter's sunbird (*Nectarinia hunter*), Donaldson-Smith's sparrow-weaver (*Plocepasser donaldsoni*), shelly's starling (*Lamprotornis shelleyi*), magpie starling (*Speculipastor bicolor*), Somali bee-eater (*Merops revoilii*), parrot-billed sparrow (*Passer gongonensis*) and grey-headed silverbill (*Lonchura griseicapilla*) are included from Afrotropical, Palearctic and Somali-Masai biome. The surrounding plains of the lake support different mammalian species including the endangered grévy's zebra (*Equus grevyi*) while the marshes support high population of amphibians and snails. The Chew Bahir basin is an important type of locality for a number of species endemic to the arid and semi-arid conditions of the Ethiopian-Kenyan border area (EWNHS, 1996a).

Western Wetlands

Baro River and Dabus Wetland

The western Ethiopia is characterized by different types of wetlands that are crucial for multiple purposes. Among these, Baro River and Dabus wetland have an importance in biodiversity conservation. Baro River is one of the important bird areas of Ethiopia. It holds huge numbers of waterbirds such as storks, pelicans, herons

and egrets (EWNHS, 1996a). In addition to its avian diversity, Baro River is represented by a great diversity of Nilo-Sudanic and East African forms of fish species (Michael, 2012). The wetland of Dabus in western Ethiopia also supports hundreds of hippos with different life features (Unbushe, 2013). Although there are various wetlands with biodiversity conservation values in the country, they are insufficiently studied to describe their role in a great manner.

CHALLENGES FACED BY WETLAND ECOSYSTEMS IN ETHIOPIA

Population growth and anthropogenic challenges

In Ethiopia, anthropogenic activities that affect the quality and safety of wetlands and surface waters are increasing because of the growing human population number. Similarly, the wetland ecosystems and biological resources are being impacted by population growth due to the increasing pressure of resource uses. Anthropogenic activities such as industry, urban complex, expansion of human settlements, farmland expansion, overgrazing, massive vegetation removal for food, construction materials and fuel wood, and open burning in an attempt to convert to farmlands are causing severe deterioration to wetlands and their surroundings in Ethiopia (Dejen, 2003; Derso et al., 2015; Gebretsadiq and Mereke, 2017). These impacts are widely prevalent in wetlands around Lake Tana and in the rift system in the country (Dejen, 2003). Increased human activities in the rift valley area of Ethiopia have also resulted in open vegetation which is floristically poor and uniform. Conversion of natural vegetation, overgrazing of natural

grasslands and clearing of forests for fire wood and construction purpose are the consequences of population pressure and related impacts in the rifts systems in Ethiopia (Abera, 2016).

Managerial, coordination and policy problems in wetland resource utilization

Lack of policy support, overlapping responsibilities of different government institutions and conflict of interests among various stakeholders are the features of wetland resource management in Ethiopia (Goshu and Aynalem, 2017). In addition, the different stakeholders such as local communities, governmental and non-governmental organizations use wetlands in an uncoordinated manner. As a result, the wetland ecosystems and water resources confront problem of overexploitation and decline in water capacity that accelerate the wetland loss (Babu and Teferi, 2015). Lack of a comprehensive wetland policy and absence of an institution empowered to issue and implement wetland laws and coordinate management activities are affecting wetlands in different manner (Tiega, 2002). These are considered as the underlying causes of the wetland destruction in Ethiopia. Furthermore, capacity limitations due to lack of skilled manpower, finance and technology have their impacts on the sustainable management of wetlands (Unbushe, 2013; Babu and Teferi, 2015).

Inadequate documentation and research work on wetland resources

Wetland resources in Ethiopia are not fully documented (Babu, 2015). Wetlands in the north-eastern, eastern, southern (in the Bale, Arsi, Kafa, Maji line), western (in Ben Shangule line) and border areas were not assessed (Shewaye, 2008). The limited research work on wetland resources has weakened the wetland management in the country (Teferi et al., 2010). Although wetlands in the country possess immense biodiversity (including migratory and endangered bird species) that have a great ecological importance, their ecological function is poorly studied and recorded in Ethiopia. As a result, there is scant information on their biodiversity and richness (Yimer and Mengistou, 2009).

Unsustainable fishing

The different problems on wetlands are making the fishery resource to decline in Ethiopia. This is mainly due to the intensive fishing pressure with narrow mesh size (Mequanent and Sisay, 2015). Correspondingly, over-fishing of selected species is one of the main concerns in

the Ethiopian lakes (Bezabih and Mosissa, 2017). The problem of using appropriate gears and nets, complete female fish catching practice and extended fishery are causing loss of wetland biodiversity, and affecting the sustainability of fishery resources in some lakes such as Lake Chamo (Gebretsadik and Mereke, 2017; Hailemichael and Raju, 2011). Moreover, desertification of lake side zones which are former fertilization sites, loss of breeding grounds, and fragmentation of fish grazing, basking and nesting grounds are resulting in the destruction of the fishery resources (Hailemichael and Raju, 2011).

Improper land use and related changes in the land use land cover pattern

Inappropriate land use in and around wetlands leads to declining of the wetland ecosystems and their associated biodiversity (Mequanent and Sisay, 2015). The changes in the land use land cover pattern of wetlands, such as deforestation and subsequent cultivation reduce wetland water while overgrazing causes loss of biodiversity and compaction during wet periods, which also lead to reduced infiltration rates. For these reasons, the volume of available surface water has decreased, and many springs and streams have dried out as observed in Kasso catchment of Bale Mountains, in Ethiopia indicating LULC dynamic affects the availability of water resources and associated wetlands (Warra et al., 2013).

Currently, there are expansions of new land use systems through the displacement of the original forests and pastureland in different wetlands of Ethiopia. This is becoming a common phenomenon in the rift system including Lake Hawassa and Cheleleka wetland (Wolka et al., 2015). Inappropriate land use is creating many challenges for the wetland ecosystems in Ethiopia like sedimentation, problem of water quality and quantity, destruction of birds' habitats, problem of grazing fields for hippopotamus, and affects reproduction sites of fish, other vertebrates and invertebrates. Inappropriate land use is also reducing the ecological function, service and importance of wetlands in Ethiopia (Hailemichael and Raju, 2011; Mequanent and Sisay, 2015).

Problem of pollution and sewage

Anthropogenic pollution on water bodies is severe because it leads to decline of the water quality and biodiversity in wetlands (Porte and Gupta, 2017). Introduction of pollution and sewage are among the biggest threats to the Ethiopian wetland ecosystems (Bezabih and Mosissa, 2017). Pollution from animal excrements and sewage discharges from towns, villages and temporary residence tents, which practiced open



Figure 5. Drying Water and Wetland resource: Abijata Lake (UNEP, 2009).

defecation lead to high turbidity, chloride concentration in wetlands and low dissolved oxygen contents (Derso et al., 2015). Vehicle washing practices along rivers have significant pollution potential to the wetlands and rivers as seen from Kulfo River, in Ethiopia. In the same manner, lake side filleting is another problem by fishermen complicating lakeside waste management in and around lakes such as Abaya and Chamo (Hailemichael and Raju, 2011). As there are little control mechanisms for industrial emissions in developing countries, the threats to wetlands from industry and development are growing. Increased pollution in the form of heavy metals and chemicals affects the wetland's capacity to filter out such pollutants and causes a serious damage to biodiversity in the wetland. The chemical release into the lakes and wetlands, from the floriculture and horticulture enterprises results in destruction of fish resources and contributes to the decline of piscivorous bird populations (Mengesha et al., 2014). Moreover, when sewage input exceeds wetland's capacity to filter it, such pollution results in eutrophication of water bodies and increases problems to wetlands (Chance, 2006).

Irrigation and extraction of industrial raw materials

Expansion of irrigation in and around wetlands by diverting rivers depletes the dissolved oxygen and causes toxic gas secretion mainly by decomposition (Hailemichael and Raju, 2011). Increased conversion of wood and wetlands to irrigated agriculture reduces the waterbird species diversity as observed in and around Lake Zeway. Similarly, fragmentation of Lake Zeway wetland habitats by small scaled irrigated agricultures is identified as one of the drivers of waterbird species diversity and abundance decline (Mengesha et al., 2014). The human intervention and intensive use of wetlands for multiple purposes such as irrigation and extraction of industrial raw materials (that is, salt from Soda-Ash factory located at Abijata Lake) in unsustainable manner resulted in the deterioration and shrinking of many wetlands including Abijata Lake (Figure 5) (Alemayehu et al., 2006).

Awareness problem and inadequate community participation

A major factor contributing to the international trend of destroying wetlands is the fact that their value is poorly understood (Turpie et al., 2010). Lack of adequate knowledge and awareness about wetlands results in wetland deterioration from overexploitation, and thereby affects their sustainable existence (Tewabe, 2014). The low level community awareness concerning wetlands and their benefits also accelerates the loss of wetlands in the country (Unbushe, 2013). This is the case in some wetlands in Ethiopia such as the Tekuma wetland, which is in Lake Tana Sub-basin, and is a sub-basin of Abay River basin, which remained little understood by the surrounding communities, but facing enormous threats (Kassa and Teshome, 2015). In the same way, absence of adequate local people participation in the sustainable wetland resource conservation is one of the factors affecting wetlands and their different values in Ethiopia. This deters the effective wetland resource management practice in the country (Goshu and Aynalem, 2017).

Invasive species

Invasive species are one of the major threats to biodiversity in the world due to their effect in the homogenization of the ecosystems (Enserink, 1999). Invasive species, particularly the exotic species are the main challenges to the wetlands of Ethiopia. Some of the invasive species affecting Ethiopia's wetlands include prosopis or mesquite (*Prosopis juliflora*) in Awash River basin, giant sensitive tree or catclaw mimosa (*Mimosa pigra*) in the Baro-Akobo basin and common water hyacinth (*Eichhornia crassipes*) in Lake Tana and Koka reservoirs (Tikssa et al., 2010; Tamene et al., 2000).

Overexploitation, climate change and poor watershed management

Although the wetlands of Ethiopia have various global

importance, they experience many problems due to overharvesting of wetland resources (Zerihun and Kumlachew, 2003; Mequanent and Sisay, 2015). This is particularly the case in the main Ethiopian rift valley lakes (Zeway, Shala, Hawassa, Abaya, Chamo and Chew Bahir basins). Excessive exploitation of wetland resources in some cases leads to a direct collapse of the wetland itself (Babu, 2015). This in turn affects the infiltration capacity of the wetland soil as well as the wetland biodiversity (Unbushe, 2013).

The wetlands of Ethiopia are also affected by climate change. Climatic factors aggravate the threats of wetlands in the country by increasing pressure on the wetland resources to meet the ever-increasing human needs (Bezabih and Mosissa, 2017). Moreover, climate change causes significant impacts on water and wetland resources by changing the hydrological cycle (Goshu and Aynalem, 2017). Poor watershed management in the uplands leads to accumulation of silt eroded from degraded uplands, and aggravates siltation of wetlands (Tulu and Desta, 2015). This occurs due to the intensive cultivation and grazing that result from population pressure in the highlands and threatening the wetlands in the lowland areas (Babu, 2015). Likewise, the introduction of perennial crops such as eucalyptus in the uplands poses a danger to some wetland ecosystems in Ethiopia (Zerihun and Kumlachew, 2003; Mequanent and Sisay, 2015).

Loss of wetland biodiversity

Biodiversity involves the variability among living organisms in different wetland ecosystems including their ecological complexes. Wetland biodiversity has a vital role in the maintenance of a healthy environment and provides direct human benefits such as food, medicine, energy and construction materials. Biodiversity also provides different services free of charge such as providing clean air and water, soil formation and protection, protection of watersheds, controlling of excessive climatic variations, pollination and pest control (Kasso and Balakrishnan, 2013). However, the different wetland based biodiversity and wildlife populations are declining and various species are going to extinct due to the degradation of natural habitats and related problems (Convention on Biological Diversity, 2010). Although the wetland biodiversity contributes to the local peoples' livelihood and local culture, they are often affected due to human threats such as wetland fragmentation, direct exploitation and failure in mitigating threats that result in very small, fragmented and isolated remnant populations (Kasso and Balakrishnan, 2013; Thomas, 2011).

In Ethiopia, the wetland dependent biodiversity and wildlife populations are declining due to degradation of wetland ecosystems. According to (Babu, 2015), some

wild animal species that exist in wetland areas such as aardvark (*Orycteropus afer*), African civet (*Civettictis civetta*), bushbuck (*Tragelaphus scriptus*), common duiker (*Sylvicapra grimmia*), African rabbit (*Poelagus marjorita*), bush pig (*Potamochoerus larvatus*) and crested porcupine (*Hystrix Cristata*) are locally extinct due to the wetland ecosystems degradation in Bule Hora Woreda of Borena Zone in Southern Ethiopia. In the same way, there is a decrease in the waterbird species diversity, abundance and distribution in wetlands of Lake Zeway and in the surrounding environs. Deforestation in the lake's catchments and overgrazing by livestock in the areas surrounding the lake are identified as the drivers of waterbird species diversity and abundance decline in that they reduce vegetation cover, nesting sites, birds' food and birds' habitats (Mengesha et al., 2014).

Generally, the threats to Ethiopian wetlands result from a combination of social, economic, development related and climatic factors (Bezabih and Mosissa, 2017). These threats are categorized as onsite that originate within the wetlands and offsite that originate outside the wetlands (Tulu and Desta, 2015). The different onsite and offsite challenges namely, excessive drainage, water diversion, pollution, accumulation of silt from degraded uplands, prevalence of invasive plant species, over harvesting of wetland resources, urban expansion, mining and the introduction of perennial crops such as eucalyptus into the wetland ecosystems pose a danger to the country's wetlands (Zerihun and Kumlachew, 2003; Mequanent and Sisay, 2015). The degradation and loss of these wetlands result in increased flooding, soil erosion, degradation of water quality, reduced dry season flows and lower groundwater tables (Teferi et al., 2010). According to (Babu, 2015), the degradation of wetland ecosystems impacts the ecological, ecotourism and biodiversity importance of wetlands. Hence, appropriate action is required to address the impacts and conserve the wetland resources in sustainable manner.

SOLUTIONS TO ADDRESS THE IMPACTS AND ENHANCE THE ECOTOURISM AND BIODIVERSITY IMPORTANCE OF ETHIOPIAN WETLANDS

Integrating wetland resources with ecotourism and developing them as an alternative livelihood option for communities

The Ethiopian economy is largely dependent on agriculture which is dominated by smallholders farming under rain-fed condition. However, as agriculture alone could not transform the Ethiopian economy in its endeavor in the past years, the country has now recognized the importance of diversifying its economic activities. Tourism industry is identified as one of the economic sector which is given a great attention recently

(Shale et al., 2014). Protecting wetlands from several human imposed activities is crucial to properly use by designing interventions such as ecotourism activities (Tewabe, 2014). Wetland ecosystems provide recreational opportunities and tourism to human well-being (IWMI, 2008; Fernando and Shariff, 2013; Ramsar, UNWTO, 2012). Ecotourism is one of the tourism forms which involve providing education for landowners and enterprises regarding the functions and values of wetlands (Sfougaris et al., 2009). In contrast to consumptive land use forms such as agriculture and grazing, ecotourism is basically a non-consumptive form of wetland resource utilization that is environmentally friendly, economically viable and a socially acceptable form of tourism (Nyakana, 2008). As ecotourism initiatives are based on sustainability, their development around the wetland ecosystems has a significant advantage (Baker, 2008). Ecotourism activities that can be developed around wetlands include but not limited to bird watching, boat riding, fishing, biking, camping, jungle trekking, cultural tourism, hiking, nature walks and photography (Bintoora et al., 2015; Do et al., 2015; Saruman et al., 2017). Utilizing wetlands for ecotourism enhances the conservation of wetlands, promotes the maintenance of biodiversity and boosts the socio-economic and cultural benefits to local communities (Sfougaris et al., 2009). However, many countries including Ethiopia have yet to make full use of ecotourism at their wetland resources, and it is here that the development of ecotourism should be promoted (Wetlands International, 2002). The appearance of ecotourism as an alternative option of wetland resources management is important in that the community can own, manage and take care of their natural resources to get income and use that income to improve their lives. Wetland and ecotourism planning should involve key stakeholders such as local business owners, private landowners, governmental bodies and non-profit entities to help promote wetland conservation with the money spent by tourists (Sfougaris et al., 2009). When different stakeholders involve in community based ecotourism, it is vital to promote conservation, to facilitate the prevalence of business enterprises and to enhance community development. Consequently, wetland resources can have a great potential in which ecotourism venture develops and are visited and loved by ecotourists to get the first-hand experience about the destinations (Thryambakam and Saini, 2014).

Implementing the integrated wetland resource management approach

Implementation of the integrated wetland resource management which includes all aspects of wetland benefits for people, wildlife, ecosystem and industrial and commercial development is crucial to sustain wetlands

and the biodiversity they support. Integrated land and water development and management involving all stakeholders is also imperative to ensure the sustainable development of the wetland resources (Jansen et al., 2007). The implementation of an integrated landscape approach to manage wetlands enables to reduce the trend of desertification in wetlands, improves the livelihood and wellbeing of the communities (Tewabe, 2014; Tiega, 2002).

Awareness creation on the importance, threats and conservation values of wetlands

Wetland management is poorly addressed in Ethiopia mainly due to the little or no awareness of the status, threats or values of wetlands, or even the need for their conservation and sustainable utilization (Mengistu 2003; Shewit et al., 2017). Lack of awareness is also one of the main factors that result in wetland reduction in Ethiopia (Shewit et al., 2017). Hence, awareness raising and education is required to reveal the different values of wetlands for communities and different stakeholders. Awareness creation activity also helps to reduce the various threats facing the wetland resources (Babu and Teferi, 2015).

Empowering stakeholders involved in wetland resource conservation

Conducive conditions for wetland resource conservation are mainly achieved by enhancing the ability of the local communities to detect, measure, and reverse wetland based ecological changes (Lamsal et al., 2015). Empowering the wetland resource use groups, managers and policy makers facilitates the effective management of vital and vulnerable wetlands by addressing human induced threats to the wetland ecosystems. Enhancing cooperative work, promoting capacity building for stakeholders and providing training for communities in relation to proper land use system in and around wetlands ecosystems is highly required (Warra et al., 2013). Promoting the role of existing local institutions is also equally important for the sustainable wetland resource management. This is due to local conservation organizations which are more effective in conservation activities compared to those of outside designed and induced projects (Lamsal et al., 2015). When the existing local conservation institutions that manage wetlands are strengthened, they promote community role in various aspects (Jansen et al., 2007).

Promoting the participation of all relevant stakeholders

Wetlands need more attention, effort and commitment at

all levels, from grass roots to decision and policy makers, in order to minimize and reverse the threats and to bring a sustainable solution to the problem (Shewit et al., 2017). The key to wetland survival is engagement of local communities in their sustainable management, with accessible technical support from the scientific community particularly in baseline assessment of the resource, monitoring and rehabilitation where required (Jafari, 2009). The involvement of communities in planning and decision making including on ecotourism development and management is an essential part of successful conservation and wise use at wetland sites (Ramsar, UNWTO, 2012). Thus, it is vital for the management bodies to enhance the active participation of stakeholders in the restoration and conservation of the wetlands and the related adjacent landscapes (Bintoora et al., 2015).

Promoting scientific studies on wetlands of the country

To ensure the sustainability of wetland environment in Ethiopia, promoting studies on the identification of wetlands, assessing their economic and ecological values as well as developing ecological indicator systems that support surface water managers are crucial to analyze the status of wetlands and watercourses and to select critical restoration actions (Derse et al., 2015; Tulu and Desta, 2015). Undertaking a comprehensive wetland study is necessary to have a complete information or database of the different wetlands and their values and identify the impact of human induced threats such as agriculture and urbanization on Ethiopia's wetlands (Karlsson, 2015; Tulu and Desta, 2015). When the knowledge of wetlands and the associated threats prevails, it helps to promote collaborative work on threats such as eutrophication which leads to the colonization (homogenization) of the habitat by single species, which are usually invasive (Enserink, 1999).

Addressing policy, management and coordination issues that arise on wetland conservation

In Ethiopia, the management of wetlands is impaired by the general public and decision makers (Teferi et al., 2010). Problems associated with management and policy issues are among the main factors for the ineffective management of wetland resources in the country. The efficient conservation of these wetland resources requires the integrated policy of water, forestry and land-use, involving indigenous knowledge of wetland conservation (Michael, 2012). Ratification of the international wetland agreements is also crucial as it enables to gain technical support and development assistance from international groups in relation to sustainable wetland resource

utilization in Ethiopia (Michael, 2012).

Undertaking the restoration of degraded wetlands and watersheds

Strategies and projects to restore the degraded wetlands and watersheds should be developed and carried out in the country. In addition, making adequate study on the overall aspects of wetlands and on their surrounding ecosystems is crucial for successful implantation of the programs (Gebretsadik and Mereke, 2017).

CONCLUSION

The wetland resources of Ethiopia have a great potential for ecotourism development and biodiversity conservation. However, the threats resulting from social, economic, climatic and development related factors affect wetlands and their ecotourism and biodiversity values. To address the threats and enhance the role of wetlands in ecotourism and biodiversity, a sustainable form of wetland resource use is required. One of such mechanism for sustainable use of wetlands is integrating wetland resources with ecotourism and developing them as an alternative livelihood option for communities. Similarly, awareness creation on the importance, threats and conservation values of wetlands, empowering stakeholders particularly existing local institutions involved in wetland resource conservation, enhancing the participation of all stakeholders, undertaking the restoration of degraded wetlands and promoting scientific studies on wetland resources are compulsory for sustainable existence of wetlands and promoting their benefit in ecotourism and biodiversity conservation in Ethiopia. In addition, implementing the integrated wetland resource management approach and addressing the policy, management and coordination issues related to wetlands enhance the ecotourism and biodiversity importance of wetlands in the country.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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