

# “Reversing the Degradation of Ethiopian Wetlands”: Is it Unachievable Phrase or A Call to Effective Action?



Mekonnen Giweta\* and Yared Worku

Ecosystem Research Directorate, Ethiopia Environment and Forest Research Institute, Central Ethiopia Environment and Forest Research Center, Addis Ababa, Ethiopia

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\*Corresponding author: Mekonnen Giweta, Ecosystem Research Directorate, Research Institute, Central Ethiopia, Addis Ababa, Ethiopia, Email: workuyared2@gmail.com

## Abstract

Ethiopia is endowed with different types of wetlands, which have several ecosystem services. However, the social, economical and ecological benefits of these wetlands are not utilized properly and sustainably, as of their potential, due to several anthropogenic and natural factors. This review showed that the wetland degradation is growing at alarming rate in many parts of wetlands, and if this trend continues without any mitigation measures, the wetland ecosystems will lose their function, biodiversity and restoration potential. In spite of these facts, this study strongly suggests that it is possible to reverse the degradation of Ethiopian wetlands by adopting sustainable wetland management, which is based on socio-ecological approach. Accordingly, it is very important to harmonize intersectional plan among relevant institutions, strengthen the capacity of institutions, conduct an intensive awareness creation and problem solving researches, find an alternative livelihood options to the local community, and involve all relevant stakeholders and respective decision makers in wetland management practices..

**Keywords:** Ecosystem Services; Ethiopia; Reversing Wetland Degradation; Social Economical and Ecological benefits

## Introduction

Although there are more than 50 definitions, which have been given to wetlands by different stakeholders at different times [1], this article uses the one agreed by the Ramsar Convention [2], and this broad definition accommodate the major types of wetlands that are found in Ethiopia. Therefore, as of Ramsar Convention definition [3], Wetlands are: “Areas of peat land, fen, marches, or water whether temporary, permanent, artificial or natural, with water that is flowing or static, salt, brackish, fresh or marine water, which does not exceed six meters at low tide. Further to this, in Ethiopian context, floodplains, irrigation fields, valley bottoms, lake fringes, shallow vegetated areas, mountain seepages, plantations and irrigation fields areas are categorized under ‘wetlands’ [4]. Wetlands are recognized as a “hotspot” for biodiversity and are distributed all over the globe, including Ethiopia, and a great number of people are depending on wetlands for their livelihood [5]. Moreover, countless species of animals and plants are depending on wetlands ecosystems for their survival [6]. At global scale, Ethiopia is one of the most affected countries due to land degradation, drought and ecosystems encroachments (natural forest and wetland) [7]. Unsustainable development practices and climate change also put Ethiopian wetlands at risk and leading them to be fragile and vulnerable ecosystems [8]. In Ethiopia, wetlands have a social, economical and ecological importance, however, due to the increasing human population size, poverty, and dependency on wetland resources,

the degradation and loss of wetlands and their biodiversity is growing at alarming rate [9,10]. Moreover, land-based sources of pollution and over-exploitation of wetland resources should be considered as significant problems, which require attention and serious action [11,12]. Thus, in order to halt the degradation of wetlands, which are found in Ethiopia, urgent action is needed, and all concerned stakeholders should react seriously [13].

In order to track the ecological changes of the wetlands as well as to make a sound decision on wetland management and protection, up-to-date information is required on the current status and trends of wetland degradation [14,15]. Therefore, the main purpose of this review is to outline the major threats of Ethiopian wetlands and highlights the alternative management and protection options, which could enable to reverse the growing degradation of the Ethiopian wetlands. The findings of the review would help policy makers, researchers, and executing institutions at various levels in order to find an alternative option for the rehabilitation and conservation of the degraded wetlands, and to protect, manage and wisely use the wetland resources.

## Wetlands Diversity and Distribution in Ethiopia

According to [16], Ethiopia’s surface area is estimated to be 1, 127,000 km<sup>2</sup>, of which 7444 km<sup>2</sup> is covered by water. The wetland resources in Ethiopia are not fully documented, however, it is estimated that the country owns more than 58 different types of

wetlands [17,18], which is estimated to be 18,587 km<sup>2</sup> (1.5-2%) of the total land mass of the country [18]. Ethiopia is endowed with different kind of wetland resources, which are distributed almost in all ecological zones across the country such as swamps, fringes, marches, rivers, lakes, flooded areas, reservoirs, seasonal plains, and valley bottom wetlands [19,20]. Furthermore, in the flood plains of Wabe-Shebelle, Dawa, Awash, Gibe, Baro and Abay, reverine types of wetlands are very common [21]. The presence of different types of wetlands in the country is due to the country's wide range of variability in topography, which is from 126m below sea level up to 4620 m above sea level [22]. The other major reason for the temporal and spatial variability for the availability of water in general, and wetlands in particular, is the very high variability exhibited by the climate components and wide variety of land forms of the country over time and space. Overall, Ethiopia has 12 river basins [23], which includes Danakil basins, Awash, Baro -Akobo, Wabe Shebele, Abay, Ghenale-Dawa, Tekeze, Omo-Ghibe, Ogadenbasin, Ayisha basin, and Rift Valley Lakes.

### Importance of Wetlands in Ethiopia

Wetlands have contributed a lot in the development of Ethiopia [24]. It is quite common to observe the high concentration of population settlements in and around the wetlands of the country (for example, in cities such as Bahirdar, Hawassa, Rift valley areas, Arba Minch). There are also many development projects, which aimed on using the water and land resources sustainably, and there by improve the livelihood of the people through various activities such as fishing, hand craft making, livestock raring, collecting wood fuel wood for domestic purpose, agriculture, forestry, tourism, and as a mechanism for adapting droughts [25,26] i.e., during the dry season, nomadic farmers use wetlands for livestock grazing and watering purpose. In areas, where there are irrigation and dam projects, the local communities are benefiting from the project as a source of income, and this in turn improved the livelihood of the people [27,28]. Further to their economic importance, Ethiopian wetlands are historical, cultural and ritual importance [29,30]. Wetlands of Ethiopia have also a great biological significance in terms of harboring huge amount of biodiversity, particularly endemic, globally endangered and vulnerable bird species. For example, Geferesa Reservoir, wetlands in Awi Zone, Lake Tana, Fincha and Chomen Swamp, Sulultal Plain and Guassa (Menz) are important areas for endemic bird species of Ethiopia. Furthermore, because these wetlands support several biodiversity resources, a large number of societies are depending on these wetlands for their livelihood [31]. The major ecosystem services, which are derived from wetlands includes: provisioning (food, freshwater, fiber and fuel, biochemical, animal feed, medicinal plants, genetic material, income and house construction material, and transportation), regulating (climate regulation, water regulation, water purification, retention of sediments and pollutants, flood and erosion regulation, natural hazard regulation and habitat for pollinators), cultural (spiritual and inspirational, recreational, aesthetic and educational) and supporting (soil formation, nutrient cycling, and carbon sequestration server as migratory routs for animals and habitat for flora and fauna)

[32,33]. Therefore, it is very important to underline the need to conserve and recover their integrity in order to use them sustainably both at national and global levels.

### Wetland Situations and Trends in Ethiopia

In many parts of Ethiopian rural areas, especially at community level; some people are still looking wetlands as a wasteland rather than as a useful resource [34]. Furthermore, although wetlands are the most productive ecosystem in Ethiopia [35], currently they are highly endangered. Because of the unwise use of the natural resources in the wetlands, and low attention and perception towards the management and protection of wetlands, the ecological condition of the Ethiopian wetlands are deteriorating over time [36]. Moreover, although wetlands play a major role in the livelihood of many people in Ethiopia through providing socioeconomic benefits and environmental services, these natural resources are under a growing and severe threats and becoming an environmental disaster [37]. The severe degradation of Ethiopian wetlands are discussed by many authors [38-40]. However, relative to the severe degradation of wetlands, efforts to reverse the degradation of wetlands is almost negligible [41], or are carried out in uncoordinated way [42,43]. For example, in the past, the rift valley areas of Ethiopia were favoring to sustain the population growth and economic development due to its agro-climate and land productivity. However, in the past few decades, due to population growth, urbanization, infrastructure development and new investments, much of the lands, which were formerly used for livestock and agriculture, are taken away and the development is reaching at a climax level of the lands' carrying capacity in terms of competing land uses for the above mentioned purposes [44]. Ecosystems (wetlands and natural forests) are facing loss of natural habitats due to environmental pollution, decrease in agricultural productivity, and generating excessive resource demands (land, water, forests for different purpose, grazing areas etc.) [45]. Furthermore, in order to obtain high productivity from the lands around wetlands, including some protected areas (for example, national parks), significant pressure is excreted on the ecosystem health, biophysical cycles, and ecosystem services provision. In spite of these facts and the existing historic tendencies, it has been very difficult in Ethiopia to protect the wetland ecosystems. Therefore, it is an urgent need protect and safeguard the biodiversity and maintain healthy wetland ecosystem in order to recover their ability to perform their ecological functions, which could provide good and services that are important to human being [46].

### Major Drivers for the Growing Degradation of Ethiopian Wetlands

The causes for the growing degradation of wetlands in Ethiopia are many and multidimensional, and include both the anthropogenic and natural factors, though the anthropogenic factors are the dominant ones [47]. The major causes for wetland degradation are the following:

- a) **Population Pressure and Over Exploitation of Wetland Resources:** Population growth rate remains high in

Ethiopia, and a large number of people are living in poverty and are depending on wetland resources for their subsistence livelihoods [48]. Population growth and the concomitant demand for additional arable land are the main drivers of human encroachment into the wetlands of Ethiopia [49]. Because of small land holding, land degradation, low soil fertility, low farm productivity, low income, lack of other livelihood options and high population pressure, particularly in most highlands of Ethiopia, communities living around the wetland put lots of pressure on wetland resources [50]. Furthermore, in Ethiopia, the natural and artificial forests, which are very important biologically, are overused and abused by the local people for the purpose of timber and fire wood [51]. Unregulated use of waters for irrigation, domestic purposes, and over grazing also contributes to the alarming degradation of wetlands in many parts of the country [52]. Because there is no fair allocation of waters among different users, no penalties for wastage of water, no regulations and payment for water usage, and absence of organized water users associations, the water use efficiency in most wetlands of the country is very low, and the wetland ecosystems are used unsustainably [53,54]. Wetland resources such as salt and minerals, fishes, macrophytes, riparian vegetations, and other biodiversities are depleting, and the major causes for these problems are the unregulated use and increased demand of these resources, poverty of the society, population pressure and urban expansion [55,56]. In line with this, [57] concluded that in many parts of the world, societies are trying to increase their income and improve their livelihood at the expense of wetlands survival. It is quite common to observe when the conversion of wetlands to another land use usually results in adverse ecological impacts, salinization, habitat degradation, destruction of traditional production system, displacement of population, and water depletion [58]. Because of the disruption of natural processes by urbanization, agricultural intensification, dam construction, pollution, water transfer, and other forms of interventions in the hydrological and ecological systems, many wetlands have been lost in Ethiopia [59,60]. The modernization of agriculture and the expansion of capital-intensive agriculture such as flowers production in greenhouse and fruit production are increasing demands of water for irrigation, which in turn has a negative impact on wetlands water resources [61]. For example, river catchments have been drained and converted to agricultural land through land use change to hydrophilic plants or drainage [62], and this is one the major reasons for the rapid degradation and loss of wetlands than that of other ecosystems. As Abebe and Geheb (2003) indicated lake Chamo, Shalla, Abaya, Abijata, Ziway and Tana are among the lakes, which are severely threatened due to water abstraction for either industrial or agricultural purposes.

b) **Industrialization, Urbanization and Environmental Pollution:** Pollutions, which are emanating from the point and non point sources, are contributing to the degradation of wetlands; particularly fishes, macrophytes, riparian

vegetations, and other biodiversities that are found in these ecosystems are suffering from these pollutions. The point sources includes: hotels and hospitals effluents, garages, farms, which uses huge amount of pesticides, (for example, flower farms), and manufacturing industries (for example, textile, leather etc...) and, the non-point sources include: domestic wastes (solid and liquid wastes) and agricultural fields (for examples, pesticides and fertilizers). All these wastes, which emanates from the above mentioned sources affects negatively some of the wetlands in Ethiopia, which includes Ziway, Abiyatta-Shalla, Hawassa, Tana, Fogera and Haik lakes and wetlands in the Awash River basin due to eutrophication.

c) **Poor Watershed Management:** The hydrological balance of the wetlands can be kept for long-term through proper management of watershed; however, due to lack of wellplanned watershed management, a number of Ethiopian wetlands are shrinking or swelling over time. In line with this had shown that the rivers flows could be affected due to severe wetland degradation. Since the majority of lakes, rivers and other wetland ecosystems lack a buffer zone demarcation; these ecosystems are losing their ecological benefit over time due to eutrophication and sediments loading. Furthermore, in most wetlands of Ethiopia, due to lack of proper watershed managements, it is quite common to observe when the upstream users divert or excessively use the water and abuse the right of the downstream users, and this ultimately lead to the over exploitation or unwise use of the water resources within the watershed. Excessive drainage of wetlands for agriculture purpose, ground water abstraction, over grazing, deforestation in the uplands and intensive agriculture in the lowlands and surface runoff are also the major causes for the decrease in water table in majority of wetlands that are found in the country. In this context, had shown evidence that loss of wetlands had been occurred due to abstractions of water for irrigation purpose.

d) **Weak Local Institutions Set Up and Capacity for Management:** Although the local institutions play a vital role in regulating wetland use, the local institutions set up in Ethiopia are fragmented, and are unable to function effectively without the support of other stakeholders such as governmental and non-governmental (NGOs) institutions [60]. The decision makers at all level of management (from the grass root level up to the higher decision making body at different regions of the country) are not well informed on the importance of management of wetlands [21]. Lack of innovative researches, lack of skilled manpower and finance, and lack of wetland management training programs in higher learning institutions are also some of the major limitations for effective and efficient wetland management and protection [21].

e) **Limited and/or No Coordination of National Institutions for the Sustainable Management of Wetlands:** In Ethiopia, various institutions, which their mandate is

linked in one way or another with wetland management, are acting in uncoordinated, dispersed and inefficient manner either because of lack coordination among institutions and/or lack of institutional capacities to implement the existing regulations [60,21]. Furthermore, despite the fact that sustainable management of wetland requires continuous stakeholder discussions and bio-physical and ecosystems monitoring, none of them are done properly on regular basis [21,47].

**f) Poor Knowledge and Lack of Awareness About Wetlands:** Information and knowledge are important for drawing up policies and decision making, which ensures sustainable wetland management; however, there are enormous gaps in this aspect [60]. Because majority of the societies are not well informed on the socio-economic benefits and ecosystem services of the wetlands [5], wetlands are considered as waste lands [31]. As of our knowledge, there is no Directory of Ethiopian Wetlands, which could serve nationally. i.e., in Ethiopia, the wetland resources are not fully documented [47]. Although there are many researches, which are carried out by various institutions within the country, the researches output are not transferred to the society properly. i.e., let alone to the larger society, the agricultural officers and development agents at various levels of administrations are not well aware of the importance of the conservation and management of the wetlands.

**g) Lack of Wetland Management Plan:** In order to benefit from multiple ecosystem services and properly manage them, national wetland management plan is crucial. However, in Ethiopia, except Berga flood plain and Abijata-Shalla Lakes National Park, most of the wetlands do not have management plan, which ensures sustainable management of wetlands [8,34]. Furthermore, there is a weak inter-sectorial coordination, which could promote wetland resources management. In order to avoid any conflicts on the use of wetland resources, which originate from the lack of protection and conservation of wetland resource, wetlands should be managed with proper management plan. Moreover,

identification and prioritization of the wetlands, which need urgent conservation, is not done, and this is one of the main challenges for wetlands conservation and management [21]. The detail inventory of the wetlands within the country is not done properly, and this resulted in lack of wellorganized wetland database, which could serves nationally for different purposes [21].

**h) Climate Change Scenarios:** According to [31] the change of hydrological cycle, temperature increase, and a sea level rise might contributed a lot to the wetlands degradation in many parts of the world. Similarly, some of the wetlands in Ethiopia are affected by natural hazards such as drought, over flooding and seismic events. As climate change increases, wetlands will suffer from different directions [60]. Some major phenomenal, which put pressure on wetlands include [60]: (a) when rainfall decreases, it will result in the decline and shrink of the size of wetlands, (b) Extraction of water due to the expansion of agriculture may lead to the growing degradation of wetlands, and (c) An intensive rainfall will result in severe erosion, which in turn increases sediment deposition in wetlands, and ultimately bury the fertile soils of wetlands.

**Major Threats and Barriers to Effective Wetlands Conservation and Management in Ethiopia:** Adequate understanding of the long-term trends underlying natural resource management, particularly the land and water management, in various landscape of the country, is very important for effective conservation of wetlands [59,7]. Furthermore, opportunities, which are found across different regions of the country, is crucial for the conservation as well as sustainable use of the wetlands, including their biodiversity. On the contrary, continued expansion of agriculture, livestock grazing, extensive urbanization and industrialization, could be a threat to wetlands, if they are not done in a planned way. The major threats to wetlands in Ethiopia are the direct result of the surrounding communities that live and use the wetlands including their biodiversity and by other social, economic and political factors, which are summarized in Tables 1-5 below.

**Table 1:** Major Types of Wetlands in Ethiopia [18].

Type of Wetland	Area (Km <sup>2</sup> )	Percent
Marshlands	2330	12.5
Saline lakes	1770	9.5
Freshwater lakes	5767	31
Seasonally Inundated	8720	47
Total	18587	100

**Table 2:** Examples of the major benefits the Ethiopian wetlands' biodiversity and productivity to the local community.

Local Area	Biodiversity	Benefit	Reference
Lake Ziway	Fish	a) Food b) Source of income, employment	[22,4,14]

	Open water	a) Fishing b) Transport c) Irrigation d) Domestic use	[10]
	Grasslands	a) Livestock grazing	[10]
Lake Hawassa catchment	Rangeland	a) Livestock Grazing	[43]
	Open water	a) Fishing b) Transport c) Irrigation d) Domestic use	[43]
	Migratory Birds	a) Eco-tourism b) Recreation	[14]
	Sub-merged and floating flora	a) Reed boats b) Thatching	[14,43]
Lake Tana	Reeds plants of Papyrus and Typha	a) Baskets, b) Mats c) Reed boats d) Thatching	[59,14]
	Chat ( <i>Catha edulis</i> ), fruits and vegetable farming	a) Cash crop (source of income and employment)	[59]
	Wood	a) Fuel b) Building material for roofs, walls and fences	[14,59]

**Table 3:** Ecological Functions (Services), Products and Attribute of Wetlands with Examples.

Ecosystem Services	Ecosystem Function	Examples with Reference
<b>Provisioning</b>		
Food, feed, fiber and fuel wood (4Fs), other products, fresh water, bio- energy, biochemical, ornamental, and extraction of medicines.	a) Retention and storage of water for various purpose (domestic as well as agricultural). b) Physical support for plant growth.	a) Production of fish, fruits, crop, wool, timber [60]. b) Flowers production for ornament [25]. c) Reeds are harvested from wetlands [60].
Genetic resources	a) Diversity of plant genotypes. b) Resistance to plant pathogens.	a) Wetland forests are a good source of diversity (species, genetics), which in turn have a positive relationship with ecosystem resilience [55,46].
<b>Supporting</b>		
Nutrient cycling	a) Storage, processing and recycling of nutrients.	a) Both natural and constructed wetlands play a vital role in nutrient cycling on the landscape [12,17,38].
Soil formation	a) It is important as landforms, plants, animals, rivers and rocks. b) It influences the distribution of plant species. c) provides a habitat for a wide range of organisms.	a) Different abiotic and biotic factors, and the interaction within them will form the hydric soil in the wetlands [35,38].

Habitat for diverse plant and animal species.	<ul style="list-style-type: none"> <li>a) Plant growth.</li> <li>b) Enhance soil biodiversity.</li> </ul>	<ul style="list-style-type: none"> <li>a) Wetlands play a key role in improving the health of the ecosystem by supporting the fauna and flora [38].</li> </ul>
<b>Regulating</b>		
Climate regulation	<ul style="list-style-type: none"> <li>a) Temperature and precipitation regulation.</li> <li>b) Carbon sequestration.</li> <li>c) Controlling the balance of atmospheric gases.</li> </ul>	<ul style="list-style-type: none"> <li>a) Precipitation and local temperature can be affected by land cover/land use change [12,38].</li> <li>b) Greenhouse gases such as CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> are affected by ecosystem function [29,38].</li> </ul>
Water regulation	<ul style="list-style-type: none"> <li>a) Flood control</li> <li>b) Water purification</li> <li>c) Recharge of groundwater</li> </ul>	<ul style="list-style-type: none"> <li>a) Water movement in the landscape is retarded by the wetlands, which in turn helps to improve the water quality and mitigate flooding [37,38].</li> <li>b) Wetlands are very useful for wastewater treatment [19].</li> <li>c) Wetlands play key roles in addressing water security and food security [20].</li> </ul>
Erosion regulation	<ul style="list-style-type: none"> <li>a) Sediment and soil retention on slopes.</li> <li>b) Coverage of soil surfaces.</li> </ul>	<ul style="list-style-type: none"> <li>a) Wetlands play a great role in erosion control through stabilizing sediments and soil retention [16,58].</li> </ul>
Natural hazard (flood regulation)	<ul style="list-style-type: none"> <li>a) Evaporation of water infiltration by soil.</li> <li>b) Interception of rainfall.</li> </ul>	<ul style="list-style-type: none"> <li>a) Wetlands are vital for mitigating river flooding [58,25,6].</li> </ul>
Cultural	<ul style="list-style-type: none"> <li>a) landscape (scenery).</li> <li>b) Symbolic species.</li> </ul>	<ul style="list-style-type: none"> <li>a) Wetlands create recreational open spaces such as hiking, fishing, boating, and bird-watching [61].</li> <li>b) Wetlands have spiritual benefits [12].</li> <li>c) Wetlands provide cultural ecosystem services such as mental, emotional and physical, and are intuitive in nature [61].</li> </ul>

**Table 4:** Some of the Major Exemplary Degraded Wetland in Ethiopia.

Wetland	Cause of Degradation	Situation of the Wetland
Choke mountain catchment	<ul style="list-style-type: none"> <li>a) Over exploitation of the land and water resources for agriculture and livestock grazing [49,50].</li> <li>b) Traditional agricultural practices with less attention for conservation of the natural resources (soil, vegetation and water biodiversity).</li> <li>c) Deforestation, water logging, soil acidity, limited access to life improving technology, limer capacity to cope up natural disasters [49,50].</li> </ul>	<ul style="list-style-type: none"> <li>a) Extremely degraded ecology, which results into poor ecological functions, and ecosystem services [49,50].</li> </ul> <p>Poor livelihood of the community [49,50].</p>
Rift valley Lakes (Lake Ziway Watershed)	<ul style="list-style-type: none"> <li>a) Population pressure, an increase in the demand of water (for domestic, industry, livestock, as well as for irrigation purpose [10,26].</li> <li>b) Deforestation (wood for construction and fuel wood) [10,26].</li> <li>d) Climate change [10,26,53].</li> </ul>	<ul style="list-style-type: none"> <li>a) Fish resources (Nile- tilapia) are decreasing at alarming rate, quality of water chemistry is deteriorating [22].</li> <li>b) The lake is shrinking due to water abstraction and sediments loading [9,53].</li> </ul>
Lake Alemaya (Eastern Part of Ethiopia)	<ul style="list-style-type: none"> <li>a) Climate change, population growth, and an increase in the demand of water for municipal, domestic, livestock, as well as for irrigation purpose.</li> </ul>	<ul style="list-style-type: none"> <li>a) The lake has already disappeared and changed to terrestrial environment [11].</li> </ul>

Awash River Basin	<ul style="list-style-type: none"> <li>a) Population increase, drainage of water for agricultural purpose, and livestock increase (over grazing) [52].</li> <li>b) Expansion of development programs (e.g., sugar plantation, commercial cotton plantation) [3].</li> <li>c) Deforestation and sedimentation [52].</li> </ul>	<ul style="list-style-type: none"> <li>a) Shrinkage of available water and land resources due to competition [3,42,52].</li> <li>b) Desertification has already started at lower Awash Basin [52].</li> <li>c) Salinity and wetland degradation [52].</li> </ul>
Lake Tana	<ul style="list-style-type: none"> <li>a) Invasion of alien species (water hyacinth) [59].</li> <li>b) Conversion of wetlands to farming and abstraction of water for small scale irrigation [59].</li> <li>c) Lake siltation due to deforestation, change in agricultural practices, dam construction, illegal fishing gear, and water hyacinth infestation.</li> </ul>	<ul style="list-style-type: none"> <li>a) Alteration of biological community composition [59].</li> <li>b) Impaired plant species diversity and invasive alien species dominated the ecological and economic importance of the native species [59].</li> <li>c) Decline of the fish community, carrying capacity for fish harvest, primary productivity, fisheries, and fish-food organisms [59].</li> </ul>
Koga catchment	<ul style="list-style-type: none"> <li>a) Over exploitation of the land and water resources for agriculture, livestock grazing, and fuel wood [61,58].</li> <li>b) Land use/land cover change due to population pressure and land use policies [61,58].</li> <li>c) High erosion due to intensive agricultural practices in sloppy areas [61,58].</li> </ul>	<ul style="list-style-type: none"> <li>a) The ecological condition of the catchment is very poor, with degraded natural resources such as woody vegetation and soil [61,48].</li> <li>b) Koga rive is loaded with silt and mud [61,58].</li> </ul>
Lake Hawassa	<ul style="list-style-type: none"> <li>a) Over exploitation of resources such as fish, water, riparian plants and other vegetation [1].</li> </ul>	<ul style="list-style-type: none"> <li>a) Poor water quality due to point and non-point sources pollution [1].</li> </ul>
Lake Basaka	<ul style="list-style-type: none"> <li>a) Excess rainfall/irrigation from the nearby farms.</li> <li>b) Active tectonic activities in the rift valleys.</li> </ul>	<ul style="list-style-type: none"> <li>a) Expansion of the lake.</li> <li>b) Salinity of the lake.</li> <li>c) Soil salinization.</li> <li>d) Ground water dynamics disturbance.</li> </ul>

**Table 5:** Summary of the Existing Major Threats and their Effects on Ethiopian Wetlands.

Existing Major Threats	Effects on Wetland Management
Population pressure, rapid urbanization and industrialization	<ul style="list-style-type: none"> <li>a) Increased damage of the fragile ecosystem because of limited opportunities currently available for rural communities to switch towards more communities-friendly activities (for example, non-farming income-generating activities that may lower the pressure on the wetlands).</li> <li>b) Possible environmental, economical and social impact of industrialization and urban development (for example, abstracting lakes for irrigation, urban and rural households' consumption etc.).</li> </ul>
Over exploitation of resources and unsustainable land-use practices	<ul style="list-style-type: none"> <li>a) Wetland biodiversity are depleting at alarming rate because of unwise of land use, particularity in agriculture and livestock practices.</li> <li>b) Increasing water demand by numerous stakeholders.</li> </ul>
Inadequate intersectional planning among relevant institutions	<ul style="list-style-type: none"> <li>a) Weak or absent coordination among institutes for the management of wetland resources and the conservation of biodiversity related to wetlands.</li> <li>b) Wetlands are not protected, conserved, managed and utilized in an organized and coordinated way.</li> <li>c) Inability to quantify the environmental goods and services provided by the wetlands to society.</li> </ul>
Agricultural intensification, and extension of illegal agriculture	<ul style="list-style-type: none"> <li>a) Increment of pollution (solid and waste), and eutrophication in wetland ecosystem.</li> </ul>
Lack of incentives	<ul style="list-style-type: none"> <li>a) Difficult to protect, conserve, manage and utilize wetlands and their biodiversity sustainably by considering the social and cultural aspects of the communities, who live in the nearby wetlands.</li> </ul>
Climate Change	<ul style="list-style-type: none"> <li>a) As results of displacement of vegetation belts due to global warming, the wetlands habitats are degraded over time.</li> </ul>

Lack of public awareness, knowledge and capacity about the conservation and economic value of the wetlands.	<ul style="list-style-type: none"> <li>a) Unwise use and abuse of the wetlands, including their biodiversity, particularly due to underestimation and underutilization of traditional knowledge and practices that are based on a comprehensive view of conservation and use of wetland resources.</li> <li>b) Limited capacity and expertise at community, institutional and individual level to conserve and manage wetlands.</li> </ul>
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### Conclusion

Ethiopia is gifted with a significant number of wetlands, which could contribute to the social, economical and ecological development of the country. However, large shares of these wetlands are under threat due to an immense pressure from anthropogenic as well as natural factors, though the anthropogenic factors contribute a lot. Unless strategic actions are put in place for the conservation of wetlands, the degradation will continue, as the population growth rate is also expected to grow. This paper aimed at considering the big picture of wetland resource management in Ethiopia by outlining the main causes and effects of wetland degradation, and possible solutions to reverse the growing wetland degradation in Ethiopia. A qualitative research was employed by reviewing some credible web pages and research papers. The aforementioned challenges/causes of wetland degradation can be addressed by considering the suggested recommendations, particularly through increasing the awareness on the social, economical and ecological importance of wetlands, involving relevant stakeholders, enriching the traditional knowledge of the local community with scientific knowledge, adapting principles of sustainable wetland management for mitigating of climate change and restoring the degraded ecosystem functions, investing on wetland restoration programs/projects, and protecting illegal use, conservation and protection of wetland resources. Therefore, further to the existing wetland management strategy, considering the suggested recommendations into account and implemented, the wetland degradation rate would be reduced a lot more and wetland resources protected, conserved and kept in a good condition for the future generation to come.

### Recommendations

The causes and effects of the wetland degradation in Ethiopia are multifaceted and complex, however, little attention is given to address the issues and tackle the root causes of the problems [21]. Therefore, based on the detail review of the available literatures, the following suggestions are forwarded in order to mitigate the growing degradation of Ethiopian wetlands.

a) In Ethiopia, there are plenty of traditional knowledge and practices, which could contribute to the conservation and sustainable use of wetland resources (for example, the soil and water conservation practices around Konso area, South Ethiopia). Therefore, this indigenous knowledge should be enriched with scientific knowledge through active participation of the local communities. Furthermore, the traditional knowledge and skills that are presently practiced by some specific local communities should be acknowledged and incorporated to the research and development agenda of the country.

b) It is very important to provide a better access to information regarding the wetland ecosystems and the service they provide to all decision makers at various levels (for example at districts, zonal, regional and federal levels) so that they will pay attention to wetlands conservation, protection and restoration of degraded wetlands. Furthermore, it is highly recommended to involve these segments of the society (especially women, youth and elderly) in the wetland management of the country.

c) It is vital that the research institutes and higher academic institutions should generate technologies and relevant information which can help to restore degraded wetlands and manage them sustainably. For example, some of the key points, which are crucial and needed to be considered are: conservation status of the flora and fauna around wetlands, detail inventory of wetlands, classification and map of wetlands, map of the land degradation, the ecosystem services at landscape or watershed level, land use arrangements (economical or environmental), valuation of ecosystem services, and the livelihood, market and value chain of products, which emanates from wetlands landscape. Furthermore, despite the fact that Ethiopia has significant areas of wetlands, researches regarding wetlands conservation and management, are at infant stages. Some universities within the country (for example, Bahir Dar University) are offering a program on wetland management; however, more wetland management related programs are necessary. Furthermore, more researches on the impact of anthropogenic and natural factors on wetland ecosystems are required

d) Because wetlands are protected, conserved, managed and used in unorganized way, it is very important to harmonize the intersectional plans among the institutes that are relevant to wetlands management (for example, Ministry of Water, Electric and Irrigation, Ministry of Environment, Forest and Climate Change, Ministry of Agriculture and Livestock Resource, and other water basin authorities). Furthermore, the goods and services, which are provided by the Ethiopian wetlands, should be monitored regularly using a standard protocol.

e) Local communities should involve in an alternative livelihood options in order to increase their incomes and thereby lower the pressure on wetland resources. The income and livelihood of smallholders living around wetlands should be strengthened, diversified and more resilient. i.e., local communities should get access to financial services and build their capacity in order to diversify their income-generating activities. For example, involving in non-farming activities



(such as rural agro- industries, apiculture, handicraft, and ecotourism) and farming activities.

f) It is very important to strengthen the capacity of institution for acquiring funding for projects that include wetland ecosystem services into considerations and incentives for local communities to apply sustainable wetland management practices efficiently. Furthermore, for adaptation of climate change, relevant institutions should be strengthened to facilitate an appropriate planning for the implementation of wetland conservation and restoration interventions. Therefore, an extensive capacity building is required for non-governmental organizations (NGOs), community-based organizations (CBOs), local communities, private sectors, national and local authorities. In addition, local communities should have access to markets for their products under sustainable wetland management, which is compatible to the environment. Furthermore, it is necessary to motivate the local communities to utilize resources in a way that increase the wetlands productivity and at the same time conserve the wetland's biodiversity.

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