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Wetland Conservation and Management Practices in Ethiopia: A Review

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Abstract
This paper reviews Ethiopia's experience and research progress in past Wetland Conservation and Management Practices and suggests possible solutions for improvement. In Ethiopia, wetlands have a social, economic 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. The influence of human activities on the landscape has traditionally been deleterious, but this trend seems to have recently reversed in some parts of the country following the engagement of the communities in land management. The efficiency of conservation and management of wetlands in Ethiopia show multi-sectoral interest that make it imperative to involve a number of sectors to coordinate their efforts to generate reliable data on the value and other attributes on wetlands; in general, restoration and creation of wetlands can help maintain the benefits of wetlands and their surrounding ecosystems and at the same time accommodate the human need for development.
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1. Introduction

Wetlands are basically areas where water is the primary factor controlling the environment and the associated plant and animal life. The extent of the world`s Wetlands is generally thought to range from 7 to 9 million Km^2 or about 4 to 6 % of the land surface of the earth (Mitsch and Gosselink, 2002). However, based on the Russian geographers, it is estimated that more than 6.4% of the land surface of the world, or 8.8% million Km2, is wetland, and almost 56% of this estimated total wetland area is found in tropical (2.6 million Km2) and subtropical (2.1 million Km2) regions. But, a more recent estimate of the world‟s wetlands by the U.S Department of Agriculture (USDA) cited in (Hayal Desta, 2006) states that 13.7% (18.8 million Km^2) of the earth`s surface is wetland. The Ramsar Convention was one of the first international treaties to have adopted the ecosystem approach, in particular recognizing the fundamental ecological functions of wetlands as regulators of water regimes (Pittock et al., 2006) as cited in (Rebelo et al., 2013).

At the global level, the International Union for the Conservation of Nature and Natural Resources, the Ramsar Convention, and Wetlands International have dealt extensively with different aspects of wetland protection (Junk *et al*., 2013)They occur where the water table is at or near the surface of the land, or where the land is covered by shallow water (Ramsar, 2004).Although there are more than 50 definitions, which have been given to wetlands by different stakeholders at different times, this article uses the one agreed by the Ramsar Convention (Abebe & Gebeyehu, 2003), and this broad definition accommodate the major types of wetlands that are found in Ethiopia.

In Africa, particularly in Ethiopia, conservation and sustainable use of aquatic resources are a big challenge (Karunamoorthi *et al*. 2009). At global scale, Ethiopia is one of the most affected countries due to land degradation, drought and ecosystems encroachments (natural forest and wetland) (Dejen, 2107). Unsustainable development practices and climate change also put Ethiopian wetlands at risk and leading them to be fragile and vulnerable ecosystems (Delelegn & Gereb, 2003). In Ethiopia, wetlands have a social, economic 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 (Desta, 2003). Moreover, land-based sources of pollution and over-exploitation of wetland resources should be considered as significant problems, which require attention and serious action (Daiz, 2006). 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 (Daixon & Wood, 2003).

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 (Daixon, 2008). 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. The objective of this paper is to review Wetland Conservation and Management in Ethiopian.

1.1. Distribution of Wetlands

According to Hillman (1993) there are about 73 major wetlands in Ethiopia with a total coverage of 13,699 km2. Furthermore, according to the FAO Land Use Map of Ethiopia, produced from air photos from the 1960s and 1970s, and early Landsat data, 0.74% of the country is made up of wetlands. However, this only includes permanent wetlands of the size which can be registered by such remote sensing sources. The report accompanying the map recognizes that the figure is nearer to 2% of its total area (22,500 Km^2) including shallow lakes, small wetlands, peat lands, swamp forests and seasonal wetlands not picked up by these sources (FAO 1984). Therefore, they were regarded as an obstacle to human development and this has led to large-scale drainage and conversion for alternative uses without regard to ecological and socio-economic values (Demissie & Addis, 2015).

Table 1: wetland distribution of Ethiopia

Regions	Total Coverage area(ha)	Wetland coverage (ha)	%wetlands
Gambella	3,203,280	247,556	7.73
Amhara	15,764,744	431,695	2.74
SNNPRS	11,064,200	152,900	1.38
Afar	9,526,567	131,000	1.38
Oromiya	35,961,996	397,853	1.11
Somali	29,151,596	250,612	0.86
Beneshangul Gumuz	5,033,592	22,466	0.45
Tigray	5,085,784	8,053	0.16
Total	**114,791,759**	**1,642,135**	**1.43**

Source: (Afework, 1998 cited in Woody Biomass, 2002 unpublished report)

1.2. Wetland Status in Ethiopia

According to (Cowardin *et.al*... 1979) cited in (Bacon, 1999), five major wetland system types are recognized: marine, estuarine, lacustrine, riverine and palustrine of the global total wetland area estimated, the greatest part is occupied by wetlands in freshwater environments

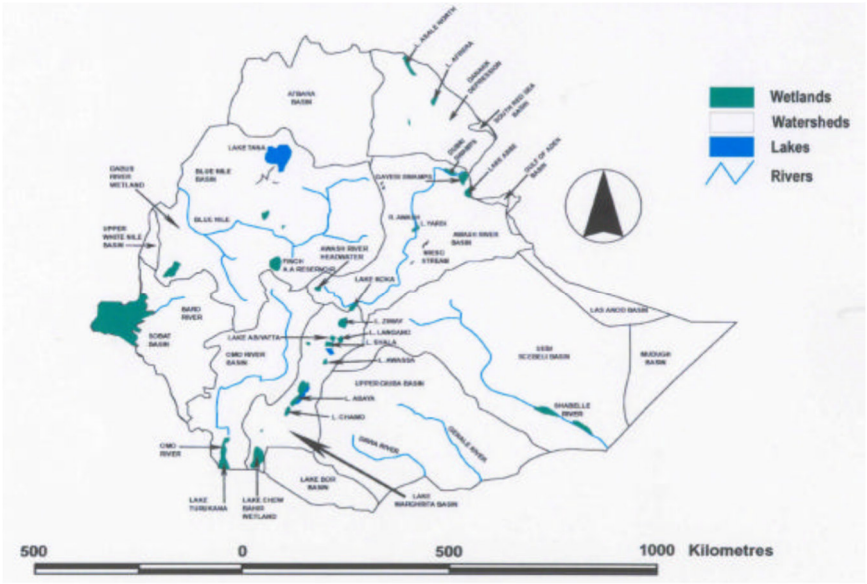
Table 2: Types and coverage of global wetlands

Wetland types Type	**Percentage (%)**
Marine	16.6 saline water
Estuarine	9.2 Brackish water
Lacustrine	23.8 Freshwater
Riverine	15.9 Freshwater
Palustrine	30.0 Freshwater
Artificial (man-made)	10.5 Freshwater

Source: Bacon, 1999

The wetlands of Ethiopia represent a significant environment in the country, estimated to cover around 1.5% of total land area (1.43% of it is within the Abay Basin) (Johnston and McCartney, 2010). Wetland communities are primarily interested in utilization of wetland resources while the management institutions at sub-county, district and national levels are more interested in conservation and the most important conflicts highlighted by the stakeholders were of two types: conflicts among the local resource users mainly about the use of land; and conflicts between the organizations interested in conservation of the wetland and the community (Namaalwa *etal*.2013).

Figure 1: Map of Ethiopia showing lakes, rivers and wetlands



1.3. Importance of Wetlands in Ethiopia

As Getachew (2004), the contributed in the development of Ethiopia 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 (Handstyle, 2005) 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 (Hillman J&Abebe, 1993). Further to their economic importance, Ethiopian wetlands are historical, cultural and ritual importance (Jorge, 2014). 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 Reservior, wetlands in Awi Zone, Lake Tana, Fincha and Chomen Swamp, Sululta Plain and Guassa (Menz) are important areas for endemic bird species of Ethiopia because these wetlands support several biodiversity resources, a large number of societies are depending on these wetlands for their livelihood (Junk, 2013).

The major ecosystem services, which are derived from wetlands includes: provisioning regulating cultural (spiritual and inspirational, recreational, aesthetic and educational) and supporting (Leykun, 2013). 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. Wetlands do not just do one thing to perform many processes simultaneously and therefore they provide a suite of values to humans (Demissie & Addis, 2015). Wetlands provide a habitat for many species of plants, animals and other organisms that depend on the reliable source of water and nutrients in the wetland to survive, and cannot live elsewhere. These are wetland dependent organisms, and are those most at risk if a wetland is threatened (Urbye, 2006). A wide range of wetland types are represented in the complex, such as red gum wetlands, lignum wetlands, cane grass wetlands, shallow freshwater marshes and freshwater meadows for habitats provide important feeding grounds and breeding sites for a large number of species (Farrington, 2014).

However, the values of wetlands became more and more recognized that wetlands have a far greater importance for ground water protection, regulation of the water cycle, water storage, water purification, and as an ecological basis for many forms of life, especially for fish (Demissie & Addis, 2015). They perform many processes simultaneously and therefore they provide a suite of values to humans when both the marketed and non-marketed economic benefits of wetlands are included, the total economic value of unconverted wetlands is often greater than that of converted wetlands (François *et al*., 2005).

Wetlands have their own positive impacts on the environment that serve to slow down storm flood, trap sediments, protect property damage in downstream, and the siltation of dams (Amsalu & Addisu, 2014).Wetlands contribute significantly to efforts aimed at poverty reduction and food self-sufficiency for Growing number of people in Ethiopia, in both rural and urban areas, depend on wetland resources for their survival of many peasant farmers in the western parts of the country make their living from wetlands (Amsalu & Addisu, 2014).

Throughout Ethiopia, past and present wetlands areas have been and still are important sites for livestock grazing specifically, wetlands are often a last destination for pastoralists during the dry season in most parts of the

country (Birhan *et al*., 2015). Moreover, the ecological potential of this wetland is that it serves as a habitat for a variety of plant, bird and mammal species and is a water source for human and livestock consumption (Mekonnen & Aticho, 2011).

1.4. Wetland Situations and Trends in Ethiopia

The extent of wetlands is not known for several major regions, e.g., South America, Africa and Russia, because detailed inventories do not exist, Small riparian wetlands along low order streams, as well as small depression or temporary wetlands, are often not considered, but may add up to large areas of example, in the Amazon basin, these areas may cover up to 1 million km2 (Junk et al., 2013). Areas with intensive agriculture around the world have often been created in river catchments by draining large wetland complexes and converting them to agricultural production (Hefting et al., 2013).

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 (Mengistu, 2008). Furthermore, although wetlands are the most productive ecosystem in Ethiopia 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 (Murdiyarso,2012). 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 (Neary, 2009).

The severe degradation of Ethiopian wetlands is discussed by many authors (Olumana, 2009). However, relative to the severe degradation of wetlands, efforts to reverse the degradation of wetlands is almost negligible (Parker,2013).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.) (Rasmer, 1997).

1.5. Major Drivers for the Growing Degradation Wetlands

Pressures on the World's freshwater resources are increasing rapidly due to rising populations and climate change, necessitating improved management of freshwater ecosystems if the many services they provide are to be sustained (Rebelo *et al*., 2013).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 the major causes for wetland degradation are the following(Seid, 2107). Although wetlands are one of the most productive ecosystems on earth, they are the most threatened by many factors including anthropogenic pressures such as unplanned urbanization, rapid population growth, indiscriminate industrial and development activities, and disposal of domestic and industrial toxic wastes into the aquatic ecosystem (Karunamoorthi *et al*. 2009).

1.5.1 Population Pressure and Over Exploitation of Wetland Resources

Population growth and the concomitant demand for additional arable land are the main drivers of human encroachment into the wetlands of Ethiopia (Simane, 2013). 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 (Tadesse, 2003).Wetland resources such as salt and minerals, fishes, macrophytes, riparian vegetations, and other biodiversity's 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 (Vigot, 2006).

In line with this, (Weisser, 2011) 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 (William, 2015). 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 (Wood, 2002).

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 (Yeshaneh, 2013). 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.

1.5.2. 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 (Wood ,2002). 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, 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 (Gashaw, 2014).

1.6 Wetlands Conservation Initiatives

Whilst there is a general consensus that the world's wetlands are under threat from development, there is some recognition that in the developing world many wetlands have been used in a sustainable manner for generations and the dependence of local communities on wetland functions and products for their subsistence is well documented yet little research has addressed the issue of indigenous wetland management. (Woodhouse *et al*., 2000).

Ethiopian wetland conservation and management outline that, the multi-sectoral interests on wetlands make it imperative to involve a number of sectors to coordinate their efforts to generate reliable data on the value and other attributes of wetlands to influence policy makers take appropriate actions (Amsalu & Addisu, 2014). Wetland management institutions (WMIs) exist throughout Illubabor and Western Wellega, although their development over time, organizational structure and functions is spatially and temporally variable. They are known locally by a variety of names, including Abba Laga (father/leader of the catchment), "Abba Adere"(father/leader of a group of villagers), "Cheffe Kore" (wetland committee) and "Garee Misooma" (development committee) (Dixon & Wood, 2007).

According to the study of (Amsalu & Addisu, 2014) Ministry of Agriculture, Ministry of Water and Energy, Environmental Protection Authority, Institute of Biodiversity Conservation, Ethiopian Institute of Journal of Resources Development and Management Agricultural Research and the Ethiopian Wildlife Conservation Authority, and the sectors in the Regional State having a stake including land administration institutions have to come together to discuss the issue and produce a document that clearly depicts the national wetland scenario and development interventions required.

In order to reverse these emerging problems and conserve these fragile but crucial wetlands, integrated problem-solving approach through realizing the collaboration of relevant stakeholders from policy level down to grassroots community is indispensable opportunity to Ethiopian wetlands (Gebresllassie *et al.,* 2014).

1.7 Status of Wetlands management

In Ethiopia, wetland management is not efficiently coordinated and lacks adequate policy support. Due to the absence of workable institutional arrangement and wetland management policy, sustainable management of wetland and capacity building are not strengthened. As a result the field suffers from shortage of skilled manpower which is capable of disseminating the concept of wise use of wetlands (Shewaye, 2008) as cited by (Birhan *et al*., 2015).Wetlands have been the focus of conflicts in societal priorities throughout human history, with competing demands for water and land use delivering a range of ecosystem services but contributing to severe degradation and loss. Conservation of wetlands is a relatively recent priority, and it has seen more recent shifts from protection of remaining wetlands initially as a static biodiversity resource towards a focus on the many, formerly largely undervalued beneficial functions that these ecosystems provide to society (Maltby *et al.,* 2013).

Studies from several parts of the world have further shown that wetland creation and restoration has definitely enhanced regional flora as well as fauna diversity in intensively used agricultural landscapes. As long as the nutrient loading of these wetlands does not surpass critical limits, plant and animal diversity is not threatened by the effects of the nutrient inputs (Hefting *et al.,* 2013).Any development related to water resources or wetland ecosystems should be better instituted (based) on environmentally sound planning system and, hence, ensuring long term ecological productivity and welfare of the local community (Abunie, 1990).

Wetland resources in Ethiopia could be considered as an integral component of the environment in the country and provide multifarious social, economic and ecological benefits (Amsalu & Addisu, 2014). Policymakers have sufficient scientific information to understand the urgent need to take appropriate actions to conserve wetlands and their services to people (Gardner *et al*., 2015). Ethiopia is often referred to as the water tower of Africa this resource potential exists in the country's highly varied landforms and climatic conditions, creating a very extensive wetland system throughput, as alpine, fresh, alkaline-lakes, rivers, swamps (Abunie, 1990). Ethiopia having variable topography and altitudinal range, from 126m below sea level to 4,620m above sea level (a.s.l.), is a country endowed with rich wetland resources that include lakes, marshes, and swamps (Yimer & Mengistou, 2009).

1.8 Wetland conservation and their challenges

According to the study of (Amsalu & Addisu, 2014) Ministry of Agriculture, Ministry of Water and Energy, Environmental Protection Authority, Institute of Biodiversity Conservation, Ethiopian Institute of Journal of Resources Development and Management www.iiste.org ISSN 2422-8397 An International Peer-reviewed Journal Vol.32, 2017 97 Agricultural Research and the Ethiopian Wildlife Conservation Authority, and the sectors in the

Regional State having a stake including land administration institutions have to come together to discuss the issue and produce a document that clearly depicts the national wetland scenario and development interventions required Ethiopian wetland conservation and management outline that, the multi-sectoral interests on wetlands make it imperative to involve a number of sectors to coordinate their efforts to generate reliable data on the value and other attributes of wetlands to influence policy makers take appropriate actions (Amsalu & Addisu, 2014). They are known locally by a variety of names, including Abba Laga (father/leader of the catchment), "Abba Adere" (father/leader of a group of villagers), "Cheffe Kore" (wetland committee) and "Garee Misooma" (development committee) (Dixon & Wood, 2007).

Wetland managers are faced with an array of challenges when restoring ecosystems at risk from changing climate and human impacts, especially as many of these processes have been operating over decadal millennial timescales and the management of the catchment drivers of wetland condition faces an additional challenge when viewed from the long-term record of change (Gell *et al*., 2013). Challenges impeding prudent management of wetlands have been identified as: political-tribal mediated insecurity; ineffective governance; different use of resources by different ethnic groups; division of labour along gender and age lines; poverty and inability to diversify resources; traditions and neglect of traditional ecological knowledge (TEK); and inadequate formal education (Hamerlynck et al. 2010).

2. Summary

Wetlands provide globally significant social, economic and environmental benefits. Ethiopia is highly endowed with different types of wetlands, which have several ecosystem services. However, the social, economic 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.

Wetlands play a vital role in climate change adaptation and mitigation. Progressive encroachment and loss of wetlands cause serious and sometimes irreparable environmental damage to the provision of ecosystem services. The destruction of wetlands is a concern because they are some of the most productive habitats on the planet. They often support high concentrations of animals including mammals, birds, fish and invertebrates and serve as nurseries for many of these species. Many animals that live in other habitats use wetlands for migration or reproduction. The ability of wetlands to recycle nutrients makes them critical in the overall functioning of earth. No other ecosystem is as productive, or as unique in this conversion process. Some places artificial wetlands were developed solely for the purpose of water purification.

Restoration and creation can help maintain the benefits of wetlands and their surrounding ecosystems and at the same time accommodate the human need for development. Being that wetlands are part of environmentally provided assets that make up our natural capital, the depletion of a large portion of them indicates that the welfare of our environment is in a poor state. In order to sustain the ecosystem, environmental assets must be maintained, or at least not depleted.

3. Refernces

1. Abebe Y, Geheb K., 2003. Wetlands of Ethiopia. Proceedings of a seminar on the resources and status of Ethiopia's wetlands. IUCN, Switzerland pp. 116.
2. Abunie, L., 1990. Distribution and Status of Ethiopian Wetlands: Overview, 37–44. Afework, Yohannes; Belayneh Ayele, and, & Tilahun, T. (2015). Effect of Wetland Degradation and Conversion on Carbon Stock: The Case of Tekuma Wetland, Lake Tana Sub-Basin, *3*(2), 121–133.
3. Amsalu, T., & Addisu, S., 2014. A review of Wetland Conservation and Management Policy in Ethiopian, *4*(9), 1–6.
4. Bahilu B, Tadesse M., 2017. Review on distribution, importance, threats and consequences of wetland degradation in Ethiopia. International Journal of Water Resources and Environmental Engineering 9(3): 64-71.
5. Birhan, M., Sahlu, S., & Getiye, Z., 2015. Assessment of Challenges and Opportunities of Bee Keeping in and Around Gondar, *8*(3), 127–131.
6. Bruijinzeel LA., 2004. Hydrological functions of tropical forests not seeing the soil for the trees? Agriculture Ecosystems and Environment 104: 185-228.
7. Dejen E, Anteneh W, Vijverberg J., 2017. The Decline of the Lake Tana (Ethiopia) Fisheries: Causes and Possible Solutions: Decline of Lake Tana Fisheries: Causes and Solutions. Land degradation and Development. Land Degrad Develop 28(6): 1842-1851
8. Delelegn Y, Geheb K., 2003. Wetlands of Ethiopia: Proceedings of a seminar on the resources and status of Ethiopia's wetlands 1(5): 13.
9. Demissie, F, & Addis, M., 2015. Human Development and Wetland Conservation Policy, *4*(3), 126–138.

10. Desta Z., 2003. Challenges and opportunities of Ethiopian wetlands: The case of Lake Awassa and its feeders. In proceedings of a conference on Wetlands of Ethiopia p. 67-76.
11. Desta, Z., 2003. *Challenges and opportunities of Ethiopian wetlands: the case of Lake Awassa and its feeders*.*Wetlands of Ethiopia. Proceedings of a seminar on the resources and status of Ethiopia's wetlands*.
12. Díaz S, Fargione J, Chapin FS Tilman D., 2006. Biodiversity loss threatens human well-being. Plos Biology 4: 1300-1305.
13. Dixon A., 2008. The resilience and sustainability of local wetland management institution in Illubador and Western Wellaga, Ethiopia Singap. J Trop Ecol 29(3): 341- 346.
14. Dixon A., Wood A., 2003. Local Institutions for Wetland Management in Ethiopia: Sustainability and State Intervention pp. 130-146.
15. Farrington, L., 2014. Wetland conservation and restoration an update on wetland restoration on private land in South Australia, (February), 27–41.
16. François, G. G. H., K, G. F., Marcelle, G. S. L., Mooney, H. a, Cropper, A., Leemans, R. Schuyt, K., 2005.Ecosystems *and Human Well-Being: Wetlands And Water*. *Regions and Cohesion* (Vol. 13). Journal of Resources Development and Management
17. Gardner, R.C., Barchiesi, S., Beltrame, C., Finlayson, C.M., Galewski, T., Harrison, I., Paganini, M., Perennou, C., Pritchard, D.E., Rosenqvist, A., and Walpole, M., 2015. State of the World's Wetlands and their Services to People: A compilation of recent analyses. *Ramsar Briefing Note*, *no. 7*(June), 1–20.
18. Gashaw T, Bantider A, G Silassie H., 2014. Land Degradation in Ethiopia: Causes, Impacts and Rehabilitation Techniques. Journal of Environment and Earth Science 4(9): 98-104.
19. Gebresllassie, H., Gashaw, T., & Mehari, A., 2014. Wetland Degradation in Ethiopia: Causes, Consequences and Remedies. *Journal of Environment and Earch Science*, *4*(11), 40–49.
20. Getachew T., 2004. Wetland ecosystems of Ethiopia: Definition, classification and Distribution. Paper presented on proceedings of the National consultative Workshop on the Ramsar convention and Ethiopia p. 18-19.
21. Handisyde NT, Ross LG, Badjeck MC, Allison EH. , 2006. The effect of climate change on world aquaculture: A global perspective. Final Technical Report by the Institute of Aquaculture, Sterling, UK and sponsored by the Department for International Development (DFID) pp. 151.
22. Hayal D., 2006. Environmental, Biological and Socio-economic study on Boye and extended wetlands in Jimma zone of Oromia National Regional State, Southwest Ethiopia. Addis Ababa University school of Graduate studies department of Environmental Science.
23. Hillman J, Abebe D., 1993. Wetlands of Ethiopia in Ethiopia: Compendium of Wildlife Conservation Information. NYZS the Wildlife Conservation Society International, New York Zoological Park, Bronx, NY and Ethiopian Wildlife Conservation Organization, Addis Ababa 2: 786.
24. Jorge D, Farhed S, Boris B, Americo J, Jose M., et al,2014. The external impact of agriculture on inland wetlands: A case study from Argentina. European Scientific Journal 10(17): 1857-7881.
25. Junk WJ, An S, Finlayson CM, Gopal B, Kvt J., et al, 2013. Current State of Knowledge Regarding the World's Wetlands and their Future under Global Climate Change: A Synthesis. Aquatic Sciences 75(1): 151-167.
26. Junk, W. J. S., Finlayson, C. M., Gopal, B., Kvt, J., Mitchell, S. a.,Robarts, R. D., 2013. Current State of Knowledge Regarding the World's Wetlands and their Future under Global Climate Change: A Synthesis. *Aquatic Sciences*, *75*(1), 151–167.
27. Karunamoorthi K., 2009. Toxic effects of traditional Ethiopian fish poisoning plant Milletia ferruginea (Hochst) seed extract on aquatic macroinvertebrates. European Review for Medical and Pharmacological Sciences 13(3):179–185
28. Leykun A., 2003. The distribution and status of Ethiopian Wetlands: An overview, proceeding of a seminar on the resources and status of Ethiopia's wetlands, IUCN.
29. Mekonnen, T., & Aticho, A., 2011. The Driving Forces of Boye Wetland Degradation and Its Bird Species Composition, Jimma , Southwestern, *3*(11), 365–369.
30. Mengistu W., 2008. The role of Wetlands in Biodiversity Conservation and Management in Ethiopia: a case study of Berga Floodplain. Ethiopian Wildlife and Natural History Society (EWNHS) Ethiopia.
31. Michael JV, Jim LR, John PT, Steven JT., 1999. Dynamics of hydric soil formation across the edge of a created deep marsh Wetlands 19: 78- 89.
32. Mitsch, W.J. and Gosselink, J.G., 2002. Wetlands. 3rd Ed, John Wiley and Sons, Inc. U.S.A. Retrieved 19 October 2009 from www.iucn.org/themes/wetlands/
33. Murdiyarso D, Kauffman JB, Warren M, Pramova E, Hergoualch K., 2012. Tropical wetlands for climate change adaptation and mitigation: Science and policy imperatives with special reference to Indonesia. Working Paper. CIFOR Bogor, Indonesia p. 10.
34. Namaalwa, S., Van dam, a. a., Funk, A., Ajie, G. S., & Kaggwa, R. C. ,2013. A Characterization of the

Drivers, Pressures, Ecosystem Functions and Services of Namatala wetland, Uganda. *Environmental Science and Policy*, *34*, 44–57.
35. Neary DG, Ice GG, Jackson CR., 2009 Linkages between forest soils and water quality and quantity. Forest Ecology and Management 258: 2269-2281.
36. Olumana M, Loiskand WW, Fürst J., 2009. Effect of Lake Basaka expansion on the sustainability of Matahara SE in the Awash River Basin. 34th WEDC International Conference, Addis Ababa, Ethiopia.
37. Parker H, Calow MB, Quattri MR, Kebede S, Alamirew T.,2016. A Thirsty future? Water Strategies for Ethiopia's new development era. Overseas Development Institute (ODI), London, UK.
38. Ramsar Convention Bureau, 2003. The Ramsar Convention Manual: A Guide to the Convention on Wetlands.
39. Seid G., 2017. Status of Wetland Ecosystems in Ethiopia and Required Actions for Conservation. Journal of Resources Development and Management 32: 1-9.
40. Simane B, Benjamin FZ, Mutlu O., 2013. Agro ecosystem Analysis of the Choke Mountain Watersheds, Ethiopia. Sustainability 5(2): 592-616.
41. Smith RD, Ammann A, Bartoldus C, Brinson M., 1995. An approach for assessing wetland functions using hydrgeomorphic classification, Reference wetlands, and functions Indices US Army Corps of Engineers. Wetland Research Programme Technical Report p. 88.
42. Tadesse G, Peden D, Sonder K., 2003. The Water of the Awash River Basin: A Future Challenge to Ethiopia.
43. Tenalem A.,2009. Natural Lakes of Ethiopia. Addis Ababa University Press, Addis Ababa, Ethiopia.
44. Urbye, R., 2006. Plant Communities of a Wetland in Western Ethiopia, (December).
45. Vogt N, Bahati J, Unruh J, Green G, Banana A., 2006. Integrating remote sensing data and rapid appraisals for land-cover change analyses in Uganda. Land Degradation Dev 17(1): 31-43.
46. Weisser WW, Scheu S., 2011. Plant diversity surpasses plant functional groups and plant productivity as driver of soil biota in the long term. PLOS one 6: e16055.
47. William J, Blanca BM, Hernandez ME.,2015. Ecosystem services of wetlands, International Journal of Biodiversity Science, Ecosystem Services & Management.
48. Wondie A., 2018. Ecological conditions and ecosystem services of wetlands in the Lake Tana Area, Ethiopia. Ecohydrology and Hydrobiology 18(2): 231-244.
49. Woodhouse, P., 2000. African enclosures? The social dynamics of wetlands in dry lands, James Currey, Oxford.