

The Contribution of Ethiopian Wetland Resources to Economic Growth and Biodiversity Conservation of the Country

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Abstract: Ethiopia has more than 58 different types of natural and manmade wetland lake resources which provide enormous socio-economic and environmental values. However, nowadays these Ethiopian wetland lake resources are under severe problems such as population pressure, aquatic biodiversity loss; drying up, pollution, and degradation. These severe problems are created due to improper extraction, over use, weak management, improper policy and misconceptions forward to wetlands. Consequently the health of the wetland lake resources of the country is continuously decreasing from year to year and from time to time. Therefore, the objective of the study was aimed: 1) to appreciate the wet land lake resources of Ethiopia for their unlimited benefit to local communities and National GDP growth 2) to identify the major threats and challenges of the country' wetland lake resources and 3) forward the possible correction measures to tackle their problems. Regarding methodology to collect the relevant data, qualitative (descriptive) research methods were used. The data were obtained through interview, field survey, observation, reviewing relevant secondary sources and organized using tables, Graphs, charts then analyzed qualitatively. Among the 100,000 total populations of the wetland lake resource users only 200 sample respondents were selected and interviewed to collect the relevant information regarding the benefit of wetland resources, conservation practices, their attitude towards them and the challenges they faced. The results of this study was expected to have a positive impacts on wetland conservation, to local users, national level, in identifying the challenges and point out the remedial correction measures to solve the problems. The study will have significance in solving problems through realizing the collaboration of relevant stockholders from policy maker's level to grassroots communities and it is the best opportunity to increase the conservation methods of Ethiopian wetland lake resources.

Keywords: Wetland Resources, Economic Growth, Biodiversity Conservation, Ethiopia

1. Introduction

1.1. Background and Justification of the Study

Many definitions for wetlands have been proposed and utilized over the years and thus, over 50 different definitions are existed since the 1971 [2]. The international convention regarding wetland site is known as Ramsar-Iran convention (1971) [5, 27, 28].

The primary purpose of Ramsar treaty is to list international wetland sites of the world to promote their wise

use and conservation activities. Since 1971 to 2015, there were about 1916 listed international wetland sites laid on 187,044,576 hectares in 160 member countries [11].

The Ramsar Convention (1971), Article 1.1 defined wetlands as: "areas of marsh, fen, peat land, or water whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh or salt, including areas of marine water the depth of which at low tide doesn't exceed 6 meters". In addition, the convention (Article 2.1) provides that wetlands: "may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine

water deeper than 6 meters at low tide lying within the wetlands.

According to the Ramsar convention and research (1987) Ethiopia exhibits a wide range of geologic formation and climatic conditions which create numerous wetland ecosystems including 12 rivers, 8 major lakes and many swamps [8]. Bogale, lists a total of 77 wetland sites in Ethiopia laying in 13,699km² areas roughly 1.14% of the total country's land surface. Wetland lakes of Ethiopia are the major sources of food, (water for drink, irrigation, industry), medicinal plants, habitat, etc. They are also the vital resources in attracting tourists and providing ground for cultural ceremonies [27]. They can again contribute for environmental wellbeing through recharging and discharging underground water, hosting biological diversity. In general, the wetland resources contribute billions of birr to the people of Ethiopia every year in the form of pure water, provision of food, fish, fuel, tourism and recreational values e. tc

Therefore, the intention of this academic review paper was to summarize the status of Ethiopian Lake water resources, Identifying the causes of their problems, challenges, consequences and finally to forward the possible strategic solutions [10, 17].

1.2. Classification of Ethiopian Wetlands Based on Biomes Criteria

The Ramsar-Iran convention in Ethiopia (1997), Categorized the Ethiopian wetlands into four groups based on their Biome or ecological zone as indicated in figure 1.

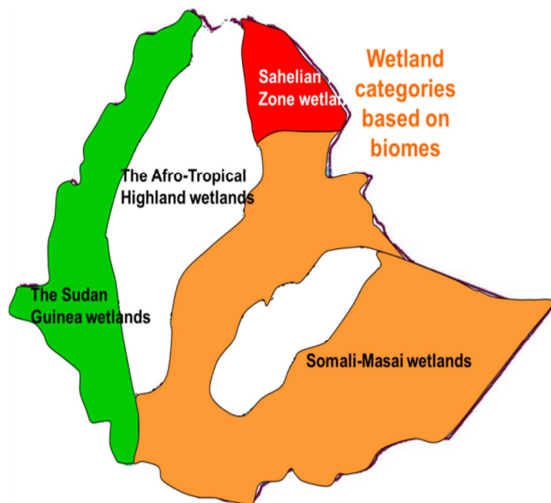


Figure 1. Categories of biomes (division based on dominance of flora) showing the main ecological location of each wetland parts within the country) Source: [8].

1.2.1. The Afro-Tropical Highlands (Mountain Wetlands)

This wetland ecological zone consists cheffa, Dembia, Bale, Ashenge, Tana, Haik, Bishiftue. e. t. c.

1.2.2. The Sahalian Belt Methods

Which includes the dry areas such as Nile River basin, mereb, Dallol depression, metema e. t. c where evapo-transpiration exceeds the annual precipitation.

1.2.3. Somali Masai Wetlands

Particularly this wetland biome comprises the rift-valley parts of the country such as Awash-lowlands, Langano, Abijata, Shalla, Zeway, Hawasa, Abaya, Chamo, bishiftu lakes.

1.2.4. The Sudan-Guinea Wetlands

Again this biome category includes the flood plains of Tekeze, beless, Baro-Akobo, Sud, Turkuana. t. c.

2. Materials and Methods

2.1. Location of the Study Area

The research was conducted in Ethiopia which is one of the 7 East African countries. Geologically, Ethiopia is located between the Equator and Tropic of Cancer and at the North Eastern part of the African continent or what is known as the “Horn of Africa.” Relatively Ethiopia is bounded by Sudan on the west, Eritrea and Djibouti on the northeast, Somalia on the east and southeast, and Kenya on the south.

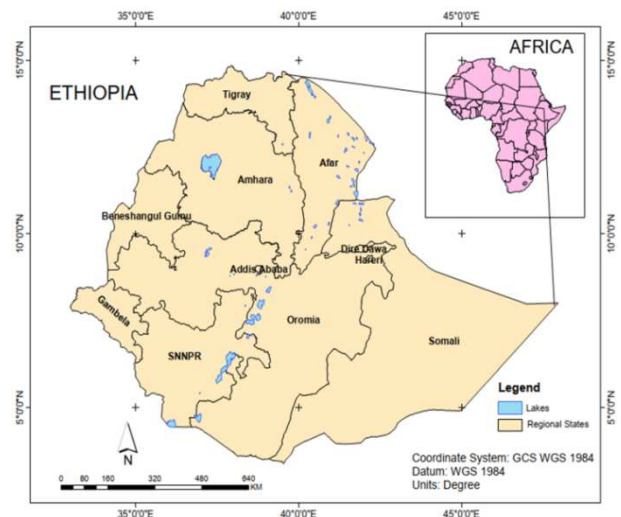


Figure 2. Map of Ethiopia as a study area (source: field survey, 2019).

Astronomically Ethiopia lies between the 30 00 N and 15000 N Latitude or 33000E and 48000E Longitude. The country occupies an area of approximately 1,127,127 square km., which is slightly less than twice the size of Texas. The total land area is 1,119,683 square km and the area occupied by water bodies is 7,444 sq. km. However, the study was conducted in 7 wetland lake resources of the country. The 7 wetland lake resources were selected purposively for their especial economic potentials, flora conservation capacities and their income sources for local communities.

2.2. Data Collection Methods, Sample Sizes and Data Collection Tools

The main approach of the study was qualitative. The focus of qualitative inquiries is on describing, understanding, and clarifying a human experience and requires collecting a series of intense, full, and saturated descriptions of the experience under investigation.

The total populations (the most users of the selected wetland lake resources) are estimated to be about 100,000. Among these only 200 sample respondents were selected randomly for interview to collect the relevant information regarding the wetland lake resources. The data collection tools that the author had used were interview, field observation, discussion and secondary data sources such as national and local documents.

Table 1. Proportion of samples sizes in each selected sample wetland lake resources.

RoNo	Name of sample study lakes	Total user population	Sample sizes
1	Lakecheffa-oromiya	16,500	29
2	Lake Tana	17,000	35
3	Lake Hawasa	20,000	37
4	Lake Abiyata	11,000	24
5	Lake Benishangul	3,500	21
6	Lake Zuway	18,000	30
7	Lake Ashenge	14,000	24
Total		100,000	200

Source: field survey, 2019.

3. Results and Discussion

3.1. The Annual Fish Production Potential of Ethiopian Wetland Lake Resources

Table 2. 14 wetland lakes resources, their fish production potential and catch fish in ton per year.

Ro no	Wetland lake resources	Area (km ²)	Fishery potential (tone/year)	Catch fish (tone/year)
1	Tana	3500	10,000	1454
2	Zway	434	2941	2454
3	Langanano	225	240	151
4	Abiyata	205	2000	500
5	Shalla	250	1300	10
6	Hawassa	97	611	853
7	Abaya	1070	600	412
8	Chamo	551	4500	4359
9	Koka	255	1194	625
10	Fincha	250	1330	333
11	Melkawakana	82	434	109
12	Ashenge	20	106	21
13	Benishangul	450	2000	200
14	Cheffa oromiya	750	3000	300
Total		8,139	30,256	11,781

Source: [5, 10].

3.2. The Contribution of Some Selected Wetlands Lake Resources to Economic (GDP) Growth of Ethiopia

Among the 7 selected sample wetland resources, let's see the economic contribution of the four ones. The rest will be included in their biodiversity conservation.

3.2.1. The Contribution of Cheffa-oromiya Wetland Lake Resource to Economic Growth

The cheffa people highly depend on wetland plant materials and typical grasses for construction of houses, to weave mats or baskets, to collect fire wood, to clean cloths as laundry etc.

As reported by Zemed during the 1986, when great famine faced in the area, non cultivated wetland plants have played a significant role being as source of food and in saving lives of

The survey was carried out in the dry season during seven field trips in the period between 5 January 2018 and 30 June 2019. Two lakes (Lake Tana and Lake Ashenge) were selected from the highlands of Ethiopia in the north and the rest five wetland lakes were taken from the Rift Valley of the country purposively. Structured interview questions was mainly deployed to assess the relevant data such as fish production, human population, bird species, ecosystem services of the wetland lakes resources, their benefits especially for local communities, and topography of the study lake resources. Focus group discussion with local fisheries, grass cutters, cement sand exacters from beaches, herders was considered. Other supportive secondary data were collected from national sources, local offices, Other Aquatic Life research center for relevant literature. The collected data were analyzed with qualitative approach method.

the local people [8, 9, 17].

3.2.2. The Contribution of Wetland Lake Tana Resource to Economic Growth

Wetland LakeTana is also among the most areas of fisheries (86 tons per year) and useful for transportation service of the local communities [23].

Fish: Lake Tana and its surroundings are home to a vast variety of different species. Some of them are endemic and others are migratory. According to [15], in Lake Tana region there are 28 fish species of which 19 are endemic, others are migratory species only staying for some months every year. While 1,454 tons of fish for food are annually produced in the Lake Tana region using traditional methods. It is possible to produce up to 15,000 tons a year by using modern methods [10, 13, 20, 23, 27, 30].

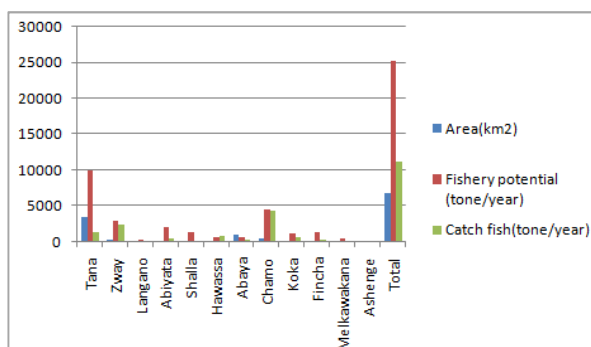


Figure 3. Fish production and management in Ethiopia.

3.2.3. The Contribution of Wet Land Lake Hawassa Resource to Economic Growth

Fish biodiversities and its market in lake Hawasa:- The increasing demand for fish during the fasting periods of Orthodox church also causes to increase fishing activities in Lake Hawasa. Currently there is one dominant fish landing market site at Lake Hawasa which is Known as Amora Gedel located close to Hawasa [2, 5, 13, 26].



Figure 5. One part of a wetland in Ethiopia (located in the southern regional state) showing the most common type of fish for human food landing at the fish market known as Amora Gedel fish market. Source: [10].

Table 3. The number of fish species annually yield at Lake Hawassa Amora-Gedel market site.

Fishing period at lake Hawasa	Different number of fish species annually yielded
Dry season	10363
Rainy season	8954
Total yield (species per year)	19317

Source of data [26].

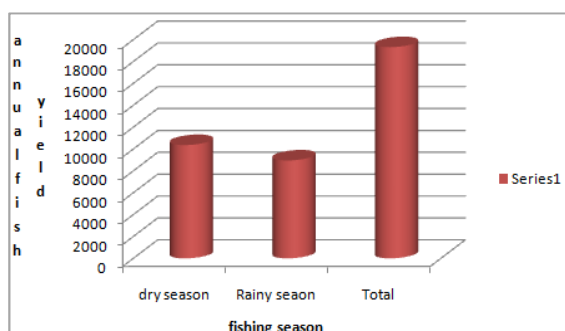


Figure 4. Annual fish yield.

Abstraction of brine water from Lake Abijata by soda Ash Factory is not only caused dramatic depth, surface area and volume reduction of the lake but it also leads the lake to have high concentration of solutes which in turn increase the alkalinity of the lake. Higher alkalinity in turn causes reduction of population of various species and ultimately leads to the death of fish eating birds [14].

3.2.4. The Contribution of Lake Abijata-shalla Wet Land Resources to Economic Growth

Nowadays, wetland lake Abijata and wetland lake shalla are located adjacently. According to some climatologists report, they were created as one lake during the Mesozoic era. However, since the Cenozoic era these two natural lakes were begun to separate and at this time they are apart by 2km of deposited silt soil created as a result of downstream flooding and geological cases. They are rich in unique natural resources such as saline, alkaline and soda ash. These mineral resources are very useful as raw material sources of industries. Lake Shalla has an independent sub-basin of its own and drains a catchment of 3920 km². A threat to this lake Shalla is not reported yet, because the lake is entirely protected, together with an area of peripheral land of lake Abijata-shalla [26].

3.2.5. Specific Services and Local Economic Benefits of Wet Land Resources of Ethiopia

Generally Ethiopian wetland resources are useful for sources of human food, grazing field, source of raw materials, collecting reed, animal fodder, habitat of biodiversities, fishing etc. To understand the other specific and local services of the Ethiopian wetland resources, let's see the following different pictures carefully [9, 13, 18, 30].



Figure 6. Part of the wetland resource, showing Collection of sheep and their herder Engaged on grazing field near Bishfitu wetland which is located at the central part of the country Source: [16].



Figure 7. This is another part of a wetland resources called Gidavo riverbanks which is located at the southern part of the country showing that local peoples engaged on Extraction of sand material which is useful as a raw material for cement production as well as constructions. Source: [27].



Figure 8. Part of a wetland resources, showing how peoples use the products of wetland resources such as grasses, green leaf to cut and carry for their animal fodder especially during the dry season. Source: [9].

3.3. The Contribution of the 7 Selected Ethiopian Wetlands Lake Resources to Biodiversity Conservation

3.3.1. The Contribution of Benshangul Wetland Resources in Conserving Flora Species

The region of Benishangul Gumuz in western Ethiopia with its many wetlands (22,466 km²) still has large areas of relatively undisturbed flora vegetation and up to 60% of the region is covered by forest and woodland [16]. This is due to the relative inaccessibility of the region together with low population density individuals per square kilometer) compared to the national average of 57.7% [9, 10, 13, 16]. However, this figure is expected to double by 2030, as the population growth of the region matches that of the rest of the country. The wetland vegetation of the region consists of two main types: these are treeless grasses and high diversity of woody Acacia species. In regarding to this a total of 28 plant species in a total of 30 m² land plot.

Table 4. The total counted amount of plant species in the specific plot land of Cheffa lake.

Total plot land under studied	Identified total plant species in the plot land	Medicinal plant species for human	Veterinary use plant species	Non cultivated human food plant species	Forage use plants
81m ²	206	83 (40.2%)	31 (15%)	54 (26.2%)	38 (18.4%)

Source: [13].

3.3.3. The Contribution of Lake Tana Wetland Resource for Biodiversity Conservation



Figure 10. part of a wetland resources locally called Lake Tana (located at the western part of the country) consisting a known monastery and churches, showing its conservation and hosting capacity of many flora and fauna specie. Source: [15].

Lake Tana wetland resource is found in Amhara regional state in west side of Bahirdar town. This wetland play an important role for wild life and biodiversity conservation. For



Figure 9. Some plant species found in Benishangule Gumuz locally called it yanbesa chaka wetland. source: [16], of wetland site, showing the huge wood land and long grasses flora as the result of water or moisture enriched wetland resources.

3.3.2. The Contribution of Cheffa-oromiya Wet Land Resource for Biodiversity Conservation

Cheffa wetland is found in Oromiya regional state which is located 300km north of Addis. Ababa along Borkena and Jara river basins. Cheffa wetland is rich in cultivated and non cultivated plant species. The plants found in cheffa wetland are used for food, shelter, medicine, forage, research center and other cultural values [6]. The most plant species of cheffa wetland are shrubs, herb, grasses and the medicinal plants. Their different parts such as their leaves, roots, flowers, barks and fruits for that purpose. However, medicinal plants are more popular than other types of plants in this ecosystem [13] counted a total of 206 individual plant species in a total of 81m² plot land area.

example the wetland region is an important roosting site for migratory bird species such as the common crane, and it provides habitat for several endangered species such as white- collared pigeon. Wetland Tana lake is also rich in flora plant species which is used to feed aquatic animals, collect reed for human ceremonies or to make traditional boats, baskets, caps, animal fodder and as well as firewood [2, 5, 10, 13, 23].

Plants There are over 6,000 species of higher plants in Ethiopia, out of which 10 percent are endemic. As indicated in various studies, of these 181 species of trees and shrubs found in and around Lake Tana.

Birds:-Ethiopia is home to 861 different bird species, of which 18 are endemic. According to studies conducted in 2009 by the Ministry of Water Resource and other professionals, more than 300 types of birds inhabit the region are found in Lake Tana, of which 50 are ecologically crucial for preserving biodiversity, while they also attract international attention for their rarity. Migratory birds, such as the Eurasian or Common Crane are sheltered in this area during the winter in the northern hemisphere. These

migratory birds come to Lake Tana from West Europe to escape from the snow and the cold during winter season and return to their home countries at the beginning of March every year.

3.3.4. The Contribution of Lake Hawasa Wetland Resource to Conserve Biodiversity

Lake Hawasa wetland is located west side of the beautiful regional city of Hawasa. The higher trees found around the lake again used to sustain arboreal animals, rare colorful birds, and other seasonal migratory birds [2, 20, 26].

According to Admin report, there is a person called Mr. Wondifraw Endashen, the developer of Lewi resort on the Hawasa lake shore, who described “instead of cutting a single tree, we instead cut the building” to show the unlimited importance of plant species. According to [29] report, there are more than 100 different plant species in and around Lake Hawasa. The dominant phytoplankton plant species inside this lake are the water lily-coruella which seen emerged and covered at least 1m depth shallow areas.

3.3.5. The Contribution of Lake Abijata-shalla Wet Land Resources to Conserve Biodiversity

Lake Abijata- shalla are one of the most living bases of 20,000 bird species, 55,000 people, 200,000 livestock's in Ethiopia [14]. However, Abijata Soda Ash plant is a factory which was established in 1984/85 near Lake

Abijata on the northern shore and it is the only soda ash producing factory in Ethiopia [14]. According to [14] the factory entirely has depend on salt water abstracted from Lake Abijata through pumping and evaporation for soda Ash production. Some research results indicated that the factory abstracts 5 million m³ of water annually, which is 1% of the amount of water lost from the lake due to natural evaporation. A clear evidence of the effect of this factory on the lake started to be seen since 1985, when the lake began to decline in depth, level, volume and surface area. According to [14] Lake Abijata showed a depth reduction of 0.7m for approximately 13 million m³ of brine water abstraction by the factory. Thus, this clearly indicates that, the Soda Ash Factory is one of the responsible factors for the decline of water volume in Lake Abijata [2, 5, 8, 9, 14]. Therefore, one can't deny that if the situation is continued, it affects the wild life, the vegetation, aquatic and terrestrial ecosystem as a whole.

3.3.6. The Contribution of Lake Ashenge Wet Land Resource to Conserve Biodiversity

Lake Ashenge, a crater lake, is located in the northern part of Ethiopia with altitude of 2450m. Like other lakes of the country this lake is one of the most hosts of several thousands of international migratory birds especially those crossing the sahara Desert [9, 14, 19, 26].

Table 5. Seasonal migratory bird species in Lake Ashenge between 2012 and and 2013.

Seasons	Migratory bird species	Number of individual counting migratory birds
Rainy season (june, July, August, Sep)	20	3064
Post- rainy season (Oct, Nov, Dec, Jan)	33	4219
Dry season (Feb, Mar, Ap, May)	30	2631
Total	83	9914

Source: [29].

From the above table 5 one can concluded that the highest abundance (number of individual migratory bird counts) has observed in the post- rainy season (october and November months). This is due to the ease of storms and flooding but calm of weather conditions.

3.3.7. The Contribution of Lake Zuway Wet Land Resource to Conserve Biodiversity

Lake Zuway is located some 163 km south of the capital city of Ethiopia. The lake has an open water surface covered an area of 434km². [16] In his research study, counted a total of 233 bird species on an area covered 51.5km² of the lake. Among these. According to his result, 54 were migrant, 8 were threatend and the rest were endemic bird species [16].

Table 6. The direct and indirect uses of Ethiopian wetland lakes.

Direct uses of wetland lakes of Ethiopia	Indirect uses of wetland lakes of Ethiopia
Water supply	Water storage
Food for human and livestock's	Ground water discharge
Fishery	Shoreline protection

Direct uses of wetland lakes of Ethiopia	Indirect uses of wetland lakes of Ethiopia
Agriculture	Nutrient retention
Fuel wood/energy	Climate stabilization
Water fowl	Sediment trap
Flowers	Biodiversity conservation
Vegetation's	Habitat
Water transport	Research center
Sand & mud collection	Others

Source: [9].

From the above table 6 one can conclude that wetland ecosystems are one of the major sources of basic food, raw materials and energy for human being either direct or indirect means. Generally, wetland resources in Ethiopia have a great role in controlling flood, irrigation, biodiversity conservation, provision of scientific research, sources of raw materials, fishing, grazing and serving as a buffer against harmful human interventions.

From the above table 4 we can understand that most wetlands resources of Ethiopia are the basic sources of

consumptions for peoples in Ethiopia.

Table 7. Bird species counted in the sampled wetland lakes resources of Ethiopia.

Wetland site name	Survey date	# of species counted
Lake Hawasa	26/01/2000	159
Lake Zuway	20/01/2000	111
Kokadom	18/01/2000	111
Lake langano	23/01/2000	69
Lake abijata	22/01/2000	51
Akaki wetland	15/01/2000	62
Lake ashenge	25/12/1999	69
Chelecklectuswamg	16/01/2000	74
Lake Haik	23/12/1999	92
Tikurwuha	27/01/2000	95

Sources: [9].

From the above table 7 one can understand that wetland ecosystems, due to their cool environment, are the main home of birds and other wild life animals in Ethiopia.

3.8. The Current Identified Threats and Challenges of Ethiopian Wetland Resources

The current major threats and challenges of Ethiopian wetland resources are identified as:

1. Improper agricultural practice.
2. Land degradation and deforestation.
3. Unwise use of the wetland resources.
4. Urban expansion and Industrialization.
5. Absence of proper policy and lack of capacity to implement the policies.
6. Lack of institutional arrangement.

3. Conclusion

Wetlands of Ethiopia are ranked amongst the most highly threatened and loss continuing ecosystems. However, some researchers, writers, advocates and IPCC reported that it is the fact that almost all wetlands found in Ethiopia are still playing a significant role in the livelihoods of the local community even though they have started to show signs of degradation as a result of the lack of appropriate management and wise use.

The wetland resources are transitional zones between dry land and open water bodies. Ethiopia owns different types of wetlands which have regional, national panelists generalized that the main wetland threatened factors are human-induced activities rather than natural factors. Thus, the author concluded that Anthropogenic interventions (human induced factors) such as deforestation on upper streams, lack of proper conservation methods, overgrazing, industrial wastes, water draining for irrigation, urban expansion, lack of proper policy and wetland area using regulations, shortage of capacities to implement, lack of continuous monitoring are the primary factors that highly affects wetland ecosystems in Ethiopia. For example, lake Haromaya (located at eastern part of the country) is already dried up and lake abijata (found at the rift-vally part of the country) as well as lake

hawasa (found at southern part of Ethiopia) are also in loss due to excessive transportation of huge sediments from their upstream to down them caused by the unwise clearing of vegetations (anthropogenic) on their up streams which leads to weaken its erosion control capacity).

On the other hand natural factors such as flooding, climate change, erosion, evapo- transpiration and even the countries geological location are the secondary causes of wetland losses and threats in Ethiopian.

To sum up, the reviewer concluded that the major challenges and threats of Ethiopian wetland resources either directly or indirectly are caused by the human induced causes (anthropogenic factors).

4. Recommendations

In order to reverse these emerging problems and to ensure wetland conservations activities in Ethiopia, the author of this review paper forwarded the following recommendations.

1. Collaboration of decision makers, experts, users, private sectors, relevant stakeholders from policy level to grass root communities should be the first step and to be practiced.
2. Arranging Capacity building and awareness creation training opportunities for local communities should be the task of the government and other concerned bodies.
3. The government of Ethiopia should keep firstly the interest and benefits of the local users, set up clear rules and regulation to conserve wetland resources. Secondly he has to accept only some part of the Ramsar treaty in order to make Ethiopia's wetlands sustainable.
4. Communities, users and other stake holders should use wet land natural resources of the country wisely to increase their National economic value, productivity, ecosystem benefit and to enhance their soil erosion control capacity.

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