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Threats and Opportunities of Central Ethiopia Rift Valley Lakes

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Abstract

Ethiopia has a various lakes and rivers with significant ecosystems' services and biodiversity. Central Ethiopia rift valley lakes are the most common lakes that are found in central rift valley of Ethiopia. Lake Ziway, Abiyata, Shalla and Langano are the common central Ethiopia rift valley lakes. These lakes are seriously affected by different anthropogenic and natural factors. The major threats of central Ethiopia rift valley lakes are over population, overgrazing, industrialization and urbanization, deforestation, siltation, agricultural expansion, investment, pollution, climate change, land use and land cover change and others. The best opportunities to reduce this different threat of lakes are policy conviction, monitoring and evaluation, impact assessment, partnership, building capacity, creating awareness and improve upstream and downstream relations.

Keywords: Over exploitation; Wetlands; Fresh water, Pollution; Siltation

Introduction

Ethiopia has a number of lakes and rivers with significant ecosystem services. The Ethiopian rift valley is one of the Great East African rift valleys and also called the Afro-Arabian rift, which extends from Jordan in the Middle East, East Africa to Mozambique in Southern Africa and from Kenya border up to the red sea and divides the Ethiopian Highlands in to the Northern and Southern halve (Lemma H, 2016). The Ethiopian rift valley is created by volcanic and faulting activities that formed volcano tectonic depressions in the floor of the rift, which later becomes lakes [1].

The CER valley is well-known for its biodiversity. Even though the vegetation of the area is now extensively overgrazed, but it is characterized by Acacia open woodland, whereas deciduous forests occupy the ridges and slopes [2]. Increased human activity has resulted in open vegetation which is floristically poor and uniform. Population pressure during the last three decades has resulted in the conversion of natural vegetation, overgrazing of natural grasslands, removal of natural shrub for firewood and clearing of forests for construction material (Lemma H, 2016). Due to land use change, susceptible sloping areas in the area face increased erosion and depletion of nutrients required for vegetative growth. Erosion and resulting sedimentation elsewhere can have an influence on the regional hydrology [3].

The Central Rift Valley (CRV) is one of the most environmentally vulnerable areas of Ethiopia. Most of the lowland in the CRV is arid or semiarid, and droughts occur frequently. Approximately the area of Central Rift Valley (CRV) is a closed to 10,320km2 [4]. The area consists of a chain of lakes, streams and wetlands with unique hydrological and ecological characteristics [5]. Owing to the fragility of the environment and competing claims for land and water resources, the area has been experiencing serious environmental deterioration and socioeconomic challenges, a growing threat to the local community's existence.

Over the last few decades, the rate and severity of the environmental degradation causes deterioration of resource use, unregulated population and climate change related stresses [6,7]. Increasing population pressure and economic developments put an increasing privilege on the valuable freshwater resources. Until recently, water from the lakes mainly supported agriculture and commercial fishery, domestic use, industrial soda extraction and recreation, while the lakes and surrounding wetlands supported a wide variety of endemic birds and wild animals. Surface water extraction for irrigation, industrial and domestic use is continuously increasing in the Central Ethiopia Rift valley lakes. Therefore, the overall objective of these review is to identify the major threats and opportunities of Central Ethiopia Rift Valley lakes.

Central Ethiopia Rift Valley Lakes

The Central Ethiopian Rift Valley is a part of the Great African Rift which situated in the administrative regions of Oromia and the Southern Nations Nationalities and Peoples Region (SNNPR).

The Central Rift Valley consist of a chain of lakes, streams and wetlands. The most common lakes in this area are: Ziway, Abiyata, Langano and Shalla.

Lake ziway

Lake Ziway is one of the largest freshwaters Rift Valley Lakes of the country with maximum depth of 9 m, whereas the average depth is only 2.5m (Lemma H, 2016). The lake and its watershed play a significant role in supporting the livelihoods of the approximately 2 million people in the watershed [8] and 1.9 million livestock [9]. The volume of the lake is approximately 1.1 billion m3 (ILRI, 2001). According to Jansen [10], the lake delivers 7-8 million cubic meters (m3) of water per year for domestic and livestock use as well as the municipality of Ziway Town abstracting thousands of cubic meters of water per day from lake for their household's consumption. it is also a source of water for open and closed farm irrigation. Water is freely abstracted from the lake, with no use charge; because of all water resources are the common property of the people and the state [11]. It is also a source of fish supply to huge market centers in the country. A large number of people, both in cooperatives and individually, depend on this lake for their livelihoods, including women and children involved in processing and selling the fish. According to Vuik [12], besides its economic and livelihood values, the lake and its watershed support unique ecological and hydrological characteristics.

Lake Ziway contains fresh water, which mainly originates from the two inward rivers, being the Ketar River and Meki River, and rainfall. Both rivers are perennial rivers. The lake shows a slight reduction after the late 1980s, as a result of uncontrolled water abstractions for small-scale irrigation schemes in the upper reaches of the catchments, [13,14]. This lake is also known mostly for its large size, fisheries and islands [15-17]. It is drained by the Bulbula River which enters Lake Abiyata. Besides the thriving fisheries, the lake supplies water for the town, irrigation for nearby floriculture farms.

Level of lake Ziway

The level of the lake is not controlled. As Wondowesen G et al. [4] indicated, the surface area of lake Ziway is reduced by 0.63% from its 1985's size (Table 1). The annual fluctuation of the water level of the lake was reported to be 0.8m, nevertheless larger fluctuations, up to 2 meters, may infrequently occur (ILRI, 2001). Current total surface water abstraction from the Ketar River and Meki River is in the order of 28 million m3 per year, which is used for irrigation (ILRI, 2001). Due to the sedimentation problem, over irrigation and diversion of water from the two main feeder rivers the lake's water level has deteriorated over the past few decades. However, after an adjustment made for the sediment deposited in the lake using the bathymetric surveys of 1976 by Over Land Seas Development and 2005/2006 by Ministry of Water Resources the annual water level of time series of the Lake is decreasing.

Table 1: Change Lake Area in (Ha) of the four lakes in the CRV for the period 1985, 1995 and 2015

Year	Area in (ha)			
	Abiyata	Ziway	Langano	Shalla
2015	13261.49	42478.66	22836.56	304.9699
1995	15387.01	42540.34	23183.73	306.9147
1985	17824.7	42746.9	23030.64	309.4953
Change (2015-1995)	-4563.21	-268.24	-194.08	-4.53
%	-25.6	-0.63	-0.84	-1.48

Source: Wondwossen G et al. [4].

Jackson R et al. [18] stated that, the change in temperature and precipitation has a significant impact on the inflow volume into the lake. The total average annual inflow volume into lake ziway might decline which lead to the drop of the lake level up to two third of a meter and shrink the water surface area up to 25km2 [18]. Therefore, in Lake Ziway Watershed, runoff is likely to decrease in the future and be insufficient to meet future demands for water of the ever-increasing population.

Threats of lake Ziway

Figure 1: Images showing certain types of electric and small motor pumps being used to abstract water from the lake and overfishing.

The major threat of the lakes are the natural factor and anthropogenic factors. The natural causes including climate change that could alter the ecosystem ending in undesirable long-term effects. Anthropogenic causes are deforestation in

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the upper watersheds, loss of Acacia woodlands, lake shore farming and destruction of buffer zones. The existence of land degradation in the watershed that induced large scale sedimentation rate was reported by Legesse et al. [13] and Billi et al. [19]. The critical threats include siltation, water abstraction as showed in (Figure 1), overfishing and release of pollutants into the lake system [20,21].

According to Hayal D [22], The expansion of small-scale farms and large-scale investment projects, mainly floriculture industries and irrigation farms as indicated in (Figure 2), and the subsequent intensive and unintended applications of agrochemicals, untreated waste discharge, and poor watershed management practices, etc. are deteriorating the water quality of this lake. Moreover, recent development of public and private works in the watershed are being abstracted water, free of any charge, from the lake and its feeder rivers. The reduction of the lake water level could also have resulted from siltation, due to the decreased vegetation cover through deforestation in the upper watershed. These activities are exploiting the lake, its feeder rivers, and its watershed resources, seemingly beyond their capacity, affecting both the water volume of the lake and its fish production [22].

Figure 2: Wetland vegetation in Ziway lake is getting depleted due to shoreline farming.
Source: Teklu G et al. 2017.

Figure 3: Direct disposal of untreated effluents into lake Ziway.
Source: Teklu G et al. 2017.

Concerning the major changes that have occurred in land use and management in Lake Ziway watershed over the last 20 years, the establishment and expansion of floriculture industries and other investment projects which discharge different pollution to the lakes (Figure 3), such as lodges; high population growth and consequent expansion of settlements and cultivated lands at the expense of other land use types, such as forestlands, woodlands, etc.; high applications of agrochemical inputs (pesticides, fertilizers, herbicides) to increase productivity; soil erosion; and, unabated deforestation practices for fuel-wood, charcoal, and farming [22].

Over-exploitation of wetland resources is now a major threat in several wetland areas of Ethiopia. A good example of over-exploitation is the fishery resource from Lake Ziway in the Oromia Regional State [23]. Excessive exploitation of resources can also lead in some cases to a direct collapse of the wetland itself. An excessive water withdrawal was believed to be a major cause for the collapse of the lake even though siltation also has played its part.

Lake abiyata

The maximum depth of the lake Abiyata is 13m, while the average depth is 7.6m (Lemma H, 2016) and the volume of the lake is approximately 750 million m3 (ILRI, 2001). Water consumption for domestic use and smaller irrigation schemes

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along the Bulbula river is unknown, but total extraction is about 59 million m3, which is about 38% of the mean annual Bulbula river discharge recorded over the past 30 years (Legesse, et al. 2004). The annual water extraction for soda factory from lake Abiyata lake through an artificial evaporation basin is estimated at 2.25 million m3 (Legesse, et al. 2004) and 15 million m3 [24].

Since Lake Abiyata is fed mainly by excursions of the upstream lakes of Ziway and Langano, and because of its terminal position in the drainage area, and its shallow depth. Lake Abiyata has more pronounced sensitivity to changes in the basin and any diversion of feeder rivers for irrigation projects along the Meki and Ketar Rivers and water abstracted directly from Lake Ziway for irrigation and domestic consumption [25].

Level of lake Abiyata

The level of Lake Abiyata is influenced strongly by its inlet Lake Ziway, which transfers water through the Bulbula River. The area of lake Abiyata is decreasing from time to time due to different factors as indicated in (Figure 4). According to Wondowesen G. et al. [4], the surface area of lake Abiyata is reduced by 25.6% from its 1985's size (Table 1). Tenalem A [24] also reported that, the level of the lake has decreased after 1985, when water abstractions and land use changes increased dramatically. Since the 1970's the lake level has dropped about 5m [26]. Such kind of drastic change in surface area of lakes may have long lasting negative consequences. The reduction in surface area of the lake Abiyata intertwined negative impact on ecosystems, biodiversity and livelihood of the community. The level of Lake Abiyata is influenced strongly by the input into Lake Ziway, which transfers water through the Bulbula River. However, the monthly gains of Lake Abiyata to storage are insufficient and less than 5% in most dry months. There was a considerable reduction in the volume of Lake Abiyata in 1985 and 1990, amounting to about 51% of its present volume [27].

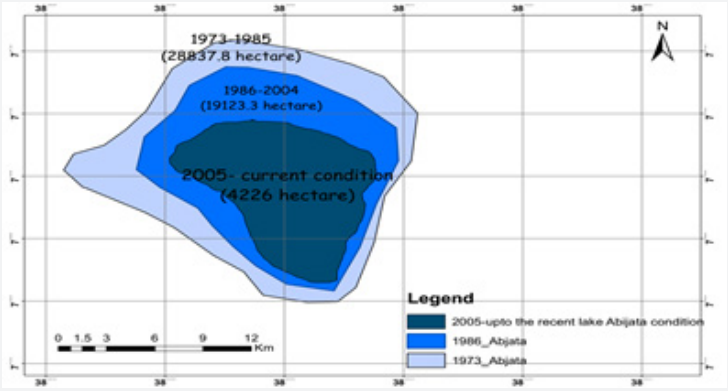

Figure 4: Trends of lake Abiyata. By: Melkamu Demelash, 2018.

In general, the level of Lake Abiyata fluctuates according to the precipitation trends in the highlands. However, the recent drastic decline in its level and the increase in salinity coincide with the time of large-scale water abstraction. The current and future uncontrolled water abstraction will have obvious environmental repercussions, which are thought to bring serious consequences to the lacustrine environment in the predictable future. Changes in Lake Abiyata should be perceived jointly with the abstraction of water for irrigation around Lake Ziway.

Major threats of lake Abiyata

Figure 5: Water abstraction in Lake Abiyata for Soda ash plant and De-vegetation of upper watershed of Lake Abiyata.

Water consumption for domestic use and smaller irrigation schemes along the Bulbula river is unknown; but, Legesse et al (2004) estimated total extraction at about 59 million m3, which is about 38% of the mean annual Bulbula river discharge recorded over the past 30 years. The direct pumping of water from the Lake Abiyata for commercial exploitation of soda ash

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by evaporation of brine also impacts on lake levels [25]. Annual water use for soda extraction from Lake Abiyata through an artificial evaporation basin is estimated at 2.25 million m3 [13] and 15 million m3 (ILRI, 2001). Currently, there is no fish and fishery activity, which could be due to the declined water level of the lake, high salinity and associated effects.

The declining of lake Abiyata by five meters over the last three decades is due to a saline-alkaline type and inters of lake level variability [26] and also found to be heavily impacted by anthropogenic activities [14,26]. Its size, for instance, was decreased by 25% over the last thirty years because the lake water is under burden due to the production of Soda Ash using solar evaporation of brines from the lake in (Figure 5) and the maximum drop agrees with the time of large-scale water abstraction [13].

However, the inter-annual fluctuations are controlled by climate variability. According to Legesse et al. [13], this lake also reacts more rapidly to an abrupt shift to wetter conditions than to dry conditions. The production of Soda Ash has not taken place for the last three years of the reporting time because of the significant decline in the water level [28]. The fluctuation of Abiyata follows the same trend as Lake Ziway, with an average time delay of about 20 days and Any abstraction of water in the Ziway watershed results in a greater reduction in the level of Abiyata than in Ziway [13].

Lake langano

A high percentage of its water comes from precipitation. Hora Kello forms its only outlet flowing into Lake Abiyata. Its mean depth is around 20 meters. The sandy beaches on the western shores attract tourists in high numbers [29]. Lake Langano experienced only small seasonal water level variations of about 1 m, and lower inter-annual water level variations compared to other lakes in the basin [14,30]. Lake-bed sedimentation is also estimated to the magnitude of about 0.5 to 0.6cm/y, with 85%-95% water content [13].

Level of lake Langano

As Wondowesen G. et al. [4] indicated, the surface area of lake Langano is reduced by 0.84% from its 1985's size (Table 1). Such kind of drastic change in surface area of lakes may have long lasting negative consequences. The reduction in surface area of lake Langano intertwined negative impact on ecosystems, biodiversity and livelihood of the community

Threats of lake Langano

The absence of considerable water abstraction and large groundwater flow from springs are considered to be the factors against its relative stability of lake level variability. The area in general is located in a dry and water scarce zone. Tourism is a high-profile industry at this lake and its effects are not clearly known [31]. Without a control system in place, increasing resorts and growing numbers of tourists can have negative effects in the long term [32].

Lake Shalla

Lake Shalla is an alkaline closed lake, located in the southern part of ASLNP

(7030'N-38030'E) and has the lowest altitude, 1570m.a.s.l, from the other three

Figure 6: Picture showing Lake Shalla and its wading birds. Source: Tafesse K [33].

lakes in the central Rift Valley [33]. Lake Shalla is 3km south of Lake Abiyata and they are separated by an elevated strip of land, which is part of the old depression edge. Lake Shalla is a deep saline depression lake with a surface area of 329km^2 at an altitude of 1570m a.s.l. It has a maximum depth of 266 meters and a mean depth of 87 meters [34]. Shalla has an independent sub-basin of its own and drains a catchment of 3920km^2. The Park was established to protect biodiversity and large number of very important birds which use Lake Abiyata as feedings and Lake Shalla as nesting and breeding grounds. Shalla is an important site for breeding colony of great white pelicans (Figure 6) and wintering ground and maintenance station for large number of birds including from Southern African, Sub-Saharan and Palearctic species.

Level of lake Shalla

As Wondwossen G et al. [4] indicated Area of lake Shalla is reduced by 1.48% from its area of 1985 (Table 1). Such kind

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of drastic change in surface area of lakes may have long lasting negative consequences. The reduction in surface area of the lake Shalla intertwined negative impact on ecosystems, biodiversity and livelihood of the community. The Over all status central rift valley lakes area is summarized in the following table 1.

Threats of lake Shalla

A threat of lake Shalla is not well documented yet, because the lake is completely protected, together with an area of peripheral land, in the Abiyata-Shalla National Park and there is the limited literature concerning Lake Shalla due to limited interest in the lake water because of its alkaline nature [14]. ASLNP was submitted to the Ramsar Convention on wetlands as an international important candidate wetland site. However, the water level and surface area of the lake and the status of the park are deteriorating may be due to human encroachment, grazing by cattle, uncontrolled water abstraction and other anthropogenic activities (Reaugh, 2011).

Over all Threats of Central Rift Valley Lakes of Ethiopia

Tesfau B et al. [35] noted that, wetlands are being encroached over time by the local community and other investment activities. As indicated in (Figure 7), the major driving factors of wetland loss are:- population growth which lead to farm land scarcity, overgrazing due to shortage of grazing land and increase in the number of heads of livestock, sedimentation due to soil erosion from the catchment, direct drainage and conversion of wetlands in to other land use types, lack of awareness, vegetation clearance, and introduction of exotic species.

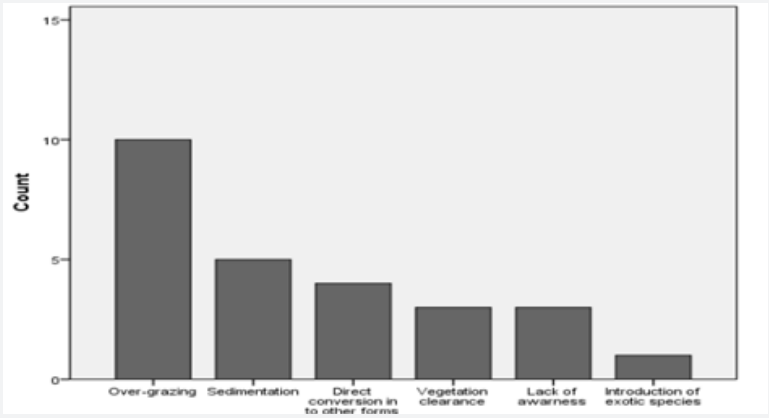

Figure 7: The major driving factor of central rift valley lakes of Ethiopia. Source: Tesfau B et al. [35].

Draining for agriculture

Long term draining interferes with the ecological recovery of the wetland system and will fasten it drying up. In Afar regional state, many areas of wetland have been lost during 1960's due to the increase of irrigation practice in the area [36]. As a result, the state has lost many of wetlands from the area.

Over grazing

Figure 8: Overgrazing in central rift valley lakes of Ethiopia. Photo by Tamiru L, 2018.

Over grazing has contribute for the deterioration of central rift valley of Ethiopia as observed in (Figure 8). Wetlands are often a last destination for pastoralists during the dry season. Over grazing is a threat when year-round grazing excludes ecological recovery period of the wetland which implies loss of biodiversity [37] Compaction of the wetland also have impact on the infiltration capacity of the soil hence affecting the hydrological system and balance of the wetland itself.

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Over exploitation of wetland resources

Over-exploitation of wetland resources is now a major threat in several wetland areas of Ethiopia. A good example of over-exploitation is the fishery resource from Lake Ziway [23]. Excessive exploitation of resources can also lead in some cases to a direct collapse of the wetland itself. A good example for this scenario is the collapse of Lake Abiyata. An excessive water withdrawal was believed to be a major cause for the collapse of the lake even though siltation also has played its part.

Deforestation siltation and soil erosion

Figure 9: Deforestation, siltation and soil erosion around Ziway and Abiyata lake. Photo by Tamiru L, 2018.

The accumulation of silt complete change in the ecosystem biodiversity alteration, decreases in the water holding capacity and in the worst case the collapse of the wetland itself (Figure 9). Introduction of nonnative plants to the wetland [38] removal of buffering vegetation and upland forest degradation (Figure 8) are the main causes for the loss of vegetation.

Urbanization and industrialization

Mekonnen G & Yared W [39] indicated that, Pollutions, which are originating from the point and non-point sources causes degradation of wetlands; particularly fishes, macrophytes, riparian vegetations, and other biodiversity that are found in these ecosystems are suffering from these pollutions. The pollution that discharge from Hotels and hospitals effluents, garages, farms, which uses huge amount of pesticides, and manufacturing industries are considered as point source pollutant, whereas domestic wastes and agricultural fields are non-point sources. These both point and non-point source of pollution are negatively affecting the central rift valley wetlands of Ethiopia which include Ziway, Shalla, Langano and Abiyata lakes and wetlands in the Awash River basin due to eutrophication.

Overfishing

Figure 10: Over fishing in lake Ziway. photo by Tamiru L, 2018.

The other problem of rift valley lakes over fishing as showed in (Figure10). Overfishing may result in the loss of some fish species. On Lake Ziway, the 'gancho' net has caused the rapid depletion of fish population which cause 70% of the fish landed from the Rift Valley Lakes comes from Lake Ziway alone, suggesting disproportionate fishing pressure [40].

Introduction of floriculture industries

The rift valley in Ethiopia is a hot spot for flower production as specified in (Figure 11). Water availability and transport links provide suitable conditions for this industry. One large company Sher Ethiopia now occupies about 300 hectares in Ziway.

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Figure 11: Introduction of floriculture industries at the shoreline of lake ziway. Source: Teklu G et al. 2017.

Climate change

In many parts of the world, change of hydrological cycle, temperature increase, and a sea level rise might contributed a lot to the lake's degradation [41]. Similarly, some of the lakes in Ethiopia are affected by natural hazards such as drought, over flooding and seismic events. Wetland ecosystems are threatened by the impacts of climate change. Globally, the impacts of climate change on freshwater systems are expected to outweigh the benefits. Climate change is increasing uncertainty in water management and making it difficult to close the gap between water demand and supply [42].

Population growth

In Ethiopia Population growth rate remains high, and a large number of people are living in poverty and their livelihoods system depending on wetland resources [43]. Un wisely use of wetland resources for irrigation, domestic purposes, and over grazing also adversely affect wetlands in many parts of the country [44]. 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 [32]. The disruption of natural processes due to urbanization, agricultural intensification, dam construction, pollution, water transfer, and other factors the hydrological and ecological systems of many wetlands have been lost in Ethiopia [45]. As Abebe et al. [46] stated that, lake Chamo, Shalla, Abaya, Abiyata, Ziway and Tana are among the lakes, which are severely threatened due to water abstraction for either industrial or agricultural purposes.

Land use and land cover change

CRV Ethiopia is a home to many notable aquatic and terrestrial ecosystems, but degradation of natural resources is definitely intertwined and expressed. Generally, rapid population growth, agricultural expansion, environmental fluctuations, degradation of natural resource and loss of biodiversity are the most visible socio-economic and environmental problem in the CRV area and all these put pressures on the water bodies (mainly on the four lakes, Ziway, Langano, Abiyata and Shalla). Landscape change as a result of LULC and simultaneous landscape pattern changes are ongoing phenomena in the CRV area. Eyasu E et al. [47], over the last 30 years' period (1985 to 2015), the major LULC changes in CRV were: arable land expansion (small and large-scale farming including irrigated agriculture), reduction of natural vegetation and shrinkage of water resources in size and depth significantly. However, lake Abiyata showed a progressive decline by 25.9% resulting in severe degradation of the fragile ecosystems that have sustained the unique biodiversity for long and Consequently, the Abiyata-Shalla National Park is on the threshold of collapse, the second incident of lake collapse in the nation next to Lake Haramaya if a serious measurement is not taken on time [47]. These all may alter the nutrient levels, water regime and other related processes and may damage both aquatic and terrestrial biodiversity which reduce production and productivity.

Opportunities to Reducing Threats of Central Ethiopia Rift Valley Lakes

Almost all of lakes in Ethiopia are under a serious problem and at the same time the efforts to restore the health and normal functioning of lakes is insignificant. So, this section considers ways in which to reverse existing damaging trends and to improve the situation. Even though the cause of lakes degradation and loss are multidimensional and complex which leads to various unexpected cost to the societies and environment, the problems usually receive less attention.

Moreover, due to the current socio-economic and political status of the country, the issue of lakes of Ethiopia as general and central rift valley lakes particularly should get priority and become the agenda of the country to reverse the adverse impact of lakes degradation. So, searching the means to reverse the existing damaging and improve the condition of lakes is important. Therefore, Multiple stakeholder analysis is very important on how can minimize the extent of lakes degradation and its consequences. In spite of the complication and complex nature of the problems, there is no quick solution to compensate the threats being faced to lakes. In spite of comprehensive study is not yet done in Ethiopian lakes, there are studies done and there recommending what and how is an opportunity to lakes in Ethiopia.

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The capacity building and education programs can be contributed to CERV lakes policies, legislation and regulation, community empowerment, pollution control, initiatives related to climate change, invasive alien species control, threatened species conservation, and adaptive management of ecosystems in response to a changing environment. Additionally, the value and role of indigenous and traditional people knowledge should not be left out when setting up awareness, advocacy and capacity building [48].

Integrated Watershed Management (IWM) and Adaptive Management are important for central Ethiopia rift valley lakes management. Implementing integrated management and Adaptive management plans which cover every aspect of the lakes and their relationships with their catchments as well as giving required priority to lakes habitats conservation issue in terms of impact assessment. Monitoring and evaluation used to address the issue of lakes integrity and change in lakes quality. The extent and causes of loss and degradation of lakes can be determined and successful conservation measure is taken through monitoring and evaluation programs. However, the monitoring and evaluation could be carried out at different levels of intensity, depending on available funding and/or technology [49].

The most sound and important to reverse the threats of lake ecosystem is cooperation between different stakeholders. Some of the many stakeholders of Central Ethiopia rift valley lakes are Ministry of Agriculture, Ministry of Water Resources, Environmental Protection Authority, Biodiversity Institute, Ethiopian Agricultural Research Organization, Ethiopian Environment and Forest Research Institute, higher institution, Ethiopian Wildlife Conservation Organization, the Regional States and international NGOs such as Horn of Africa, idh, ide and other stakeholders who directly involve in lake conservation activities. For instance, Walkite university and Arsi university sign agreement to restore and protect the upper catchments central Ethiopia rift valley lakes in order to reduce siltation and sedimentation that affect the life span of the lakes. Multisectoral interest is an opportunity to lake conservation if they were work jointly. For example, experience has shown that seizing land from the people and setting aside a conventional protected area is not workable [50]. Many advantages and synergies can be achieved because of working in partnership with all concerned stakeholders.

Improve the relationship between upstream and downstream in related to utilization of resources is very important to reduce the threat of lakes. Establishing different soil and water conservation activities on the upper catchment by collaborating with the downstream community play a great role to reduce the effect of siltation and insure the existence of lakes. Disproportionate consumptive use or pollution of water by upstream users may negatively influenced the downstream users of their genuine use of the shared resource and consequently, upstream users must recognize the legitimate demands of downstream users to share the available water resources in order to reduce or manage the conflict between downstream and upstream stakeholders [48]. Therefore, any initiatives and development plans should maintain the associations between upstream and downstream users of water.

There are many formulated national and international lakes conservation policy to insure the sustainable use of lake ecosystem and maintain its biodiversity. Formulating policy and sign different international agreement is not enough unless implementing it very well. Encouraging political conviction is another important opportunity to reduce the threats of the central Ethiopia rift valley lakes of Ethiopia. politicizing the issue of lake ecosystem may also play a great role to get required attention from government to insure sustainable conservation. Such a policy and political convections enable to cope up with the various functions of lakes and guarantee into which lakes are integrally managed. So, develop a National lakes Policy as an integral part of Ethiopia's Land Use Policy is very important [51-54].

Conclusion and Recommendation

Ethiopia is gifted with numerous lakes which provide different ecosystem service such as provisioning, supporting, regulating and cultural services. Most of these lakes are situated in central Ethiopia rift valley. The major known lakes of central Ethiopia rift valley are lake Ziway, Abiyata, Langano and Shalla. The major threats of central rift valley lakes are deforestation, siltation, urbanization and industrialization, population growth, over grazing, over fishing, investment, land use and land cover change and climate change. The major opportunities to reduce the loss of lake degradation in central rift Ethiopian rift valley are capacity building, awareness creation, political conviction, partnership, and etc.

Economic policies and strategies that diminution the biodiversity and food security of local communities should be avoided. The understanding of possible solutions to lake degradation has to be reviewed encouraging effective local strategies. Sound strategies and projects need to be designed and implemented to rehabilitate degraded lakes. The amount and type of agricultural chemicals used in the lake's catchment and leached into it has to be studied. Empowering local communities to conserve and protect their lakes and finally, it is useful to remain realistic about the feasibility of policy and strategy, implementation and law enforcement.

The gap that has been identified during reviewing different research articles on central Ethiopia rift valley lakes are

a) limited research work on lake Shalla and Langano

b) lack of research work on management techniques of different threats because of most of the research done are a kind of surveying the problem, cause and consequences of different threats

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c) there is the limitation of research work on ecosystem service valuation of central rift valley of Ethiopia which is very important input for policy recommendation

d) the impact of each threats on the storage capacity of each central rift valley lakes are not well quantified (estimated).

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