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Flow Status and Challenges on Hora Kallo and Bulbula Rivers; Lake Abijata Tributaries in case of Abijata Shalla Lakes National Park, Ethiopia.

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Abstract

The study was conducted at Abijata Shalla Lakes National Park (ASLNP), Ethiopia to investigate flow status and challenges on Hara Kallo and Bulbula Rivers; Lake Abijata tributaries. The general objective of the study was to conduct survey assessment on the flow status of Lake Abijata's tributary Rivers and their management challenges to forecast their sustainable conservation managements. Data was collected through measurement of the rivers depth, width and water flow speed with simple random sampling method and GPS point was taken for each sample points. The width of rivers was measured by using meter tape rising from side to side and the depth was taken on the midpoint of the lake using a tall and straight tree. The rivers flow speed was measured by taking the sample of four meter (4m) length and drop a cover of an orange which could simply flow over the water and registered time taken to finish the four meter sampled distances. Structured interview by means of focus group discussions using a semi structured questionnaire regarding the challenges and community attitudes towards the water resource use and conservation challenges was undertaken organized by data collector. Five sample points for Hora Kallo River with the mean value inlet to the Lake Abijata 4,49m, 0.37m and 2.76m/s width, depth and flow speed, while six sample points for Bulbula River with the mean of 11.5m, 1.3m and 4.22m /s width, depth and flow speed respectively were taken due their distance from outlet to inlet were different. We have assessed some challenges at Hora Kallo River: Overconsumption for livestock drinking, for home purpose and over pumping huge amount of water from Bulbula River by big tracks for road constructions. Comparing with the last years of this season, both rivers are flowing to Abijata Lake in good and normal flow. The over consumptions on domestic water needs following the course of Bulbula River already creates water demand conflict between individuals, communities, and the investors. This lead may entrusts on the government or administration by the local community and perceived negative attitude towards the

projects. It is better to do cooperatively on integrated water resource management (IWRM) has to be done at the basin to minimize and control the challenges to enhance environmental productivity and sustainable water resource management is highly recommended.

Keywords: Tributary Rivers, over consumptions, Integrated Water management

Introduction

1.1.Background

Wetland ecosystems has become an urgent theme worldwide since providing adequate supplies of clean water to all people becomes more challenging. Although we have the tendency to reduce water to a biological fact when thinking about its nature, it is integral, even essential, to many if not most domains or institutions of society; economic, political, religious, leisure, etc. (Strang, 2004). At the same time, water as a social fact takes concrete forms, even though physically and in the intellectual we conceive of it as a continuous and homogeneous substance. When washing our bodies, we think of personal hygiene, and yet it matters to us whether water is delivered by a stopper into a bath or by a shower head into a stall whether the spray is strong or weak, sharp or gentle; and let us not even approach the cultural nuances of water temperature and softness.

Soil and water conservation measure used to increase for the availability of surface water for different uses. Well managed watershed play a key role in the improvement of the life of watershed community through reduction in natural resource degradation, access to fodder for their livestock, expansion in off-farm economic activities and socio economic conditions. Access to employment opportunities outside farming could help to reduce the pressure on natural resource and emerging landlessness (Amsalu Taye, 2006).

Water world could productively explore three specific sites: watersheds (catchments), water regimes and waterscape (water landscape), Rodriguez's (2006). Ethnography of community managed irrigation in northern New Mexico examines watersheds, shows that the social boundaries of parishes and the hydrological boundaries of basins are close but not always overlapping because local residents redirect water between drainages. The study considers water regimes by tracing conflicts between customary practices and new state regulations. It also depicts the sensory and ritual aspects of waterscapes and shows how the annual cleaning of canals and other ritual practices by local residents inscribe them in the landscape and in the multilayered ethnic history of their region. Meteorological and hydrological records can help understand the response of low latitude regions to global climatic change and can be used to analyze the sensitivity of a lake to environmental fluctuations through hydrological modeling (Nicholson and Yin, 2000 in Vallet Coulomb *et al*., 2001).

The East African saline lakes support spectacular concentrations of wetland dependent wildlife especially birds; 452 terrestrial and aquatic species of birds have been described from Lakes Shalla and Abijata, of which 1 is endemic (Hillman, 1993). The Ethiopia's greatest four Central Great Rift Valley lakes: Dambal/Ziway, Langano, Abijata and Shalla lakes ecosystems highly inhabit enormous biodiversity rich especially avian species of wetlands. Abijata and Shalla are saline with PH of 9.3-9.5 and 9.0 -10, respectively while Langano and Dambal/Ziway are relatively fresh water (Legesse *et al*., 2004; kebede *et al*., 1994). Lake Abijata is one of the most important saline rift terminal lakes which have different uses and ecosystem values. One important ecological value of saline and salt lakes are their role as feeding, refuge and breeding sites for many water and water related-bird species. As a result of the presence of various bird species, the lake and its environs has been designated as one of the national parks (Abijata Shalla Lakes National Park). Water is crucial for humankind, not only for a means to sustain our life, but as a

determining factor in many production activities and conservation. These uses and values are increasingly subjected to degradation from a variety of different anthropogenic and climatic impacts like mining of soda ash, poor land use management and over pumping of water both on recharging Feeder Rivers and directly from the lake without accounting environmental flows to downstream users and ecosystem services. Due to high level of stress human development is putting on the environment and the services it provides, the concept of water use has arisen. Then, the park has already been converted in to farm and grazing land with a lot of settlement areas which aggravate the stresses and impacts upon the lake. Central rift valley is one of the environmentally very vulnerable areas in the country due to different kinds of anthropogenic impacts. There is a clear decrease of the water resources. Lake levels have been lowered and wetlands have been deteriorated. Recently, Lake Abijata is one of the most endangered lakes of Ethiopia next to Haromaya (Ayenew, 2003; Flower, 2010). Therefore, need to understand how water interacts with the environment and with human activities in order to properly determine how to protect human kind from potentially devastating effects of mismanaging, to optimize benefits that it can bring to development with good conservation. On the other hand, the most appropriate geographical entity for the planning and management of water resources is the river basin, including surface and ground water. Therefore, this survey is based at the river basin scale. The river basin can be defined as the portion of land drained by a river and its tributaries, which may drain into the Lake Abijata. In order to devise a water budget within this lake, knowledge of the water balance is required. There is an argumentative and many long years burning issues by all concerned bodies at regional, national and international levels about the shrinking down of Lake Abijata. Abijata Shalla Lakes National Park (ASLNP) which nearly leads the resource and all corned bodies has come to the decision that this issue has to be addressed urgently. Following this, the park has mobilized experts to look in to the current status of Lake Abijata's tributaries to come up with feasible management interventions to save this nationally and globally important rift lake. As a result, the survey was done for a period of time, exhaustive literature review, field observation, separate focal group and individual discussions were applied to provide baseline information on the current status Lake Abijata's tributary rivers (Hora Kallo and Bulbula) interference measures to decision makers.

Objectives of the Study

General Objective

The overall objective of the study was to conduct survey assessment on the flow status of Lake Abijata's tributary Rivers and their management challenges to forecast their sustainable conservation managements.

Specific Objectives

- To determine the recent flow status of Hara Kallo and Bulbula Rivers currently the only tributary Rivers of Lake Abijata.
- To identify the major challenges of the Rivers and their upper streams to recommend sustainable management decisions.
- To review literatures regarding the challenges and statuses of Lake Abijata's tributary Rivers

Scope of the Assessment

Lake Abijata is extremely depends on the balance of the upstream hydrogeological systems; Dambal/Ziway Abijata catchment of the Dambal/Ziway Shalla sub-basin and Lake Langanno watershed. This assessment focused on the current situation of the tributary rivers and the impacts exerted on it. Irrigation, industrial expansion and Water supply, direct and indirect effect of Abijata Shalla Soda Ash Share Company on the environment and upstream water users that affect the flow of Bulbula and Hora Kallo Rivers are also main parts of our assessment. Geographically the assessment area can be delineated by the hydrological boundaries/ watershed and the boundaries of the major

woredas (used for the regional statistical information).

Main Limitations of the Assessment

The main limitations of our assessment are lack of modern and well equipped hydrological survey field equipment's and insufficient up-to-date relevant hydrological and meteorological data. In addition, the assessment was mainly focused on water quantity of the tributary rivers flows to Lake Abijata while hydro chemical changes are not addressed well.

Materials and Methods

Brief Description of the Study Area

Abijata-Shalla Lakes National Park was established in the 1960s as a National Park when most of Ethiopia's Wildlife Protected Areas were designated (Hillman, 1993) cited in Jaldu Lalisa *et, al*, (2025). It is located in the Oromia Region and the Ethiopian Highlands region, 200 kilometers south of Addis Ababa, and east of the Batu–Shashamane highway. It contains 887 square kilometers including the Rift Valley lakes of Chittu, Abijata and Shalla. The two lakes Chittu and Shalla are separated by 0.8 kilometer and shalla and Abijata are separated by three kilometers of hilly lands. The altitude of the park ranges from 1540 to 2075 meters, the highest peak being Mount Fike, which is situated between Abijata and Shalla lakes. Abijata-Shalla Lakes National Park has many attractions: viewpoints, bird-watching, and photography, the three alkaline lakes Chittu, Shalla and Abijata, (Abijata and Shalla lakes are the two alkaline lakes that were formed during the volcanic activities of O'a Caldera and rare earthquakes while lake Chittu was created through long eras process of lake Shalla condensing and shrinking to the current size as the name Chittu indicated separated/cut from lake Shalla. Besides the three lakes, the primary attraction of this National Park is a number of hot springs on the northeast corner of Lake Shalla and large numbers of flamingoes on the lakes. Rich hot springs are also found on Shalla's southwest and eastern shores. Mount Fike is located between two lakes, befitting for trekking and viewpoint of three lakes, including Langano. Lake Chitu, a small blue-green saline lake, is found south of Lake Shalla which was covered in Blue-green algae (Keto, Yosef & Saibi, Hakim, 2021).

The habitat of Abijata-Shalla National Park contains open grasslands, dry savannas, arid shrublands, and deciduous woodland that were dominated by Acacia trees, which include umbrella thorn acacias, red acacias, gum acacias, Acacia etibicas, Egyptian balsams or *Bedanas*, and sycamore.

Abijatta Shalla National Park is home to 76 species of mammals which includes: Grants gazelles, Bohor reedbucks, Oribis, Warthogs, Greater kudus, Caracals, Guereza (Colobus monkey), Spotted hyenas, Kilipsringers, Porcupines, Olive baboons, Aardvarks Honey badgers, Abyssinian hare and Black-backed jackals. Other species that were abundant in Abijatta Shalla National Park, such as lions, giraffes, waterbucks, buffalos, and Swayne's hartebeests, were locally extirpated due to hunting or possibly habitat loss. Other mammalian species that are endemic to this park include Scott's hairy bat (*Nyotis scotti*), white-toothed shrew (*Crocidura phaeura*), Mahomet mouse (*Mus mahomet*), Ethiopian white-footed mouse (*Stenocephalemys albipes*), Abyssinian grass rat (*Arvicanthis abyssinicus*), and Harrington's rat (*Desmomys harringtoni*) Worku, Zerubabel (2018).

The park is also home to more than 453 (representing 52.5% of the total country) bird species have been recorded (Rezenom A, 2012), that are listed as endemics, residents, and migratory. Common Ostriches and Somali Ostriches are mostly common for their breeding. Two species of flamingos commonly thrived on Lake Chittu, Abijata and Shalla for algae-feeding and breeding areas: greater flamingoes and lesser flamingoes. Great white pelicans only settled on Lake Shalla which also serves as both a breeding site and a feeding

ground along with several species of storks, herons, egrets, plovers, and cormorants. Other bird species such as parrots, ducks, eagles, owls, hornbills, barbets, bee-eaters, and pigeons are also flourish within these scrublands, Worku, Zerubabel (2018). Wattled ibis and yellow-fronted parrot are the only know endemic species known in Ethiopia. Black-winged lovebird, white-winged cliff chat, and white-billed starling are near-endemic species found within the park's habitat, Molla, A. (2014, June 6).

The most challenging issues of the day affecting the existence the National Park is that even if its intent was to protect wildlife, livestock grazing, settlements, agricultural activities, deforestation and habitat encroachments that currently viewed there are happened from the tumultuous period of the last days of the Derg regime, and for some time afterward, large numbers of nomads took advantage of weakened central authority to move into the Park and after exercises a land tenure. Much of the *Acacia* woodland surrounding the Lakes has been cut down for charcoal and other purposes. Currently, small groups not only continue to fall *Acacia* trees, but they also go as far as to remove the salty soil from the lake shoreline and sell it, (Birdlife International website (accessed 22 May 2025).

Location and Climate of the Study Area

Geographically the park is located between 7022'4.8" to 7042'47.7" N longitudes and 38022'32.8" to 38040'36.4" E Latitudes. The Park encompass an area of 482 km^2 aquatic ecosystem from the total size of 887Km^2 (principally by the alkaline lakes, Chittu, Shalla and Abijata) and their shorelines, and the rest 405 km^2 is land or terrestrial ecosystem.

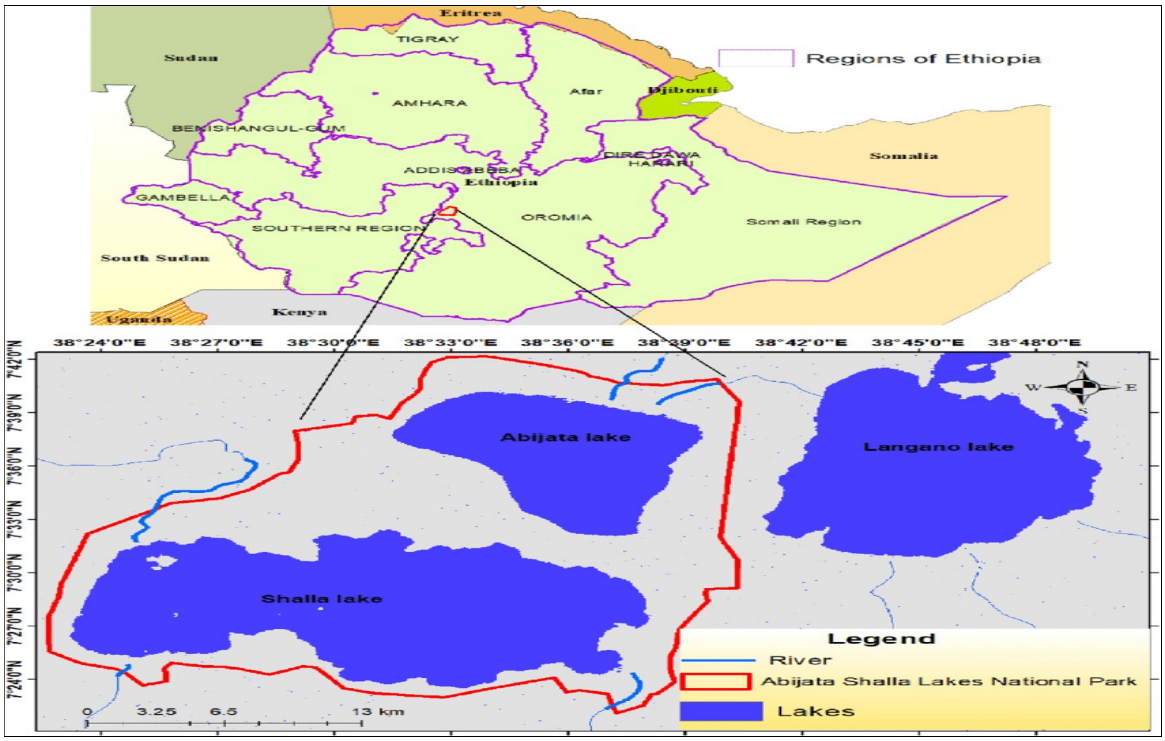

Figure 1: Map of Abijata Shalla Lakes National Park (Source ASLNP General Management Plan, 2023 unpublished document).

Climate

The lakes of the Ethiopian Rift Valley experience a wide range of climate, emphasized by the annual north-south movements of inter- and sub-tropical frontal zones across the country. The climate is humid to sub-humid in the highlands and semi-arid in the rift valley. The mean annual temperature is around 15°C in the highlands and 20°C in the rift valley. The average annual rainfall ranges from 650 mm in the rift floor and 1150 mm in the highlands (Kassie *et al*., 2013). The area has a bi-modal rainfall pattern, main rainy season (June–September), locally known as Kiremt and a short rainy season (March–April), locally known as Belg as well as the dry season lasts from October to February.

Methodology

Field or site observation was taken for both rivers; Hora Kallo and Bulbula starting from their Drainages (outlets) Langano and Dambal lakes respectively to their destination (inlets); Lake Abijata. Through the physical observation, survey was undertaken to measure the rivers depth, width and water flow speed with simple random sampling method and GPS point was taken for each sample points. To minimize the edge effect, the survey point was taken at a minimum of fifty meter (50m) distance from both outlet and the destination (inlet). The width of rivers was measured by using meter tape rising from side to side and the depth was taken on the midpoint of the lake using a tall and straight tree. The rivers flow speed was measured by taking the sample of four meter (4m) length randomly and drop a cover of an orange which could simply flow over the water and registered time taken to finish the four meter sampled distances.

Finally mean value of all variables (width, depth and flow speed) was taken to measure the amount (by what depth width and flow speed) of water that discharge to Lake Abijata through both Hora Kallo and Bulbula rivers. From side to side personal observation all challenges and threats imposed on both rivers were critically identified. Structured questionnaire were prepared to collect hydrological data, land use, water use and environmental rehabilitation and management system were collected. Interview and short discussion were made with respective stakeholders. Secondary data were also compiled from different sources. Finally the primary and secondary data collected were analyzed carefully.

Figure 2:- Field survey of the assessment

Results and Discussion

Current flow Status of Hora Kallo and Bulbula Rivers

Table 1:- Survey result of the tributaries of Lake Abijata (Hora Kallo and Bulbula) rivers

Sample points	**Hora KalloRiver**				**Bulbula River**			
	GPS Coordinates	Width in meter	Depth in meter	Flow speed m/s	GPS Point	Width in meter	Depth in meter	Flow speed m/s
SP1	X= 467978 Y= 847808 Z=1583 m.a.s.l	3.75m	0.28m	1.94	X= 456708 Y= 845301 Z=1571m.a.s.l	7m	40cm	2.11
SP2	X= 466677 Y= 848488 Z= 1584 m.a.s.l	8m	0.20m	2.73	X= 457449 Y= 847310 Z= 1577 m.a.s.l	7m	55cm	1.83
SP3	X= 462731 Y= 848907 Z= 1578 m.a.s.l	3.2m	0.50m	2.30	X= 459651 Y= 850525 Z= 1586 m.a.s.l	10m	52cm	1.74
SP4	X= 460457 Y= 847378 Z= 1575 m.a.s.l	5m	0.48m	3.83	X= 461156 Y= 853518 X= 1585 m.a.s.l	8m	30cm	2.51
SP5	X= 459034 Y= 846084 Z= 1575 m.a.s.l	2.5m	0.40m	3.03	X= 470542 Y= 872386 Z= 1665 m.a.s.l	27m	4.5m	14.54
SP6	-	-	-	-	X= 470289 Y= 869049 Z= 1648 m.a.s.l	10m	1.5m	2.60
Mean		**4.49m**	**0.37m**	**2.76**		**11.5m**	**1.3m**	**4.22**

As described on the above table; width, depth and flow speed of both rivers were measured based on random sample points starting from their outlet Lake Langanno for Hora Kallo and Lake Dambal/Ziway for Bulabula Rivers. The mean of measurement was taken for each river to determine the depth, width and flow speed of water discharged to Lake Abijata through the tributary rivers. Five sample points for Hora Kallo River with the mean value inlet to the Lake Abijata 4,49m, 0.37m and 2.76m/s width, depth and flow speed respectively while six sample points were taken for Bulbula River with the mean of 11.5m, 1.3m and 4.22m /s width, depth and flow speed respectively due their distance from outlet to inlet were different. We have assessed some challenges at Hora Kallo River: overconsumption for livestock drinking, for home purpose and over pumping huge amount of water from Bulbula River by big tracks for road constructions.

In addition, we have encountered with car washing activity on Hora Kallo following the main asphalt road near the bridge that much affect both the water quality and volume of the river. Comparing with the last years of this season, both rivers are flowing to Abijata Lake in good and normal flow. For the last two to three years at the same season, both of the rivers were totally dried and the area was under big problem of drought. The wetlands surrounding Lake Abijata Shorelines were in a good situation and supporting lots of aquatic avian species rather than the previous consecutive two years. There were small scale irrigations following Bulbula River and also high water consumption by SherEthiopia floriculture and Castle Wine factory.

Figure 3: Current situations of Lake Abijata shoreline Wetlands on the inlets of the rivers

Challenges of the Upper stream catchments of Hora Kallo and Bulbula Rivers the tributaries of Lake Abijata

The main challenges that negatively affecting both rivers includes: overgrazing, deforestation of the Upper catchments, upstream water block especially from Bulbula River for SherEthiopia floriculture, Castle Wine factory and over pumping of water by many small scale irrigations following the river and chronically over obstruction of water for soda ash mining which results in drying up of the lake at end through declining the water volume.

Additionally, expansion of irrigation activities following the rivers because of population increment around the area, high increasing of industrialization and urbanization, the Dambal/Ziway-Shalla basin is under a big problem in terms of sustainable conservation. These conditions made the area over populated and exerted a big pressure on the natural resource such as water and biodiversity sustainable management. The wide plains or grassland on the inlets of the rivers were being used for overgrazing, the population density was high in the area that caused the forest and Acacia wood land has become blowing sand due to extensive farming and deforestation for charcoal production and severe grazing.

Figure 4:- Overgrazing challenges at Lake Abijata wetlands

Irrigation and water demand on the upper catchments of the Rivers

The domestic demand calculated by assuming average national water use rate (Jensen *et al.* (2007), in Dambal/Ziway-Shalla sub-basin, there are a total of 49,250 ha of planned irrigation but the analysis has estimated that only 8,588 ha could be supported (Table 1).

Table 1:- Water use upstream watershed catchments (from seven sub catchment).

Demand site	Total Area (ha)	Required Water Allocation m^3/ha or m^3/person)	Water consumption m^3 per year
Meki Irrigation	388.00	12,087.00	4,689,756.00
Katar Irrigation	856.00	11,483.00	9,829,448.00
Ziway Irrigation	2,000.00	12,691.00	25,382,000.00
SherEthiopia	500.00	14,600.00	7,300,000.00
Castel Winery	500.00	2,200.00	1,100,000.00
Bulbula River Irrigation (farmers)	477.00	12,691.00	6,053,607.00
Bulbula River Irrigation (investors)	3,037.00	12,691.00	38,542,567.00
Langanno Lake Irrigation	830.00	12,691.00	10,533,530.00
Soda Ash	15,800 ton	150 m^3/ton	2,370,000.00
Ziway Lake Water Supply	43,660 (person)	32.80	1,432,048.00
Bulbula River Water Supply	5,000 (person)	32.80	164,000.00
Total	**8588**		**107,396,956.00**

As showed on table 1 the water demand by local community and investor for different purpose indicates 107.4 million m^3. As a result the visible change in almost all lakes mainly as a result of water uses from feeder Rivers and lakes.

There were a lot of water based development projects planned to implement in Dambal/Ziway-Shalla sub basin estimated annual gross water demand that accounts totally 701.81Mm^3. From these projects the Abijata Shalla Soda Ash S.C, SherEthiopia P.L.C, Frigofrico Boran P.L.C and irrigations have the big share in annual water demands. The Great Central Rift Valley ecosystem has short rainy season and frequently affected by drought. Although the natural ecosystem of the area is under critical climate change, it's obviously stressed due these human induced factors and the future development and water resource would imbalanced (RVLB Master Plan, 2009).

The impacts local communities on the rivers water resources through over use

Many thousands of the surrounding communities livestock depends their life feeding water on the Rivers water resources (Bulbula and Hora Kallo) and wetlands surrounding the lakes throughout the years. The agricultural based communities are also affecting the rivers catchments, while their productivity also affected with the effects of the Rivers water resources fluctuations. The exercises of over consumptions in water resources for domestic purposes, unbalanced irrigation practices and soda ash production compete with the environmental services of the surrounding ecosystems. The over consumptions on domestic water needs following the course of Bulbula River already creates water demand conflict between individuals, communities, and the investors. Due this there were challenges of untrusted on the government or administration by the local community and perceived negative attitude towards the projects due to illness and death of livestock (through water use competition and pollution).

Conclusion and Recommendations

Conclusion

The Central Great Rift Valley ecosystem of Ethiopia has been characterized by various nested lakes dominantly controlled and feeds by tributary rivers and highland rain fall and tectonically active volcanic terrain with very fast ecosystem degradation. Lake Abijata is one of these major nested lakes (Dambal, Langanno, Abijata, Shalla and Chittu) and their ecological services are intensely fluctuating both bio-physically and geo-chemically. Five sample points from Hora Kallo and six sample points were taken from Bulbula Rivers to determine flow speed and depth of the Rivers from their outlet Langanno and Dambal Lakes respectively to their inlet Lake Abijata to know their contributions to Lake Abijata water volume. Accordingly Hora Kallo River flows to the Lake with the mean value 4,49m, 0.37m and 2.76m/s width, depth and flow speed respectively while Bulbula River flows with 11.5m, 1.3m and 4.22m /s width, depth and flow speed to recharge the Lake Abijata. We have assessed some challenges at Hora Kallo River: overconsumption for livestock drinking, for home purpose and over pumping huge amount of water from Bulbula River by big tracks for road constructions. In addition, we have encountered with car washing activity on Hora Kallo following the main asphalt road near the bridge that much affect both the water quality and volume of the river. Comparing with the last year of this season, both rivers are flowing to Lake Abijata in good and normal flow. Comparing with the last year of this season, wetlands surrounding Lake Abijata Shoreline were in a good situation with supporting lots of aquatic avian species rather than the previous consecutive three to two years. The land use and land cover change was also intense only remnant trees and shrubs were present even inside the national park, unless the areas that were protected and conserved by organized local youths and elders. The area has been facing the challenges from farm land expansion, saline soil locally called "Boojjii" excavation on the dried bare land of Lake Abijata's, Overgrazing, Overfishing and

the alarming rate of deforestation. The exercises of over consumptions in water resources for domestic purposes, unbalanced irrigation practices and soda ash production compete with the environmental services of the surrounding ecosystems. The conservation and sustainable management of water resource that is vulnerable and very scarce natural resource, is very pivotal through enhancing and promoting all efforts towards the efficient, equitable and optimum utilization of the available water resources for the significant socioeconomic and environmental development on viable basis is very essential.

Recommendation

Meaning full and targeted stakeholders and partners including the sub-basin water users participation and engagement enables to have opportunities for intensive involvement in planning, decision making and evaluation of all activities of the Rivers Watershed management plan preparation and implementation to overcome the challenges of water resources use and conservation management. There should be also very necessary to know our water resources balance and proper usage guidance to manage resource use conflict and over consumptions. The following recommendations were forwarded based on the survey assessment.

- The operational rule of the control gate of Bulbula River would be always opened and made transparent to all water users in order to flow through the river channel for ecological sustainability and environmental service.
- Pumping of water from the Rivers using floating pump especially following Bulbula Rivers should be manageable if Possible reduced to water balance of the River, because such system can dried up the River that affects directly Lake Abijata.
- Detail study on quantifying, the amount of water being consuming in the basin system through water balance analysis and adopt regulatory way of water use system should be implemented correctly.
- Supplementary discussions and awareness creation for water users of the area on sustainable use and management is very important to reduce water use conflict and some confusion about environmental degradation in the areas.
- Encourage modern and efficient technologies in irrigation system and agricultural practices are very important and would be supported by all concerned bodies.
- According to the newly proclamation of the River sides and Lakes buffer zone protection and development; the Rivers and Lakes should be delineated and protected, development works and settlements would have to be far from the water sources in case of the Rift Valley basin.
- To summarize participatory water management through active involvements of water users in every activities and decisions would be practiced to minimize water use conflict and environmental degradations.

Authors Contributions

Lalisa Mekonnen Jaldu: Conceptualization (lead); data collection and curation (lead); formal analysis (lead); investigation (lead); methodology (lead); project administration (lead); validation (lead); writing original draft (lead); writing review and editing of the writing (lead). **Tolera Sori Debassa**: Conceptualization (lead); data collection and curation (lead); formal analysis (lead); investigation (equal); methodology (lead); project administration (equal); validation (equal); writing original draft (equal); writing review and editing of the writing (equal).

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Conflicts of Interest

The authors declare that there is no conflict of interest.

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