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Impact of Keremt Rains in Water Resource of Ethiopia with Reference to Rift Valley

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Abstract: In this paper, an important to review of studies on the impact of summer or keremit rains in water resource of Ethiopia with Special related to rift valley as well as the problems and future utilization of water resource in the rift valley lakes basin of Ethiopia was conducted. The overall land mass of the country is hydrologically divided into twelve basins, eight of these are River Basins, one Lake Basin and three Dry Basins. The rift valley lake basin is endowed with a number of rivers as well as lakes of varying size with high environmental significance. The Kiremt season is the major rain season over Ethiopia where it covers up to 90% of the total rain of a year over some regions of the country and the major driver of this rainfall is the ITCZ. Most of rivers, dams, lakes and different water bodies filled with water during this season resulted occurrence flood and drought as well as land degradation, sedimentation, drought and floods as the major challenges of water resources in the rift valley lakes basin of Ethiopia during the rainy season. The main water resources problem in Ethiopia is the uneven spatial and temporal occurrence and distribution with the groundwater potential of the country is not known with any certainty. So the future opportunity to develop and proper utilization is critical of water resources through sustainable and conserve water resource.

Key Words: Kiremt Rain, Rift Valley, Water Resource

Introduction

Climate is one of the most important resources that all social and economic activities in the world are directly or indirectly depend on climate (USDA, 2015). In particular, the economy of under developed country especially Africa, depends on seasonal rainfall as an important climatic resource (Diro et al., 2011). The economy of developing countries that depend on rain fed agriculture activities are the most vulnerable to climatic shifts, changes and variability. The production level of these economies depends on the availability of moisture for their crops and cattle to survive. Subsistence agriculture is the main employer of the population.

Ethiopia is one of the developing countries of the East Africa with subsistence agricultural practices adopted by 85% of the workforce of the country (World Bank, 2010). Ethiopia is also endowed with a substantial amount of water resources divided into 12 basins; 8 of which are river basins; 1 lake basin; and remaining 3 are dry basins, without significant flow out of the drainage system. Almost all of the basins radiate from the central plateau of the country that separate into two due to the Rift Valley. It is also gifted with inland aquatic ecosystems including lentic and lotic water bodies namely the Rift Valley, Abay, Awash, Baro-Akobo, Omo-Gibe, Tekeze and Wabishebele-Genale drainage basins (Utaile and Sulaiman, 2016).

The Kiremt rains are more reliable and run from June to mid-September, providing water mainly for agriculture in the western half of the country (Walker, 2016). However, it covers Kiremt rainfall benefiting areas around mid-July. The Kiremt season is the major rain season over Ethiopia where it covers up to 90% of the total rain of a year over some regions of the country and the major driver of these rainfall is the ITCZ as indicated by different researcher, the onset of the season starts in the southwestern parts of the country around early June and propagates to north and eastwards and covers Kiremt rainfall benefiting areas around mid- July.

The Ethiopian rift valley is about 80 kilometers (50 mi) wide and bordered on both margins by large, discontinuous normal faults that give rise to major tectonic escarpments separating the rift floor from the surrounding plateaus which contain the major Lake of Ethiopia are Abaya, Chamo, Zuway , Shala , Koka, Langano, Abijatta and Awasa (Muluneh et al., 2016). So, most of rivers, dams, lakes and different water bodies filled with water during this season resulted occurrence flood and drought as well as land degradation, sedimentation, drought and

floods as the major challenges of water resources in the rift valley lakes basin of Ethiopia during the rainy season (Funk et al., 2012).

The main water resources problem in Ethiopia is the uneven spatial and temporal occurrence and distribution with the groundwater potential of the country is not known with any certainty, but so far only a small fraction of the groundwater has been developed and this mainly for local water supply purposes (encyclopedia of Earth, 2008). In addition, the major challenges of water resources development in Ethiopia namely hydro politics challenges, uneven spatial and seasonal distribution of rainfall, uneven temporal and spatial distribution of major rivers, technical challenges, topographic features of the country and economic challenges.

Water abstractions are often done without a basic understanding of this complex hydrological and hydrogeological system, and the fragile nature of the Rift ecosystem. The rapidly growing, and improper use of water resources has resulted in noteworthy negative environmental problems in some Rift lakes and their environments (Tenalem and Dagnachew, 2007). Therefore, the aim of this review is to assess the impact of keremit rains in water resource of Ethiopia with relative to rift valley. Generally the utilization of water resource with sustainable use is very important to combat water problem through the involvement of society as well as other different organization at various level to enhance the water resource development.

Objective of the Study

The objective of this study is to review the impact of summer or keremit rains in water resource of Ethiopia with Special reference to rift valley.

Related Literature Review

Definition of Some Terms

Water Resource is a resource includes Rivers, Lakes and Sub-Surface Water.

Rift Valley refers defined as a tectonically formed structural depression. It is bounded by two major and more or less parallel escarpments. The formation of the Rift Valley has separated the Ethiopian Highlands and Lowlands in to two. It extends from the Afar triangle in the north to Chew Bahir for about 1,700 km.

Chew Bahir is not a lake as it is a salt lake, and it has poor water quality and quantity

The Main Ethiopian Rift or Central Rif is refers to the narrow belt of the Rift Valley that extends from Awash River in the north to Lake Chamo in the south. It is bounded by the western and eastern escarpments.

Rainfall Seasonality of Ethiopia

Rainfall in Ethiopia is seasonal with high spatial and temporal variability that has three seasons are the short rainy season (Belg) that extends from February/March- May, the Kiremt from June to September and Bega last from October to January. The rainy season starts in the south and central regions of Ethiopia during spring or Belg and moves towards the north. When this happens, it signals the commencement of the summer or Kiremt rainfall all over Ethiopia (Gissila et al*.,* 2004; Diro et al., 2008). The Kiremt rainfall contributes 60% of the annual rain received in most areas followed by the Belg with 24% of the average contribution to annual rainfall totals (Cheung et al., 2008). The only exception is in southeastern or the Genale- Dawa watershed where the Belg rainfall contributes 48.8% and Kiremt rainfall only contributes 20.5%. Hence, food production in Ethiopia is carried out during the Belg and the Kiremt seasons. This small rain in Belg has great significance for growing short maturing crops such as teff and beans (Funk et al*.,* 2012a).

Kiremit Season and Summer Rainfall

During kiremt (rainy) season*,* moist air flow is mainly dominated by zone of convergence in low-pressure systems, which is usually accompanied by north-south-north oscillatory of inter tropical convergence zone (Diro et al., 2008). Major Rain-producing systems during kiremt include the northward migration of the ITCZ, development and persistence of the Arabian and the Sudan thermal lows, development of quasi-permanent high-pressure systems over the South Atlantic and South Indian Oceans, development of tropical easterly jet (TEJ) and its persistence, and generation of low-level jet (Somali Jet). It is to be noted that Kiremt rainfall covers most of the country with the exception of some part of south and southeast of Ethiopia (Korecha and Barnston, 2007).

On the other hands, kiremt (June-September) is the main rainfall season for most parts of the country except for the lowlands of southern and southeastern Ethiopia. Kiremt wet period occurring from June to September is the main rain season in most parts of the country and it is influenced by the South to North migration of the ITCZ, the Southwest Monsoon, TEJ, the subtropical high pressure systems and ENSO Teleconnections (Cheung et al., 2008).

Form of kiremit or summer rainfall

The kiremt rains are more reliable and run from June to mid-September, providing water mainly for agriculture in the western half of the country (Walker, 2016). The major driver of the Kiremt rainfall is the ITCZ as indicated by different researcher, the onset of the season starts in the southwestern parts of the country around early June and propagates to north and eastwards and covers Kiremt rainfall benefiting areas around mid-July (Diro et al., 2011). The Kiremt season is the major rain season over Ethiopia where it covers up to 90% of the total rain of a year over some regions of the country. The southwestern, western, northwestern, northern, eastern and central parts of the country are the major regions that benefit from the Kiremt rains.

In JJAS, convective activity typically develops over the Ethiopian highlands, while southern and southeastern Ethiopia receives little rain. The spatial distribution of mean total (June July August September) rainfall shows the greatest rainfall over the highlands of western/west-central Ethiopia, the northeast and southeast lowlands being relatively dry (Korecha and Barnston, 2007). Over the South-western parts of the mountainous areas, an afternoon to midnight maximum rainfall occurrence is observed. However, over the North-eastern part, an afternoon maximum is observed but with relatively lower magnitude. This suggests the existence of orographic influences in the area that leads to rain shadow effect in the mountainous areas facing the Northeast (Fenta, 2010).

Kiremt rainfall distribution over Ethiopia

Kiremt rainfall distribution over the country is almost similar like that of the annual rainfall distribution. During Kiremt season the rainfall amount in the western and north western parts of the country is higher. The southern and south eastern parts of the country receive no small or no rainfall during this season. The southern, central and eastern highlands of the country receive small amount rainfall during this season. (Suzuki et al., 2004) stated that the changes of

rainfall distribution depend on various factors related to atmospheric conditions or topographic features includes: moisture sources, wind speed, wind direction, topographic elevation, slope orientation, barrier characteristics, scale of mountains, and other factors.

According to NMA (2014) stated that, during September the better rainfall distribution is observed across western half basins of the country. According to this firstly most part of Abay, Baro Akobo, weatern AtbaraTekeze, Mereb Gashe, in the margin of upper Genale Dawa and Rift Valley, some parts of upper Omogibe and upper Wabisheble got above 150mm rainfall. Secondly most of upper Genale Dawa, upper and middle Wabishebele, upper Denakil, , middle and upper Central Rift Valley, middle and upper Awash and eastern half Omo-Gibe catchments received 50mm to 150mm rainfall and Thirdly most part of Afar Denakel, Ogaden, lower part of Wabishebele and Genale Dawa, lower Awash and lower Rift Valley received below 50mm rainfall.

Characterization of Kiremt rainy season over Ethiopia

During Kiremt the air flow is dominated by a zone of convergence in low-pressure systems accompanied by the oscillatory ITCZ extending from West Africa through the north of Ethiopia towards India. Major rain-producing systems during Kiremt are: the northward migration of the ITCZ, development and persistence of the Arabian and the Sudan thermal lows along 20 °N latitude, development of quasi-permanent high-pressure systems over the South Atlantic and south Indian Oceans; development of the tropical easterly jet and its persistence, and the generation of the low-level 'Somali jet', which enhances low level southwesterly flow. It is to be noted that Kiremt rainfall covers most of the country with the exception of the south and southeast of Ethiopia e.g. Gode, Negele, and Moyale (NMA 2014).

Ethiopia Rift Valley

The Ethiopian rift valley is about 80 kilometers (50 mi) wide and bordered on both margins by large, discontinuous normal faults that give rise to major tectonic escarpments separating the rift floor from the surrounding plateaus (Muluneh et al., 2016). These faults are now thought to be inactive at the northern rift valley termination, whereas to the south they are still tectonically and seismically active. The rift floor is cut by a series of smaller en echelon, right-stepping, rift basins of Quaternary to recent age (Keir et al., 2005). The Ethiopian Rift Valley lakes are the northern most of the African Rift Valley Lakes and it's occupying the floor

of the rift valley between the two highlands. Most of the Ethiopian Rift Valley lakes do not have an outlet, and most are alkaline.

Although the Ethiopian Rift Valley Lakes are of great importance to Ethiopia's economy, as well as being essential to the survival of the local people, there were no intensive and extensive limnological studies undertaken of these lakes until recently *(*Hynes*,* 2002). The major ones are : Lake Abaya (1162 km^2, elevation 1285 m), the largest Ethiopian Rift Valley lake, Lake Chamo (551 km^2, elevation 1235 m) , Lake Zuway (485 km^2, elevation 1636 m), Lake Shala (329 km^2, elevation 1558 m), the deepest Ethiopian Rift Valley lake ,Lake Koka (250 km^2, elevation 1590 m) ,Lake Langano (230 km^2, elevation 1585 m) , Lake Abijatta (205 km^2, elevation 1573 m) and Lake Awasa (129 km^2, elevation 1708 m).

The hydrology of the Rift Valley Lakes Basin can be considered as four main surface water sub-basins. These include: a) The Ziway-Shala sub-basin (14,477 km2), b) The Awasa sub-basin (1,403 km 2), c) The Abaya-Chamo sub-basin (18,118 km 2) and d) Chew Bahir sub-basin (19,029 km 2). The Central Rift Valley covers the Ziway-Shala sub-basin which comprises the catchments of Lake Ziway, Lake Langano, Lake Abiyata and Lake Shala. Lake Shala is generally separate but under high flow conditions some water will transfer to Lake Abiyata. Lake Ziway receives most of its water from two tributaries, being the Meki River and Ketar River. Lake Ziway is connected with Lake Abiyata through the Bulbula River. Lake Langano is connected with Lake Abiyata through the Horakela River. Both Lake Abiyata and Shala are terminal lakes (without surface water outflow) Hengsdijk, H. and Jansen, H.(2006).

Table 1 Characteristics of Central Rift Valley lakes

Lake	**Area (Km2)**	**Max. depth**
Ziway	423	9
Abiyata	132	6
Langano	247	23
Shala	302	252

A) Lake Ziway: This is an open lake, connected to the terminal Lake Abiyata via the Bulbula River. It is the largest lake in the CRV. The Katar and Meki Rivers originate in the highlands and drain to the lake. The lake's water level has declined over the past few decades as a result of water diversion from the two main feeder rivers for irrigation, as well as direct pumping from the lake. The lake is home to many endemic birds and a wide variety of wild animals. It also is one of the main sources of commercial fish farming in Ethiopia (Ayenew and Legesse, 2007).

B) Lake Abiyata: Since Lake Abiyata is fed principally by spills 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 a more pronounced sensitivity to changes in the basin and is especially susceptible to any diversion of feeder rivers for irrigation projects along the Meki and Katar Rivers and to water abstracted directly from Lake Ziway for irrigation and domestic consumption (MoWR, 2021).

Owing to this, any reduction in levels in Lake Ziway will have a significant impact on the lake levels in Lake Abiyata because Lake Ziway is the main feeder, through the Bulbula River, for Lake Abiyata. Since the mid-1980s Lake Abiyata water levels have been in almost constant decline, which is not explainable through the rainfall record, indicating that water abstractions are the main cause of the decline. Lake Abiyata is also sensitive to any reduction of flow in the Bulbula River, either through lake levels in Lake Ziway dropping or through direct pumping of water along the course of the Bulbula River to supply Ziway and Bulbula town water supplies, or diverted for small irrigation plots. The direct pumping of water from the Lake Abiyata for commercial exploitation of soda ash by evaporation of brine also impacts on lake levels (MoWR, 2021).

C) Lake Langano: Lake Langano is fed by rivers from the highlands on eastern side of the Rift Valley. Lake Langano flows towards Lake Abijatta to the south through the Horakela River. The level of Lake Abiyata is only a few meters lower than that of Lake Langano, and the two lakes could unite and overflow to Lake Shala to the south if they were to rise by a few meters (MoWR, 2021). Lake Langano experiences only small seasonal water level variations of about 1 m, and lower inter-annual water level variations compared to other lakes in the basin. Lake Abijatta is less sensitive to reductions in flow in the Horakela River (as compared with the

Bulbula River) from increased water use in the Lake Langano basin, as this river contributes only about 8% of the total inflows of Lake Abijatta (MoWR, 2021)

D) Lake Shala: Lake Shala is the deepest lake (256 m), and is separated from Abiyata by a volcanic caldera rim. Lake Shala is a closed lake and is highly alkaline. The alkaline nature of this lake makes water abstraction directly from Lake Shala for irrigation not possible (MoWR, 2021).

Ethiopian Water resources Reference to Rift Valley

The overall land mass of the country is hydrologically divided into twelve basins; eight of these are River Basins, one Lake Basin and three Dry Basins. Four of the River Basins, Abbay, Baro-Akobo, Mereb and Tekeze are part of Nile River System, flowing generally in the Western direction toward Sudan eventually terminating in the Mediterranean Sea. Five Basins namely, the Omo-Ghibe, Awash, Rift-valley Lakes, Denakil and Aysha can be categorized as the Rift-valley system as all of them drain their water in the Great East African Rift-valley. The remaining three, Genale-Dawa, Wabishebelle and Ogaden are part of the Eastern Ethiopian Basin that generally flows in the South-easterly direction toward the Somali - Republic and then to the Indian Ocean (MoWR), 2009). Most of the rivers in Ethiopia are seasonal and about 70% of the total runoff is obtained during the period June-August (encyclopedia of Earth, 2008).

Ethiopia the Water Tower of Africa/East Africa: Myth or Reality, the logical meaning Ethiopia compared to water availability of countries. Water Resources availability in Ethiopian Basins are Spatial and Temporal Variability, Per capita water availability, Per capita Water Storage capacity and Level of water resources development (Ministry of Water, Irrigation and Energy, 2013). There are two types of water resource are surface water resource which includes rivers and lakes and subsurface water resource.

The Ethiopian Rivers: Unlike many other African countries, Ethiopia is endowed with many rivers. As to, Teferi *et al*. (2019) the majority of the Rivers originate from highland areas and cross the Ethiopian boundary. Altogether, Ethiopian Rivers form 12 major watersheds separating the Mediterranean Sea from the Indian Ocean drainage systems.

In addition, the overall features of Ethiopian rivers are owing to the highland nature of the Ethiopian landmass, surface ruggedness and the outward, Inclination of the highlands, and the

climatic conditions (Teferi *et al*. (2019), Ethiopian rivers has Characterized the following: Almost all major rivers originate from the highlands elevating more than 1500 meters above sea level, Majority of Ethiopian Rivers are trans-boundary, Due to the marked seasonality of rainfall, Ethiopian rivers are characterized by extreme Seasonal fluctuation. In the wet season, runoff is higher and rivers are full bursting their Banks, destroying small bridges, damage roads and flooding low lands; during the dry Seasons they became mere trickles of water or even dry up, Due to surface ruggedness they have rapids and waterfalls along their course, They have cuts, steep-sided river valleys and deep gorges along their courses, Rivers in Ethiopia flow on steep slopes having steep profiles and Some of the rivers serve as boundaries, both international and domestic administrative Units (Teferi *et al*. (2019).

The Ethiopian Lakes: Relatively Ethiopia is rich in lakes. Almost all Ethiopian lakes are result of tectonic process that took place during Quaternary period of Cenozoic era. Except few, the majority of Ethiopian Lakes are located within the Rift Valley System (Muluneh et al., 2016). The lakes in the drainage are mainly formed on Faulted depressions and are clustered along the system forming linear pattern. Lake Tana, the largest lake in Ethiopia occupies a shallow depression in the highlands. The Tana depression is believed to be formed following slower sinking and reservoir by lava flow between Gojjam and Gonder massifs. Ethiopia is also gifted with crater lakes. These include the lakes at and around Bishoftu, Wonchi (near Ambo), Hayk (near Dessie) and the Crater Lake on top of Mount Zikwala. Lake Ashenge (Tigray) is formed on a tectonic basin. Other types of lakes in Ethiopia are man-made such as Lakes Koka*,* Fincha and Melka Wakena, and many other lakes dammed following hydroelectric power generation projects. Lake Abaya is the largest of all the lakes in the system. The southern tip of the Rift Valley forms the marshy land called the Chew Bahir which is drained by Segan and Woito. Shala and Zuway are the shallowest and the deepest Lakes in the central Ethiopian Rift (Teferi *et al*. (2019).

Subsurface (Ground) Water Resource of Ethiopia: As compared to land water resources**,** Ethiopia has lower ground water potential. However, there exists higher total exploitable ground water potential. Climatic and geophysical conditions determine the availability of groundwater resource. Based on existing very little knowledge, the groundwater potential of our countries is estimated to be *2.6 - 6.5 BMC.* However, this estimate is now

considered underestimated. Considering various separate studies, Ethiopian potential of Ground water is believed to range between 12-30 BMC (Teferi *et al*. (2019).

Importance of Water Resource and their Factors Affecting

The water resource of Ethiopia are essential includes: Building Healthy Workforce, Ensuring Food Security (Irrigation, Fishery, Tourism), Provision of Clean Energy for Agriculture, Industry and Service, Maintenance of Healthy Ecosystem, Recreation (Aesthetic Value), Transportation (Navigation), Hedge against climate change and variability and catalyst for any other sector (Ministry of Water, Irrigation and Energy , 2013).

As stated by Awulachew *et al*. (2017), little has been developed for drinking water supply, hydropower, agriculture and other purposes though the country possesses a substantial amount of water resources. The great majority of the rural Ethiopian population community water supply relies on groundwater. The safe supply of water in rural areas is usually derived from shallow wells, spring development and deep wells. People who have no access to improved supply usually obtain water from rivers, unprotected springs, hand-dug wells and rainwater harvesting.

In contrary to this, the evolving water scarcity is global and national phenomenon. The Water resources availability of Ethiopia being affected by some factors includes: Increasing population, Increasing Demand, Disappearing sources, Increasing cost, Deterioration of Water Quality and Climate change (Ministry of Water, Irrigation and Energy, 2013).

The Problem of Ethiopian Water Resource

The big and main water resources problem in Ethiopia is the uneven spatial and temporal occurrence and distribution. The groundwater potential of the country is not known with any certainty, but so far only a small fraction of the groundwater has been developed and this mainly for local water supply purposes (encyclopedia of Earth, 2008). There are six major challenges of water resources development in Ethiopia namely: hydro politics challenges, uneven spatial and seasonal distribution of rainfall, uneven temporal and spatial distribution of major rivers, technical challenges, topographic features of the country and economic challenges.

Due to the challenge of the above there is effect on lower part of the population during rainy season such as include migration people and animals from homeland area, exploitation of

resource (house, food), degradation of natural resource, increment of sedimentation in lakes rivers, affect the living organisms in water and etc.

According to the Ministry of Water, Irrigation and Energy, (2013) reported that there are different challenge of Ethiopian water resource are a)Natural challenges: the natural challenged such as Temporal and Spatial Variability in availability, Disparity in settlement and location of water, Topography, Degradation of Ethiopian Highlands and Extreme Events –Climate change, b) Economic includes: Increasing Cost of Investment, Investment not in parallel with the need and Low level of private sector involvement, c) Social also include: Poverty, low level of service provision Settlement, Disparity of, d) Transboundary Nature of Water Resources are contain Absence of Legal and Institutional Framework Past Cooperation Efforts, Current Status of Legal Framework Agreement and Cooperation, Associated problem of Financial Generation, e) Capacity: Institutional, Human Resources/ Technical, Tools and inputs and f) finally Infrastructure are contain Hydraulic Infrastructure and others.

Future Opportunities for Water Resources Development

According to Ayalew (2018), Ethiopia has a great future opportunity to develop and utilize water resources. Among many opportunities, some of them are: i) enough water sources potential, ii) the government of the country turn the face and focus on water resources development and utilization, iii) different funders are promised to support the water sector development, iv) a probability to apply multipurpose use of those water resources like for irrigation and hydropower generation, v) an opportunities to produce qualified expertise in different higher institutions to fill the gap of knowledge barrier and distributed throughout the country being expertise and train the low level expertise which works in different sectors in the form of training, experience sharing, give technical support if required and vi) the opportunity to gender mainstreaming in all levels of water development projects starting from the beginning of the project to the end of it.

On the other hand there are also major opportunities for the development and protection of groundwater, including: (i) exploiting shallow groundwater; (ii) enhancing water recharge in aquifers, including forestation in hilly areas, infiltration galleries, and subsurface dams to increase the available water in the sub-surface; and (iii) using a watershed-based approach to

enhance soil and water conservation and increase the groundwater level in the valley bottoms for easy access to groundwater (Awulachew, 2017).

The Impact of summer rains on Ethiopia water Resource

The Kiremit is the main rainy season for most parts of the country apart from for lowlands of southern and south eastern parts. Most of rivers, dams, lakes and different water bodies filled with water during this season. However, in some areas due to heavy rain there might be flood occurrence. August is the major rainy month from Kiremit season and except some lowland part of the country most part receives a high amount of rainfall usually (NMA 2014). The following figure 1. Shows growing of flood, increasing of soil erosion and deterioration of water quality especially, at lower part of the country due to the coverage of extreme heavy rain of highland area.

Figure 1 increment of flood with taking soil resources

According to World Bank (2006), the primary water resource challenges of the rift valley lakes basin in particular and Ethiopia in general are its extreme hydrological variability and seasonality and the international nature of its most significant surface water resources. In addition land degradation, sedimentation, drought and floods as the major challenges of water resources in the rift valley lakes basin of Ethiopia during the rainy season. In the wet season, runoff is higher and rivers are full bursting their banks, destroying small bridges, damage roads and flooding low lands; during the dry seasons they became mere trickles of water or even dry up. The following figure 2. Shows increasing heavy rains in Ethiopia that started in June and peaked in Auguest have led to flooding, displacement, loss of lives and livelihoods, as well as damage to infrastructures in different parts of the country.

Figure 2 Extreme kiremt rainfall has directed to flooding, displacement and loss of lives and livelihoods across the country.

Conclusion

Water Resource is a resource includes Rivers, Lakes and Sub-Surface Water. The rift valley lakes basin is endowed with a number of rivers and lakes of all sizes. Although the basin possesses a significant amount of water resources, little has been developed for drinking water supply, hydropower, agriculture and other purposes. kiremt (rainy) season, moist air flow is mainly dominated by zone of convergence in low-pressure systems, which is usually accompanied by north-south-north oscillatory of inter tropical convergence zone which distribution over the country is almost similar like that of the annual rainfall distribution.

The impacts of summer rains in water resource are most of rivers, dams, lakes and different water bodies filled with water during this season resulted occurrence flood and drought as well as land degradation, sedimentation, drought and floods as the major challenges of water resources in the rift valley lakes basin of Ethiopia during the rainy season. The main water resources problem in Ethiopia is the uneven spatial and temporal occurrence and distribution with the groundwater potential of the country is not known with any certainty. The importance water resource is to developed for drinking water supply, hydropower, agriculture and other purposes though the country possesses a substantial amount of water resources.

In order to limit the impact of water resource through future opportunities for water resources development and sustainable utilization of water resource at local, regional and community level must be the key concern to solve water problems.

Reference

Awulachew, S. B., Yilma, A. D., Loulseged, M., Loiskandl, W., Ayana, M., Alamirew, T., 2017. Water Resources and Irrigation Development in Ethiopia. Colombo, Sri Lanka: International Water Management Institute, 78.

Awulachew, S., 2010. Irrigation potential in Ethiopia: Constraints and opportunities for enhancing the system. International Water Management Institute.

Ayalew, D.W., 2018. Theoretical and Empirical Review of Ethiopian Water Resource Potentials, Challenges and Future Development Opportunities. International Journal Waste Resource, **8**, 353. doi:10.4172/2252-5211.1000353.

Ayenew, T. and Legesse, D. (2007).The changing face of the Ethiopian rift lakes and their environs: call of the time. Department of Earth Sciences, Addis Ababa University.

Cheung, W.H., Senay, G.B. and Singh, A. (2008). Trends and spatial distribution of annual and seasonal rainfall in Ethiopia. International Journal of Climatology, **28**(13), 1723 -34.

Diro, GT., Black, E. and Grimes, D. (2008). Seasonal forecasting of Ethiopian spring rains, Meteorological Applications, **15**(1), 73-83.

Diro, G.T., Grimes, D.I. and Black, E. (2011). Teleconnections between Ethiopian summer rainfall and sea surface temperature: observation and modelling. Climate Dynamics, **37**(2), 103–119.

Fenta, A.A., 2010. Assessing diurnal variability of rainfall: A remote sensing based approach, International Institute for Geo-Information Science and Earth Observation/ Integrated Watershed Modelling and Management-Surface Effect of Topography on Rainy season Rainfall Water Hydrology/Enschede, 66.

Funk, C., Rowland, J., Eilerts, G., Kebebe, E., Biru, N., White, L. and Galu, G. (2012a), A climate trend analysis (Ethiopia). US Geological Survey, Fact Sheet, vol. 3053.

Gissila, T., Black, E., Grimes, D. and Slingo, J. (2004). Seasonal forecasting of the Ethiopian summer rains, International Journal of Climatology, **24**(11), 1345 -58.

GIRDC (Halcrow Group Limited and Generation Integrated Rural Development Consultants) and MoWR (Ministry of Water Resources). 2009. Rift Valley Lakes Basin Integrated Resources Development Master Plan Study Project,

Hengsdijk, H. and Jansen, H. (2006). Ecosystems for water, food and economic development in the Ethiopian central rift valley, BO-10-006-22. Report of inception mission to Ethiopia and Work plan. Plant Research International. Note 403.

Hynes, H.B.N., 2002. Ethiopian Rift Valley Lakes. www.euronet.nl. *Retrieved 2008-03-16*.

Keir, D., Ebinger, C.J., Stuart, G.W., Daly, E. and Ayele, A. 2005. Strain accommodation by magmatism and faulting as rifting proceeds to breakup: seismicity of the northern Ethiopian rift, Journal of Geophysical Research, 111(B5), B05314, doi: 10.1029/2005JB003748.

Korecha, D. and Barnston, A.G. 2007. Predictability of June-September Rainfall in Ethiopia. Monthly Weather Review, **135**(2), 628–650.

Ministry of Water, Irrigation and Energy, 2013. Water Resource of Ethiopia: the National and international perspective, 2, 20-30.

MoWR (Ministry of Water Resources of Ethiopia)., 2022. Available at January 2/ 2020. http://www.mowr.gov.et.

Muluneh, A., Bewket, W., Keesstra, S. D. and Stroosnijder, L. 2016. Searching for evidence of changes in extreme rainfall indices in the Central Rift Valley of Ethiopia. Theoretical and Applied Climatology, doi: 10.1007/s00704-016-1739-4.

National Meteorological Agency., (2014). Hydro Meteorological monthly bulletin for summer, http://www.ethiomet.gov.et, 1-9.

Suzuki, Y., Nakakita, E., Hasebe, M. and Ikebuchi, S. 2004. Study on Rainfall-Topography relationships in Japan with regard to the spatial scale of mountain slopes. International Symposium on Hydrological Applications of Weather Radar, 6, 1-8. Melbourne, Australia.

Teferi Mekonnen, Nigatu Gebremedhin, Alem-meta Assefa and Binyam Moreda., 2019. Drainage Systems and Water Resource of Ethiopia and the Horn. Pp 41-69. In: Geography of Ethiopia and the Horn Module Final. Ethiopia

Tenalem Ayenew and Dagnachew Legesse. 2007. The changing face of the Ethiopian rift lakes and their environs: call of the time. Lakes & Reservoirs: Research and Management. 12, 149–165. Blackwell Publishing Asia Pty Ltd.

The encyclopedia of Earth., 2008. Water profile of Ethiopia .http: //www. eoearth.org/article/ water_profile_of_Ethiopia.

USDA. 2015. Climate Change, Global Food Security, and the U.S. Food System. 146.

Utaile, Y. and Sulaiman., 2016. Assessment of water quality parameters of Lake Chamo-implications for freshwater fishes, Gamo Gofa Zone, Southern Ethiopia. Journal of Hill Agriculture **7**(2):237-241.

Walker, B., 2016. Seasonal Weather Assessment for Ethiopia during March-July 2016. London: Government of the United Kingdom (http:// reliefweb.int/report/ethiopia/seasonal weather- assessment-ethiopia-during-marchjuly-2016).

World Bank., 2006. Managing Water Resources to Maximize Sustainable Growth. A World Bank Water Resources Assistance Strategy for Ethiopia.

World Bank., 2010. Development and Climate Change: 2010 World Development Report. The World Bank, Washington DC, New York.

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