

Review of The Under-Utilised Potentials of Kiri Lake

Ahmed Bafeto Mohammed

The Federal Polytechnic, Damaturu, Yobe State. Nigeria

Correspondence: gonibafeto@gmail.com

ORCID Identity: 0009-0003-2025-4294

Abstract

The water impounded by Kiri Lake is assumed to be only partially been used. At the moment, only 1.3% of the annual design impoundment is put into use from the lake by Savannah Sugar Company. That means over 98% of the impoundment is idle. This is at the same time when the region around the lake is desperately in need of irrigation water, stable electricity supply and portable tap water. This paper focused on identifying the unutilized potentials of the Lake. The potentials are identified by reviewing literatures about the region and the lake. Considering the available literatures about Kiri dam, Kiri Lake, the soil properties around the lake and Nigeria's population and its economic situation, the following potentials are identified; irrigation, water supply, hydroelectric power (HEP) generation and advance fishing. All the identified potentials are achievable, only if federal government of Nigeria will commit financial resources and sustainable policies. Achieving them will improve the economic situation in the country. Further studies on the cost, feasibility and sustainability policies are recommended.

Key words: *Kiri Lake, Water, Potentials, Irrigation, HEP, Water Supply.*

1.0 INTRODUCTION

Kiri Lake is an artificial water impoundment at the upstream of Kiri dam. It is located around Kiri village in Shelleng Local government area, Adamawa state Nigeria, with a geographical coordinate of 9°40'47"N, 12°00'51" E. The lake is pictorially shown on Fig. 1.



Figure 1: Aerial view of Kiri Lake (*Kiri_Reservoir.Jpg* (1032×658), 2024)

The Lake is found as a result of the construction of Kiri dam which is 1400m long, 20m high, zoned embankment with a central clay core and an upstream clay blanket. Kiri dam is constructed across Gongola River which is the principal tributary of the Benue River (Tukur & Mubi, 2002). The Lake is approximately impounding 615 million cubic meters per year which occupies 11,500 hectares (Youdeowei et al., 2019). Inflow into Kiri Lake peaks from June to September and low from December to May of every year because it is dependent on the rainfall in the rain reason and interflow in the dry season (Tukur & Mubi, 2002). Rainfall records around Kiri dam ranges from 700mm and 900mm per annum (Sambo et al., 2022). There's no worry about losses of the impounded water due to seepage because Water loss due to seepage through the dam and its foundation is numerically estimated to be only 3% of its annual impoundment (Mohammed et al., 2019). The estimation was achieved by the use of SEEP/W, 2007.

At the moment, only 1.3% of the lake annual impoundment is put into use, despite the dire need for dry-season irrigation by the locals around the lake because of their fertile land and food shortage in the country. Nigeria is also having large deficit of electricity generation if supply is compared with demand. Numan, Guyuk and Sheleng and the smaller communities around are dependent on either bore holes, hand-dug wells and/or river/stream waters for consumption despite having about 615 million cubic meters impounded around them. This paper is aimed at identifying the under-utilised potentiality of Kiri Lake to create awareness to the authorities in-charge. If considered, ideas in this paper will benefit the locals by provision of irrigation avenues, treated drinking water, expanding the electricity generation and modernizing fishing activity.

2.0 THE POTENTIALS OF THE LAKE

2.1 Irrigation

Northern Nigeria is dependent on rain season for all its farming activities with the exception of a very negligible percentage. This is due to ineffective utilization of the available surface water resources like Kiri Lake. That has contributed to the persistent poverty in the region. Idama, (2003) reported that, effective utilisation of abundant water resources in Adamawa state, Nigeria can alleviate poverty. Kiri dam was primarily constructed for irrigation of Savannah sugar project (Adebayo & Yahya, 2015).

Savannah sugar is 30km from Kiri dam (Obi & Zemba, 2016). Also, known as Dangote Sugar Company, Savannah Sugar Company, is fetching out of Kiri Lake using a trapezoidal channel that is flowing by gravity for the purpose of irrigating 32,000 Hectares of land for sugarcane production targeting to produce 100,000 tons of sugar per year. However it is now cultivating only 2,500 ha (Girei & Giroh, 2012) leaving the rest of the water idle.

Instead of leaving the water idle, other irrigation activities should be put into consideration because the lake is surrounded by a fertile agricultural land

of alluvial and vertisols soil type with the exception of some minor rocky areas (Obiefuna et al., 2010). This type of soil is conducive for many varieties of crop production that need fertile soils (Obiefuna et al., 2010; Tukur & Adebayo, 1997). Rice, sugarcane and wheat production need this type of soil for its richness in nitrogen and water conservation (Watro et al., 2019).

The growing population in Nigeria increased the daily demand for sugar in particular and food in general (Gazal et al., 2024) which Kiri Lake should have supplemented. It is left for the federal government to put in place the conveyance facilities that conveys the water to the farms of the rural dwellers for dry season agriculture because with the exception of Savannah sugar company canal, there are no other irrigational facilities for the local communities around the Lake. (Shalangw et al., 2014).

2.2 Water supply

Water supply is one of the potentialities of Kiri Lake even though the water will have to be treated before being put into use for human consumption, because (Joshua, 2023; Milam et al., 2020) reported that, fresh water obtainable from Kiri Lake is not suitable for direct human consumption, but suitable for irrigation. However, the growing need for portable and affordable water in communities around Kiri Lake necessitate the need for federal government to think of installing a treatment plant around the lake. The treated water will be pumped to the communities like Numan, Guyuk and Sheleng with the inclusion of some smaller communities that are numerous to mention. As at 2015, up to 9.9% of Nigerians are using surface water for drinking purpose (Oyekanmi & Mbosssoh, 2018) thereby taking in all the contamination therein. This treatment and supply will be part of the measures to be taken against consumption of surface waters in Nigeria which will help in alleviating the growth and persistence of water related diseases, like typhoid. Guyuk, Shelleng and Numan are located only 38, 29 and 32Km respectively from the lake and can

easily be supplied with the treated water from the lake for all domestic and industrial purposes.

From the physical, chemical and biological investigation of Kiri Lake, it was concluded by (Joshua, 2023) that, consuming the water without treatment is risky. Many factors are considered to have contributed to the contamination of Kiri Lake water. One of which is the chemical application on farmlands in Gongola River catchment during rainy season farming which increase in the concentration of anions (Maitera & Shinggu, 2010; Maitera et al., 2010). According to (Maitera et al., 2011) heavy metals are present in both water and sediments in Gongola River water but sediments used to hold about 99% of the heavy metals if compared to water.

On the other hand, consumption of catfish and tilapia obtainable from Kiri Lake is not having any health issue to humans unlike consuming the water because it is moderately polluted with heavy metals (Adamu et al., 2023; Milam et al., 2012; Orosun et al., 2017). This is concluded after testing the presence and concentration of lead, cadmium, iron and chromium in the fishes sampled from the Lake.

2.3 Hydro Electric Power Supply

According to *International - U.S. Energy Information Administration (EIA)*, (2021), Nigeria has a population of over 213 million people. According to '*List of Countries by Electricity Consumption*', (2024), Nigerians are consuming only 14 watts per capita per year which is just 1.09% of per capita consumption in the United State of America. It can now be observed that Nigeria is in short of electric power generation despite the abundance of water resources. Kiri dam was one of the dams considered for retrofitting the generation hydro-Electric-power to meet the current deficit in Nigeria's electric supply (Yuguda et al., 2020).

The major problem Kiri Lake is face is silting. Silting is the accumulation silts as a result of the erosion from the tributaries of the lake, normally

caused by human activities from the catchment area of the lake. The activities include but not limited to uncontrolled human settlement, increase in human population and its dependent on fire wood which led to deforestation (Yuguda et al., 2016). From 1984 to 2016, the area occupied by Kiri Lake is reduced by 43% while its depth has reduced by about 58% all as a result of silting (Gadiga & Garandi, 2018). To make effective use of all the reservoir storage, routine desilting activity must be considered. That will reduce the flooding threats of the lake and overtopping threat of the dam. Post-construction studies on Kiri dam revealed a less significant displacement of vertical and horizontal axis of the dam body. The studies recommended routine inspection of dam against failure (EdanJ et al., 2014). Another studies on impact of the dam revealed that the impoundment lead to flooding which causes erosion and destruction of lands around the lake (Bobboi et al., 2021). This will have more effect if the silting process continued because the inflow remains the same.

2.4 Advanced Fishing

Any accumulation of water brings about accumulation of aquatic life, most important to human is fish. Fishes are collected from water bodies by the process called fishing. Effective fishing in stationed water body needs artificial tools and equipment which the rural fishers may not afford. Therefore, appropriate fishing facilities need to be provided to the local fisher men and women (Shalangw et al., 2014; Zemba et al., 2016) as they are lacking. Providing these facilities will boost the economy of the rural dwellers around the lake and that will not have any reduction in the volume of water in the lake.

Conclusion

This position paper is aimed at identifying the rich potentialities of Kiri Lake. From the paper, it can be noticed that the Lake is rich in potentialities that are not put into use. Effective irrigation, water supply scheme, hydro-electric power supply, and advanced fishing are identified as unused

potentials of the Lake. Putting all the above-mentioned potentialities into use will definitely improve the economy of the whole region by increasing food concentration in circulation, supplementing the electric power generation deficits, provision of portable drinking water and enhancing fishing activity in the region. However, the potentialities can only be realised if federal government will commit some financial resources coupled with maintenance and sustainability policies.

Recommendations

Findings of this paper highlights the following recommendations:

- Irrigation canals be provided to reach farms of the locals around the lake
- Electricity generation facility be installed at the lake to generate electricity
- Treatment plant and conveyance facilities be installed for supplying, Numan, Guyuk and Sheleng towns with portable tap water.
- Advanced fishing stations and tools be provided to enhance the fishing activity
- Further studies on the cost, feasibility and sustainability policies

References

- Adamu, N., Edward, A., Apollos, T. G., & Duwal, S. D. (2023). Assessments Of Heavy Metal Levels in Water and Fish (*Brycinus Leuciscus*) From Kiri Reservoir, Shelleng Local Government, Adamawa State, Nigeria. *Advance Journal of Agriculture and Ecology*, 8(4), Article 4. <https://aspjournals.org/Journals/index.php/ajae/article/view/300>
- Adebayo, A. A., & Yahya, A. S. (2015). Assessment of Climate Change in the Savannah Sugar Project Area, Adamawa State, Nigeria. *Proceedings of International Academic Conferences*, Article 1003036. <https://ideas.repec.org/p/sek/iacpro/1003036.html>

- Bobboi, I., Umar, A., & Oliver, K. (2021). Assessment of Environmental and health problems caused by Kiri dam in Kiri area, Shelleng Local Government Area of Adamawa State. *3(2)*.
- EdanJ, D., Abubakar, T., & Onom, N. (2014). Structural Deformation Monitoring of Kiri Dam, Adamawa State, Nigeria. *ATBU Journal of Science, Technology and Education*. <https://www.semanticscholar.org/paper/>
- Gadiga, B., & Garandi, D. (2018). "The Spacio-Temporal Changes of Kiri Dam and Its Implications" In Adamawa State, Nigeria. *International Journal of Scientific and Research Publications (IJSRP)*, 8. <https://doi.org/10.29322/IJSRP.8.8.2018.p8058>
- Gazal, A. A., Jakrawatana, N., Silalertruksa, T., & Gheewala, S. H. (2024). Water-Energy-Land-Food Nexus for Bioethanol Development in Nigeria. *Biomass Conversion and Biorefinery*, *14(2)*, 1749–1762. <https://doi.org/10.1007/s13399-022-02528-8>
- Girei, A. A., & Giroh, D. Y. (2012). Analysis of the Factors Affecting Sugarcane (*Saccharum officinarum*) Production under the Out Growers Scheme in Numan Local Government Area Adamawa State, Nigeria. *Journal of Education and Practice*, *3*.
- Idama, A. (2003). Water Resources Planning in a Typical State in Nigeria: A Management Science Approach. *Global Journal of Mathematical Sciences*, *2(1)*, Article 1. <https://doi.org/10.4314/gjmas.v2i1.21327>
- International—U.S. Energy Information Administration (EIA)*. (2021). <https://www.eia.gov/international/data/world/electricity/electricity-consumption?pd>
- Joshua, W. (2023). Appraising Water Quality, Health Risk and Correlation of Water Quality Parameters of Kiri Dam Reservoir – Shelleng LGA. *International Journal of Environmental Pollution and Environmental Modelling*, *6(1)*, Article 1. *Kiri_Reservoir.jpg (1032×658)*. Retrieved 17 May 2024, from https://upload.wikimedia.org/wikipedia/commons/c/c4/Kiri_Reservoir.jpg
- List of Countries by Electricity Consumption. (2024). In *Wikipedia*. https://en.wikipedia.org/w/index.php?title=List_of_countries_by_electricity_consumption&oldid=1218865254#cite_note-Our_World_in_Data_2021-6
- Maitera, N., & Shinggu, D. Y. (2010). An Assessment of Some Anion Levels of River Gongola in Adamawa State, Nigeria. *2*.
- Maitera, O. N., Magili, S. T., & Barminas, J. T. (2011). Determination of Heavy Metal Levels in Water and Sediments of River Gongola in Adamawa State, Nigeria. *Journal of Emerging Trends in Engineering and Applied Sciences*, *2(5)*, 891–896. <https://doi.org/10.10520/EJC156598>
- Maitera, O., Ogugbuaja, V., & Magili, S. (2010). An Assessment of the Organic Pollution Indicator Levels of River Gongola in Adamawa State, Nigeria. *Journal of Environmental Sciences*, *2*.
- Milam, C., Maina, H. M., Onyia, L. U., & Ozoemena, P. E. (2012). Heavy Metal Pollution in Benthic Fishes from Kiri Dam in Guyuk Local Government Area of Adamawa State, Nigeria. *African Journal of Biotechnology*, *11(54)*, Article 54. <https://doi.org/10.5897/AJB11.1034>
- Milam, C., Maina, H., Maitera, O., & Daniel, V. (2020). An Assessment of Heavy Metal Contents Impact on Fish Species Obtained from Kiri Dam, Adamawa State. *FUW Trends in Science & Technology Journal*, *5(1)*, 001–006.
- Mohammed, A. B., Salau, O. B. E., Daffi, R., & Gimba, A. S. (2019). Seepage Analysis

- of Kiri Dam Using Finite Elements Method. *The International Journal of Engineering and Science (IJES)*, 8(11), 66–86.
- Obi, J. N., & Zemba, A. A. (2016). Impact of Local Climate on Sugarcane Water Footprint: A Case study of Dangote Sugar Company Numan, Nigeria. *FUTY Journal of the Environment*, 10(1), Article 1.
- Obiefuna, G. I., Oreagbune, M. O., & David, C. (2010). Geotechnical Evaluation of Soils in Numan and its Environs, North East Nigeria. *Continental Journal of Earth Sciences*, 5(I), 20–31.
- Orosun, M., P, T., Orosun, R., Fc, A., Ige, s, & Victoria, O. (2017). Determination of Selected Heavy Metals and Human Health Risk Assessment in Fishes from Kiri Dam and River Gongola, Northeastern Nigeria. *Journal of Physical Chemistry & Biophysics*, 06. <https://doi.org/10.4172/2161-0398.1000229>
- Oyekanmi, M. O., & Mbosoh, E. R. (2018). Dams and Sustainable Development Goals: A Vital Interplay for Sustainability. *Journal of Environment and Earth Science*, 8(4), 1–11.
- SAMBO, G., ABDUSSALAM, B., KOLO, W., & MUSA, B. (2022). Utility of Universal Soil Loss Equation Model (USLE) And Geospatial Technology for Soil Erosion Estimation in Bayo LGA Of Borno State, Nigeria. *Journal of Forest Science and Environment*, 7, 110–121.
- Shalangw, A., Adebayo, A., Zemba, A., & Boniface, T. (2014). Effects of Kiri Dam Construction on the Economy of Lower Gongola Basin of Shelleng Local Government, Adamawa State, Nigeria. 5, 48–54.
- Tukur, A., & Adebayo, A. (1997). Variation in Environmental Resources and Food Crop Production in Adamawa State. *Issues in Environmental Monitoring in Nigeria*, 20.
- Tukur, A. L., & Mubi, A. M. (2002). Impact of Kiri dam on the lower reaches of river Gongola, Nigeria. *GeoJournal*, 56(2), 93–96. <https://doi.org/10.1023/A:1022449113407>
- Watroś, A., Tkaczyk, P., Lipińska, H., Lipiński, W., Krzyszczak, J., Baranowski, P., & Brodowska, M. (2019). Mineral nitrogen Content in Soils Depending on Land Use and Agronomic Category. *Applied Ecology and Environmental Research*, 17, 5663–5675. https://doi.org/10.15666/aeer/1703_56635675
- Youdeowei, P., Nwankwoala, H., & DD, D. (2019). Dam Structures and Types in Nigeria: Sustainability and Effectiveness. *Water Conservation and Management*, 3, 20–26. <https://doi.org/10.26480/wcm.01.2019.20.26>
- Yuguda, T., Jijingi, H. E., & Awhari, D. (2016). An Assessment of Changes in Land-Use and Land-Cover within the Kiri Lake, Nigeria (1976-2014). <https://doi.org/10.17950/ijer/v5s7/713>
- Yuguda, T. K., Li, Y., Xiong, W., & Zhang, W. (2020). Life Cycle Assessment of Options for Retrofitting an Existing Dam to Generate Hydro-Electricity. *The International Journal of Life Cycle Assessment*, 25(1), 57–72. <https://doi.org/10.1007/s11367-019-01671-1>
- Zemba, A. A., Adebayo, A. A., & Ba, A. M. (2016). Analysis of Environmental and Economic Effects of Kiri Dam, Adamawa State, Nigeria. *Global Journal of Human-Social Science*, 16(B1), 1–6.