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Restoring Lake Tana Through Reduction of Outflow and Compensation of the Power Gap with An Alternative Energy Source

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Abstract

Since the beginning of the Tana Beles hydropower generation, Lake Tana has a half meter drop from its annual average because of inflow and outflow changes. The outflow pattern has changed because of the Beles hydropower project which demanded consistent flow of water, releasing 7 times more than the dry season's historical flow. On the other hand, inflow to the lake has decreased due to irrigation abstractions made over the 3460 km^2 watershed of the tributaries of Lake Tana. Irrigation developments on Gumera, Rib, Megeche and Gilgel-Abay tributaries reduces the inflow by 2890 m^3 ha^{-1} totalling 1 BCM. Finally, Lake Tana has to support navigation, meet the ecological requirement of the Blue Nile River riparian, and supply to TIS ESAT Falls for tourism. The highest hydrological pressure on Lake Tana seems to have emanated from hydropower generation. Accordingly, this study reviews the possibility of scaling down Beles hydropower by decreasing outflow from the lake and supplementing the reduced power production from alternative energy sources. A country level solar energy survey indicates that the western escarpments of the rift valley, specifically from Afar triangle all the way to southern Wollo and North Shoa, as well as North Western part of the country, surrounding Lake Tana have irradiation and photovolatic values of 6KWh/sq. meter and 5.2 KWH/KW-p, respectively. The contribution of solar power to the energy sector of Ethiopia is only 1%, despite its plans to tap the priciest Concentrated Solar Power (CSP) that produces 15000 GW from 1 km^2. This study suggests that photovoltaic power is cheaper, and it could compensate even the maximum energy planned from the Beles hydropower station (400 MW). Producing 400 MW from solar energy needs 200 ha, which can make use of degraded and irrecoverable lands. The study concludes that solar energy harvesting evens out against hydropower generation on initial investment, economic lifetime, maintenance costs and abundance of energy sources. In fact, because of the erratic behavior of rainfall, Beles hydropower could be unreliable. The return from tourism sector is 8 times more than the maintenance cost of the solar energy technologies. Finally, the study recommends making use of an existing tunnel to fill a series of dams for irrigation purposes, which are already planned on the project design. The filling can take place during the wet season in which Lake Tana has peak outflow.

Keywords: Lake Tana, Tana Beles HP project, alternative energy resources, Flow, Solar energy

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