Implementation of customized hydropower model for enhancing the hydropower generation in Tanzania.

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The growing demand for energy and the need to reduce carbon emissions has made hydropower generation an increasingly important source of energy in many countries, including Tanzania. Hydropower plants generate electricity by utilizing the energy of falling water, making it a clean, renewable, and sustainable energy source. Tanzania has nine hydrological basins which are Pangani, Wami/Ruvu, Rufiji, Ruvuma, Lake Nyasa, Internal Drainage, Lake Victoria, Lake Tanganyika, and Lake Rukwa. These basins contain 13 hydropower plants and 76 promising areas for establishing new local hydropower plants. Despite these resources, the dependence on hydropower in Tanzania reduced from 96% in 2003 to 34% in 2015. This reduction may partly be caused by the effect of climate variability and change. For instance, prolonged severe droughts have been the primary cause in a reduction of water for hydroelectric production. Power cuts have been common in the country. To maximize the potential of the hydropower sector and ensure its long-term viability, it is crucial to both accurately predict the performance of hydropower plants and identify potential challenges.

This work is developed under a case study for the FOCUS-Africa project, funded under the European Union Horizon 2020 programme. FOCUS-Africa aims to provide customized, sustainable climate services to stakeholders in four key sectors: agriculture and food security, water, energy, and infrastructure, in six countries within the Southern African Development Community (SADC) region. The case study concerning energy in Tanzania aims to develop a cutting-edge hydropower generation simulation model. The model is designed to evaluate the performance of six of the country's most significant hydropower plants: Kihansi, Kidatu, Nyumba ya Mungu, Hale, Mtera, and Pangani. The model considers a range of factors to predict the hydropower generation of each plant; such as rainfall, water flow and installed capacity. A robust machine learning technique, the Random Forest algorithm, is employed to build the simulation model and produce predictions of hydropower generation.

The simulation results will provide crucial insights into the performance and potential of each hydropower plant in Tanzania. The findings will help decision-makers in the energy sector, including policy-makers, energy managers, and investors, to make informed decisions about the management (a few months ahead) and planning (a few decades ahead) of the hydropower sector in the country. This study will also contribute to the body of research on hydropower generation and the application of machine learning techniques in the energy sector. In conclusion, the development of this hydropower generation simulation model using the Random Forest algorithm in Tanzania will be a significant step towards a more sustainable and efficient energy future for the country.