Towards sustainable hydropower generation in West Africa

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Background

Hydropower is a major component of the current and future renewable energy mix, helping to limit CO_2 emissions into the atmosphere and thus reduce the climate impact of energy generation. While the construction of large dams has declined in Western Europe and North America, it is still booming in many emerging countries, particularly in Africa. Rising to the challenge of sustainable hydropower management involves looking closely at problems of interdependence between various social, economic and environmental factors, and at the many conflicts of objectives and interests that pose complex dilemmas. In an attempt to resolve these, new transdisciplinary approaches have emerged in recent years, co-constructed between users and scientists within the framework of sustainability science..

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Further reading

Obahoundje S. *et al.*, 2021 – Sensitivity of Hydropower Generation to Changes in Climate and Land Use in the Mono Basin (West Africa) using CORDEX Dataset and WEAP Model. *Environmental Processes*, 8 : 1073-1097.

Hydropower and climate change in Africa

Hydropower generation is the largest source of renewable electricity in the world and accounts for over half of all electricity generation in West Africa. The relationship between hydropower and climate is twofold. Firstly, hydropower has the potential to contribute to climate change mitigation through low or zero greenhouse gas emissions. Secondly, hydropower generation is impacted by climate change through disruption of the water cycle. West Africa has been impacted by the negative effects of global change, particularly in terms of the intensity and frequency of extreme weather events such as drought and floods. These events have affected many key sectors (such as water resources for agriculture or energy demand, generation and supply) and threaten countries' efforts to contribute to achieving the Sustainable Development Goals. An important challenge for West Africa is to gain a better understanding of the specific link between climate, water, energy and land use, and this must also factor in the countries' socio-oeconomic development scenarios. One of the main obstacles to making decisions to pursue sustainable hydropower generation pathways is that climate projections are uncertain and most studies on future land-use change do not address the issue of the relationship between water and energy for development.

Kpong hydroelectric dam (Ghana).

SUSTAINDAM

The SUSTAINDAM project (Pathways to Sustainability, Belmont Forum, 2021) aims to support the sustainable management and planning of hydropower generation in West Africa in the context of climate uncertainty and land-use change. The goal of the project is to build communities of practice that promote climate resilience and environmentally friendly solutions. SUSTAINDAM brings together stakeholders in hydropower generation, local policymakers, civil society representatives and women's market gardening associations to work together to address challenges and find synergies and trade-offs for the sustainable management and planning of hydropower generation. In particular, the project investigates the link between SDG 13 (climate), 6 (water) and 7 (energy) and the positive effects on SDG 15 (land) and 17 (partnership). SUSTAINDAM proposes a comparative study involving different decision support tools in four pilot sites in West Africa (Ghana, Senegal, Burkina Faso and Côte d'Ivoire) with different climatic and socioeconomic contexts. The project aims to provide a comprehensive description of the conditions that support sustainable development in the face of climate uncertainty. Sharing and joint learning between the case studies are an important goal of the project over the course of its implementation. It also aims to promote the use of decision support tools based on multidisciplinary data that are already available or will be acquired. Another goal is to train stakeholders to use these tools so that they can then work with them and apply their knowledge in the pilot sites. The aim is to provide flood risk management models, scenario-based impact models for use in dam operation and maintenance, socio-economic indicators, and maps of changes in land use and land cover.

Initial results

The preliminary results of modelling work on the impacts of climate change on power generation at the Kossou hydroelectric dam (Côte d'Ivoire) show that, on a monthly scale, the hydropower generated will be lower during the period 2030-2050 compared with the period 1980-2005, irrespective of the climate scenario used. Furthermore, simulations that take into account the effects of climate change, land use and socio-economic developments (increased water demand for irrigation, livestock, etc.) predict a decrease in hydropower generation from the Nangbéto (operational) and Adjarala (planned) dams in the Mono river basin (Togo, Benin). This decrease is even more pronounced as the demand for water from a wide variety of users increases. However, the impacts of land cover dynamics in the catchment area (reduction of vegetation and growth of developed areas) on runoff and water availability for dam generation could also affect output from the models and need to be better understood. Furthermore, land cover dynamics are associated with

water erosion processes and increased sediment transport that could be detrimental to the efficient operation of hydropower plants. These results show the need for an integrated approach to the various environmental and socio-economic components associated with hydropower generation. To address this, a crucial challenge for SUSTAINDAM is to incorporate the wide range of stakeholders involved in the different water uses and to use empirical data and simulations to identify the links between local uses and global changes.

KEY POINTS

A good understanding of the climate-water-land-energy nexus is crucial for the sustainable management and planning of hydroelectric dam generation in West Africa. There is a need to better understand the feedback loops between land-use changes (especially from urbanisation and agricultural intensification along rivers), regional climate and runoff processes, and water flows and how these will change in the future for sustainable development in Africa.

SUSTAINABILITY SCIENCE

UNDERSTAND, CO-CONSTRUCT, TRANSFORM

Collective thinking coordinated
by Olivier Dangles and Claire Fréour

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