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Applying the climatic water balance to the Volta basin as an accounting framework to aid policy makers in understanding climate pressures on the water-energy-food (W-E-F) nexus

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The multinational FutureDAMS consortium -- funded by the UK's Global Challenges Research Fund -- is working to improve the design, selection and operation of dams to support sustainable development. Existing and planned large water storage infrastructure systems have the potential to make a significant contribution towards achieving the Sustainable Development Goals and Paris climate change commitments. But maximising the benefits while minimising the negative social and environmental impacts of large-scale infrastructure in the river basins comprising the multifunctional cores of the Water-Energy-Food (WEF) nexus remains a challenge. One critical aspect of this challenge is the difficulty of achieving uptake of scientific guidance by policy makers and other influential stakeholders.

The climatic water balance (CWB), i.e. precipitation minus potential evapotranspiration, provides a methodological framework for understanding moisture supply-demand equilibrium at a range of spatial scales including those relevant to land management – administrative districts and tributary watersheds – within basins. The CWB framework understood as an accounting analogy – i.e. rainfall as income, evapotranspiration as expenditure – can be comprehensible to scientific lay persons and help to understand the climate pressures which constrain WEF resource management. Viewed through a CWB framework, rural lands are critical both as determinants of rainfall partitioning between runoff and infiltration as well as areas of consumptive water usage for food production. Runoff entering engineered river systems becomes available for satisfying water supply and (hydropower) energy demands. As a transboundary river basin in a region experiencing substantial demographic growth and with strong aspirations for rapid economic development, inter-sectoral tensions are likely as Volta basin decision makers and economic actors seek to satisfy elements of the W-E-F nexus. By quantifying spatiotemporal moisture supply-demand balance conditions the CWB can provide valuable information to quantify trade-offs and potential synergies resulting from land management practices, infrastructure development and water allocation policies.

In this work we will examine point/site-based values and spatial aggregates of CWB for a range of locations and scales within the larger Volta basin. For each case we will identify key WEF issues which are influenced by the CWB as well as stakeholders whose decision-making processes could

be informed by insights derived from the CWB (accounting) framework.