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Water use, livelihoods, and sustainability: Analysing blue water footprints in smallholder vegetable production in northern Ghana

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Abstract

Water use is central to sustaining livelihoods, however increasing pressures from climate change, population growth, and governance challenges threaten freshwater availability and long-term sustainability. In rural and peri-urban communities of the Global South, water insecurity undermines food security, income generation, and social equity, highlighting the need for integrated approaches that link water, energy, and food systems with livelihood perspectives. Despite methodological advances, persistent gaps remain in harmonizing social sustainability indicators and integrating behavioural dimensions into water use research. This literature synthesis therefore seeks to address these gaps by examining empirical and conceptual evidence on the interconnections between water use, livelihoods, and sustainability, with a focus on identifying frameworks, methodological contributions, and spatial scales that inform policy and practice. A systematic review approach, guided by PRISMA principles, was employed to identify and synthesize relevant studies published between January 2015 and March 2026. Literature was retrieved from major academic databases, including PubMed, Web of Science, MEDLINE, EMBASE, Google Scholar, JSTOR, and Semantic Scholar. Inclusion criteria emphasized methodological rigor, empirical evidence, and relevance to water use, livelihoods, and sustainability. Narrative synthesis was used to integrate findings thematically, given the heterogeneity of study designs. The review employed several analytical tools to structure and interpret findings. Automation tools assisted in duplicate removal and preliminary screening, while manual cross-checking ensured reliability. Frameworks such as the Analytical Hierarchy Process (AHP) and TOPSIS were used as reference points to evaluate the robustness of included studies. Hydro-economic models and composite indices provided comparative benchmarks for assessing how different studies linked water management strategies with livelihood outcomes. Narrative synthesis was then organized thematically, guided by these methodological lenses, allowing for structured comparison across heterogeneous study designs. AHP and TOPSIS informed how trade-offs between efficiency, equity, and sustainability were interpreted, while hydro-economic models highlighted integration of biophysical and socioeconomic dimensions. Livelihood sustainability indices guided thematic coding of social assets and resilience factors. The review highlights the importance of integrated natural resource management for sustainable livelihoods, promote environmental livelihood security, equity, and resilience in the face of global change, and reveals how methodological innovations can strengthen evidence synthesis and inform policy-relevant insights.

Keywords: Environmental livelihood security, governance and equity, sustainable livelihoods, water footprint evaluation, water-energy-food (WEF) nexus