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Ecosystem-based approaches for flood risk reduction: Advances in their comprehensive evaluation using the case of the Ouémé River Basin in Benin

Balzer, J.[1,2], Janzen, S.[1], Merk, F.[3], and Walz, Y.[1]
Contact: balzer@ehs.unu.edu

[1] United Nations University, Institute for Environment and Human Security (UNU-EHS), Bonn, Germany
[2] University of Bonn, Department of Geography, Bonn, Germany
[3] Technical University of Munich , Chair of Hydrology and River Basin Management, Munich, Germany

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1. BACKGROUND

- Ecosystem-based disaster risk reduction (Eco-DRR) is well recognized as cost-effective measure to tackle flood risk (Renaud et al., 2013). Eco-DRR provide ecosystem services (ES) that reduce all three components of flood risk, namely the flood hazard, the exposure to and the vulnerability to flood (Walz et al., 2021).
- Yet, the contribution of Eco-DRR towards all risk dimensions is not sufficiently acknowledged in evaluations. Neither are there established standards for modelling Eco-DRR effects on the flood hazard in extensive catchments (Kumar et al., 2021), nor is ecosystem functionality and vulnerability adequately considered (Shah et al. 2020).
- By the case of agroforestry in the Ouémé River Basin in Benin, this research addresses the need to better understand and evaluate the effect of Eco-DRR on all components of disaster risk to move towards the comprehensive evaluation of Eco-DRR.

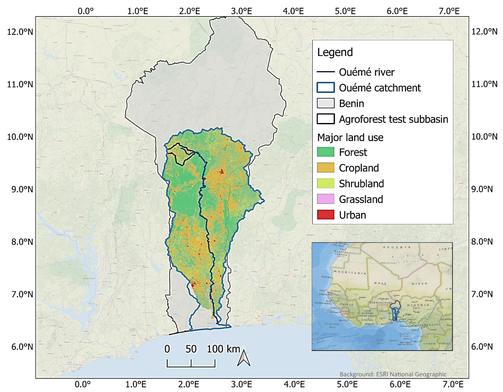

***Figure 1**: Map of the Ouémé catchment in Benin with the main land use classes (Janzen et al., forthcoming). Data sources: Lehner and Grill, 2013; Stanford University, 2015; Buchhorn et al., 2020.*

2. METHODS

2.1 Flood hazard workflow

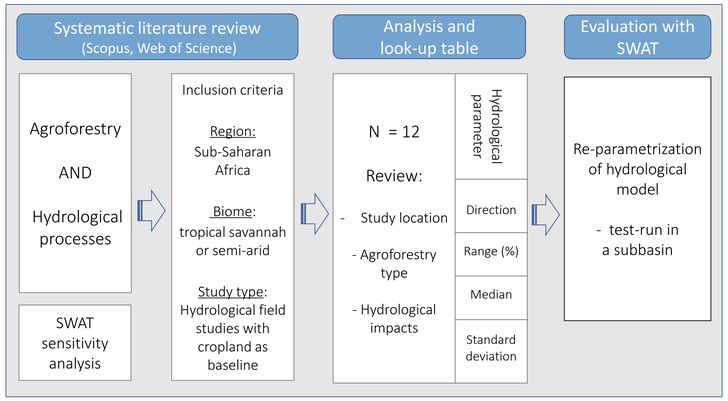

***Figure 2**: Workflow for hazard (Janzen et al., forthcoming).*

2.2 Socio-ecological vulnerability workflow

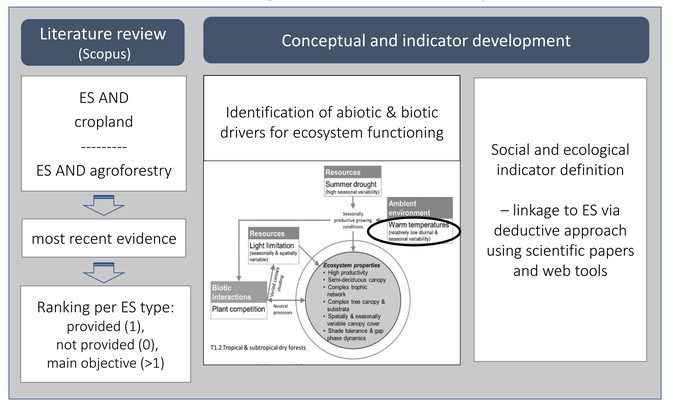

***Figure 3**: Workflow for vulnerability (Janzen et al., forthcoming). Tropical and subtropical dry forests as one of the referred to ecosystem typologies by Keith et al., 2022.*

3. RESULTS

3.1 Flood hazard evaluation framework

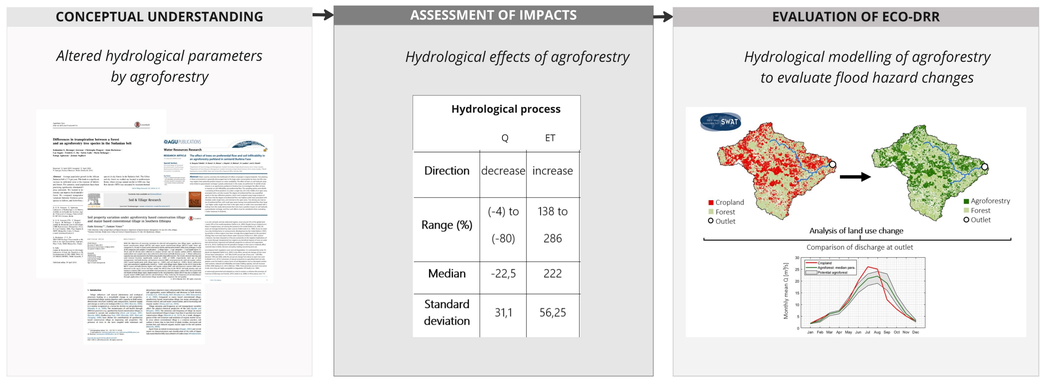

***Figure 4:** Framework for advancing the conceptual understanding, assessment and evaluation of agroforestry's impact on the flood hazard and, eventually, exposure. (Janzen et al., forthcoming).*

3.2 Socio-ecological vulnerability evaluation framework

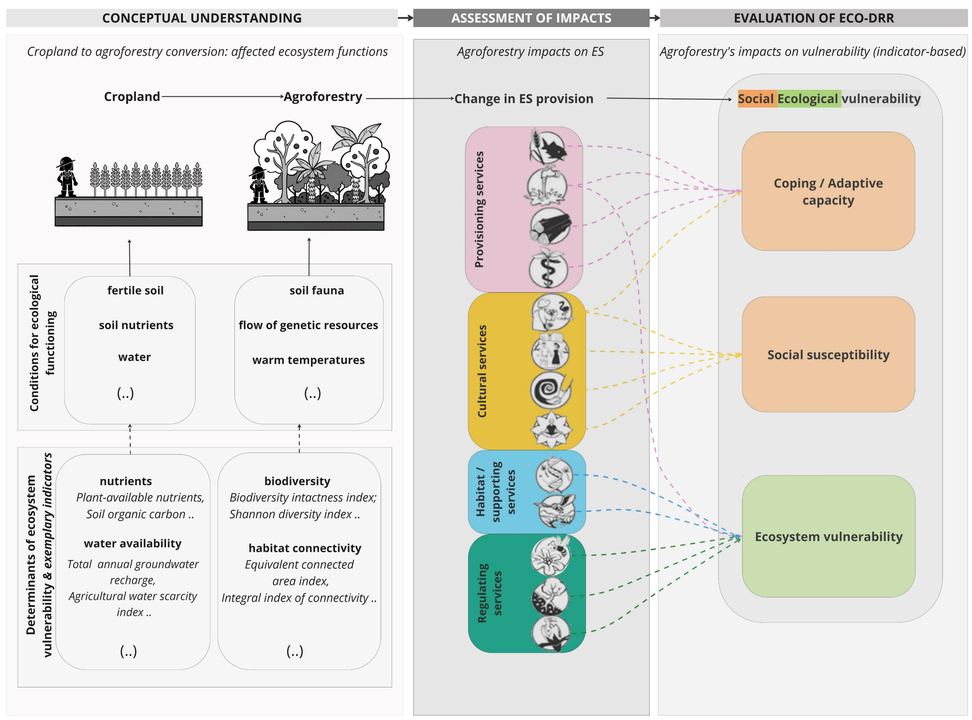

***Figure 5:** Framework for advancing the conceptual understanding, assessment and evaluation of agroforestry's impact on socio-ecological vulnerability (Janzen et al., forthcoming; ES classification and illustration according to TEEB, 2010).*

4. CONCLUSIONS

Understanding the impacts of agroforestry on all three components of flood risk (hazard, exposure, vulnerability) revealed possibilities to advance on the comprehensive evaluation of Eco-DRR.

While demanding context-specific adjustment, many of the entry points are applicable for the evaluation of Eco-DRR measures tied to land use conversions:

- Reviewing hydrological studies on Eco-DRR effects in a particular biome can inform a look-up table on mean changes in hydrological parameters upon implementation. A respective re-parameterization of the hydrological model can demonstrate the effect of Eco-DRR on the flood hazard at catchment-scale.
- Understanding and assessing ES provided by the Eco-DRR compared to the previous land use allows evaluating a measure's impact on social-ecological vulnerability.
- For ecosystem vulnerability, a clear understanding of what constitutes a functioning ecosystem is key.

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