The GDVI –A blueprint for spatial vulnerability assessments in deltas facing multiple hazards

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Disasters continue to exact a heavy toll on humans, ecosystems and economies, thus undermining ongoing efforts to achieve sustainable development. River deltas host dense populations, feature rich biodiversity and are hot spots of both agricultural and industrial production. But due to their ecological and economic importance, they are increasingly recognized as central to research and policy-making in the context of regional sustainability. Being located at the interface between the land and the ocean, the long-term sustainability of deltas is increasingly under threat due to the impacts of a range of natural and man-made threats, including large-scale human interventions as well as a range of environmental hazards (e.g. sea level rise, floods, storms, droughts, salinity intrusion, etc.). Understanding risks associated with these hazards, including both drivers of exposure and vulnerability of deltaic social-ecological systems (SES), and identifying hotspots at the sub-delta scale is hence becoming increasingly important for the development of spatially-targeted adaptation options.

Drawing on a holistic SES-centered risk and vulnerability framework as well as a “library” of environmental, socioeconomic and governance-related indicators (Sebesvari et al., forthcoming), we developed the Global Delta Vulnerability Index (GDVI) as a blueprint for delta risk and vulnerability assessments worldwide. Relevant indicators to be included in the indicator library were identified by means of a systematic review of peer-reviewed (and grey) literature combined with expert consultations during a series of stakeholder workshops in three model deltas, the Amazon, the Ganges-Brahmaputra-Megna, and the Mekong delta. In the library, indicators are organized in a modular structure, i.e. according to their relevance for different environmental hazards, hence being responsive to the specific multi-hazard settings of a given delta SES while also considering the interactions between the hazards in a given location. Based on these preliminary steps we followed a largely sequential, multi-stage workflow to construct the GDVI for the above mentioned model deltas. Important modeling stages include data acquisition and pre-processing (identification and treatment of outliers, missing data and multi-collinearities), normalization, (weighted) aggregation, sensitivity analysis (e.g. impact of indicator choice, etc.) and visualization. Further, for one of the deltas a validation of the resulting risk against observed loss and damage information was carried out.

Results show that risk, exposure and vulnerability are very heterogeneous both between and within the three deltas, with varying contributions of the underlying indicators. The highest level of risk and exposure was observed in the Mekong delta, followed by the GMB and the Amazon, while vulnerability of the coupled SES was found to be particularly high in the Amazon. Both facts have crucial policy-making implications since (a) interventions aiming at reducing risk must be spatially targeted, and (b), due to its relatively high level of vulnerability, risk might increase dramatically in the Amazon delta if exposure to natural hazards increases in the future, hence calling for improved preparedness.

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