Name : Md Khairul Islam

Dissertation title : Developing a methodology for integrated flood risk assessment in a transboundary river basin using multi-platform data under global change– the case of the Meghna river basin

Institution : National Graduate Institute for Policy Studies

Summary

Flood risk has been tremendously increasing due to changes in climate, population, and land use. To reduce such risk through mitigations measures, flood risk assessment (FRA) is required for strengthening preparedness and building back better. However, lack of various observed data makes FRA difficult to perform in local river basins. Performing FRA is even more difficult in transboundary basins due to unavailability of upstream data. Because of these limitations, FRA hasn't been implemented in transboundary basins, though useful, if implemented, to acquire policy level information for sustainable development. Accordingly, this study proposed a research framework to develop an Integrated FRA (IFRA) model in the Meghna river basin that shares the wettest areas of India upstream and economically important north-eastern rural Bangladesh downstream. An IFRA model consists of three main components: assessment of flood hazard, vulnerability, and exposure. Flood hazard assessment requires reliable basin-wide rainfall data, which is unavailable in the Meghna basin beyond Bangladesh border. Therefore, a reference rainfall dataset was developed using locally available ground and globally available satellite estimates. The potential of the dataset was successfully investigated by calibrating and validating a hydrological model to simulated streamflows. Such dataset overcome the data limitation issues and produced hazard maps in terms of depths, duration, and extent for a past flood across the basin.

Flood vulnerability was assessed through a field survey data due to the lack of recorded flood damage data. Vulnerability curves for Boro rice (main crop of the area), house building, and in-house property damage were established using the survey data. Findings

revealed that Boro plants can tolerate the inundation without any damage up to an average height of 25 cm (at which rice tiller evolves), though rice damage becomes ~100% at 70–75 cm water height (at which grains start to flourish). Findings also showed that the household damage is mainly dependent on inundation height above floor level and construction method and building material of different house types.

Flood exposure, third component of the IFRA model, was assessed for Boro rice and households using a rice extent map (provided by the International Rice Research Institute) and a household distribution map (prepared using population distribution and average household size), respectively. By combining the hazard, vulnerability, and exposure maps, potential flood damage to Boro rice and households were estimated for 2017 flood and satisfactorily validated with the damage reported for the flood.

Using the validated IFRA model, flood risk to Boro rice was assessed under the global changes in climate and land use. Future hazard parameters were produced using global climate models' outputs. Established damage functions (at present value) and rice extent maps predicted for future climate were respectively used for vulnerability and exposure assessment. The results revealed that the effect of climate change will increase the vulnerability of the study area by increasing both depth and extent of inundation. Boro rice damage is expected to increase by about 124%, in future.

Based on findings, new policy implications are recommended to reduce flood disaster risk through structural and non-structural measures. However, the non-structural measures, such as near-real-time flood forecasting and warning, dissemination and implementation of hazard maps, allowing excess water into the Boro fields up to a 25 cm or more water height, and introduction of flood insurance program, were found more effective and environmentally friendly than the structural measures. These recommended non-structural measures have to be promoted by the government as well as non-governmental organizations to reduce increasing flood risk in the study area in order to achieve sustainable development goals and building back better.