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A risk assessment for major river flooding in Myanmar incorporating hazard, exposure, and vulnerability

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Worldwide, floods have major impacts on people, economies, and the environment. In Myanmar, floods are the most frequently occurring hazard and have the highest contribution to average annual loss compared to all other hazards. Although the population has learned to adapt to yearly flooding, climate change exacerbates the frequency and magnitude of flood events to an extent where the population has little capacity to cope. Many factors such as poverty and dependency on agriculture make the Burmese people more vulnerable to major flood events. The need to better understand flood risk and its spatial patterns in Myanmar has become extremely important.

However, the state of the art on flood risk in Myanmar is not well developed. Analysis has mostly focused on flood loss, hazard, mitigation, and resilience, or future vulnerability to flooding. Here we present a comprehensive quantitative indicator-based risk assessment for a major flood event with a 100-year return period at the township level for Myanmar. This analysis will show the spatial distribution of major river flood risk based on the IPCC framing of risk while highlighting factors of vulnerability that contribute to risk. The analysis considered the present-day flood risk to people. Flood extent and population distribution were used to create a hazard/exposure indicator. Then, a systematic literature review was performed to identify relevant vulnerability indicators and drivers for Myanmar. Data for each vulnerability indicator was collected and compiled into one vulnerability index score. Then, we compared two different methods of aggregation of the elements into a risk index: multiplicative arithmetic aggregation and overlay of different quantiles of hazard/exposure and vulnerability. Post hoc analysis was conducted to test the relationship between elements for the multiplicative aggregation method.

The analysis showed that the highly exposed populations and townships are adjacent to rivers, with most flooding in the Ayeyarwady region. Major urban population centers such as Yangon and Mandalay cities have high exposure to flooding. Vulnerability to river flooding is primarily triggered by poverty, inadequate access to healthcare with a limited number of doctors and beds, poor road networks, and a small number of households with boats. Risk is highly concentrated in townships in the Ayeyarwady, Bago, and Rakhine regions in both aggregation methods.

Importantly, there are limitations in this study and future work could focus on addressing these gaps. For example, this assessment focused on a single hazard (flood) and a single exposed

element (people) whereas Myanmar has a multi-hazard environment with complex social-ecological systems and high levels of resource dependency. Nevertheless, our study results remain essential for local and national authorities and related organizations in the field of disaster risk reduction as it has a strong conceptual foundation of risk with a clear focus on entry points for vulnerability and risk reduction.