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IMPACTS OF CLIMATE CHANGE AND DAM CONSTRUCTION ON RICE DAMAGES IN THE CAMBODIAN FLOODPLAIN OF THE MEKONG RIVER BASIN

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ABSTRACT

Introduction and Objective

The Mekong River Basin (MRB) is one of the large-scale river basins in mainland southeast Asia, travelling across six countries including China, Myanmar, Thailand, Lao PDR, Cambodia, and Vietnam. This area is one of the vulnerable zones to be severely affected by climate change. Climate change has become a global environmental and socioeconomic issue that has a potential impact on changing the river hydrology and flood characteristics. Hydropower dam construction in the upper basin of the Mekong River is an essential driving factor affecting the flooding in the MRB. The study of flood-related damages under climate change impact and dam construction in this river was not yet carried out.

This study aims to investigate the potential impacts from future climate change and dam construction on agricultural damages on extreme flood events in the Cambodian floodplain (Fig. 1) in the Lower Mekong Basin (LMB).

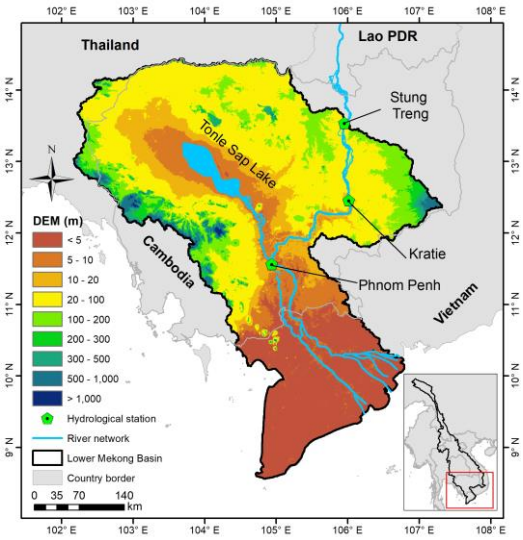

Fig. 1 Location of Cambodian floodplain

Method

This study used a fully distributed rainfall-runoff-inundation (RRI, Sayama et al., 2015) model to simulate flood hazards. The RRI model was set up with a spatial resolution of 2.5 arc-minutes (approximately 4,613 m) for the whole MRB for river discharge simulation and 60 arc-seconds (approximately 1,832 m) for simulation of flood inundation in the LMB considering discharge as boundary condition input. We used a calibrated and validated RRI model by previous studies (Try et al., 2020a, 2020b).

This study used the climate change dataset from a large ensemble Database for Policy Decision-Making for Future Climate Change (d4PDF) which consists of 100-ensemble for present climate (1950-2010) and 90-ensembles for future projections (2051-2110) under increasing of 4°C. Moreover, this study investigated the impact of dam construction from 126 dams in the whole MRB (all six countries), and their operation rule is considered as hydropower generation. The calculation of agricultural economic damage during the growing period (September-November) was performed using the following equation:

$$\text{Economic Damage Value} = \text{Rice Yield} \times \text{Damage Area} \times \text{Yield Loss} \quad \text{(eq. 1)}$$

Results and Discussions

The results of agricultural flood damages in the Cambodian floodplain was summarized in Table 1. The extreme flood events in the LMB were investigated from the d4PDF dataset as input into the RRI model. The flood extent of 10-year, 50-year, and 100-year return periods (see more detail in Try et al., (2020a)) showed an increase of 12%, 14%, 17% for under climate change impact; and 7%, 10%, 14% under integrated impact from climate change and dam construction. The estimated agricultural damages in the Cambodian floodplain for the present climate were approximately 160, 210, and 240 million US$ for 10-, 50-, and 100-year return periods, respectively. Under climate change effect alone, the change in agricultural damages would increase by 32%, 38%, and 39%. In comparison, the integrated impacts from climate change and dam construction would reduce these rates to 17%, 24%, and 31% for flood event in 10-, 50-, and 100-year, respectively. Fig. 2 illustrated the spatial distribution of rice damages for 50-year return period.

TABLE 1. Estimated agricultural damages in present, climate change, and dam scenarios

Extreme event	Climate scenario	Agricultural damage [M US$]
10-year	HPB	160.35
	HFB (CC)	211.15 *(+32%)*
	HFB (CC+dam)	188.05 *(+17%)*
50-year	HPB	210.26
	HFB (CC)	289.25 *(+38%)*
	HFB (CC+dam)	260.77 *(+24%)*
100-year	HPB	239.69
	HFB (CC)	332.21 *(+39%)*
	HFB (CC+dam)	314.87 *(+31%)*

Conclusions

In conclusion, the results from this study indicated a potential increase in agricultural damages in the Cambodian floodplain of the MRB under the effect of future climate change dam construction. Therefore, appropriate activities and countermeasures should be prepared for response and adaptation to these severe flood events.

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