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Improvement of Disaster Management Approaches in Japan Using Paddy Field

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Japan has a history of major natural disasters, mostly due to its geographical characteristics and topographic features. Major typhoons and floods cause severe damages to lives, properties and important infrastructure, which may increase in future due to climate change. Therefore, sustainable and cost-effective disaster management strategies are of timely requirement, and paddy fields in the river flood plain areas of Japan can be effectively utilized in this regard. After the paddy harvest season, most paddy fields remain unused for a few months and during this time it can work as storage reservoir with minor interventions. During intense rainfall, water can be stored within the paddy field bunds if the drainage outlets are kept closed for some time. Thus, contribution of rainwater to the river can be lessened, resulting river discharge reduction to some extent and protecting important areas from flood damages. The potential of paddy fields in Japan as storage reservoir is not well represented in any research that involves hydrological modelling. This study is performed to assess the impact of using paddy fields for river discharge and inundation reduction, through hydrological model simulation. Two major river basins in Japan, Abukuma river in Fukushima prefecture and Chikuma river in Nagano prefecture are selected as study areas. Paddy field covers 15-20% of watershed areas of these rivers and most of these fields are very close to the main river stream, which indicates their fair potential to store rainwater and contribute to discharge reduction. A global hydrological and water resources model named ‘H08’ is used in this study to simulate river discharge for two scenarios, where one is the control scenario with no storage of water within the paddy field and another is storing rainwater within the exiting or extended paddy bunds. Simulations are performed for 2018 and 2019 to compare the normal flood year and extreme event (a super typhoon occurred in Japan in 2019). Observed and simulated discharge is compared for model calibration and results show better correlation in the upstream section of the rivers. More adjustment of model parameters is still necessary for better calibration. Simulation results show that for 2018, Abukuma river experienced 21-25% decrease in river discharge when water is stored within the conventional 25cm paddy bund. The reduction increased up to 35% when the paddy bunds are assumed to be extended up to 50cm in height. Similar results are observed for Chikuma river basin. For 2019, discharge shows 10-15% decrease

for 25cm paddy bunds and around 20% reduction for proposed 50cm bund. With this discharge reduction potential, if paddy field bunds can be extended up to 50cm with a working public-private partnership, where farmers are aware of the advantages of utilizing unused paddy fields as such an effective means of flood management, then this strategy can be considered a sustainable and cost-effective way of disaster management, where the existing land-cover will act as a natural means of storage reservoir. Moreover, this sustainable strategy can be adopted in other countries having similar geographical features as Japan.