Flood risk index using distributed hydrological modeling in Laos

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1. Introduction

The Laos PDR has experienced a range of floods of different magnitudes and duration. Particularly in three consecutive years -1994, 1995 and 1996- the flood were large and disastrous. Currently Laos is in the stage of development both of economic and social and another reason is the impacting resettled communities and people living the downstream of the dams (Bakker, 1990). A lot researches have been done about the resettlement area both in present and history (Baird and Shoemaker, 2007) but nobody has understood about safety of the area against the natural hazard yet. This study aimed to provide the flood risk map of Laos to figure out a suitable area and countermeasure against or live along with flooding threats.

2. Data set

The Topographic data, soil data, land use, DEM data, these data will get from National Geographic department of Laos (NGD). The weather parameter like precipitation, maximum and minimum temperature, wind speed are from Department of Meteorology and Hydrology of Laos (DHM), steam flow data from DHM will be use to calibration and validation process of the model.

3. Methodology

In this study was used 3 different hazard maps to integrate for generating a flood risk map and namely, (1) flood depth hazard map generated by use of hydrological distributed model developed by Kashiwa et al. (2010) under the structure proposed by Kazama et al. (2004), The objective of this map is the production of a flood risk map over the entire area of Laos. The model is based on hydrological distributed model as show in chapter three, but instead of simulation of the runoff flow, we will take into account for every grid cell's highest water depth that determines by major contributing factors namely, extreme peak daily rainfall, land use types, soil hydrologic characteristics and elevation. (2) To evaluate the distribution of landslide hazard over Laos, this study uses a probabilistic model based on multiple logistic regression analysis (Kawagoe et al., 2010). (3) Land use impact for a flood hazard map, this map used scenario of deforestation and urban expansion to find sensitive area.

The flood risk index is the relationship between the water depths and landslide probability as shown in equation 1 scale from zero to one, which zero described the low risk and up to one is high risk, which was adapted from the relationship between water depths.

Flood risk index = f(flood water depth, landslide probability) (1)

4. Results & Discussion

First, from the results of probability of landslide as shown in fig. 1, the highest risk index (0.75-1) are occurred around the central to northern part of Laos; for the flood hazard map as shown in fig. 2, the most sensitive areas are distributed around the country; for land use impact to flood map as shows in fig. 3 the hazard area in southern part are expand because of change in land use.

The flood risk map as shown in fig. 4 that generated by integration of 3 hazards maps, indicates the sensitive area for the whole country. Especially in southern part of Laos that have impact from the land use change, those area are

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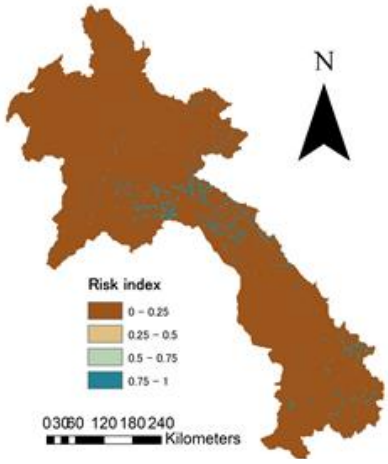

Fig. 1 Probability of landslide map

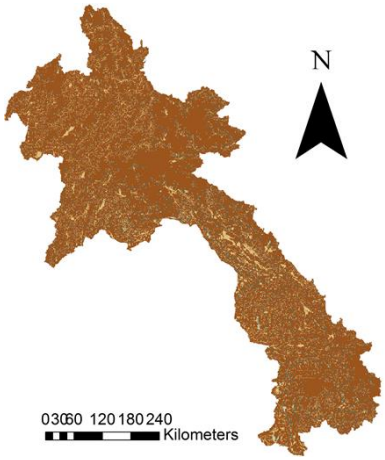

Fig. 2 flood hazard map

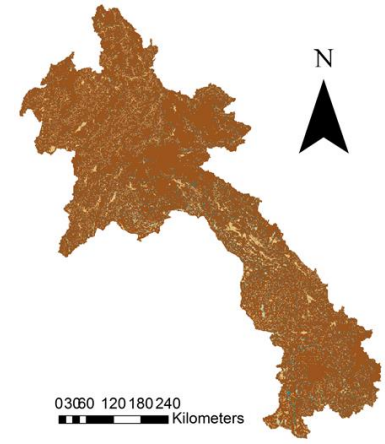

Fig. 3 Land use impact to flood map

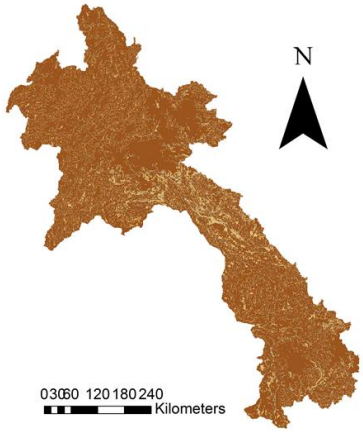

Fig. 4 flood risk map

new economic developing area for industries. Also the central part of Laos has an important role for the transportation of export and import goods from China and Vietnam.

5. Conclusions

This study provides the flood risk map to identify the future study or can be used for disaster counter measure management plan. For the future study, still some factors should be used to improve the quality of a flood hazard map such as impact of many years return period rainfall. In addition, the distribution of each risk factor still has not discussed yet in detailed.

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References

Baird and Shoemaker., 2007. Unsettling experiences: internal resettlement and internal aid agencies in Laos. Dev. Change, volume 38, pages 865-888.

D.N.Moriasi et al., 2007. Transaction of the ASABE, volume 50, pages 885-900. Model evaluation guideline for systematic quantification of accuracy in watershed simulations

J.E.Nash, J,V.Sutcliffe, 1970. Journal of Hydrology, valume 10, page 282-290. River forecasting through conceptual model.

Kashiwa S, Kazama et al., 2010. Proceeding of the river Technology, volume 16, pages 289-294. Flood analysis modeling of snow melting and estimation.

K. Bakker., 1999. The politics of hydropower: developing the Mekong. Political geography, volume 18, pages 209-232.

Kawague et al., 2010. Probabilistic modelling of rainfall induced landslide hazard assessment. Hydrology and earth system sciences, volume 14, pages 1047-1061

Mekong River Commission, Mekong River Hydrological Year book 1992.