Integrated approach to analyse the damage cost from multi hazard and evaluating adaptation measure for reducing damage cost, case study: Lao PDR.

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Introduction

Single risk analysis addressing single hazards provides information about only an individual risk in a specific location; however, in a specific location, more than a single hazard can occur. Therefore, the integration of the risk assessment of these hazards is necessary. Recently, Lao People's Democratic Republic (or Lao PDR) suffers from flooding every year. Lao PDR is a developing country located in Southeast Asia. The country's people depend heavily on agriculture and natural resources for their livelihood.. The objective of this study is to develop integrated risk maps for estimate the damage cost from multi risk hazard such as flood, land use change impact to flood and climate change leading to flood risk map.

Study area

The Laos PDR is located in the middle of South East Asia. The country is landlocked, therefore it has no direct access to the sea and has common borders with China, Vietnam, Cambodia, Thailand and Myanmar. The country is located in the Center of the Indochinese peninsula, located between Longitude 100 to 108 degree East and latitude 14 to 23 degree North, with a total area of 236,800 km^2 with Mekong river flows through almost 1,900 km of Lao territory from the North to the South and it forms a natural border with Thailand on over 800 km

Methodology

Hydrological distributed model based on kinematic equation developed by Kashiwa et al (2010) was used to simulated rainfall-runoff in the study area. For the land use change impact to flood, the scenario of future expansion of urban and increase of agricultural area were used to simulate land use change impact to flood risk map. Average of rainfall from 7 Global Climate Models (GCMs) under three scenario (RCP 2.6, 4.5 and 8.5) with two time period near future (2010-2050) and far future (2051-2099) were used to assessing climate change leading to flood hazard map. In addition, land use price from Ministry of agriculture and Forestry of Lao PDR (2018) were used to estimate the damage cost from the hazard maps. Subsequently, we use equal weight for aggregated individual risk map together. Additionally, benefit lost analysis (discount rate = 0.05) is apply to analyze relocatable area of agricultural and paddy field from the integrated risk maps of near future with three RCP scenarios.

Results and discussion

According to the results shown in Fig. 1, most of the risk areas illustrated occur in the central to southern parts of Laos. The integrated risk maps consist with 6 maps from 3 RCPs scenario and with two time periods. For near future, total damage costs across the study area is around 14.9 billion USD/year under RCP 2.6 scenario and it increase to 15.02 billion USD/year under RCP 4.5 scenario. Under RCP 8.5, the total damage cost of risk areas across the study area increase to 15.17 billion USD/year. For far future, the total damage costs under RCP 2.6 scenario is around 15.13 billion USD/year and it increase to 15.21 billion USD/year under RCP 4.5 scenario. Under RCP 8.5, the total damage cost of risk areas across the study area increase to 15.32 billion USD/year (Fig 1). Many studies in Mekong delta (Dinh et al., 2012; Lauri et al., 2012) revealed that the climate change has impacts on rainfall intensity which leads to increase in flood and landslide frequencies. Therefore, these results are in line with those of other research studies. According to the benefit-lost analysis, the relocatable area under scenario of RCP 2.6 is around 14.65% and it decrease to around 13.87% under RCP 4.5 scenario. For under scenario of RCP 8.5 the locatable area is around 13.14% (Fig 2).

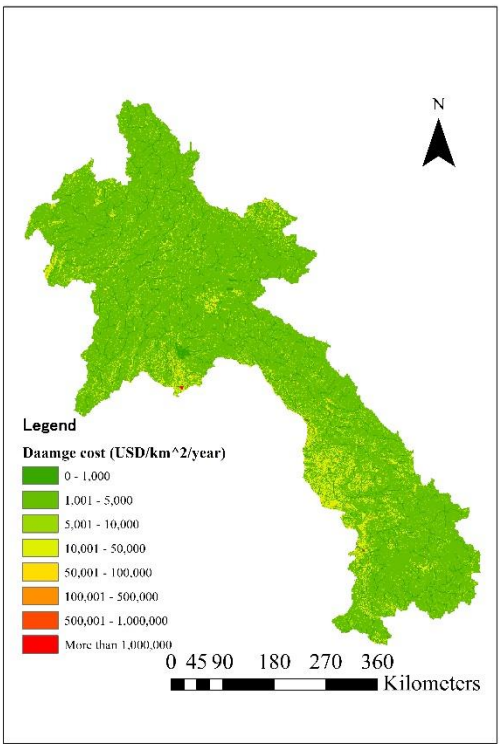

Fig 1 Integrated risk map under scenario of RCP 8.5 with far future period

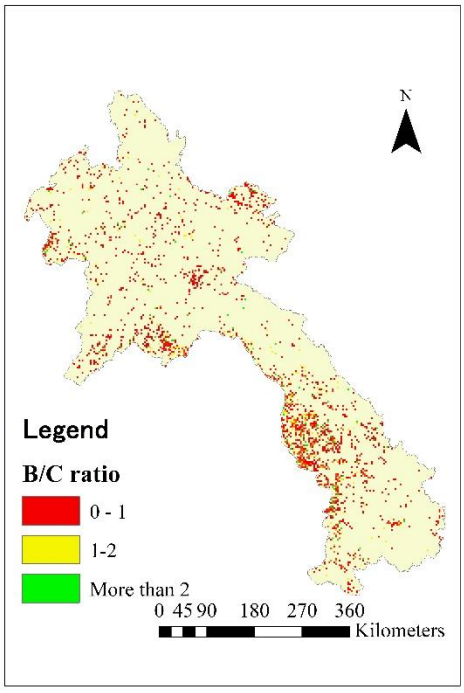

Fig 2 B/C ratio with discount rates (r = 0.05) in the case of relocation from agricultural and paddy field with RCP 8.5 scenario for the intergrated risk map

Conclusions

This study was accessed the potential damage cost of integrated risk maps. The total damage cost across the study area increase with the increase of RCP scenario for both of near future and far future. For relocatable area from the integrated risk maps, the relocatable area decrease when the RCP scenario change from RCP 2.6 to RCP 8.5 scenario. It is important for government to pay more attention to those area to prevent the impact of various risk hazard, this study also can provide essential data for future development plan.

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