

Estimating Affected Croplands and Potential Crop Yield Loss of an Individual Farmer Due to Floods

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Abstract : Farmers who are living in flood-prone areas such as coasts are exposed to storm surges increased due to climate change. Crop cultivation is the most important economic activity of farmers, and in the time of flooding, agricultural lands are subject to inundation. Additionally, overflow saline water causes more severe damage outcomes than riverine flooding. Agricultural crops are more vulnerable to salinity than other land uses for which the economic damages may continue for a number of years even after flooding and affect farmers' decision-making for the following year. Therefore, it is essential to assess what extent the agricultural areas are flooded and how much the associated flood damage to each individual farmer is. To address these questions, we integrated farmers' decision-making at farm-scale with flood risk management. The integrated model includes identification of hazard scenarios, failure analysis of structural measures, derivation of hydraulic parameters for the inundated areas and analysis of the economic damages experienced by each farmer. The present study has two aims; firstly, it attempts to investigate the flooded cropland and potential crop damages for the whole area. Secondly, it compares them among farmers' field for three flood scenarios, which differ in breach locations of the flood protection structure. To achieve its goal, the spatial distribution of fields and cultivated crops of farmers were fed into the flood risk model, and a 100-year storm surge hydrograph was selected as the flood event. The study area was Pellworm Island that is located in the German Wadden Sea National Park and surrounded by North Sea. Due to high salt content in seawater of North Sea, crops cultivated in the agricultural areas of Pellworm Island are 100% destroyed by storm surges which were taken into account in developing of depth-damage curve for analysis of consequences. As a result, inundated croplands and economic damages to crops were estimated in the whole Island which was further compared for six selected farmers under three flood scenarios. The results demonstrate the significance and the flexibility of the proposed model in flood risk assessment of flood-prone areas by integrating flood risk management and decision-making.

Keywords : crop damages, flood risk analysis, individual farmer, inundated cropland, Pellworm Island, storm surges

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