

Assessment of extreme precipitation changes on flood damage in Chungcheong region of South Korea

Bashir Adelodun*, Golden Odey**, Qudus Adeyi***, Kyung Sook Choi****

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Abstract

Flooding has become an increasing event which is one of the major natural disasters responsible for direct economic damage in South Korea. Driven by climate change, precipitation extremes play significant role on the flood damage and its further increase is expected to exacerbate the socioeconomic impact in the country. However, the empirical evidence associating changes in precipitation extremes to the historical flood damage is limited. Thus, there is a need to assess the causal relationship between changes in precipitation extremes and flood damage, especially in agricultural region like Chungcheong region in South Korea. The spatial and temporal changes of precipitation extremes from 10 synoptic stations based on daily precipitation data were analyzed using the ClimPACT2 tool and Mann-Kendall test. The four precipitation extreme indices consisting of consecutive wet days (CWD), number of very heavy precipitation wet days (R30 mm), maximum 1-day precipitation amount (Rx1day), and simple daily precipitation intensity (SDII), which represent changes in intensity, frequency, and duration, respectively, and the time series data on flooded area and flood damage from 1985 to 2020 were used to investigate the causal relationship in the ARDL-ECM framework and pairwise Granger causality analysis. The trend results showed that majority of the precipitation indices indicated positive trends, however, CWD showed no significant changes. ARDL-ECM framework showed that there was a long-run relationship among the variables. Further analysis on the empirical results showed that flooded area and Rx1day have significant positive impacts on the flood damage in both short and long-runs while R30 mm only indicated significant positive impact in the short-run, both in the current period, which implies that an increase in flooded area, Rx1day, and R30 mm will cause an increase in the flood damage. The pairwise Granger analysis showed unidirectional causality from the flooded area, R30 mm, Rx1day, and SDII to flood damage. Thus, these precipitation indices could be useful as indicators of pluvial flood damage in Chungcheong region of South Korea.

Keywords : Extreme precipitation indices, Flood damage, Causal impact, ARDL-ECM

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* Member, Researcher, Dept. of Agri. Civil Eng., Kyungpook National University

** Member, Graduate student, Dept. of Agri. Civil Eng., Kyungpook National University

*** Member, Graduate student, Dept. of Agri. Civil Eng., Kyungpook National University

**** Professor · , Dept. of Agri. Civil Eng., Kyungpook National University · E-mail : ks.choi@knu.ac.kr