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Improve of Critical Exponent Formula for Heavy Rain Impact Weather

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The south Chungcheong Province has experienced the highest frequency of heavy rain disasters in Korea over the past 12 years. Current heavy rain warning system is determined according to the volume of precipitation, which makes it difficult to identify the degree of disaster risk and the deviation of disaster probabilities. It is necessary to develop a disaster risk index that reflects geographical characteristics, exposure, and vulnerability in addition to meteorological elements.
We improve Heavy Rain Critical Index (HRCI). Which predict the impact of heavy rainfall by subdividing warning zones and criteria. The target area is Buyeo in Korea. Buyeo has the strongest rainfall intensity and the highest precipitation. In addition, the damage caused by the heavy rain is the largest. We compiled statistical data on damages caused by heavy rainfall during 2006 $\sim$ 2017 : six meteorological elements (1h, 3h, 6h rainfall, daily rainfall, duration of rainfall, and antecedent precipitation for previous 3 days), and eleven non-meteorological factors (mean bed slope, lowland ratio of less than 25m, mean elevation, mean river bed slope, area, population density, vulnerable social group ratio, agriculture field, ratio of impervious area, mean levee height, mean river width) in each regions. The standardized sub-indicators selected major influential factors through correlation analysis. Using the Ridge regression analysis method and the AHP method, candidate formulas were designed for each representative damage types (landslide, collapse, farmland, other facilities) ($p < 0.05$). We set the minimum rainfall threshold from the data except for outlier. Then, we estimate the total damage level by considering the influence weight β of the non-meteorological factor and the meteorological elements. Finally HRCI was calculated by applying the weighting factor α (frequency of damage-occurrence) to the selected equation.
It was possible to improve the prediction accuracy of rainfall effect by damage type and regional differential effect on the same precipitation. And, it showed better results than the previous exponential equation ($R2 = 0.33 \sim 0.66$, $MSE = 0.029 \sim 0.072$).

Key words : Heavy rain disasters, Impact weather forecast, meteorological element, non-meteorological factor, multiple regression analysis