Integrated Geospatial Socioeconomic Analysis to Forecast Climate Change Impact on Food Insecurity

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While climate change's environmental impacts are well recognized, its humanitarian impacts depend on complex interactions between climate and population factors. This study simulated land-use-land-coverage (LULC) transitions alongside socioeconomic developments to predict food insecurity. Remote sensing imagery and household data were processed for Uganda, a nation with diverse LULC, developing population dynamics, and severe climate change impacts. Land types were classified and correlations with climatic, geologic, and topographic variables were analyzed in preprocessing. A Cellular-Automata Markov Chain model simulated transitions under varying climate scenarios every decade until 2060. An increase in climate severity caused a transition of forest-land into grassland. The conversion of forest-land and grassland into arable-land and built-up land presents a reduction of land quality, likely caused by rising population demands. To forecast food security, variable predictive correlations were analyzed with a support vector machine and integrated into Markov transitions. The regulation parameter was optimized at C=0.23 and an accuracy of 80% with 90% positive recall was reached, error primarily due to allocation. Food-vulnerable regions were identified as uplands from erosion, arid zones from soil salinity, and coastal areas from water pollution. Hydrologic factors and agricultural behaviors were most influential. A positive feedback loop between arable-land loss and decreasing food security was identified, emphasizing the need for sustainable population development and resource management. Reform in humanitarian action is recommended, with geospatially targeted approaches toward relief. Application in more variable climates is recommended to verify model robustness.

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