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Land Subsidence Susceptibility Mapping in Bandarawela & Ella DS Divisions in Sri Lanka, using GIS

U. S. Kangana* and I. A. K. S. Illeperuma

Department of Remote Sensing & GIS, Faculty of Geomatics, Sabaragamuwa University of Sri Lanka
*usupeka@stdgeo.sab.ac.lk

Land subsidence is gradual settling or sudden sinking of the earth's surface owing of subsurface movement of earth materials; most of the identified subsidence were caused by server withdrawal of underground water and increasing development of land and water resources. Land subsidence at Bandarawela is a controversial topic, because of environmental issues caused by Uma oya multipurpose development project. Villages of the Ella and Bandarawela divisional secretariats face that hazard. The main objective of the study was to identify land subsidence susceptibility areas in Bandarawela and Ella DS divisions using Geographic Information System (GIS) techniques. Recorded data of subsidence areas, which were reported as coordinates, were collected by National Building Research Organization. Nine land subsidence conditioning factors were considered such as altitude, slope, aspect, distance from fault, distance from river, Normalized Difference Vegetation Index (NDVI), Stream Power Index (SPI), Topographic Wetness Index (TWI) and land use to generate land subsidence index maps. Altitude, Slope, Aspect, SPI and TWI data layers were generated by height data from survey department. Distance from faults layer derived by faults coordinators buffering and similarly distance from river layer was derived by river map buffering. NDVI layer was derived by Landsat-8 images. Spatial data layers for each of these factors were created in raster mode and classified layers into classes. Land Subsidence Susceptibility Map was created using Frequency ratio (FR) model and Analytic Hierarchy process (AHP) method. In FR analysis, each individual considering factor is compared to the land subsidence inventory map and assigned weighted value for each class. AHP is pair wise comparison method and to apply this approach, select conditioning factors; arrange these factors in a hierarchic order; assign numerical values to subjective judgments on the relative importance of each factor and synthesize by generating map. Those two models were compared. Result shows that 16.99% and 6.92% of the total area were in high and very high susceptibility prone area in FR model. But AHP model shows that those values are 8.42% and 3.99% respectively. Result also stresses that high susceptibility prone areas lie closer to the tunnel axis. Theses result can obtain an understanding of the nature of land subsidence and promulgate public awareness of such geo hazard to decrease human and economic losses. The advantages of using statistical modeling is easiness and the convenience of handling the inputs, outputs, and the hierarchy of the whole calculation process. It can process large amount of data in the GIS environment within a short period of time. In statistical models, conditioning factors must have normal distribution, which is considered as a deficiency in this type of modeling process.

Keywords: Land subsidence, Frequency ratio model, Analytic Hierarchy Process, GIS, Bandarawela & Ella DS divisions.

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