Mapping of Land Subsidence Vulnerability: Case Study at the Tarkwa-Prestea Mining Areas of Ghana

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SUMMARY

Land slides and subsidence with disastrous consequences are serious geo-environmental events with high probability of occurrence in mining areas. To minimize their occurrence and negative impacts on humans and the environment, appropriate preventive and mitigation measures must be put in place and these require knowledge and understanding of the risk factors involved and the vulnerable areas within a given geographical region. This paper discusses the combined use of the 'DRASTIC' ground vulnerability modeling technique, the analytical hierarchy process (AHP), Geographic Information System (GIS), GPS and Remote Sensing to collect, process, analyze and evaluate the relative and combined influences of the risk factors involved and to map the susceptible areas of land subsidence in the Tarkwa Mining Areas (TMA) of Ghana. The relevant risk factors identified in the study area include high rainfall, drainage density, elevation and slope, soil, land use/land cover (LULC), depth to ground water, proximity to mine sites, geology and hydrogeology. The relative influence of each of the factors were estimated and combined to generate land subsidence vulnerability maps for the study area with five different classes, namely very low, low, moderate, high and very high vulnerability zones. The vulnerability map indicates that a significant proportion (about 16.5%) of TMA lies within the high and very high vulnerability zones and these occur mainly at the north-western parts of the area. The results further show that geology and soil, elevation, slope and rainfall were the major natural contributing factors while mining land uses and activities such as excavations, blasting and waste dumping, and residential settlements were among the main anthropogenic factors. Based on the results, it is recommended that the high and very high vulnerability zones should not be used for siting residential buildings, landfills and other projects that can compound the negative effects of land slides or subsidence in TMA and similar areas. These areas include highlands and slopes close to active mining sites where blasting and heavy rainfall increase the risk of their occurrence. The results of the current studies may be used as preliminary references or criteria to check the suitability of proposed land uses or development projects in terms of subsidence risk in the study area.