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Landslide detection and susceptibility analysis using aerial photographs and weight of evidence

Lee Saro and Oh Hyun-Joo

Korea Institute of Geoscience and Mineral Resources (KIGAM), Geosciece Information Center, Daejeon, Republic of Korea (leesaro@kigam.re.kr)

The aim of this study was to detect landslide using aerial photographs and apply the landslide to probabilistic landslide susceptibility mapping at Jinbu-myeon area, Korea using a Geographic Information System (GIS). For probabilistic landslide susceptibility analysis, accurate detection of the location of landslides is very important. Interpretation of aerial photographs has the advantage of enabling the rapid and accurate detection of landslides. During the Korea rainy season in June 14 to July 19, 2006, a series of typhoons such as EWINIAR, BILIS and KAEMI has hit Gangwon-do area by storm and heavy rainfall. The 2 days-rainfall was 675mm and 3 hours-rainfall was 209mm. As the result, the damage to property was about a value of 449 billion USD. So, among the Gangwon-do area, the Jinbu-myeon area was selected as study area because one of the most landslides occurred area. In this study, the location of landslide detected using web-based digital aerial photographs with 50cm resolution provided from Internet portal site "Daum (www.daum.net) and field work. The photographs were taken before and after this rainy season (4, Arial 2005 and 27, May 2008, respectively). For aerial photograph interpretation, an aerial photograph database was constructed by ortho-rectification and by merging many aerial photographs. About 90% of the landslide locations detected by photographic interpretation (comparison of the two photographs) were verified by fieldwork. Landslides were observed in aerial photographs as a break in the forest canopy, bare soil, or other geomorphic characteristics typical of landslide scars; for example, head and side scarps, flow tracks, and soil and debris deposits below the scar. In total, 1,801 landslides were mapped within a total study area of 59.78km2. In this study area, the majority of the landslide is soil slide and debris flow. The weights-of-evidence model (a Bayesian probability model) was applied to the task of evaluating landslide susceptibility using GIS. Using landslide location and a spatial database containing information such as topography, soil, forest, geology, lineament and land cover, the weights-of-evidence model was applied to calculate each relevant factor's rating for the Jinbu-myeon area in Korea, which had suffered substantial landslide damage following heavy rain in 2006. In the topographic database, the factors were slope, aspect, curvature, Topographic Wetness Index (TWI) and Stream Power Index (SPI); in the soil database, they were soil texture, soil material, soil drainage, soil effective thickness and topographic type; in the forest map, they were forest type, timber diameter, timber age and forest density; lithology was derived from the geological database; land cover information came from SPOT satellite imagery; and lineament data from hillshade map. For the analysis of mapping landslide susceptibility, W+ and W-, of each factor's rating were overlaid spatially. The result of the analysis was validated using the known landslide locations (30% of total landslide occurrence), which were not used during the training of the weight-of-evidence model. The demonstrated prediction accuracy was 82.82%. Tests of conditional independence were performed for the selection of factors, allowing 17 combinations of factors to be analysed. The combination of slope, aspect, curvature, SPI, lineament, land cover, timber density, soil drainage and topography showed the best results. The results can be used for hazard prevention and land-use planning. The photograph was a time and cost effective to identify landslide prone area in the study area, and the landslide locations were equal to the locations where were checked in the field. In addition, it can help to assess a better understanding of the landslide processes.

Keyword: Landslide susceptibility, Digital aerial photograph, GIS, Korea, Weight of evidence.