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Application of remote sensing and GIS to near-surface aquifer mapping for landslide susceptibility assessment: a case study in in Hoa Binh Province, Vietnam

Hung, L.Q.¹, Hien, N.T.¹, Khac, D.V.², Khanh, N.Q.¹, Van, N.T.H.¹ and Son, P.V.¹

¹Vietnam Institute of Geosciences and Mineral Resources, 67 Chien Thang, Ha Dong, Ha Noi, Vietnam, email: hunglan@gmail.com.

²Hanoi National University of Education, 136 Xuan Thuy, Cau Giay, Hanoi, Vietnam

The areas with high capacity of water retention in the near-surface aquifers are often characterized by dense vegetation, water abundant on the surface, high soil moisture, fractured rocks, etc. The features can be depicted through digital image processing and interpretation combined with using geological documentation [1]. The purpose of this study is to apply an integrated approach of remote sensing and GIS techniques to carry out the near-surface aquifer mapping in Hoa Binh Province, which will be used for landslide susceptibility assessment. Landsat 7 ETM+ satellite images and 1:50,000 topographic maps were used as main input data. Previous works on geology, geohydrology, soil, land use and so on for the study area were collected to verify the results.

The focus of this study is the application of imagery analysis techniques to produce the four index maps: Normalized Difference Water Index (NDWI), Normalized Difference Vegetation Index (NDVI), Normalized Difference Soil Index (NDSI) and Lineament Density Index (L_DEN). Those index maps were then integrated into a GIS environment to analyse, assess and determine the distribution of the near-surface aquifer.

Figure 1: Summary of distribution of near-surface aquifers and comparison with the distribution of the inventoried landslides

Zone of near-surface aquifers	
Area	
Landslide distribution	
<i>km²</i>	
<i>%</i>	
<i>sum</i>	
<i>per 100 km²</i>	
Surface waters	
532.03	
7.69	
0	
0	
Water-rich areas	
1,036.93	
26.73	

52
5
Water-poor or non-aqueous areas
2,996.63
65.58
131
4
Total
4,605.59
100
183

As the achievements of the mapping, the study area consists of three different zones of near-surface aquifers: surface waters, water-rich areas and water-poor or non-aqueous areas that are accounted for 7.69%, 26.73% and 65.58% of the total area, respectively. The analyses also point out that the areas with high NDWI, high NDVI, high L_DEN and low NDSI are often located in the aquifers with high water retention, and vice versa. The comparison with landslide inventory map figures out there are 4 landslides occurring over 100 km² of the water-poor or non-aqueous areas, while 5 landslides occurring over 100 km² of the water-rich areas. It reveals that the result map is reasonable and reliable. The results of this study indicate that the integration of remote sensing and GIS analyses is considered as an efficient and feasible alternative method for mapping of the near-surface aquifers, which will be used assessed as one of controlling factors for landslide susceptibility assessment and zonation.

References:

[1] Meijerink AMJ (2007). In: *Remote sensing applications to groundwater. IHP-VI, Series on Groundwater No. 16:*

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