



Landslide susceptibility modelling using Fuzzy Logic in the oued Larbaa basin (Oriental Rif, Morocco)

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Together with flash floods and soil erosion, landslides are relevant natural hazards that affect marly slopes in the oued Larbaa basin, located in the Oriental Rif, Morocco. Landslides have been generated important economic, social and ecological effects, by the destruction of farming lands, and by the collapse and interruption of roads and other human infrastructures (e.g., houses). The reduction of socio-economic losses due to landslide activity needs to be accomplished through the implementation of a comprehensive mitigation landslide risk program. The first task of this program is the definition of landslide susceptible areas based on the study of relationships between spatial distribution of past landslides and the cartographic set of landslide predisposing factors. Therefore, the major aim of this work is to create a landslide susceptibility map for the study area.

The oued Larbaa basin, located northwards the Taza city, has an area of 245 km² and the elevation ranges between 450 m and 1300 m. Morphology is characterized by rounded hills cutting marly formations essentially of Cretaceous age. Land use is dominated by cereal cultures and a few sparse tree plantations. Natural vegetation shows a very high level of degradation and usually appears as shrub tufts.

The inventory of instability events has been made for the study area and it includes both rainfall-triggered rotational and shallow translational slides. These landslides were included into a GIS database that comprises also the following landslide predisposing factors: slope angle, aspect and curvature, inverse wetness index, lithology and land use. The susceptibility assessment was carried out for each type of landslide (rotational slides and shallow translational slides) under the assumption that future landslides will occur under the same environmental patterns that generated landslides in the past. The modelling of landslide susceptibility was made using the Fuzzy Logic method (Fuzzy Algebraic Product, Fuzzy Algebraic Sum and Gamma operators). The fuzzy memberships were defined for the set of variable cases in an objective way by computing the corresponding conditional probabilities. The obtained results are critically compared and validated through the construction of Receiver Operator Characteristic (ROC) curves and the computation of the corresponding Area Under Curve (AUC).