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Evaluation of two GIS-based Models for Landslide Prediction

Master Thesis

by

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Summary

Agricultural systems and the people depending on them are extremely vulnerable to any kind of surprising events. In recent history the number and frequency, but also the impact, of extreme climatical events increased. While events like droughts and floods are comparably easy to understand and tackled with technological improvements, other events, such as landslides, present themselves highly complex. Agricultural research is conducted frequently on-farm in representative study regions, but often no vulnerability analysis with respect to landslide occurrence exists. Here, a simple and easy to apply tool could add valuable information and conclude the efforts regarding (sustainable) land use planning.

GIS-based models are found and offered in increasing variety. Spatial information is often readily available to run GIS-based models for landslide prediction. Problematic is that most modeling approaches are based on common landslide risks. This raises the issue whether and how available GIS-based models or modeling approaches will account for landslide occurrences caused by extreme climatic events. Satisfactory results could form an attractive bridge to combine available material and resources to fields of growing interest. This issue was tackled in cooperation with CIAT for a benchmark watershed in San Dionisio, Department of Matagalpa, Nicaragua. Screening of available information resulted in even more information than required or suggested for most modeling approaches. A deterministic-based approach was represented by SINMAP (Stability Index Mapping, PACK *et al.*, 1998) and a probabilistic-based approach by ArcWofE (Weights of Evidence extension for ArcView; KEMP *et al.*, 1998).

The results show that common deterministic-driven approaches are insufficient and fail to adequately explain the processes underlying landslides caused by extreme events. To predict a landslide at a location that is stable under the common variation of climatic and other stresses, the model overpowers all stabilizing forces assumed by the program. A large amount of landslide captured goes along with an over proportional amount of area classified as critical. As a result, the utility value is unsatisfactory.

A limitation regarding probabilistic approaches is the lack of knowledge on the processes involved. Without this, an identification of adequate input themes is problematic. Probabilistic models correlate known landslide locations with classes of the input data. The known landslide locations are thereby used to identify classes that show a higher expectation of landslides and rank them against each other. This approach delivers more promising results, as especially very critical areas are

identified. Still, the relation critical area/captured landslides is unsatisfying, but the user must be aware that his choice of input information is essential for the final result.

This opens perspectives for a more complex identification of processes and parameter driving landslides under extreme events. Their behavior may be modeled and the results included into the probabilistic model. This way, locally valid models may be established. Their demand of data, time, and resources is however excessive. Areas without a powerful project or donor will not be able to generate a landslide risk assessment.

Landslides caused by extreme events are not included in most studies. The problems encountered while trying to utilize a generally available tool with data that can be expected to exist, revealed that the complexity of the topic allows to match models and their results to a specific situation but makes it impossible at this time to make the underlying method generally available.