



## **Reconstructing past human impact on the landscape with logistic regression**

**T. Vanwalleghem**(1), M. Van Den Eeckhaut (2), J. Poesen (2), G. Govers (2) ,J. Deckers (3)

(1)Faculty of Agronomy, University of Córdoba, Spain,(2)Physical and Regional Geography Research Group, K.U. Leuven, Belgium,(3)Institute for Land and Water Management, K.U. Leuven, Belgium.(tomvanwalleghem@hotmail.com)

Although several studies have reported on past geomorphic change, the role of driving human or climatic forces remains vague. This study attempts to unravel the role of natural and anthropogenic factors in the formation of old geomorphic features, i.e. closed depressions and permanent gullies. Forests are important natural archives to study past geomorphic change, as the landscape has been conserved since the last deforestation. Within a 1300 hectare large area within the Meerdaal Forest (central Belgium), several geomorphic phenomena were observed that could indicate a land use change in the past but could just as well have formed by natural causes (like extreme rainfall). The most frequent features are permanent gullies ( $n = 43$ ) and closed depressions ( $n = 71$ ). In previous studies, the detailed analysis of the stratigraphy of a few representative gullies and closed depressions showed that these formed between Middle Bronze Age and Roman times (cal. yr. 1743 BC - 354 AD) and that they were most probably anthropogenic in origin. The overall objective of this study is to analyze the spatial distribution of all gullies and closed depressions in order to confirm or contradict these limited case-studies. Rare events logistic regression, a relatively new technique in geomorphological and geoarchaeological research, is used because of the relative low frequency of closed depressions and gullies within the study area. To understand the spatial distribution of both geomorphic features, both anthropogenic and physical factors are important in the obtained logistic regression models. For the prediction of the occurrence of closed depressions, anthropogenic factors are most important however. The probability of finding a depression is larger close to reported prehistoric and Roman archaeological sites, on well-developed, undisturbed Luvisols and on northeast-

to southeast-facing slopes. This indicates that the closed depressions were excavated close to former cropland, but at the same time only locations with a sufficiently thick loess cover (i.e.  $> 2.5$  m) were selected. The local slope gradient of the soil surface is the most important factor in the multivariate model for predicting the presence of the permanent gullies. The occurrence probability of permanent gullies is also larger on northeast- to southeast-facing slopes. The anthropogenic factor expressed by the distance to the closed depressions is significant as a univariate model. This suggests that a critical slope gradient is a prerequisite for gully incision, but gully formation still needs to be triggered by a human-induced land use change. It can therefore be concluded that both the gullies and the closed depressions in the Meerdaal Forest are related to past human activity, either directly (mining by humans for extraction of calcareous loess) or indirectly (through runoff production on cropland).

**Key words:** closed depression; permanent gully; logistic model; Belgian loess belt