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Application of Numerical Models to Estimate Rainfall Erosivity in Ethiopia — A Case Study of the Central Highlands

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Abstract

Land degradation through water erosion poses a severe ecological threat in Ethiopia. The country's highlands lose 1.9 million tonnes of fertile soil per annum. Each year, the region's agricultural lands lose 100 tonnes of productive soil per hectare. Onsite effects of water erosion cause 2% reduction in Ethiopia's cereal production per annum, affecting the country's food supply significantly. Previous studies report only a rough estimate of soil loss from the central highlands. However, in spite of its key role in causing water erosion, the erosivity of rainfall is not sufficiently addressed. The aim of this co-operative research project is to assess rainfall erosivity in the study area, and to develop forecasting models applicable at local and regional scales. Long-term rainfall data (1898–1997) of 168 weather stations throughout the country were statistically analysed. The Modified Fournier Index — recommended for Ethiopia by the FAO — was applied to derive the index of water erosion potential. In addition, precipitation data of 44 selected weather stations in the agricultural region of the central highlands of Ethiopia were statistically analysed in further detail, using monthly rainfall data ranging from 30 to 100 years. This contribution presents selected results of this research project which enable to estimate and to forecast the risk of water erosion potential at local and regional levels. It was confirmed that rainfall erosivity in Ethiopia is very high, and it represents potential threat to the ecology and the economy of the country. As could be concluded from seasonal rainfall distribution, soil loss from the study area mainly occurs during summer. The stochastic numerical models developed in this study enable to estimate and prognoses water erosion potential at local and regional scales in the event of limited financial and physical resources as well as database. Rainfall and land management database should be enhanced to enable to test and validate resource management models, and to conduct their sensitivity and stability analyses. Soil erosion should be more efficiently controlled and further research carried out to find out more efficient control techniques suitable for the agro-ecological regions of the study area.

Keywords: Forecasting, land degradation, modelling, resource management, soil loss