Water erosion risk assessment in South Africa: towards a methodological framework

by

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ABSTRACT

Soil erosion is a major problem confronting land and water resources in many parts of the world and the spatial extent should be assessed and continually monitored. The combination of existing erosion models and remote sensing techniques within a Geographical Information System framework is commonly utilized for erosion risk assessment. In most countries, however, especially in developing countries such as South Africa, there is still an absence of standardized methodological frameworks that deliver comparable results across large areas as a baseline for regional scale monitoring. Assessment at the regional scale is often problematic due to spatial variability of the factors controlling erosion and the lack of input and validation data. Due to limitations of scale at which techniques can be applied and processes assessed, this study implemented a multi-process and multi-scale approach to support establishment of a methodological framework for South African conditions. The approach includes assessment of (*i*) sheet-rill erosion at a national scale based on the principles and components defined in the (Revised) Universal Soil Loss Equation, (*ii*) gully erosion in a large catchment located in the Eastern Cape Province by integrating eleven important factors into a GIS, and (*iii*) sediment migration for a research catchment near Wartburg in KwaZulu-Natal by means of the Soil and Water Assessment Tool.

Case Study *i* illustrates that 20% (26 million ha) of South African land is classified as having a moderate to severe actual erosion risk (emphasizing sheet-rill erosion) and describes the challenges to be overcome in assessment at this scale. Case Study *ii* identifies severe gully erosion affecting an area of approximately 5 273 ha in the large catchment (Tsitsa valley) of the Eastern Cape Province and highlights gully factors likely to emerge as dominant between continuous gullies and discontinuous gullies. Case Study *iii* illustrates that a cabbage plot in the upper reaches of a research catchment near Wartburg is a significant sediment source,

but is counterbalanced by sinks (river channel and farm dams) downstream. Model assumptions affecting outputs in the context of connectivity between sources and sinks are described. The factor-based nature of this multi-process and -scale approach allowed scrutiny of the role of the main factors in contributing to erosion risk. A combination of poor vegetation cover and susceptible parent material-soil associations are confirmed as the overriding factors in South Africa, and not topography and rainfall as frequently determined in the USA and Europe.

A methodological framework with three hierarchical levels is then presented for South Africa. The framework illustrates the most feasible erosion assessment techniques and input datasets for which sufficient spatial information exists, and emphasizes simplicity required for application at a regional scale with proper incorporation of the most important factors. The framework is not interpreted as a single assessment technique but rather as an approach that guides the selection of appropriate techniques and datasets according to the complexity of the erosion processes and scale dependency. It is useful in determining the relative impact of different land use and management scenarios, as well as for comparative purposes under possible future climate change scenarios.

DECLARATION

I, J.J. Le Roux declare that the thesis, which I hereby submit for the degree PhD in Geography at the University of Pretoria, is my own work and has not been submitted by me for a degree at this or any other tertiary institution.

SIGNATURE:……

DATE:……

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Text following text on this page is quoted from:
Lennox CL. 2007. God's undertaker; has science buried God? Gutenburg Press: Malta.

"*The existence of a limit to science is, however, made clear by its inability to answer childlike elementary questions having to do with first and last things – questions such as 'How did everything begin?'; What are we all here for?; What is the point of living?*" "(Sir Peter Medawar).

"Studying all the parts of a watch separately will not necessarily enable you to grasp how the complete watch works as an integrated whole…
There would seem then to be two extremes to be avoided. The first is to see the relationship between science and religion solely in terms of conflict. The second is to see all science as philosophically or theologically neutral…
…The rational intelligibility of the universe, for instance, points to the existence of a Mind that was responsible both for the universe and for our minds. It is for this reason that we are able to do science and to discover the beautiful mathematical structures that underlie the phenomena we can observe…
…It is, therefore, not illogical that one of the major reasons why we have been given minds is not only that we should be able to explore our fascinating universe home, but also that we should be able to understand the Mind that has given us the home…
…In conclusion, I submit that, far from science having buried God, not only do the results of science point towards his existence, but the scientific enterprise itself is validated by His existence."

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