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Objectives

One of the major threat for sustainable land management is soil erosion that has been identified as the major type of human-induced land degradation in a global perspective. Nearly one sixth of the world usable land has been already degraded by water or wind erosion (Oldeman et al., 1991). The GCTE soil degradation task will therefore initially concentrate on soil erosion the severity, frequency and extent of which are likely to be altered by expected changes in rainfall amount and wind intensity, interlinked and exacerbated by human activity.

In accordance with GCTE's objectives, the first objectives of the Soil Degradation Task's could be:

- To design and undertake experimental and monitoring programmes to provide a predictive understanding of the impacts of changes in climate and land use on soil erosion.
- To refine and adapt current erosion models for use in global change studies from the plot to the region.

Possible approaches.

Past data

Even though the lack of knowledge over the precise climate in the future renders predictions uncertain, it is crucial to anticipate the consequences of possible future scenarios. This has to be considered regarding data currently available on present erosion. In this respect one must be aware that the already large archive of air-photos and satellite data has not been yet sufficiently used as a retrospective basis for predicting models. New techniques like radioactive fallout 137Cs measurements could also provide information on recent erosion rates. Additional information on longer time-span erosion, related to climatic changes, could be derived from the numerous data on Late Quaternary. Pollen, charcoal, chemical, physical, magnetic mineral and radiocarbon dating (14C) along with archaeological record, and local documentary evidence could be interpreted in the light of models of climatic change. However helpful as they are, the use of paleoclimatic analogues should be pursued with care as it is not clear that they are realistic for the mid-twenty-first century.

Long-term monitoring and experimental programmes

Since erosion processes are commonly threshold exceedance related, emphasis should be put on the determination of such thresholds, on reversibility of processes, and on soil resilience. Low-frequency climatic events, like heavy storms, typhoons, etc., can trigger severe erosion unpredictable from short-term records. Monitoring erosion in the long run is therefore essential to observe possible transient and not equilibrium responses to climatic and land use changes.

Despite the numerous current and past experiments conducted on the factors affecting soil erosion, some uncertainties remain. An international set of collaborative experiments could be specifically designed to cope with changing environmental conditions. This research could concentrate on the impact upon soil losses of rain and wind storm profiles, of soil surface structure as related to soil organic matter status and faunal activity. Another pivotal issue should be the integration of erosional processes, i.e., sealing, wind and water erosion. Such field experiments, propitiously conducted at various scales from the plot to the watershed, and possibly to larger scales, should be combined to remote sensing data and integrated into GIS.

Modelling

The broad range of data covering the space-time domain can be used to calibrate, initialize, and validate models. We need models that should be concurrently highly sensitive to climatic and land use changes and sufficiently flexible to be relevant under the largest range of conditions. The recent soil erosion process-based model, WEPP (Water Erosion Prediction Process; Lane and Nearing, 1989), is highly sensitive to precipitation (Nearing et al., 1990). However, considerable developments are ahead in linking global climatic models with more detailed erosion models accounting for interactions between physical and human factors. Some attempts have being made in this direction. Physically based simulation models such as the erosion productivity impact calculator (EPIC; Williams et al. 1984) allow us to link climate with other factors to estimate erosion and to examine the impact on crop yields. Skidmore and Williams (Skidmore and Williams, 1991) developed a wind erosion interface with EPIC. Approaches as Expert Systems may be an effective alternative to these models that are data-intensive in nature (Boardman et al. 1990). The rules generated by the Expert System may be used to predict erosion rates at a different scale across the landscape under varying climatic conditions. There is a need to develop decision support systems that facilitate the transfer of scientific knowledge to land management.

Conclusion

1. Even though the climatic models are still inaccurate, sufficient information has been collected to make some assessment of the likely effect of climate and land-use induced changes on soil erosion.
2. This requires a better integration of long-term monitoring, experimental and modelling programmes at different scales both in time and space.
3. A network should be inaugurated to test the existing models in terms of sensitivity and flexibility and to implement the experiments necessary to provide lacking input data.
4. Another goal to meet the dual GCTE's objectives is the assessment of potential feedbacks of soil erosion to the physical climate system. Changes in albedo resulting from denudation, crusting and erosion make necessary a multidisciplinary approach at a regional scale, permitting linkages to General Circulation Models (GCM). This requires a close collaboration with other programmes like BAHC (Biospheric Aspects of the Hydrologic Cycle).
5. Soil erosion results from complex interactions of physical and human factors. These latter are potentially more damaging than the direct effects of climate change on soils. Strong links should be therefore established with HDP (Human Dimensions Programme of Global Environmental Change), notably with LUCC (Land Use and Cover Change).

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