An Efficient Approach for Monitoring Land Resources at a Regional Scale

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Soil degradation processes are vicious circles triggered by land cover / land use changes. Assessing and monitoring land resources is important to improve our understanding of the effects of land use on soil resources, in order to support sustainable land management (SLM). As a basis for planning of SLM, datasets at the regional level are crucial. However, up-to-date data on land resources at the requested level is often rare in developing countries, as the example of Tajikistan shows. Especially challenging when elaborating regional datasets are (i) the low quality of readily available / low cost spatial data and (ii) heterogeneous landscapes. Thus, effective methods are needed, suitable for such conditions. The aim of this study was to adopt, adapt, combine and develop methods for efficient assessment and analysis of land degradation and conservation at a regional scale.

A data-driven, scientifically rigorous approach was adopted to conduct spatial land resource assessment and allow for impact assessment. Specific methods applied included, on the one hand, soil reflectance spectroscopy for prediction of soil properties for large numbers of soil samples. On the other hand, classification and regression tree modelling was chosen as a non-parametric approach for mapping. Furthermore, the hot/bright spot concept was adopted. For map information to be most useful for planning, it should provide a basis for prioritisation of SLM activities. Different levels of degradation and conservation, from hot spots of soil degradation to bright spots of soil conservation, were expected to fullfil this requirement. Additionally, by setting the focus not only on soil degradation but also on well-conserved soils, it was expected that crucial information for SLM planning would be obtained.

The results of the study showed that the elaborated soil spectral library for the loess hills of central Tajikistan allows for low-cost and rapid determination of soil organic carbon (SOC) content. Classification tree modeling not only allowed land resource mapping in heterogenous areas, but also made it possible to derive rules to support SLM implementation. The hot-bright spot matrix developed proved to be a straightforward and flexible method, as it is applicable to semi-quantitative data as well as to field and raster data. The maps elaborated for erosion occurrence and “low” and “high” SOC content classes provide a baseline that enables future evaluation of the land conservation efforts currently being undertaken in the hills of central Tajikistan. Further, the hot/bright spot map is expected to be a valuable basis for planning of SLM, providing information on the state of soil resources at a suitable level of detail for regional assessments.