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Student Project

ASSESSING THE CURRENT STATE OF SOIL EROSION POTENTIAL IN KYRGYZ HIGHLAND PASTURES

A Case Study in the Naryn Oblast

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Summary (Krüger)

The results published in this report are embedded in the project *Utilization and protection of agricultural ecosystmes in Central Asian high mountains – case study Kyrgyz alpine pastures* (UPAGES-KYR) of the Humboldt-Univeristät zu Berlin and the Kyrgyz National Agrarian University Bishkek (KNAU).

Land degradation in the mountainous country Kyrgyzstan is a widely perceived problem for sustainable land management (Bussler, 2010). Despite this scientific awareness, herders in the predominant agricultural sector of pastoralism are increasing their livestock numbers (Gottschling, 2002) which implies higher stress on the natural resource soil. Soil loss due to erosion processes by water in alpine landscapes, are of major concern. This report has the objective to estimate the current soil erosion potential by rainfall at the research sites in Teshik and Sary Dzhel in the Naryn Oblast.

During the past decades many erosion prediction models have been developed among which the USLE model by Wischmeier and Smith (1978) was considered to be the most suitable for the research sites. The USLE model, compared to e.g. WEPP and EUROSEM, requires less highly resolved data but can predict reasonable results of soil losses by rainfall. The USLE model has been adapted to local circumstances comparable to how the USLE has been adapted within the Cross Compliance framework of the European Union.

Data acquisition is based on a 4-week fieldwork in 2014, laboratory analysis, calculations, geographic information system application and literature studies.

The results show that the estimated erosion potential for the slopes in Teshik are much higher compared to those in Sary Dzhel. The highest erosion potential in Teshik with 82 t ha^{-1} yr^{-1} is almost double the amount to the highest erosion potential in Sary Dzhel with 42 t ha^{-1} yr^{-1}. The results correlate to the fact, that the slope length and slope steepness factor in Sary Dzhel has a smaller value than Teshik. Furthermore the soils in Sary Dzhel are less prone to erode because soil organic matter contents are higher.

The computed results have to be taken with caution as only poorly resolved climate input data are available and could have been used. As rainfall is the basis for the overall soil loss estimation the accuracy of the results is limited. Besides the need of climatic data input improvement to achieve more reliable erosion prediction estimates, it is suggested to extend the input variables for the soil erodibility factor. The soils in Teshik and Sary Dzhel show relatively high calcium carbonate contents (varying between 11.02% and 1.27% respectively) which contributes to aggregate stability and therefore reducing the soil partical's potential to erode. For a final remark, the authors suggest that empirical validation of the estimated erosion potential is needs to be conducted and that the sensitivity of the USLE model to high calcium carbonate contents in the research sites needs to be tested.

5 Conclusion (Lemke)

Multiple measurements and computation for the research areas Teshik and Sary Dzhel revealed a wide range of estimated soil loss results. The cause and effect relations can be determined to a certain extend with help of the gained results for the single factors considered, based on the USLE equation. In general, as the main outcome of the computations the estimated soil loss or rather soil erosion potential for the examined slopes in Teshik and Sary Dzhel can be regarded with a **higher estimated soil erosion in Teshik (55 to 82 t ha^{-1} yr^{-1}) compared to Sary Dzhel (15 to 42 t ha^{-1} yr^{-1})**.

Knowing about this potential and the spatial distribution of it in dependence on the topographical and soil characteristic of the respective pastures has been the aim of this research. The underlying data consist of three multiplicative factors whose results reflect to some extend the climatic, soil and topographic conditions of Teshik and Sary Dzhel (Schwertmann et al., 1990). Thus, measurements and computations gave answers to the research questions posed in the beginning of this investigation which resulted in an **erosivity factor (*R*) of 28 kj mm (m^2 h)$^{-1}$** for the entire area of investigation. Mean annual precipitation data have been the base for this computation. Its main inaccuracy lies in the interpolation of the data from Naryn city with 2039m.a.s.l.

A distinction between the erodibility factors (*K*) was carried out based on its multiplicative, underlying variables. The content of soil organic matter as well as the amount of very fine sand and the silt content influence the soil loss potential in particular (Ekwue, 1990; Wischmeier and Smith, 1978). The **soil erodibility in Teshik is therefore generally higher compared to Sary Dzhel**. Not considered in the determination of *K* but substantial for aggregate stability, are the calcium carbonate contents in Teshik and Sary Dzhel with an average of 11.02% and 1.27% for the latter, revealing an overestimation of *K*, especially for Teshik (Shabani et al., 2014).

Not only the soil erodibility but also the slope length and steepness factor (*LS*) for Teshik are higher compared to Sary Dzhel. A correlation between the latter results and the estimated soil loss shows that the soil erodibility, slope length and steepness factor have a major influencing share in the spatial distribution of soil erosion potential seen in Figure 15. More exact, the extend of soil organic matter closely connected to the geographical exposition of the slopes, soil texture class content, and the steepness of the slopes could be determined as the most influencing factors.

However, regarding this model, a higher accuracy for the estimation of soil loss is more likely in association with an empirical validation with long-term measurements for the physical parameters. Nevertheless, the USLE model is a good choice for a more or less simple calculation based on a small amount of underlying data and of low resolution e.g. for remote areas. Following this argumentation, **the gained results show an approximate range of estimated soil loss values** which can be used for further considerations. Within the UPAGES project, these results may be applied to examine further research or even consider further investigations towards a sustainable pasture management.