Complex Terrain and Ecological Heterogeneity (TERRECO): Evaluating Ecosystem Services in Mountainous Landscapes

Soil erosion and management measures in the Haean catchment of Korea

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Introduction:

Soil erosion by intense rainstorm events especially in rural regions, dominated by agriculturally used areas is a big problem with respect to economics and environment. On the one hand it leads to lost of large amounts of fertile top soil which is essential for agricultural productivity. On the other hand large amounts of fertilizers and biozides are transported by surface runoff and sediment into streams, lakes, and reservoirs and can lead to imense degredation of water quality. Thus, erosion control is a precondition for sustainable agriculture and it plays a key role in the conservation of surface water bodies.
The primary aim of this project is the quantification of soil loss and sediment transport from agricultural areas within the Haean catchment and to detect the factors influencing soil hydrology and erosion. Further erosion control measures shall be developed for enduring conservation of soils and agricultural land and to increase water quality in streams and the adjacent water bodies.

Methods:

Erosion measurement with runoff plots

Runoff plots (Fig. 1) are installed on three field sites for measuring the amount of surface runoff and transported sediment by single rainstorm events. The complete surface runoff with eroded soil material from the subplots is collected and directly transported into the water tanks below. Through measuring the water volume and sampling the suspension in the tanks after rainstorm events the amount of soil loss from the subplot can be quantified. Soil physical and chemical analysis of sediment samples give information about the amount of particle bound nutrients and preferential texture class transported by water.

Each site consists of four subplots with the same conditions with respect to initial soil material, crop and slope, but they differ in the treatment of the topsoil. Soil stabilizing polymer (PAM), Black carbon (BC) and a mixture of both PAM and BC is mixed in the upper 5 cm of the soil to investigate the effects on soil hydrology (infitration rates, amount of surface runoff) and erosion susceptibility.

On three positions within each subplot (up slope, middle, down slope) tensiometers and TDR sensors are installed in three different depths to measure continuously soil hydraulic potential and water content. Lysimeters are used in order to quantify the amount of soil evaporation. For sampling and analyzing the nutrient amount in the seepage water suction cups are installed in the subplots.

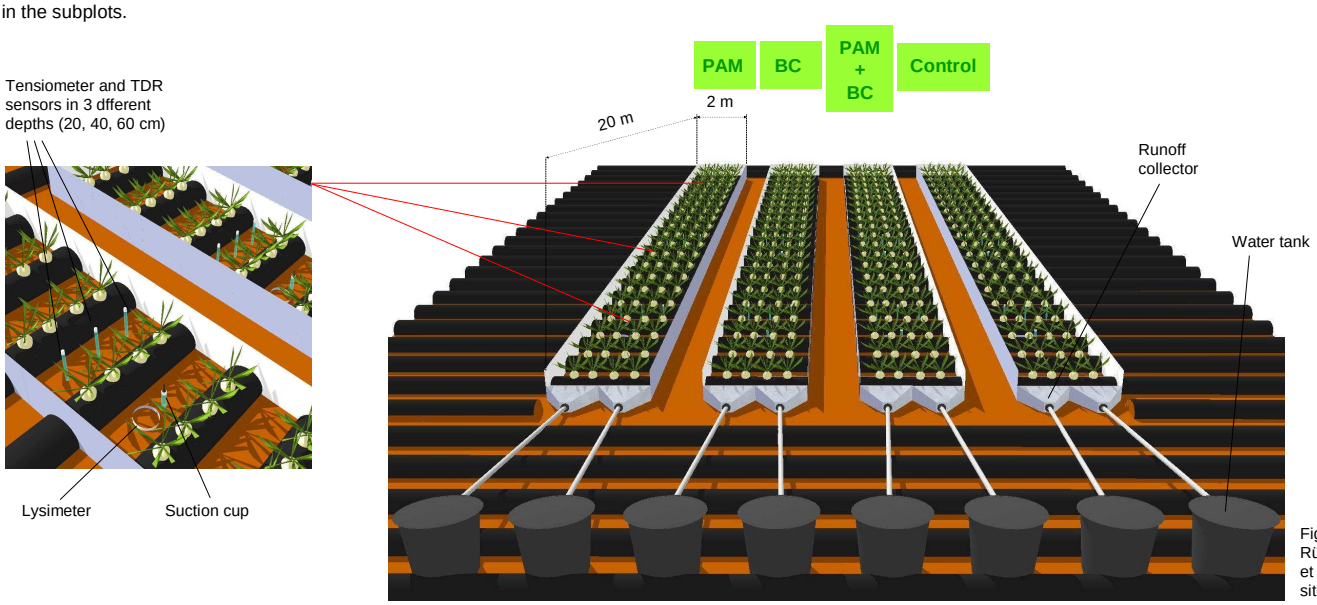

Fig. 1: Runoff plot design (after Rüttimann et al. 1995 and Yang et al. 2007) for installation on field sites in Haean catchment

Modeling soil erosion

By using physically based soil erosion model EROSION 3D (Schmidt 1991) (Fig. 2) and the hydrological model SWAT 2005 (Bracmort et al. 2006) the total amount of soil loss and sediment export from Haean catchment will be simulated.

Datasets of analyzed soil samples from the Haean catchment and available soil maps will be used for parameterizing the erosion models. With learning classifier systems such as classification and regression trees (CART) (Mertens et al. 2002) soil landscape datasets will be completed.

Results from erosion measurement and sediment export data with the runoff plots are used to validate erosion models EROSION 3D and SWAT 2005. Additional Infiltration experiments and continuous monitoring of soil hydraulic conditions (hydraulic potential, water content) on test sites during intense rainfall periods will be conducted in order to achieve best model adaptation.

A realistic simulation approach provides the framework for quantifying particle bound nutrient and pollutant transport on larger scale e.g. into the Soyang reservoir and for deriving measures to improve water quality and conserve agricultural land. Further it allows authentic simulations of future scenarios regarding changes in land cover, cultivation measurement and climate.

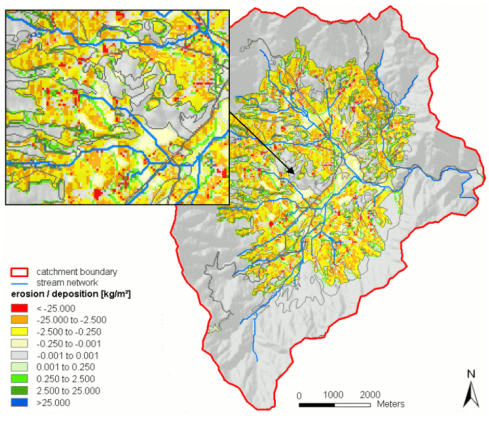

Fig. 2: EROSION 3D erosion map of Haean catchment, critical sites regarding erosion and sediment routing into the stream network can be localized

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