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Land Management, Erosion, and Sediment Transport in Mountainous Landscapes

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Background:

Soil erosion by water is the major source of soil and water quality degradation worldwide (Oldeman, 1994). Especially in mountainous landscapes with high precipitation, effective erosion control measures are essential to conserve soil and water resources.

Effective soil and water conservation requires the integration of existing local land management systems in conservation plans to assure the acceptance of farmers to implement and maintain proposed erosion control measures (Morgan, 2005).

Existing land management systems comprise local crop cultivation strategies applied on agricultural fields, but also the surrounding land use patterns of a complex mountainous landscape (Fig. 1) that control erosion and the transport pathways of sediment.

Figure 1. *Complex land use patterns in the Haean catchment*

Materials and Methods:

Crop cultivation in South Korea is dominated by row crop farming with intensive herbicide applications resulting in low ground cover. Organic farming systems, however, can help to increase weed coverage and soil protection on row crop fields.

We measured the vegetation development of crops and weeds for conventional and organic farms (Fig. 2) and we applied the Revised Universal Soil Loss Equation (RUSLE) (Renard et al., 1997) to calculate the associated erosion rates for both systems.

Land use patterns of a mountainous landscape in South Korea are characterized by small fields with a variety of different crops surrounded by field margins, forest patches, riparian areas, and a network of farm roads and channels.

We applied the EROSION 3D model (von Werner, 1995) to the entire Haean catchment to identify the transport pathways of sediment over the landscape and we monitored sediment and nutrient concentrations in the stream network (Fig. 3).

Figure 2. *Weed mapping on row crop fields*

Figure 3. *Stream water quality monitoring*

Results:

Crop Cultivation and Soil Erosion:

Organic cultivation reduced soil erosion for radish, as a consequence of an increased weed biomass and ground cover, but increased soil erosion for potato due to lower crop yields (Fig. 4).

However, simulated average annual soil loss between 30 and 55 t ha^{-1} exceeded for both farming systems the tolerable erosion level.

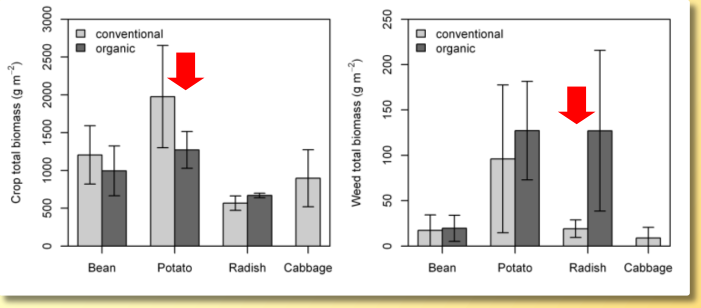

Figure 4. *Crop and weed biomass for conventional and organic cultivation*

Land Use Patterns and Soil Erosion:

Erosion prediction maps of the catchment revealed locations of erosion hot spots, sediment transport pathways, but also retention potentials of landscape elements such as riparian forests, fallow farmland, and plantations of perennial crops (Fig. 5).

However, the water quality monitoring program over the last years demonstrated high sediment concentrations and phosphorus loads in the streams for most of the monsoon rain events.

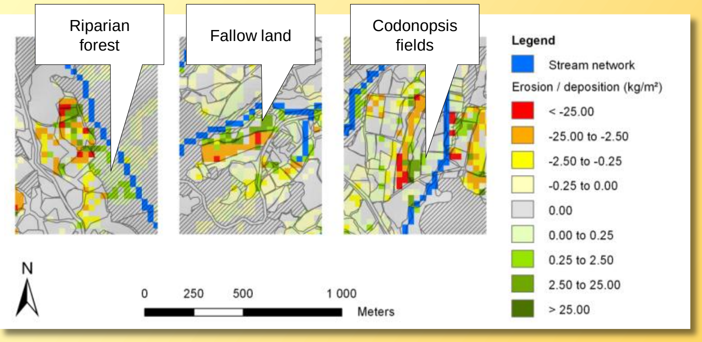

Figure 5. *Land use patterns, soil erosion, and sediment retention in the Haean catchment*

Conclusions and Outlook:

To provide a better soil protection on agricultural fields, cover crop cultivation and residue mulching are recommended. Additional best management practices such as grass mats along field margins and sand basins are currently investigated to prevent the transition of sediment into streams and the transport to the Soyang Lake.

References:

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