Overlandflow generation and surface erosion in Mongolia

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I Introduction

In Mongolia, significant soil erosion is thought to be caused by overgrazing and unsuitable management. Soil erosion also makes desertification, a key issue of environmental concern. However, very few field data are available on overland flow mechanism, soil erosion processes and amount and desertification processes. The purpose of our research project (2001-2006) is to study and assess the state and the causes of soil erosion through the monitoring of overland flow and soil erosion.

II Material and methods

1. Study area

The study sites locate 60-100 km east of Ulanbaatar. One site is Kherlen Bayaan Ulaan (KBU; underlain by sedimentary rocks, vegetation cover in rainy season is 30%), and the other site is Baganuur (BGN; underlain by granite, vegetation cover in rainy season is 70%), the drainage area of the watershed is 7.1 ha and 8.0 ha, and relative height is 105 m and 160 m, respectively.

Parshall flumes and sediment traps were installed at the outlet of the catchments. Also we established 2 hillslope plots (50 m × 50 m) in each area in which one is surrounded by fens. Discharge flow plots were monitored by Parshall flumes, and tensiometers, raindrop impact sensors, wind velocities were also recorded. About 50 soil cores were sampled in each catchments and Cs-137, Pb-210$_{ex}$ analysis were conducted.

2. Estimation of soil erosion

The Cesium-137 is an artificial radionuclide, with a half-life of 30.2 years, which was introduced into the environment as a result of the atmospheric nuclear weapons tests in the 1950s and 1960s. The Cs-137 has no natural sources in the environment and global fallout of Cs-137 has often being below detection levels. The Pb-210 is a naturally occurring radionuclide from the U-238 decay series, with a half-life of 22.2 years. The gaseous Rn-222 in soil diffuses into the atmosphere and decays to Pb-210 (excess) and subsequently fallout onto the landscape surface. Atmospheric fallout of Pb-210$_{ex}$ is constant over the years. In the undisturbed soils, most of the Cs-137 and Pb-210$_{ex}$ concentrate near the surface and the depth distribution exhibits an exponential decline with depth. They are strongly adsorbed by soil particles and are essentially non-exchangeable in most environments (Tamura, 1964). Cs-137 and Pb-210$_{ex}$ have been widely used as environmental tracers for studying erosion and sedimentaly systems (He and Walling, 1997). Using Cs-137 and Pb-210$_{ex}$, we estimated the pattern, rate and history of soil redistribution in the watershed.

III Results

The runoff peak in 2003 in KBU is greater than BGN. However, the runoff events which were observed in BGN in 2004 indicate that the occurrence of overlandflow is correlated with the intensity of raindrop impacts.

Through the Cs-137 analysis, long term soil erosion is very significant throughout the catchment in KBU, but deposition area were detected downslope of the catchment and lower overall erosion rate in BGN (fig.1). The net erosion rate was estimated as 0.4 t/ha/y and 2.6 t/ha/y for BGN and KBU watersheds, respectively (fig.2).

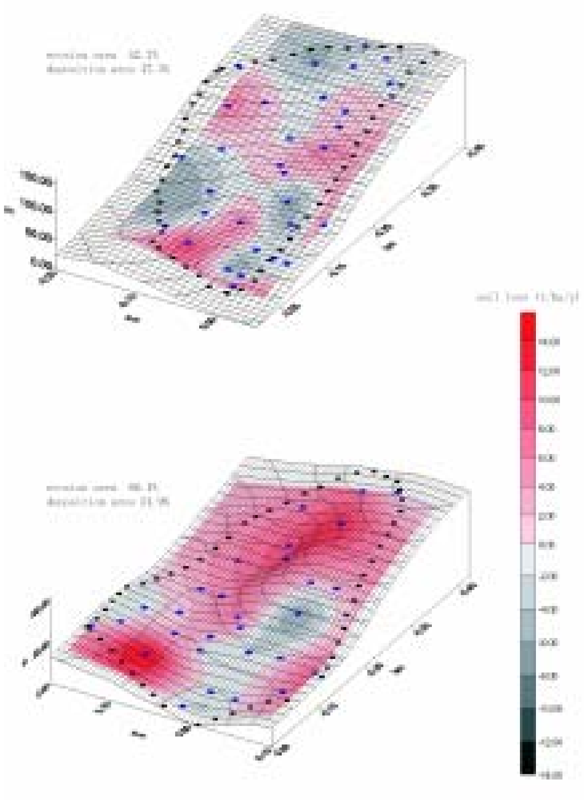

Fig. 1 Spatial distribution of soil erosion rate.

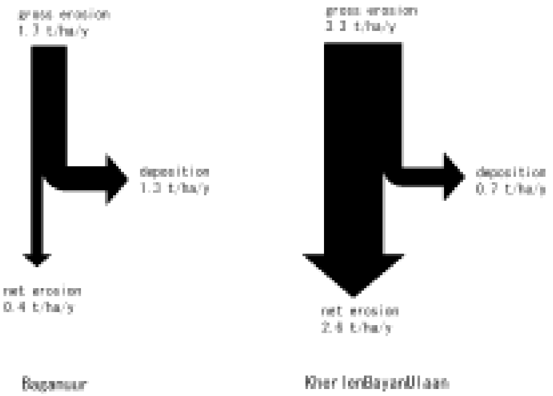

Fig. 2 Sediment budget in the study sites.

IV Conclusions

The significant differences were found in soil erosion characteristics between two watersheds with different vegetation cover. These data suggest the overland flow erosion is significant in the study area, and loss of vegetation cover increases surface erosion.

References

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