Sediment Transport and Deposition under Different Subsurface Hydrologic Conditions

Zhaoxia Li[1], Chi-hua Huang[2]

Introduction

Sediment transport capacity (T_c) is a conceptual term used in soil erosion modeling to identify whether erosion or deposition process is occurring. Currently T_c is estimated using flow related parameters.

Recent findings indicate that subsurface hydrology, through its control on soil erodibility, may play an important role in erosion and deposition processes. Changes in surface morphology, i.e., red for erosion and green for deposition, clearly showed that the deposition zone developed more extensively when the box was drained as compared to the seepage condition.

The objective of this study is to determine the effects of subsurface hydrology on soil erodibility, sediment deposition and total sediment transport .

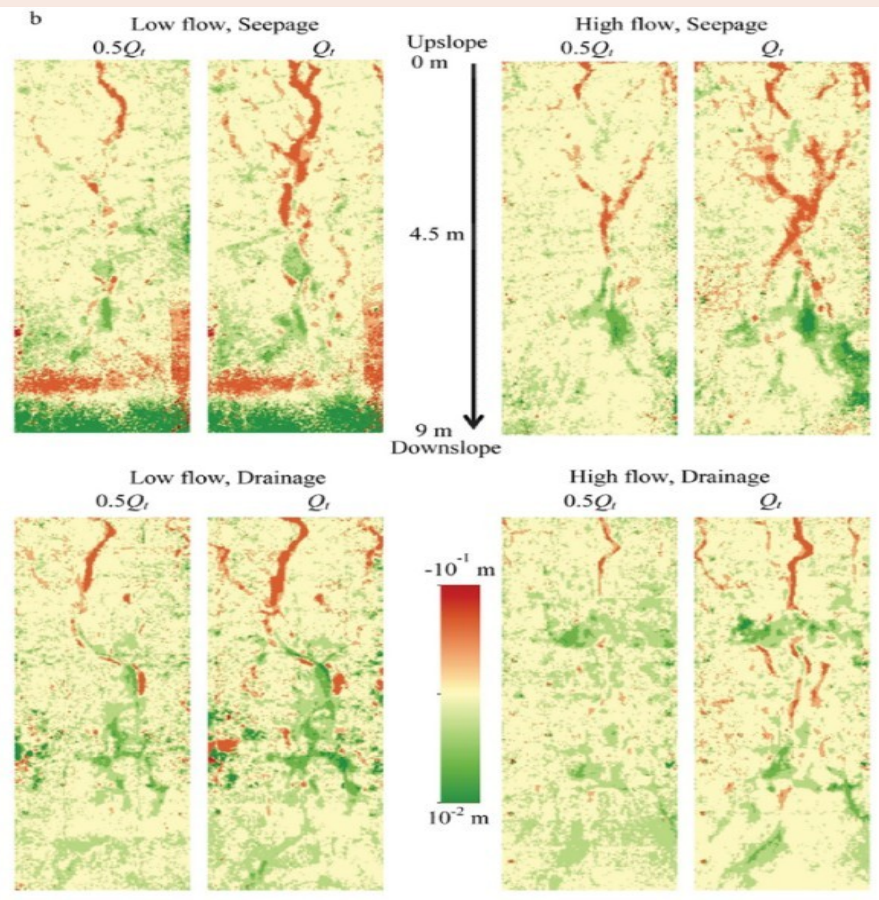

Fig.1 Changes in surface microtopography in a 3.7 x 9.7 m soil box under seepage and drainage conditions. The red color shows areas of soil erosion while the green color shows areas of sediment deposition.

Materials and Methods

Indiana Soil (Miami clay loam)

Rainfall Simulation Experiment

Feeder input & Without feeder input

- Drainage
- Saturation
- Seepage1 (240ml/m^2/min)
- Seepage2 (480ml/m^2/min)

Rill erodibility Experiment

Mini rill flume

- Drainage
- Saturation
- Seepage1 (240ml/m^2/min)
- Seepage2 (480ml/m^2/min)

The effect of subsurface hydrology condition on erosion and deposition
The T_c under different under different subsurface hydrology

Results and Discussion

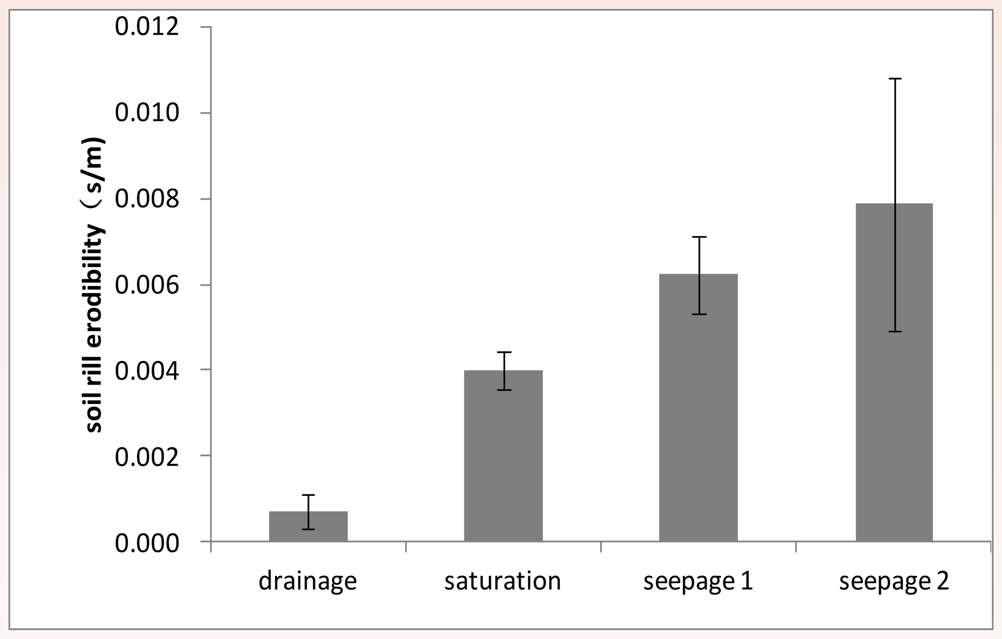

Fig. 2 Rill erodibility under different subsurface hydrological condition

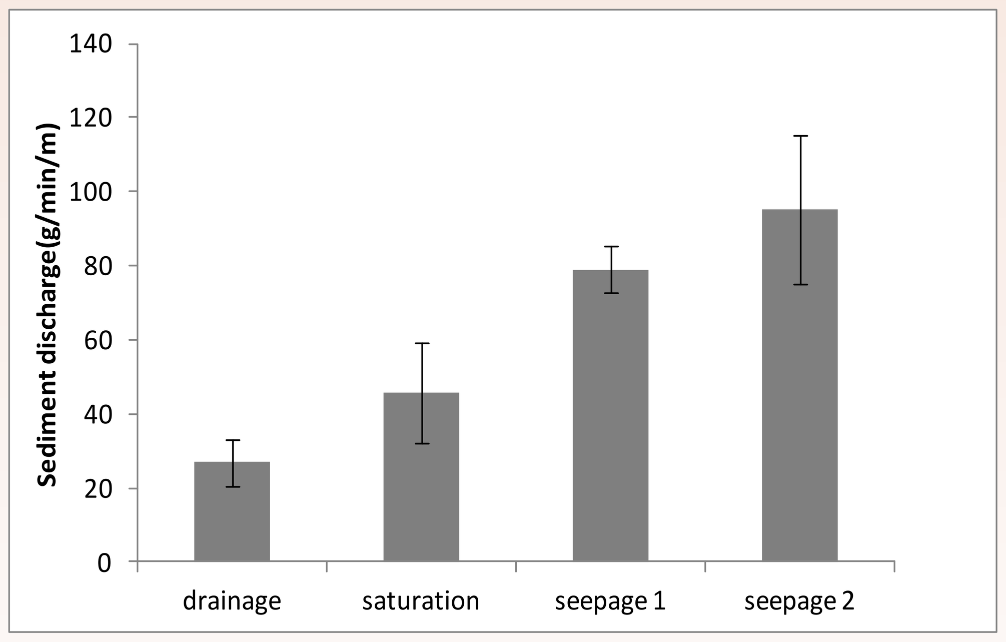

Fig.3 Sediment discharge without feeder input

The rill erodibility increased as increasing the seepage rate in the mini flume experiment. The vertical water gradient or the vertical water movement impacts the soil cohesion, resulting in an increased erodibility.

Without feeder input, the sediment discharge shows the same trend: Drainage ＜ Saturation ＜ Seepage 1 ＜ Seepage 2.

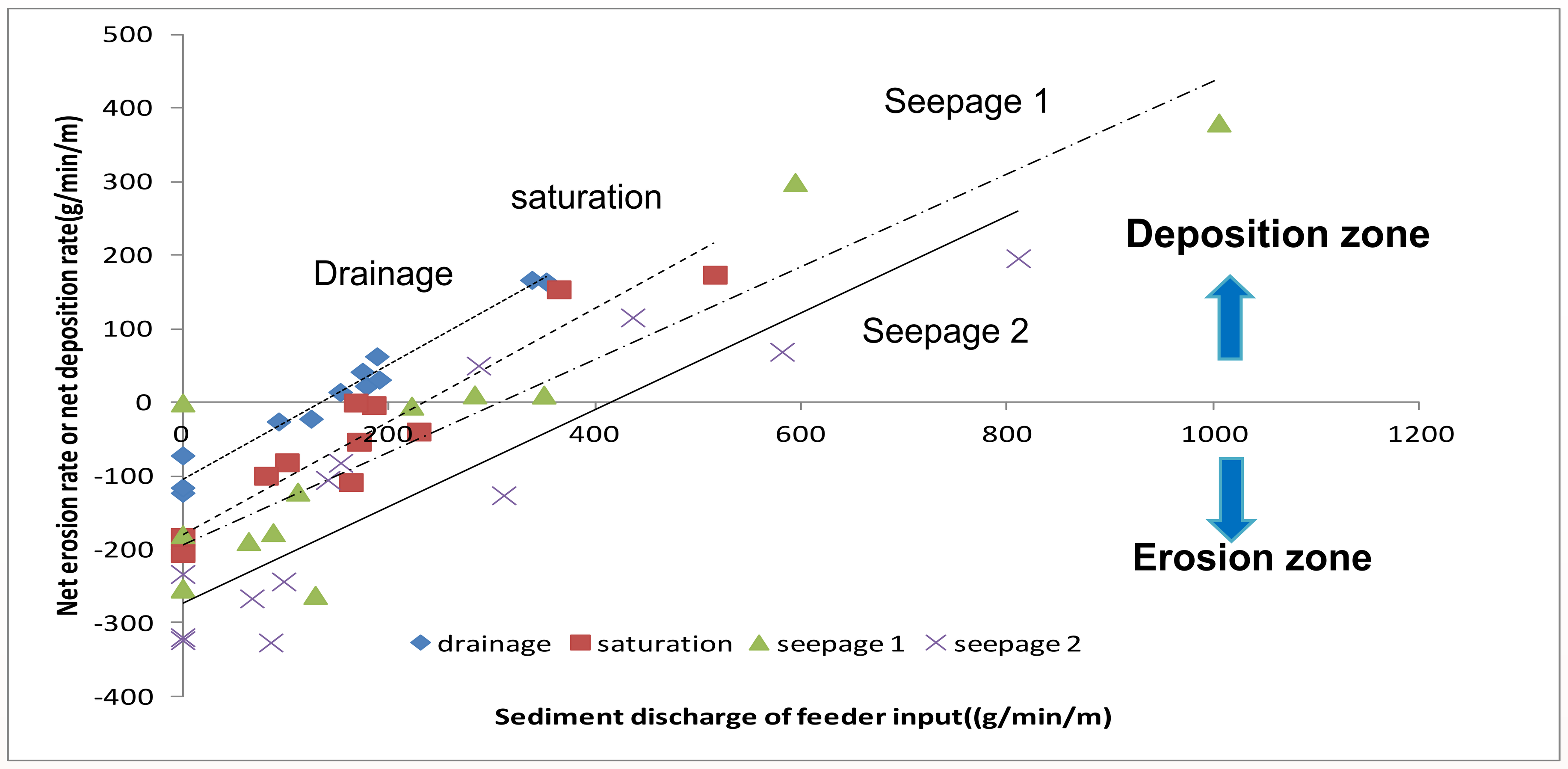

Fig. 4 Net erosion or net deposition under different subsurface hydrologic condition

For the same shift in subsurface hydrology from drainage to seepage, an increased soil erosion and a decreased sediment deposition was observe in the test flume (Fig. 4)

When T_c was defined as the equivalent sediment discharge (sediment input = sediment output) , T_c values increased as the subsurface hydrology was changed from free drainage to saturation to low and then high seepage rates (Fig. 4 and Table 1).

Table 1. T_c values under different subsurface hydrologic condition

	Drainage	Saturation	Seepage 1	Seepage 2
T_c (g/min/m)	133.9	235.2	327.2	409.3

Conclusion

The subsurface hydrologic condition affects soil erosion and sediment deposition. Changing subsurface hydraulic gradient can change the soil erodibility, sediment deposition and total sediment transport .

The estimated transport capacity increased as the subsurface hydrology was varied from free drainage to saturation to low and then high seepage rates.

These results demonstrate how an extrinsic condition, such as the subsurface moisture gradient, can affect soil erosion and sediment deposition.

Acknowledge

Zhaoxia Li would like to acknowledge the scholarship from China Scholarship Council (CSC), the scientific guidance of Prof. Huang, I also thanks H. Brenda and all the staff in USDA – ARS National Soil Erosion Lab.

Contact Information

1.College of Resource and Environment, Huazhong Agricultural University, Wuhan, 430070, China.
zxli@ mail.hzau.edu.cn(Z. Li)
2.USDA-ARS National Soil Erosion Lab. 275 S. Russell St. W. Lafayette, IN, 47907, USA.