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Impact of vegetation cover and topography on runoff and topsoil erosion at the hillslope scale at experimental plots in a semi-arid region of China

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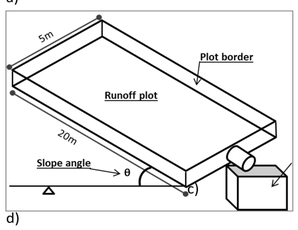
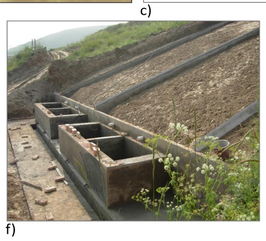
Introduction

Ningxia is a semi-arid continental region in the upper reaches of the Yellow River, characterized by a long, cold winter, hot, short summer, with dry heat and winds, strong evaporation, high radiation and temperature, and little total precipitation. The region's average annual temperature is around 5 - 9 ℃, ≥10 ℃, and the frost-free period is 124 - 184 days, the average annual precipitation 200 - 600mm, and the potential evaporation is 1300 - 2600mm. Soil erosion throughout the region, both wind and water, is a severe issue.

Study Site and Experimental Design





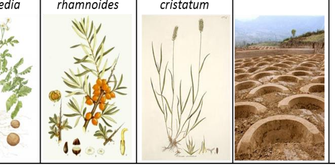
Legend:
a) Map of study area
b) Location of experimental plots
c) Plots distribution
d) Runoff plot design
e) Photo of four of plots on hillslope
f) Concrete discharge and sediment collectors below the plots

The study consisted of 20 runoff plots designed on the hillslope of loess area (Fig.a) with a 1m cement ridges (area of 5m x 20m) constructed the basin for various types of land cover, along with a drainage sink for sampling water and soil loss after rainfall events. Runoff was measured at the basin (Fig.d and Fig.f) in both wet and dried conditions to determine the ratio of water to soil. Rain gauges and soil gauges collected data for precipitation, temperature, evapotranspiration, humidity, and ground temperature as well as soil moisture data at increments of 10 cm up to 50 cm below the surface.

Slope	Soil type	Vegetation cover						Bare
5°	Heilu soil Calcic Kastanozems, FAO	*Medicago sativa*	*Medicago indica*	*Caragana intermedia*	*Hippophae rhamnoides*	*Agropyron cristatum*	Fish-scale pit	Control group
10°								
15°								
20°								

Soil profile description:

Horizon	Depth (cm)	Description
Ap	0-21	Light grayish brown, clay loam, weak medium structure
Ah	80-100	Darkish brown, clay loam, fine subangular blocky structure
AB	80-100	Darkish brown blocks in pale brown soils, clay loam, fine subangular blocks break to granules
Bk	100-129	Pale brown, clay loam, massive
C	129-200	Yellowish brown clay loam, blcks breaking to granules

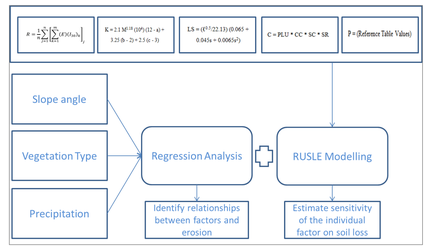


It is expected that soil erosion is affected by three major factors: slope, vegetation cover, and rainfall intensity. The study consisted of 22 runoff plots on slopes at 5, 10, 15 and 20 degrees with land cover types given in the Table.

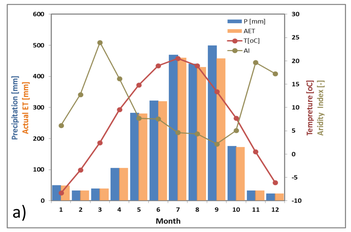
Methods

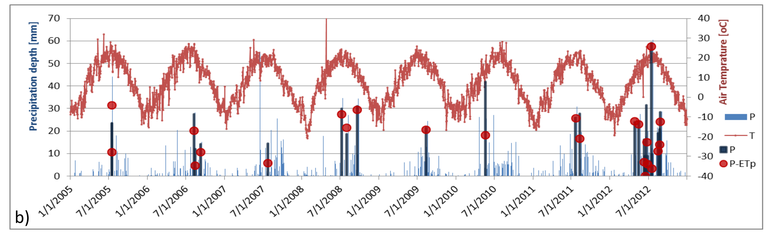
Regression analyses were used to evaluate the relationship between erosion and the factors of slope, vegetation cover, and rainfall intensity through sensor-gathered data and site-collected data.

The Revised Universal Soil Loss Equation (RUSLE) will be used to evaluate the primary drivers of soil erosion in the study area , determine their individual impact, and make recommendations to better address soil loss from water-base d erosion by modeling the factors individually.



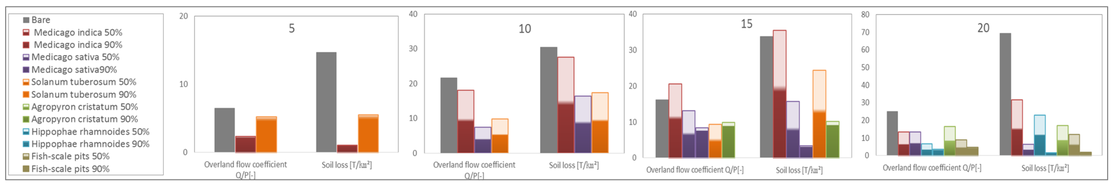
Preliminary Results (1)





Climatic information (Fig. a and b) shows an expected pattern of localized, intense rain in the summer months, along with higher temperatures and lower aridity. Precipitation events occur in the summer months.

Preliminary Results (2)



Bare land is the most susceptible to erosion and experienced the highest overland flow, followed by sparse (50 percent) *Medicago sativa*, with the exception of slopes at 15 degrees. Higher concentrations of *Medicago sativa* performed better, even on steeper slopes. *Solanum tuberosum* did not perform particularly well in preventing overland flow or soil loss. Vegetation cover, as a whole, slowed overland flow and soil loss, and a higher percentage of coverage in vegetation was related to a reduced risk of topsoil erosion.

Outlooks

The next step will to be perform a RUSLE evaluation to identify the primary drivers in erosion in the study area and to compare results to make clear, detailed recommendations as to preventative measures to be taken in the Ningxia area.

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