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Exploring the impact of spatial morphology of terraces on soil erosion from high spatial resolution digital elevation models

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1. Background Introduction

- 1. Soil erosion

  A **Big** problem!

- 2. Why Terrace?
  - reshape topography
  - larger farming area on gentle slope
  - **soil and (water) conservation**
- 3. Why Terrace in the Loess Plateau?
  - arid and semi-arid climate
  - concentrated summer rainfall as the main driver
  - porous soil (easily to be infiltrated by water)
  - vertical joints
- 4. So, How to evaluate the soil conservation ability of a terrace?
  - Soil Erosion Model (empirical model)
    - ★ RUSLE
      - a revised version
      - depend on the environmental condition
      - suitable for croplands or gently sloping topography
      - proved to be useful in some area of our country

$$A = f \cdot R \cdot K \cdot \bigstar LS \cdot C \cdot P$$

A is the annual soil erosion per unit area [t/(hm²·a)]

f denotes the modification constant

R is the rainfall erosivity factor [MJ.mm/(hm²·h·a)]

K is the soil erodibility factor [t·hm²·h/(hm²·MJ·mm)]

LS denotes the slope and slope length factor

C is the vegetation cover factor

P is the factor of soil and water conservation measures within a value range of [0,1]

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Abstract
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2. Data & Methods

1. The study area: Yaojiawan watershed

- **Where?**
  - 37°32′ N, 110°14′ E to 37°30′ N, 110°16′ E
- **How is the base DEM generated?**
  - 1cm point cloud data from UAV
  - 0.1 m resolution DEM from interpolation
- **Why use the detailed DEM?**
  - To better depict the spatial morphology of the terraces
  - Morphology factor (LS) matters

2. Methods

1) Destruction of terraced fields

- **Why?** Because the study aims to evaluate the soil erosion before and after terrace construction. **LS factor will change.**
- **How?** In terraces, choose contour lines running parallel to the edge line and the edge offset line from each terraced field surface. Then, these contour lines will be interpolated to generate a new DEM representing non-terrace fields.

2) RUSLE: for calculating soil erosion modulus

$$LS = (L/L_0)^m \times (65.41\ sin^2\theta + 4.56 sin\theta + 0.065)$$

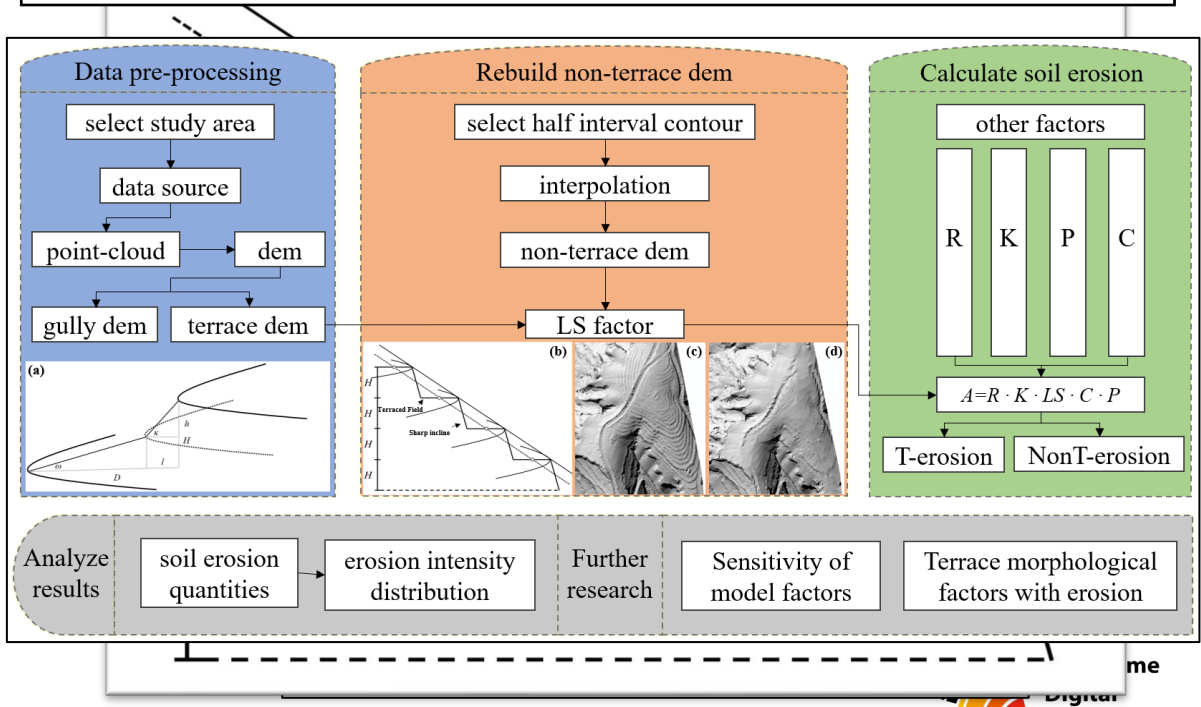
$$R_{h-mon} = \alpha \cdot \sum_{n=1}^{k} (P_n)^{\beta}$$

$$K = \theta_{c-sand} \cdot \theta_{cl-si} \cdot \theta_{orc} \cdot \theta_{h-sand}$$

$$c = VFC = \frac{NDVI - NDVI_{min}}{NDVI_{max} - NDVI_{min}}$$

$$C = \begin{cases} 1, & c = 0 \\ 0.6508 - 0.3436 * lgc, & 0 < c < 78.3\% \\ 0, & c \geq 0 \end{cases}$$

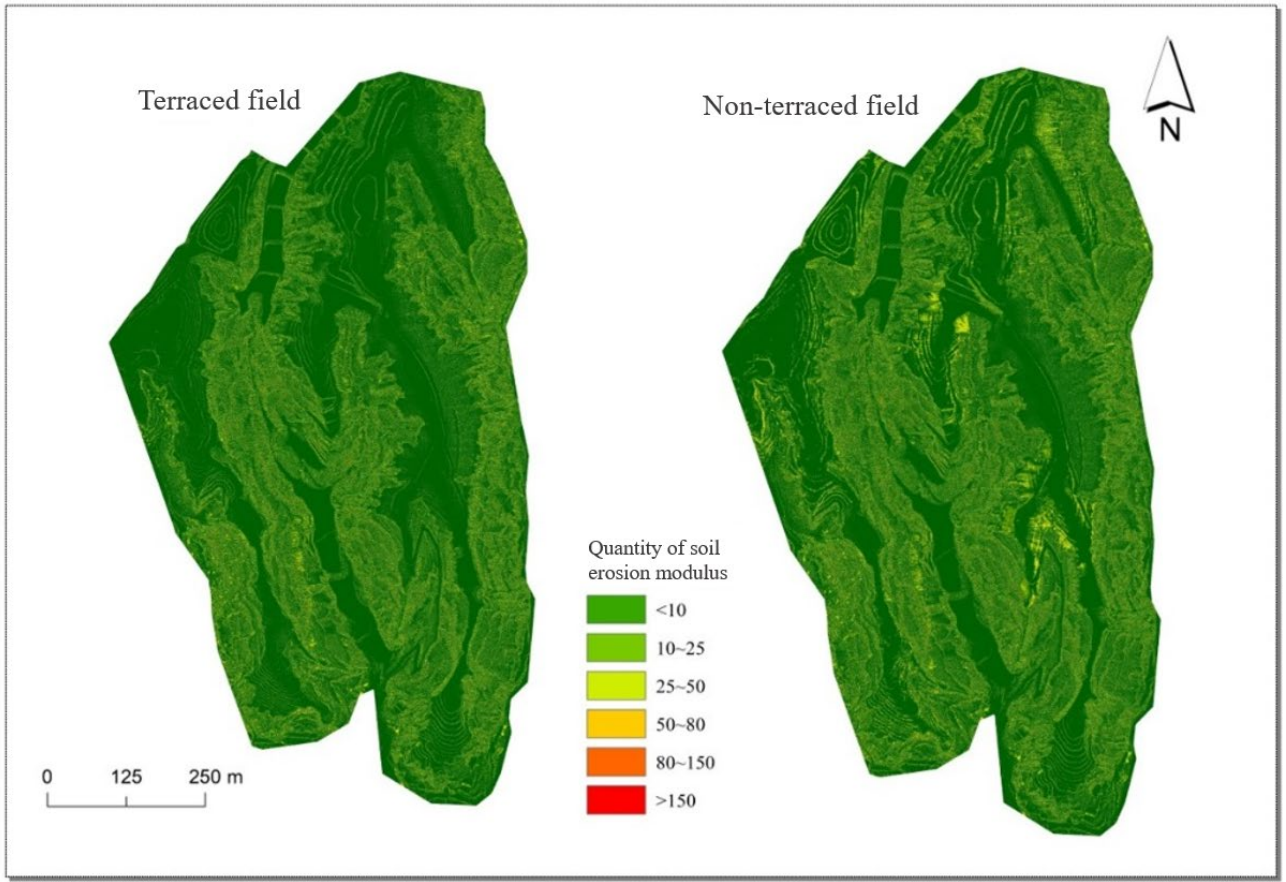
land use Types	Forest	Grassland	Dryland	River	Unused
P	1	0.15	0.35	0	1



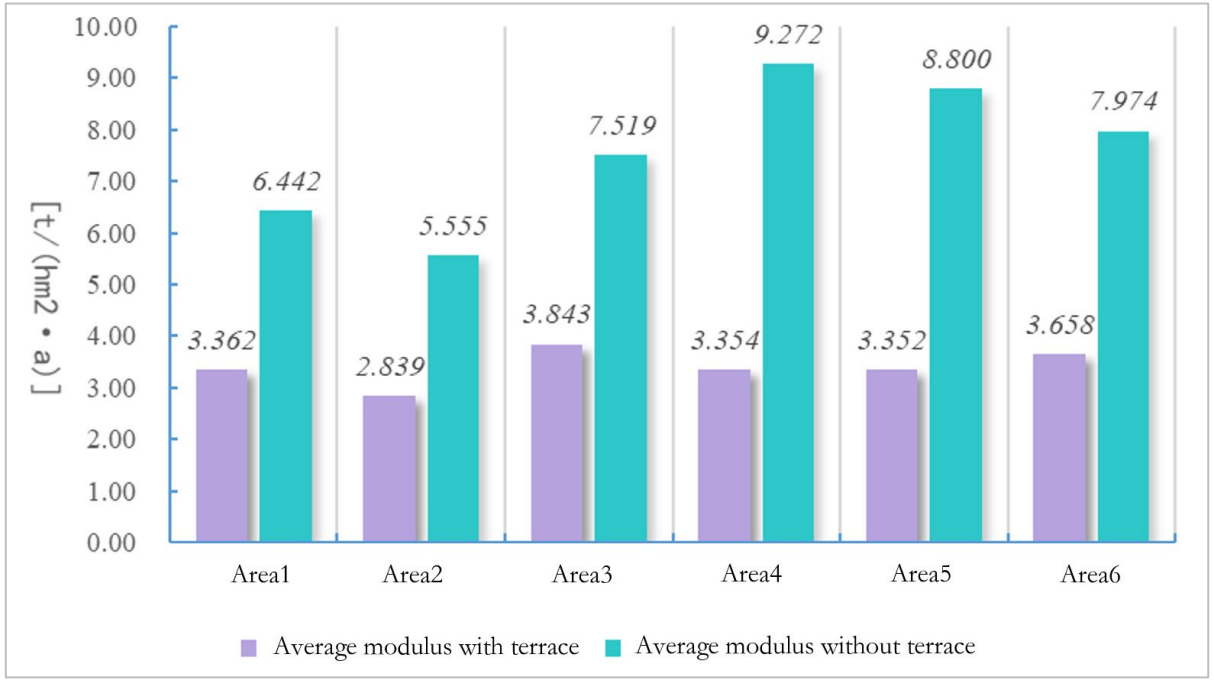
3. Results

Soil erosion before and after terrace construction

Scenario	Average soil erosion modulus	Total eroded area	Total amount of soil erosion
terraced	8.30 t/(hm²·a)	32.86 hm²	272.74 t/a
non terraced	9.92 t/(hm²·a)	36.96 hm²	343.36 t/a



Soil erosion changes in sample areas



Disussion: further study on terrace's morphology

Name of morphological factor	Definition
$\bar{W}$	Average width of the terraced fields in a terrace
AR	Area of a terrace
$\bar{T}$	Average number of terrace steps passed by the ridge line
$\bar{h}$	Average height of the sharp declines in a terrace
$\bar{S}$	Average slope of a terraced area
$\bar{P}$	Average slope of all side slopes in a terrace
H	Total elevation difference of a terrace

Thanks for listening!!