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DEM BASED TERRAIN FACTOR OF SOIL EROSION AT REGIONAL SCALE AND SOIL EROSION MAPPING

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BACKGROUND AND OBJECTIVES

Terrain is commonly accepted as one of the key factors leading to soil erosion. Current international-advanced erosion models were applied in soil erosion researches in the Loess Plateau. However, those models are available mostly only at surface slope lever or watershed lever. Objective of this paper is to explore a regional terrain factor of soil erosion and its spatial distribution based on DEM.

DATA AND METHODS

The Loess Plateau is the most severe soil and water loss area in the world. The Loess Plateau in northern Shaanxi province is chosen as the study area. Erosion of this area is the most intensive in the Loess Plateau, and here is the national key area to prevent soil and water loss. It covers an area of 92.5 thousand km^2. Ground cracking is well-developed and gully density is high. 48 test areas with different terrain complexity and roughness were selected (Fig.1).

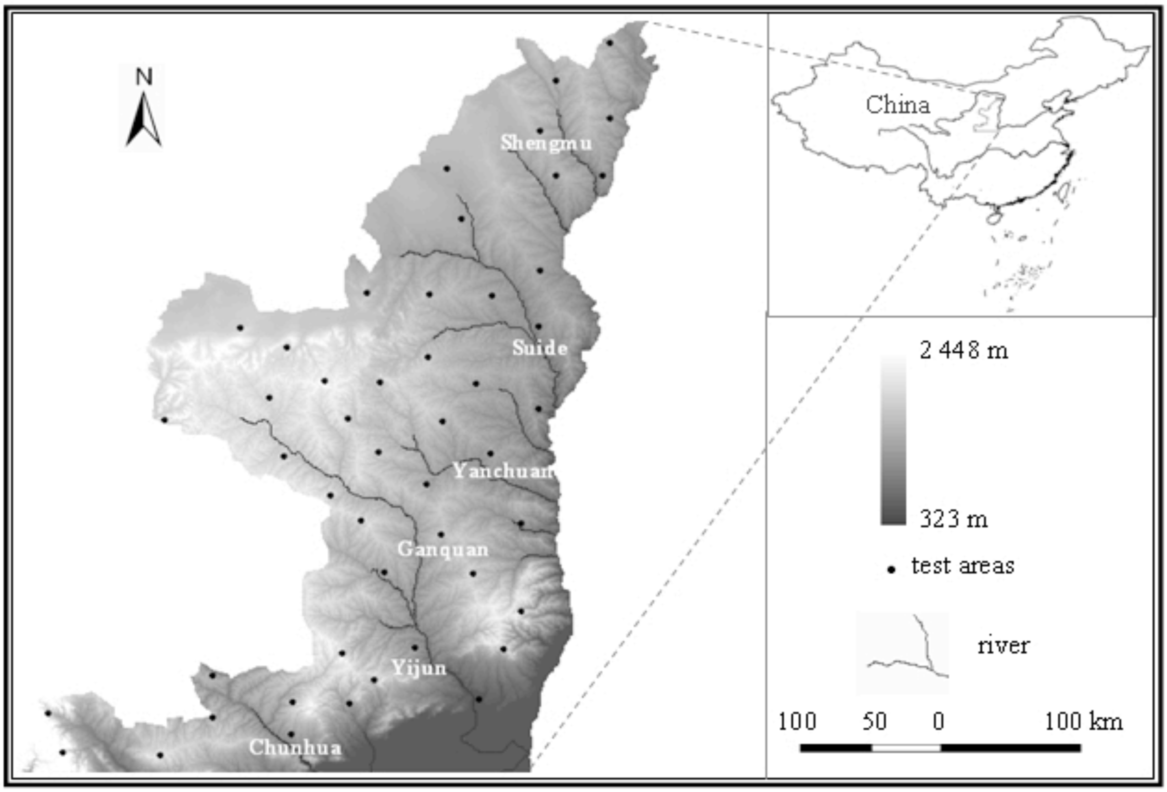

Figure 1 The distribution of the test areas

Test data were the corresponding 5 m-grid resolution DEMs produced according the national standard of China. The 1:100,000 soil erosion intensity map of Shaanxi were used for a comparative analysis.

Following an overall consideration, we propose the terrain factor of soil erosion at regional scale can be represented as:

$$G = \sum_{i=1}^{n} \sum_{j=1}^{m} \ln(CA_{i,j} \times \sin \alpha_{i,j} \times SOS_{i,j} \times SOA_{i,j}) \Big/ (i \times j) \quad (1)$$

Where $CA_{i,j}$ denote specific catchment area at location (*i, j*), $SOS_{i,j}$ denote slope variability at location (*i, j*), $SOA_{i,j}$ denote aspect variability at location (*i, j*).

RESULTS AND DISCUSSIONS

Based on the DEMs data, G, T_d, T_d', *SOS* and *SOA* of 48 test areas are calculated. Then the terrain factor G and its spatial distribution is predicted using the ArcGis geostatistical analysis tools (Fig. 2).

Fig.2 shows spatial distribution of G is obvious. Fig.3 is the soil erosion intensity map of northern Shaanxi produced by institute of soil and water conservation of C.A.S. Through Fig.2 and Fig.3, we can see that spatial distribution of G is correlatable with spatial distribution of the soil erosion intensity. Along N-S trend, G value in the region of Kuye river drainage area, Tuwei river drainage area, Suide County and Yanchuan County show the maximum of the North Shaanxi. This area is the center of intense soil erosion in the Loess Plateau, and is the major source area of sediment load in the lower reach of the Yellow river. Along the W-E trend, from the east foot of the Baiyushan mountain, Zhidan County, Ansai County to Zichang County, it is another center of the soil erosion in the Loess Plateau. But there are some inconsistencies between the two maps. For example, G of Huanglong area which lies to the east of the Yijun County is big, but erosion intensity here is faint. This is due to good vegetation cover condition and perfect soil and water conservation management. Another abnormal area is the northern of Shaanxi, where soil erosion is the strongest yet because of the severe natural environment, such as long storm, endless desert, infrequent vegetation, and unconsolidated loess. But G of this area is small because of low relief.

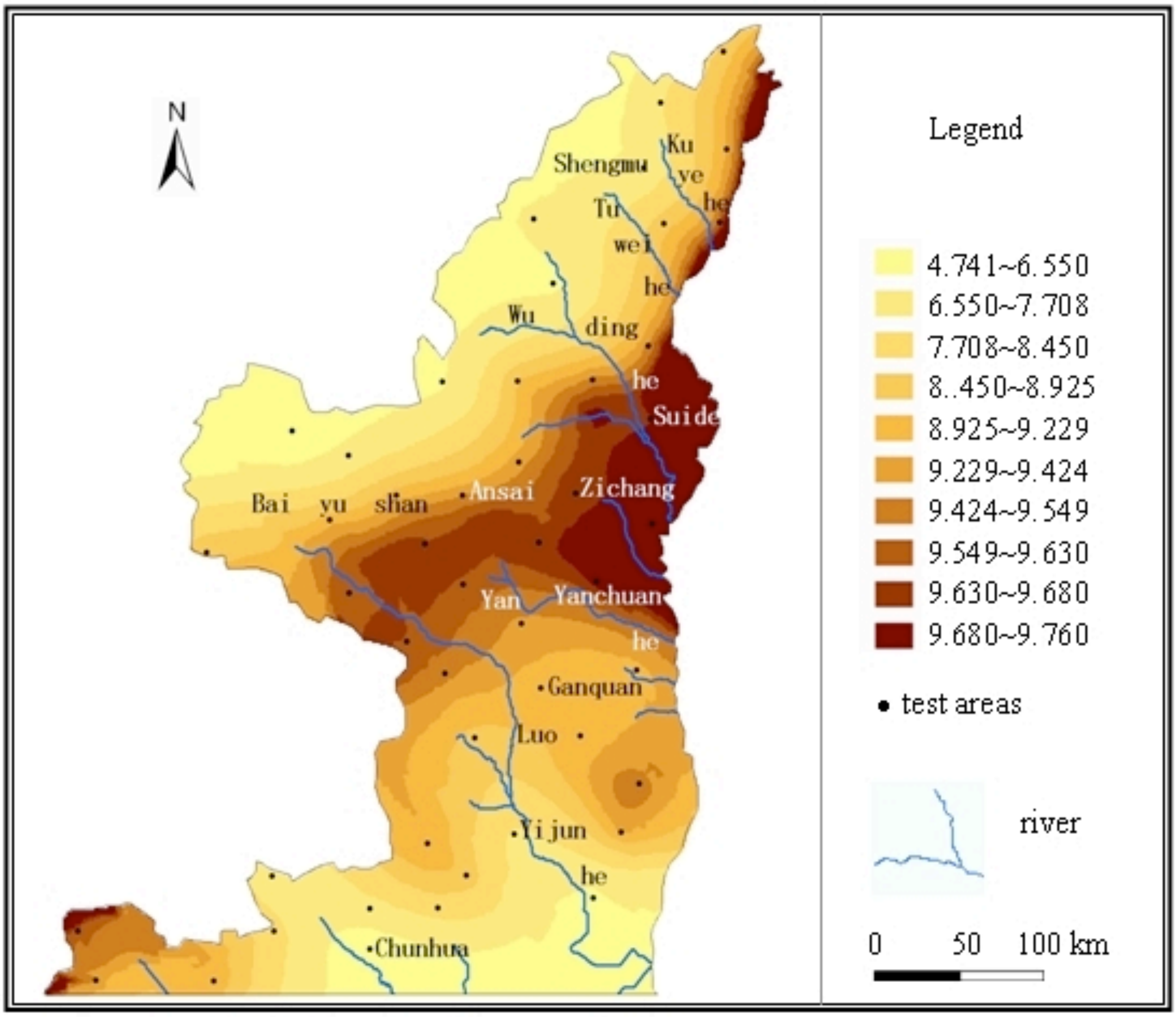

Figure 2 Map of spatial prediction of G in north Shaanxi province

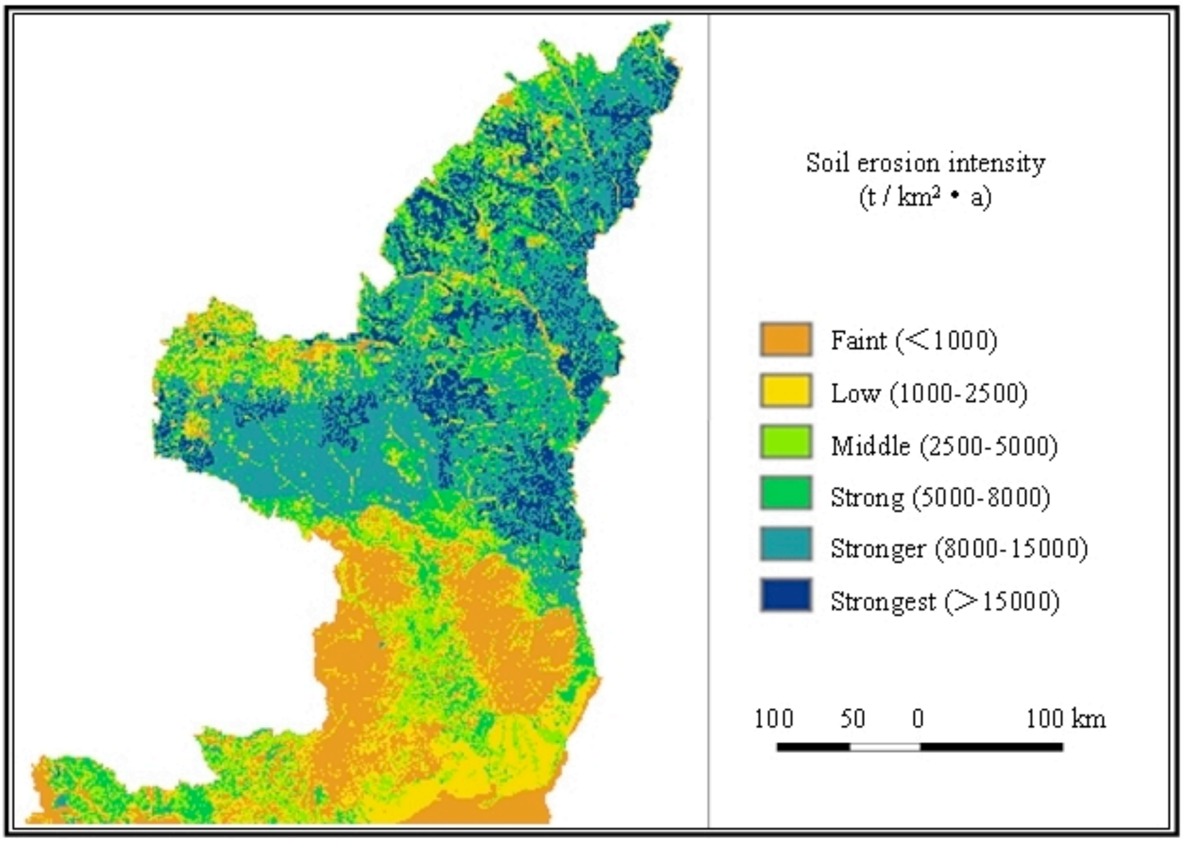

Figure 3 Soil erosion intensity map of north Shaanxi (from Institute of soil and water conservation, CAS)

When applying *G* to evaluate the regional soil erosion in the Loess Plateau, an integrated analysis combining the climate, vegetation cover, and soil and water conservation management is needed. According to the evaluation model provided by Li et al (2008), we can set up a simple model:

$$A = R^{a} \cdot C^{b} \cdot G^{c} \cdot V^{d}$$

Where *A* denotes evaluation coefficient of soil erosion intensity, *R* denotes rainfall erosivity, *C* denotes soil antierodibility, *V* denotes vegetation cover, a, b, c, d denote weight coefficient. To avoid the impact of dimension, all factors are standardized with the way of maximum difference formalization method. Primary data of *R* were calculated according to 43 weather stations and hydrological stations which are mainly located in Shaanxi province. Primary data of *C* were on-the-spot observed by Jiang (1997). *V* is 1 km resolution *NDVI* index provide by CNES, this paper use the average of month 6, 7, 8, 9, 1998. *G*, *R*, *C* are interpolated as dada layers, and the converted into grid layers with 1 km resolution. Then we can get A through data overlaying calculation (Fig. 4).

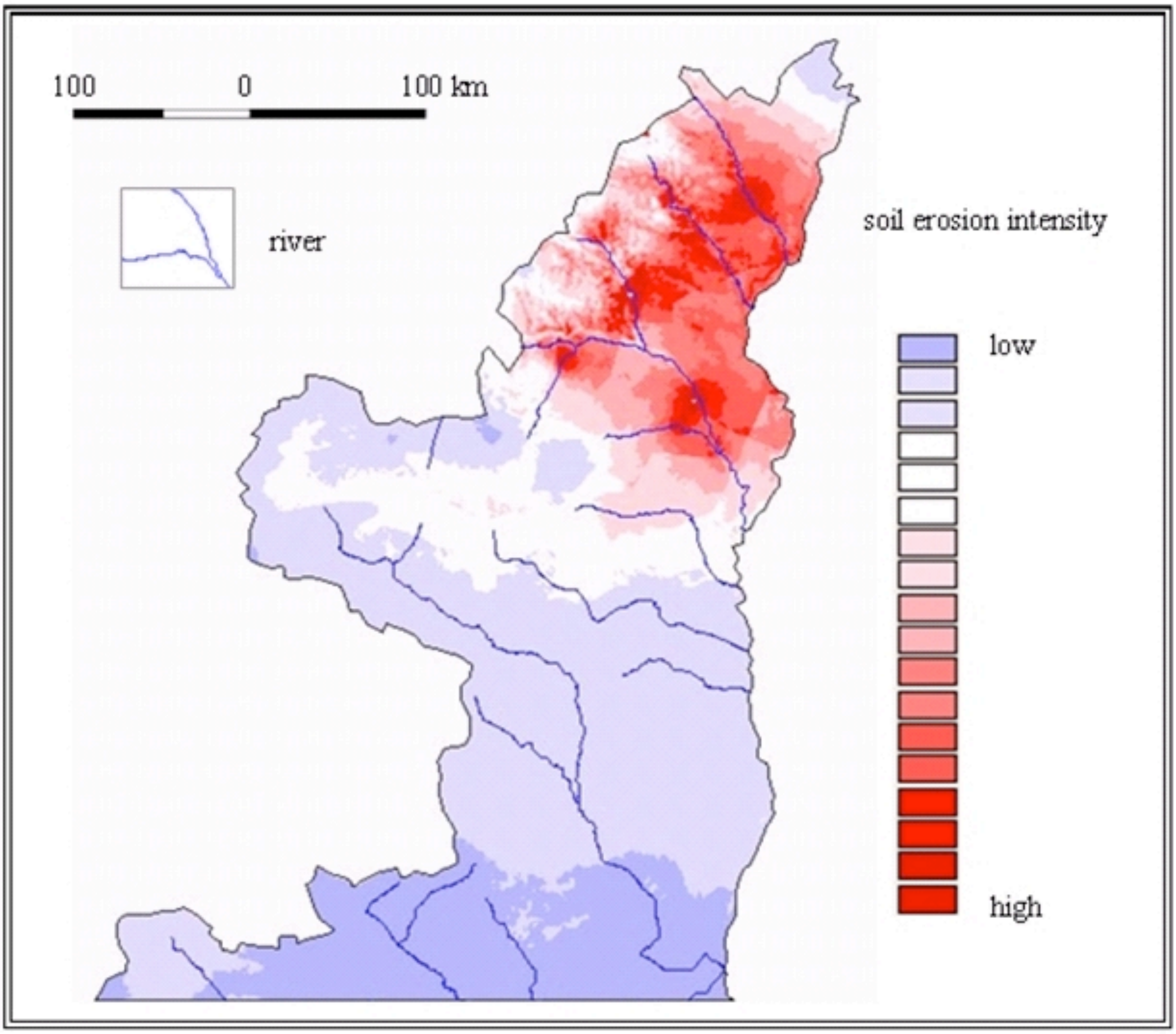

Figure 4 Soil erosion intensity map of northern Shaanxi

Figure 4 shows that soil erosion intensity along Kuye river drainage area, Tuwei river drainage area, Mizhi County and Suide County is the most strong, and then from north to south the soil erosion intensity changes gradually. With this way, we can get a simple model to evaluate soil erosion. However there still exit some errors, this is because the unsuitable sample density between the four factors.