Soil erosion map development for the Parkent district, Uzbekistan
ウズベキスタン国パーケント地方の土壌侵食図の作成

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I. Introduction

Soil erosion is a major environmental issue after salinization in Uzbekistan. Uzbekistan is characterized by a semi-arid climate and low levels of precipitation, which have led to soil degradation and erosion. Around 800 thousand hectares of rain-fed land and approximately 15% of the total agricultural land in the country have been affected by varying degrees of soil erosion. Additionally, unsustainable land use practices, such as overgrazing and improper irrigation techniques, have further exacerbated the problem.

The objectives of the research is to estimate the rates of soil erosion in the region by applying the RUSLE model. The erosion map can provide some information about the severity of erosion, identify areas of high risk of erosion. The information will be profit to farmers for soil conservation, and policy makers can easily develop strategies to mitigate the effects of erosion.

II. Material and Method

Parkent district is located in the Tashkent region, which is situated in the northeastern part of the Uzbekistan. It covers a territory of about 1080 km².The landscape of the Parkent region is characterized by diverse relief. As we move from the west to the east, the elevation gradually rises, starting from around 487 meters above sea level and reaching up to 3265 meters above sea level in the eastern part of the area, where the Tien Shan Mountain ranges are located (Figure 1). The climate in Parkent district is continental, with hot summers and cold winters.

The soil in the area is mostly classified as arid which is typically low in organic matter and nutrients. The soil in the region is also susceptible to erosion due to the dry and windy conditions. RUSLE stands for the Revised Universal Soil Loss Equation, which is a widely used empirical model for estimating soil erosion. The equation estimates the long-term average annual soil loss caused by water erosion based on several factors:

$$A = R \times K \times LS \times C \times P$$

where A is the average soil loss (Mg/ha/year), R is the rainfall erosivity factor (MJ mm/ha/h/year), K is the soil erodibility factor (Mg h/MJ/mm), L is the slope length factor, S is the slope steepness factor, C is the cover

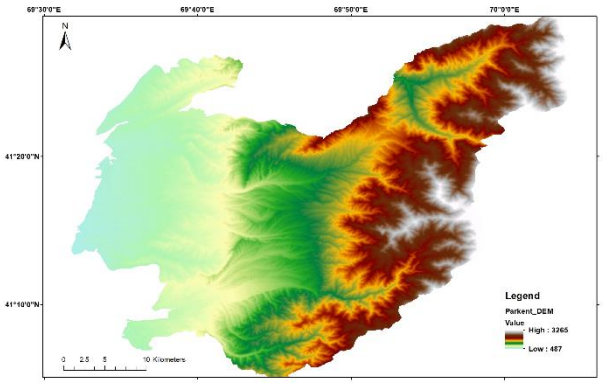

Figure 1. DEM map of Parkent area.

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and management practice factor and P is the support practice factor.

Input data required for the RUSLE equation include rainfall data, soil characteristics, land use practices, slope data, erosion control practices.

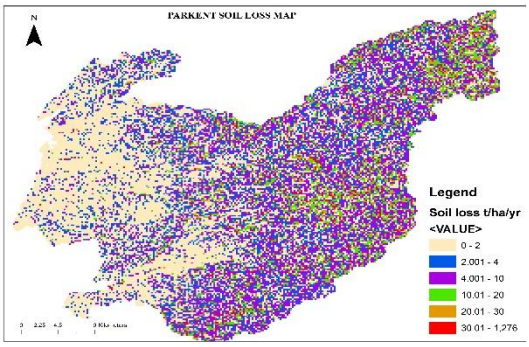

Figure 2. Soil loss map of Parkent area.

III. Results

Precipitation (R): Precipitation amount and intensity are crucial for erosion assessment. Data from 2000-2023 from the Uzhydromet agency were used to determine the R factor. Soil erodibility (K): Soil erodibility varies based on factors like texture, organic matter content, structure, and permeability. 367 soil samples were collected across the territory, analyzing organic matter content and mechanical composition to calculate the K factor. Slope length and steepness (LS): To determine the LS factor, calculated the flow direction and the flow accumulation grid using DEM map. Vegetation management (C): Quantity and effectiveness of vegetation cover significantly impact erosion control. To calculate the C factor, used the Uzaerogeodesy agency data set (Table.1). Utilizing GIS and the mathematical equation of RUSLE, we estimated the average annual erosion rate to be 3.38 Mg/ ha^{-1} /$year^{-1}$(Figure 2).

Based on the estimated soil loss in each grid cell, a soil erosion risk map was developed, categorizing areas into five risk classes. The spatial distribution of risk classes indicated that 28.4% of the area had a slight, 59.7% had a moderate, 8.24% had a high risk, 3% had a very high risk of erosion. The very severe and severe soil erosion consists of a 0.7% area. It shows that around 12 % of high-risk zones need conservation to reduce the risk of soil erosion (Table2).

Areas with a high risk of erosion require the implementation of appropriate erosion control measures. Agricultural practices such as overgrazing in pastures, deforestation, intensive tillage, monoculture, soil compaction, improper irrigation and excessive use of fertilizers and pesticides can all contribute to soil erosion. Sustainable farming practices can help mitigate soil erosion by preserving soil structure, organic matter, and vegetation cover

Table 1 Parameter set in RUSLE

Factors	Average	Min.	Max.
R	267.6	213.6	297.3
K	0.0363	0.0007	0.0571
LS	0	1360.48	10.81
C	0.15	0	1
S	13.66	0	67.42

Table 2 Output of RUSLE model

Severity	**Erosion rate (t/ha/y)**	**Area (ha)**	**Area (%)**
Slight	0-2	31274	28.38
Moderate	2-4	65735	59.65
High	4-10	9067	8.24
Very high	10-20	3311	3.0
Severe	20-30	699	0.63
Very severe	>30	103	0.09