Article ID 240204024

Soil Erodibility Status of Nandurbar District, Maharashtra

V. K. Balsane* and S. B. Nandgude

Department of Soil and Water Conservation Engineering, MPKV, Rahuri.

*Corresponding Author: vijaybalsane121@gmail.com

Maharashtra has high hills and significant rainfall, which contributes to the state's high rates of land degradation (Challa *et al*. 2000). The most serious issue with land degradation is soil erosion, which has a significant impact on the quality and productivity of the land in many ways. The strain of an expanding population coupled with excessive and incorrect land use practices has led to the degradation of a significant portion of arable land. Soil erosion, as highlighted by Challa *et al*. (2000) contributes to the decrease in regional productivity. This issue is not confined to a particular region but is a global concern. Annually, vast quantities of top soil are lost from agricultural fields due to erosion, exacerbating the problem.

According to Singh and Khera (2008), soil erosion is a function of both the soil's erodibility and the rainfall's erosivity. It is a complex process influenced by various factors, including climate, topography, land use practices, and soil properties. Lal (2003) underscored the significance of organic matter in mitigating erosion and its crucial role in the global carbon budget. Cerda *et al*. (2009) conducted a study examining the influence of rock fragment cover on soil properties and splash erosion under different rainfall intensities, emphasizing the importance of structural stability. Soil erodibility stands out as a pivotal factor determining the soil vulnerability to erosion amidst these considerations.

Understanding and quantifying the soil erodibility factor, 'K', is crucial for effective soil erosion management and conservation practices. By assessing the erodibility of different soil types, land managers and policymakers can make informed decisions regarding land use planning, erosion control measures, and sustainable land management strategies.

Despite its significance, the estimation of the soil erodibility factor, 'K', remains challenging due to the complex nature of soil erosion processes and the inherent variability of soil properties across landscapes. Furthermore, the existing methods for measuring soil erodibility often require labour-intensive field experiments or rely on empirical relationships derived from limited datasets, which may limit their accuracy and applicability. However, Wischmeier and Smith (1978) have found it to be related with surface soil texture, structure, organic matter content and profile permeability and can be determined from these properties either through regression equation or monograph produced by them (Yadav *et al*. 2005). The importance of the soil's organic and chemical components can be attributed to their impact on aggregate stability.

This study aims to investigate and analyse the soil erodibility factor 'K', with a focus on developing improved methodologies for its estimation. This study aims to enhance our understanding of soil erodibility factors through field observations, lab tests, and advanced modelling techniques, providing valuable insights for erosion control and land management strategies. Its objectives are to establish of the Soil Erodibility factor 'K' and create soil erodibility maps for the soils of Nandurbar district while examining variations.

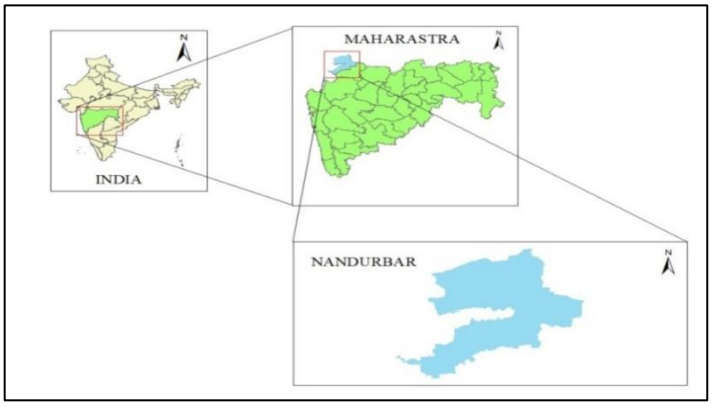


Fig. 1. Location map of study area

The purpose of this study was to determine the soil erodibility factor 'K' for soils of Nandurbar district. The study was undertaken for the soils of Nandurbar district and district is shown in Fig.1.The soils studied were selected on the basis of their agricultural importance and their wide range of characteristics representative of soils within the Nandurbar district. The district comprises 06 tehsils namely, Nandurbar, Nawapur, Shahada, Taloda, Akkalkuva and Akrani. The study area lies between north latitude 21°00'00" to 22°00'30" and east longitude 73°31'00" to 74°45'30". Agriculture serves as the primary occupation for the inhabitants of the district, which lies within Tapi and Narmada basins. Covering an area of 5034 square kilometers, it constitutes approximately 1.9 percent of the total land area of the state. District falls receives 801 mm of

average annual rainfall mostly through south west monsoon. The region experiences erratic rainfall patterns with uneven distribution, leading to increased uncertainties in agricultural activities. Main crops cultivated include jowar (*Sorghum bicolor*), bajara (*Pennisetum glaucum*), maize (*Zea mays*), wheat (*Triticum aestivum*), groundnut (*Arachis hypogaea*), cotton (*Gossypium spp.*) and sugarcane (*Saccharum officinarum*).

Soils in study area are mainly black. Five soil parameters are predicted the erodibility factor according to Wischmeier and smith *etal.* (1978). The data require for computation of soil erodibility factor 'K' is percent sand, percent silt, percent clay, per cent organic carbon, soil structure and soil permeability. A total of 162 composite soil samples from the study area were taken by plotting the 5 x 5 km grid. The collected Soil samples were mostly from the agricultural land. Soil structure and soil permeability was determined by using soil texture.

Computation of Soil Erodibility Factor 'K'

The erodibility of soil is an expression of its inherent resistance to particle detachment and transport by rainfall.

Soil erodibility factor (K) values for the soil samples were computed using the formula developed by of Wischmeier and Smith (1978), represented as:

$100K=2.1\times10^{-4}\times M^{1.14}(12-a)+3.25\times(b-2)+2.5\times(c-3)$

Where,

K=Soil erodibility factor, t ha h/haMJmm

M=(percent silt + percent very fine sand)×(100-percentclay),

a =Percent organic matter content,

b= Structure code used in soil classification,

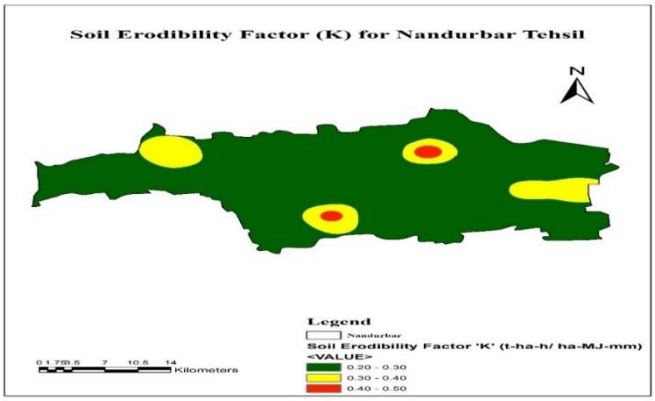
c =Soil permeability code.

Classification of Soil Erodibility

The K values were classified into 6 classes keeping an interval of 0.10 given by Manriquein1988 are shown in below Table 1

Table 1 Classification of soil erodibility (Manrique, 1988)

Class	Soil erodibility	K values (thah/haMJmm)
1	Very low	0.00-0.10
2	Low	0.10-0.20
3	Moderate	0.20-0.30
4	Moderate high	0.30-0.40
5	High	0.40-0.50
6	Very high	>0.50



The results remarks the highlight of the estimation of soil erodibility factor K. Study includes 06 tehsils of Nandurbar district namely Nandurbar, Nawapur, Shahada, Taloda, Akkalkuva and Akrani. The parameters including percent very fine sand, percent silt, percent clay, organic matter content, permeability codes and structure codes of soil were determined for six tehsils.

In this, work were done to study soil erodibility of surface samples of soils. Maps of Soil erodibility factor 'K' was prepared using IDW interpolation technique in Arc GIS 10.1 software. The obtained results during investigation are listed under following titles: Soil erodibility factor.

Soil erodibility factor K for soils of Nandurbar tehsil

The value of soil erodibility factor of Nandurbar tehsil varies between 0.2235 to 0.4670 t ha h/ ha MJ mm with mean value 0.2728 t ha h/ ha MJ mm. Soil erodibility factor(K) map for soils of Nandurbar tehsil are shown in Fig.2. Soil has been termed as moderate high erodible soil.

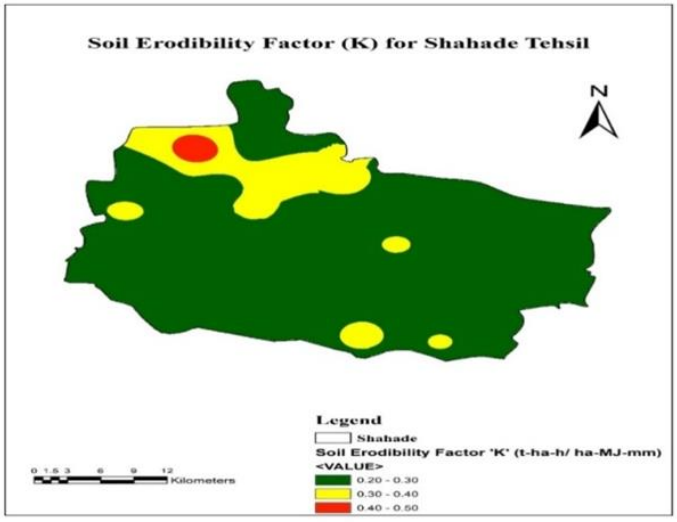


Fig.3. Soil erodibility factor (K) map for soils of Shahade tehsil

In this study, the soil erodibility of Shahade tehsil was assessed by analyzing soil samples from 33 villages.

Soil erodibility factor K for soils of Shahade tehsil

The value of soil erodibility factor of Shahade tehsil varies between 0.2230 to 0.4384 t ha h/ ha MJ mm with mean value 0.2738 t ha h/ ha MJ mm. Soil has been termed as moderate high erodible soil.Soil erodibility factor(K)map for Shahade tehsil are shown in Fig.3

Soil erodibility factor K for soils of Talode tehsil

The value of soil erodibility factor of Talode tehsil varies between 0.2294 to 0.3208 t ha h/ ha MJ mm with mean value 0.2698 t ha h/ ha MJ mm. Soil has been termed as moderate erodible soil.Soil erodibility factor (K) map for soils of Talode tehsil are shown in Fig.4.

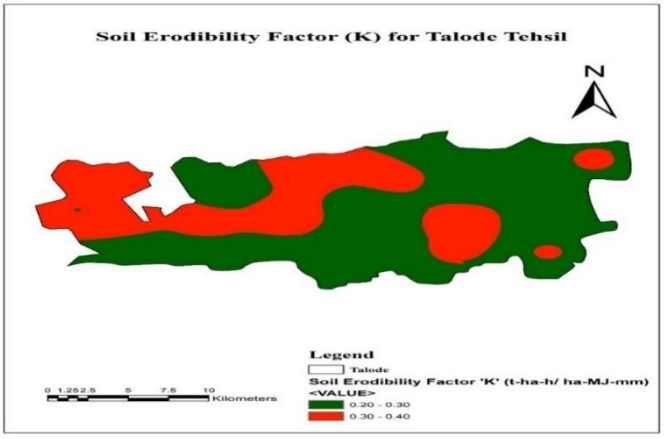


Fig.4. Soil erodibility factor (K) map for soils of Talode tehsil

Soil erodibility factor K for soils of Nawapur tehsil

The value of soil erodibility factor of Nawapur tehsil varies between 0.2249 to 0.3223 t ha h/ ha MJ mm with mean value 0.2608 t ha h/ ha MJ mm. Soil has been termed as moderate erodible soil.Soil erodibility factor(K) map for soils of Nawapur tehsil are shown in Fig.5

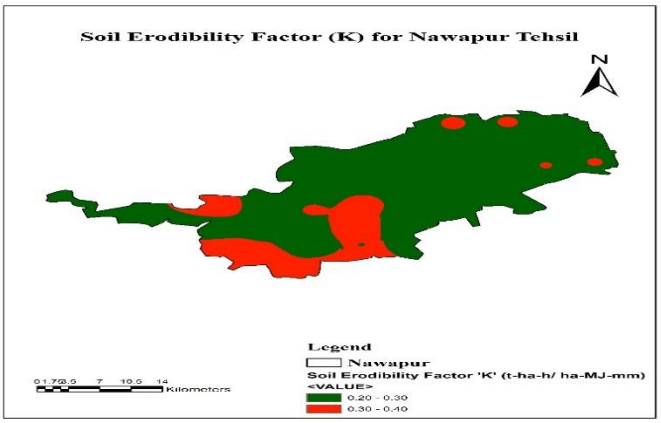


Fig.5. Soil erodibility factor (K) map for soils of Nawapur tehsil

Soil erodibility factor K for soils of Akkalkuwa tehsil

The value of soil erodibility factor of Akkalkuwa tehsil varies between 0.2245 to 0.4378 t ha h/ ha MJ mm with mean value 0.2955 t ha h/ ha MJ mm. Soil erodibility factor(K) map for soils of Akkalkuwa tehsil are shown in Fig.6.Soil has been termed as moderate high erodible soil.

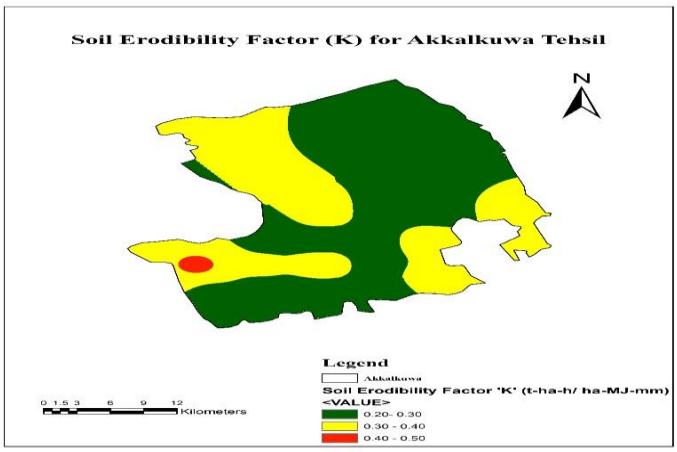


Fig.6. Soil erodibility factor (K) map for soils of Akkalkuwa tehsil

Soil erodibility factor K for soils of Akrani tehsil

The value of soil erodibility factor of Akrani tehsil varies between 0.2286 to 0.3949 t ha h/ ha MJ mm with mean value 0.3123 t ha h/ ha MJ mm. Soil erodibility factor(K) map for soils of Akrani tehsil are shown in Fig.7.Soil has been termed as moderate high erodible soil.

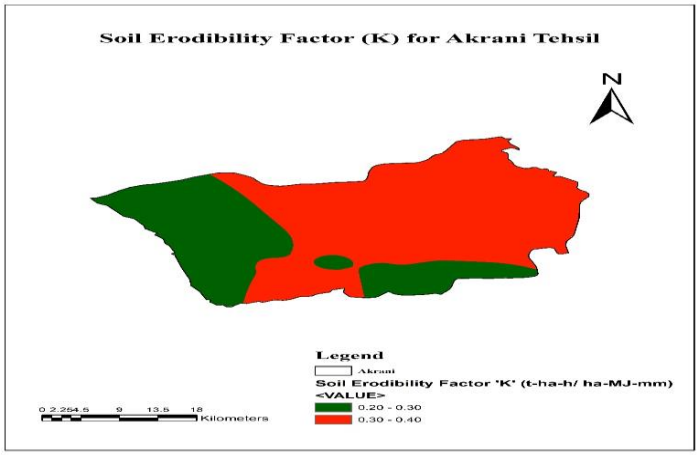


Fig.7. Soil erodibility factor (K) map for soils of Akrani tehsil

Variation in soil erodibility of soils of Nandurbar district

Soil sample collected mostly from agricultural land. The clay content is high in all sample. Percent sand (9.95 % to 69%), percent silt (9.9% to 51.3 %) and percent clay (16.16% to 60.48%) with average sand (26.55%), silt (23.66%) and sand (49.01 %) respectively.

Organic matter percent varies between 0.3965% to 1.6722% with mean value 1.3426 %. Soils of district are very slow permeable with permeability code 6. Soil structure mostly found in the district is 4, having structure type massive blocky.Tehsil wise soil erodibility factor(K) values and map for soils of Nandurbar district are shown in Table 2 and Fig.8 respectively.

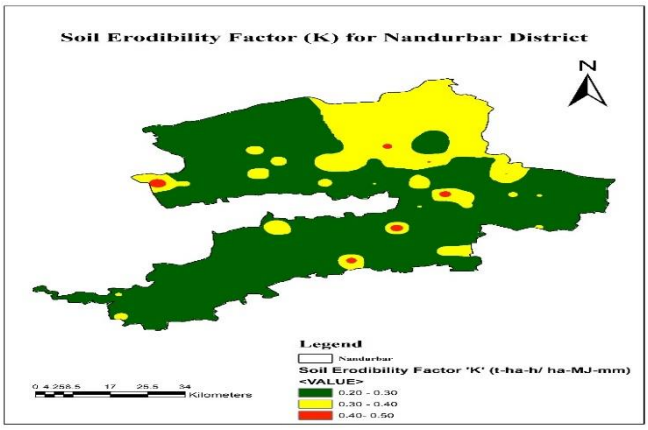


Fig.8. Soil erodibility factor (K) map for soils of Nandurbar district

Soil erodibility factor of Nandurbar district varies between 0.223 to 0.467 t·ha·h·ha^{-1} ·MJ $^{-1}$ · mm^{-1}mm with mean value 0.2753t·ha·h·ha^{-1} ·MJ $^{-1}$ · mm^{-1}. K factor value of Talode and Nawapur tehsil belongs to class 0.20 to 0.30. Soils in the tehsils are moderate erodible. K factor value of Nandurbar, Shahade,Akkalkuwa and Akrani tehsil belongs to class 0.30 to 0.40 having type moderately high erodible. From mean value 0.2753 t ha h/ ha MJ mm it can be said that soils in the district are moderately erodible. Generally Akkalkuwa and Akrani tehsil shows higher soil erodibility value with respect to other, this is due to different soil texture classes and variation in percent organic matter observed in these tehsils. Agricultural soils of tehsils except Akkalkuwa and Akrani shows same pattern in soil texture, soil permeability and soil structure.

Based on the comprehensive study conducted on soil erodibility factor (K) estimation in Nandurbar district, the author has arrived at the following conclusions:

1. Soil Erodibility Variability: The research demonstrated that the soil erodibility factor (K) exhibits significant spatial variability across the Nandurbar district with mean value 0.27 t·ha·h·ha^{-1} ·MJ $^{-1}$ · mm^{-1}.

2. Soil Erodibility Mapping:North-Eastern part of District (Akrani) has Moderate high soil erodibility, so this part needs attention for reduction of erosion on priority.

3. Soil Conservation Recommendations: Based on the study's results, specific soil conservation strategies were proposed to mitigate erosion in vulnerable areas. Implementation of practices such as contour farming, terracing, cover cropping, and reduced tillage can effectively reduce soil erosion and maintain soil health

Table: 2 Tehsil wise soil erodibility factor values of Nandurbar district

Tehsil	Sand (%)	Silt (%)	Clay (%)	OM	c	b	K (t ha h/ ha MJ mm)
Nandurbar	24.07	24.78	50.37	1.3408	6	4	0.2728
Shahade	27.04	22.81	49.36	1.3310	6	4	0.2738
Talode	25.18	23.36	50.67	1.3499	6	4	0.2698
Nawapur	22.98	23.64	52.58	1.3402	6	4	0.2608
Akkalkuwa	32.75	22.85	43.63	1.3315	5	4	0.2955
Akrani	37.20	24.32	37.67	1.3858	5	3	0.3123

* * * * * * * *