



RESEARCH ARTICLE

Determining and mapping the soil erodibility factor (K) in relation to pedological properties across land uses in the Umsarang micro-watershed, Meghalaya

Pritisha Patgiri^{1*}, Sanjay Swami¹, Rahul Saikia², Kishor Jyoti Bhuyan³, Bijoy Krishna Handique⁴, Naorem Janaki Singh¹, Aditya Kumar Singh², Shubham Singh⁵ & Basant Tamang¹

¹Department of Soil Science and Agricultural Chemistry, School of Natural Resource Management, Central Agricultural University (Imphal), Umiam 793 103, Meghalaya, India

²Department of Agronomy, School of Natural Resource Management, Central Agricultural University (Imphal), Umiam 793 103, Meghalaya, India

³Department of Agronomy, Assam Agricultural University, Jorhat 785 013, Assam, India

⁴Department of Space, Northeastern Space Application Centre, Umiam 793 103, Meghalaya, India

⁵Department of Soil Science, Krishi Vigyan Kendra (KVK), ICAR-Central Institute of Agricultural Engineering (CIAE), Bhopal 462 038, Madhya Pradesh, India

*Correspondence email - prishapatgiri@gmail.com

Received: 30 August 2025; Accepted: 31 December 2025; Available online: Version 1.0: 04 February 2026

Cite this article: Pritisha P, Sanjay S, Rahul S, Kishor JB, Bijoy KH, Naorem JS, Aditya KS, Shubham S, Basant T. Determining and mapping the soil erodibility factor (K) in relation to pedological properties across land uses in the Umsarang micro-watershed, Meghalaya. *Plant Science Today*. 2026; 13 (sp1): 1-9. <https://doi.org/10.14719/pst.12499>

Abstract

Soil erosion poses a significant threat to agricultural productivity, ecosystem stability and sustainable land management, particularly in fragile hill landscapes of the Northeastern Himalayas. The soil erodibility factor (K) plays a critical role in determining the susceptibility of soils to detachment and transport by water, with key controls including organic matter, texture, structure and permeability. Despite its importance, knowledge of K variability under different land-use systems in Meghalaya remains limited, constraining effective soil conservation planning. Therefore, this study focused on determining and mapping the soil erodibility factor across the Umsarang micro-watershed, while examining its relationship with critical pedological properties. Forest and agricultural land-use systems were treated as comparative management conditions to assess land-use-induced variability in soil erodibility. The K-factor values ranged from 0.135 to 0.345 t ha h ha⁻¹ MJ⁻¹ mm⁻¹, with forest soils exhibiting higher soil organic matter content (4.32 %) and lower variability in K compared to agricultural soils (3.49 %). Forest soils exhibited balanced texture and greater aggregate stability, resulting in lower and more uniform K-values, whereas agricultural soils showed reduced organic matter and greater variability in K, indicating higher erosion risk. Correlation analysis showed that K increased with silt content and decreased with organic matter, sand and clay fractions, highlighting the combined influence of soil composition and structural stability on erodibility. The generated spatial maps provide a clear visualization of erosion-prone areas and offer a practical tool for prioritizing site-specific soil and water conservation interventions to minimize crop loss. By linking soil properties with erosion vulnerability, the study provides actionable insights for sustainable watershed management, emphasizing the importance of maintaining organic matter, stable soil structure and vegetative cover to reduce erosion risks and enhance long-term soil health, which further safeguards crop yield and health in hilly regions.

Keywords: erosion susceptibility; GIS interpolation; hilly region; land-use systems; spatial assessment

Introduction

Soil erosion is widely recognized as one of the most critical forms of land degradation, threatening agricultural productivity, food security and environmental sustainability (1). It involves the detachment, transport and deposition of soil particles by water or wind, resulting in the loss of fertile topsoil, deterioration of soil quality and disruption of ecosystem services, which compromise the crop growth and yield (2). Along with the natural causes, climate change and anthropogenic activities such as unscientific cultivation practices have accelerated soil erosion at an alarming rate, particularly in hilly areas. Globally, more than 10 million hectares of arable/cultivable land are lost annually due to erosion, directly impacting agricultural output and rural livelihoods (3). Beyond soil fertility loss, erosion

accelerates sedimentation in reservoirs, reduces water storage capacity, causes water pollution, diminishes biodiversity and alters ecological balance (4).

In India, soil erosion affects nearly 175 million hectares, with water erosion alone impacting around 82 million hectares, resulting in the loss of an estimated 5.3 billion tonnes of fertile soil annually (5, 6). The average annual soil loss in the country is estimated at 16.53 t/ha/yr (7), which exceeds the global average of 12-15 t/ha/yr (8). The Northeastern hill (NEH) region of India, characterized by fragile hill ecosystems, steep slopes, intense rainfall and unsustainable land use practices such as shifting cultivation, is particularly vulnerable to accelerated erosion, threatening ecological balance and the livelihood security of local communities

(9). In Meghalaya, continuous deforestation and traditional cultivation practices have led to severe soil loss, depletion of organic matter and long-term decline in soil productivity (10). Additionally, understanding land-use impacts on soil erodibility is crucial for devising effective soil and water conservation measures. Smallholder farming systems, steep slopes and intensive rainfall in the region exacerbate erosion risks, making site-specific assessments essential. Furthermore, linking pedological characteristics with erosion susceptibility can provide practical guidance for sustainable watershed management. These conditions necessitate location-specific investigations into soil erosion processes and soil resilience mechanisms.

To assess soil erosion risk and guide conservation planning, several empirical models have been developed. Among them, the Universal Soil Loss Equation (USLE) and its revised form, the Revised Universal Soil Loss Equation (RUSLE) (11, 12), are the most widely applied across different agro-ecological regions due to their relative simplicity and adaptability. These models estimate annual soil loss through 5 parameters: rainfall erosivity (R), soil erodibility (K), slope length and steepness (LS), cover management (C) and support practice factor (P). Among these, K is of fundamental importance as it quantifies the inherent susceptibility of soils to detachment and transport, governed primarily by pedological properties such as particle size distribution, organic matter content, soil structure and permeability (13–15). Although the USLE nomograph is commonly used to estimate the K factor, it often yields generalized values that may not reflect spatial variability in heterogeneous landscapes, thus requiring direct site-specific assessments (16). In the NEH region, particularly in Meghalaya, very limited studies have quantified the variability of the K factor and its relationship with soil properties under different land-use systems. Consequently, soil conservation

planning in the region often relies on generalized estimates, reducing the effectiveness of interventions (17). Integrating soil erodibility assessments with geospatial tools such as GIS provides an opportunity to quantify and map erosion-prone zones, thereby strengthening conservation strategies (18–20).

Against this background, the present study was undertaken with the hypothesis that K is significantly influenced by variations in soil texture, organic matter, structure and permeability and that these effects differ between forest and agricultural land-use systems. Therefore, the present study aimed to evaluate the K, analyse its relationship with key pedological characteristics and generate its spatial distribution map to identify erosion-prone zones and support targeted soil and water conservation planning.

Materials and Methods

Description of the study area

The present study was conducted in the Umsarang micro-watershed, situated in the Bhoirymbong block of Ri-Bhoi district, Meghalaya, India (Fig. 1). The watershed extends between 25°41' to 25°42'00" N latitude and 91°10'00" to 92°00' E longitude, covering an area of about 805.17 ha. It lies within the north-central part of Meghalaya and is geographically bounded by the districts of Kamrup and Morigaon (Assam) to the north, Karbi Anglong (Assam) to the east and East and West Khasi Hills to the south. Topographically, the area is characterized by undulating hilly terrain with elevations ranging from 817 to 1058 m above mean sea level. Slopes vary considerably, from gentle (1–15 %) in the valley lands to moderate (15–33 %) and very steep (> 33 %) in the upper reaches, reflecting a mix of lower rolling valleys, intermediate plateaus and dissected

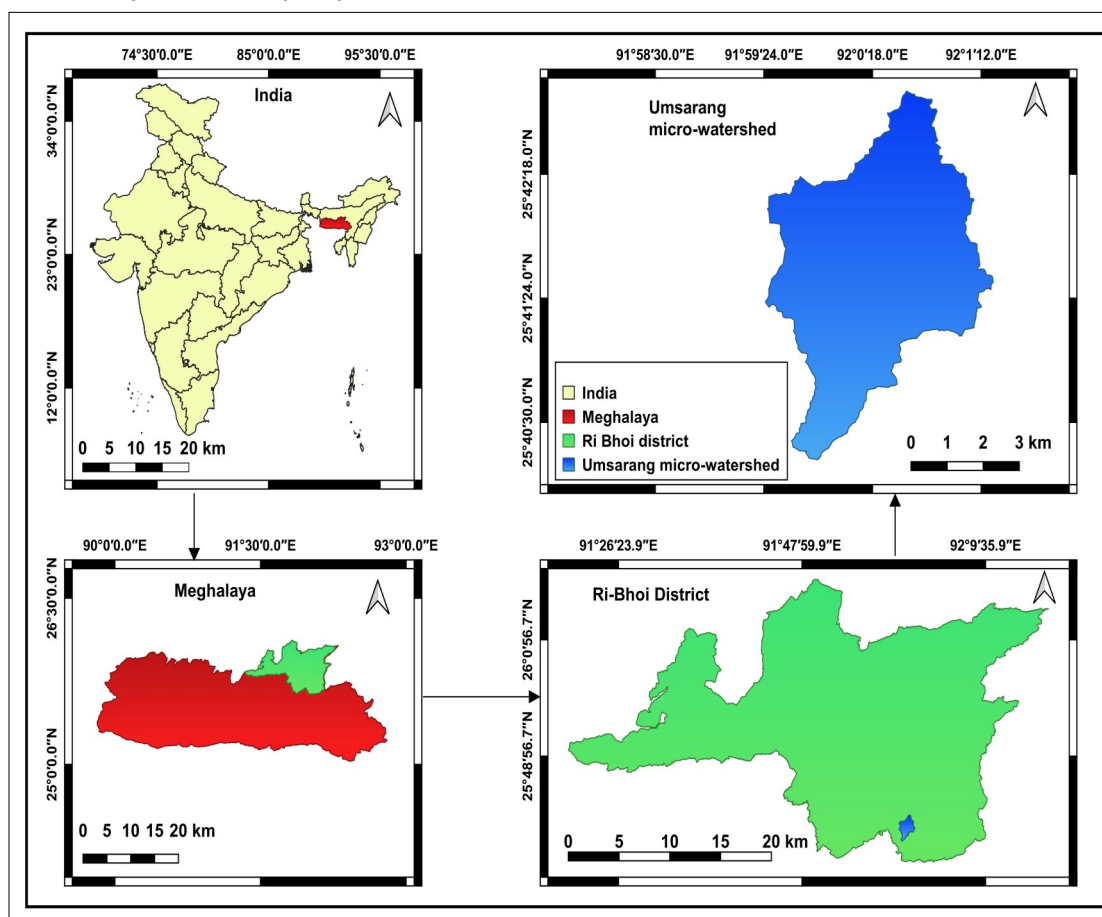


Fig. 1. Location of the study area (prepared using ArcGIS 10.8.2).

uplands. Geologically, the watershed is dominated by gneissic rock formations, with groundwater movement largely confined to fractures and weathered zones. The soil texture ranges from silty clay loam on sloping lands to clay loam and clay in the low-lying areas. Soil depth varies from shallow to deep and the soils are generally acidic and erosion-prone, owing to the combination of undulating topography and inadequate vegetative cover. The Umsarang micro-watershed has a humid subtropical climate with warm summers, a prolonged monsoon, mild winters and an average annual rainfall of 2200–2400 mm, nearly 77 % occurring between July and September.

Land use and land cover

Agriculture is the primary livelihood in the Umsarang micro-watershed, where shifting cultivation (jhum) predominates and major crops include hill paddy, ginger, vegetables and fruit crops such as orange, pineapple, jackfruit and litchi. Farmers also grow diverse commodities including French bean, tomato, potato,

cabbage, cauliflower, turmeric, pea, black pepper, areca nut, betel leaf and broom grass, with livestock rearing supplementing household income. The natural vegetation is of mixed forest type, comprising *Quercus*, *Castanopsis*, *Toona ciliata*, *Albizia*, *Aporosa*, *Bauhinia variegata*, *Duabanga* and *Ficus* spp., although forest cover has declined considerably due to jhum expansion. Land use and land cover (LULC), delineated using Sentinel-2 satellite imagery and validated using ground-truthing during field surveys at a 1:2500 scale, indicated that agriculture accounts for 53.10 % of the watershed area, followed by forest (38.80 %), settlement (7.45 %) and water bodies (0.65 %) (Fig. 2).

Field sampling and sample points

The Umsarang micro-watershed is primarily characterized by two dominant land uses: agriculture and forest. Accordingly, 22 sampling sites were selected from agricultural land and 18 from forest land, with locations randomly chosen and geo-referenced using a handheld GPS (Fig. 3). From each site, composite soil samples were

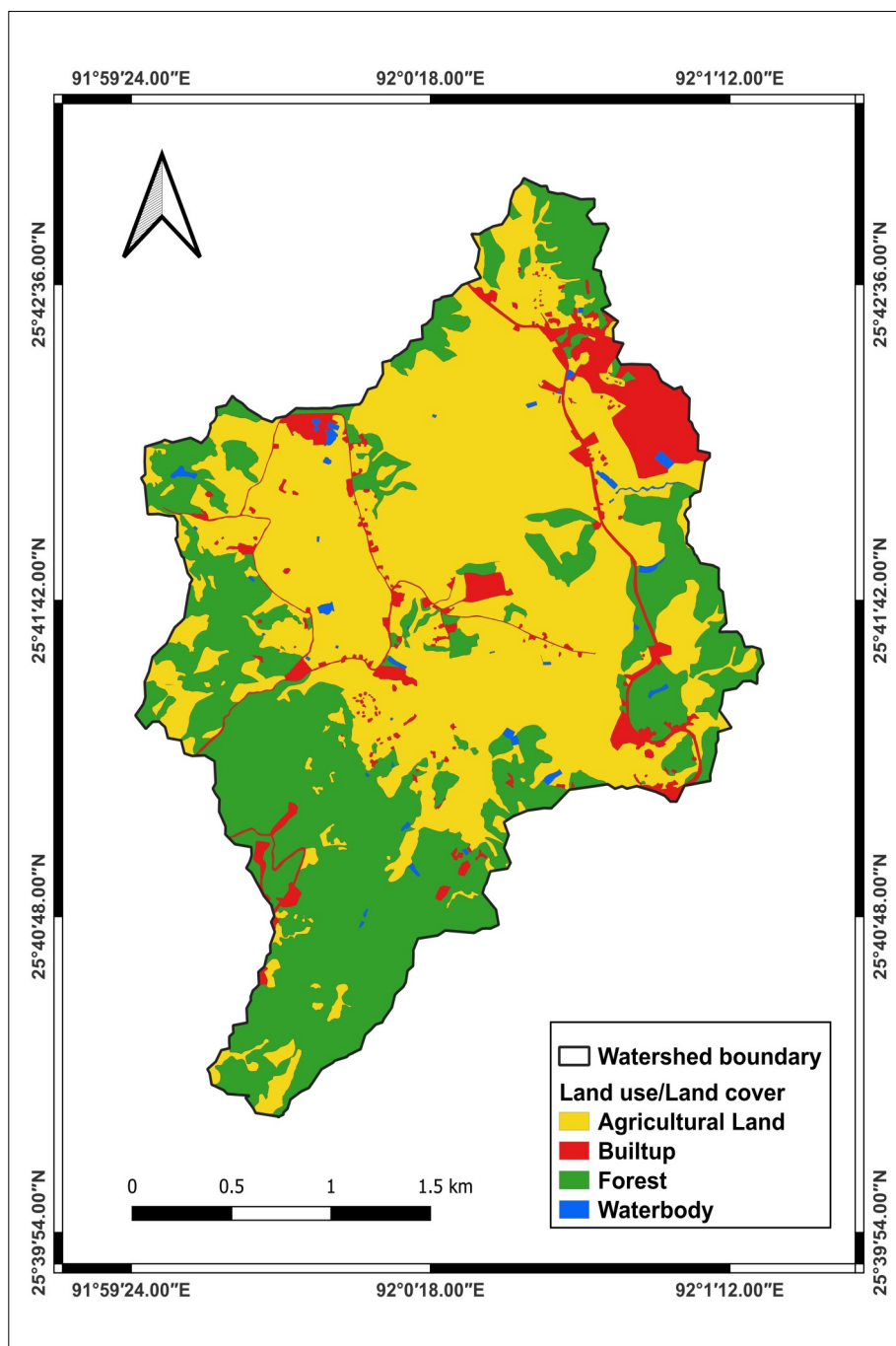


Fig. 2. LULC map of the study area (prepared using ArcGIS 10.8.2).

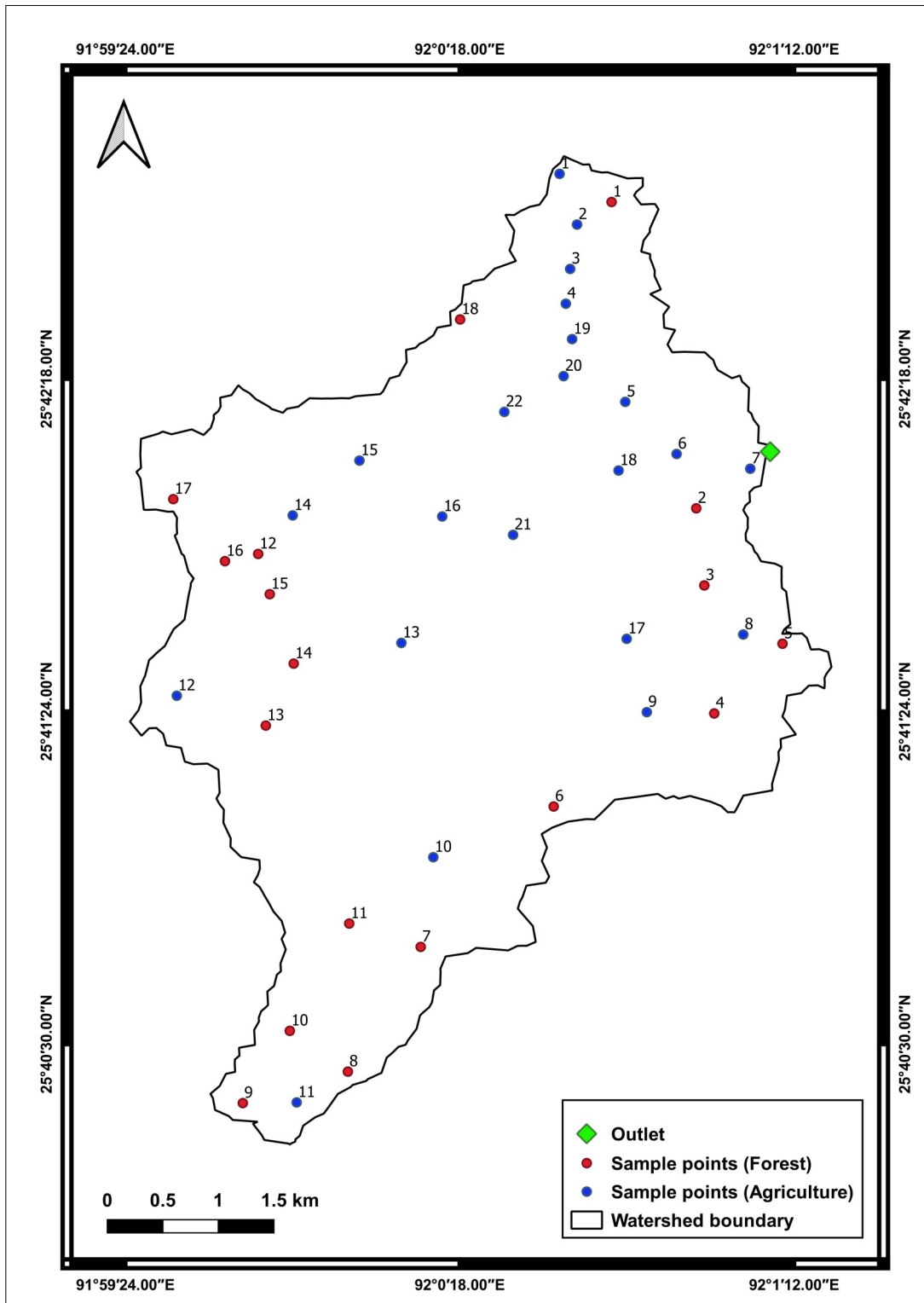


Fig. 3. Sampling points in the watershed (prepared using ArcGIS10.8.2).

collected at 0–15 cm depth using a soil auger for subsequent laboratory analyses.

Laboratory analysis

The collected soil samples were subjected to laboratory analyses to determine their basic physico-chemical properties. Soil texture was determined using the International pipette method, while organic carbon content was estimated following the dichromate wet oxidation method (21, 22). The measured organic carbon values were subsequently converted to organic matter content by applying the Van Bemmelen’s correction factor of 1.724. The soil structure

Table.1. Soil structure and permeability codes based on texture

Texture	Symbol	Structure code (b)	Permeability code (c)
Clay, silty clay	C, SiC	1	6
Sandy clay, silty clay loam	SC, SiCL	2	5
Clay loam, sandy clay loam, Silt	CL, SCL, Si	2	4
Silt loam, loam	SiL, L	2	3
Sandy loam, loamy sand	SL, LS	2	2
Sand	S	3	1

codes and soil permeability codes were assigned to each sample based on texture (12) (Table 1).

Determination of soil erodibility factor (K)

K is a key parameter of the RUSLE, expressing the inherent susceptibility of soil to erosion under a given set of conditions. It quantifies the combined influence of soil texture, organic matter, structure and permeability on the resistance of soil particles to detachment and transport by raindrop impact and surface runoff (23). In this study, K-values were computed following the procedure, who developed a nomograph for estimating K based on soil properties (11). The factor was calculated using the following equation:

$$K = 1.2917 \left[\frac{2.1 \times 10^{-4} \times M^{1.14} \times (12-a) + 3.25 \times (b-2) + 2.5 \times (c-3)}{100} \right] \quad (\text{Eqn. 1})$$

Where, K= soil erodibility factor ($t \text{ ha h ha}^{-1} \text{ MJ}^{-1} \text{ mm}^{-1}$); M= Percent silt X (100 percent clay); a = organic matter percentage; b = the soil structure code; c = the profile permeability code.

According to the texture of each soil sample, the corresponding soil structure (b) and permeability (c) codes were obtained from the Agriculture Handbook No. 703, USDA, (12), wherein each soil texture class is assigned a specific structure code and permeability code (Table 1).

Interpolation of sampled data

The analysed soil samples from each sample point are further presented in map form. In the GIS environment (ArcGIS 10.8.2), spatial data were interpolated using the kriging interpolation method on the point data to transform them into raster forms. This approach has been widely applied in soil and environmental studies, as reported by (5, 24–27). Descriptive statistics of soil characteristics, including minimum, maximum, mean and standard deviation were determined. Moreover, bivariate relationships between the measured K-factor and individual soil parameters were examined using Pearson's correlation analysis and all the statistical analysis were carried out with SPSS software (Version 22).

Results and Discussion

Soil properties

The spatial distribution of soil primary particles (sand %, silt % and clay %) and soil organic matter percentage (SOM) was mapped using kriging interpolation in ArcGIS 10.8.2 (Fig. 4). Forest and agricultural soils exhibited marked differences in texture and SOM, reflecting the contrasting influences of natural ecosystem processes

and anthropogenic land use (Supplementary Table 1). The descriptive statistics in Table 2 showed that forest soils had a relatively balanced texture (sand 29.07 %, silt 36.10 % and clay 34.84 %) and higher SOM (4.32 %), maintained through continuous inputs of leaf litter and root biomass and minimal disturbance, which promoted aggregation, porosity and overall structural stability (28). In contrast, agricultural soils showed slightly higher sand (30.18 %) and clay (38.56 %) contents but lower silt (31.26 %) and SOM (3.49 %), indicating soil compaction and structural degradation resulting from long-term cultivation, repeated tillage and crop residue removal (29, 30). Across the watershed, soil structural codes ranged from 1 to 2 and permeability codes from 4 to 6, reflecting variations in soil physical properties under different land uses.

Soil erodibility factor (K)

Soil erodibility factor (K), which integrates the influence of texture and organic matter on susceptibility to erosion, showed similar mean values in both land uses but with different variability patterns (Table 2). Forest soils exhibited K factor, with a mean value of $0.19 \text{ t ha h ha}^{-1} \text{ MJ}^{-1} \text{ mm}^{-1}$ and low variability ($SD = 0.04$), indicating relatively uniform susceptibility to erosion. This stability is attributed to higher organic matter content and improved soil aggregation (31). In contrast, agricultural soils exhibited a wider range of K-value ($0.14\text{-}0.35 \text{ t ha h ha}^{-1} \text{ MJ}^{-1} \text{ mm}^{-1}$) and greater standard deviation (0.05), suggesting greater spatial heterogeneity and increased erosion risk. This variability likely reflects differences in land management practices, such as tillage intensity, residue retention and slope conditions. In a similar study, K-factor values in the Jirang block of Meghalaya ranged from 0.09 to $0.32 \text{ t ha h ha}^{-1} \text{ MJ}^{-1} \text{ mm}^{-1}$ (18). The spatial distribution of the K-factor across the Umsarang micro-watershed was generated using the ArcGIS 10.8.2 platform and its range in the micro-watershed was found to be $0.135 \text{ to } 0.345 \text{ t ha h ha}^{-1} \text{ MJ}^{-1} \text{ mm}^{-1}$ (Fig. 5). In another study, working across the entire Ri-Bhoi district of Meghalaya, it has been reported that K-factor ranges of $0.08\text{-}0.41 \text{ t ha h ha}^{-1} \text{ MJ}^{-1} \text{ mm}^{-1}$ (mean 0.25) for agricultural lands and $0.09\text{-}0.40 \text{ t ha h ha}^{-1} \text{ MJ}^{-1} \text{ mm}^{-1}$ (mean 0.22) for forest lands (5). Similarly, K-factor values of $0.12\text{-}0.23 \text{ t ha h ha}^{-1} \text{ MJ}^{-1} \text{ mm}^{-1}$ in agricultural lands and $0.20\text{-}0.22 \text{ t ha h ha}^{-1} \text{ MJ}^{-1} \text{ mm}^{-1}$ in forest soils were reported for the Nongpoh watershed situated in Ri-Bhoi district of Meghalaya has also been reported (19). The close agreement between these studies and the present findings highlights the consistency of K patterns across land-use systems in the Northeastern Hill region and underscores the dominant role of soil texture and organic matter in controlling erosion susceptibility. Although slope gradient and rainfall erosivity (R-factor) were not explicitly quantified in this study, their interaction with K is well established in hilly watersheds. In the Umsarang micro-watershed, steep slopes and high monsoonal

Table 2. Descriptive statistics of soil properties and soil erodibility factor (K)

Parameters	Soil type	Minimum	Maximum	Mean	Standard deviation (SD)
Sand (%)	Forest soil	17.76	37.75	29.07	6.90
	Agricultural soil	18.70	40.99	30.18	4.91
Silt (%)	Forest soil	29.40	46.63	36.10	6.12
	Agricultural soil	23.64	51.80	31.26	6.97
Clay (%)	Forest Soil	29.45	41.68	34.84	2.99
	Agricultural Soil	29.50	47.40	38.56	5.45
SOM (%)	Forest Soil	4.21	4.44	4.32	0.07
	Agricultural Soil	3.04	3.58	3.49	0.14
K factor	Forest Soil	0.15	0.26	0.19	0.04
	Agricultural Soil	0.14	0.35	0.18	0.05

Note: Number of soil samples for forest and agricultural soils were 18 and 22 respectively.

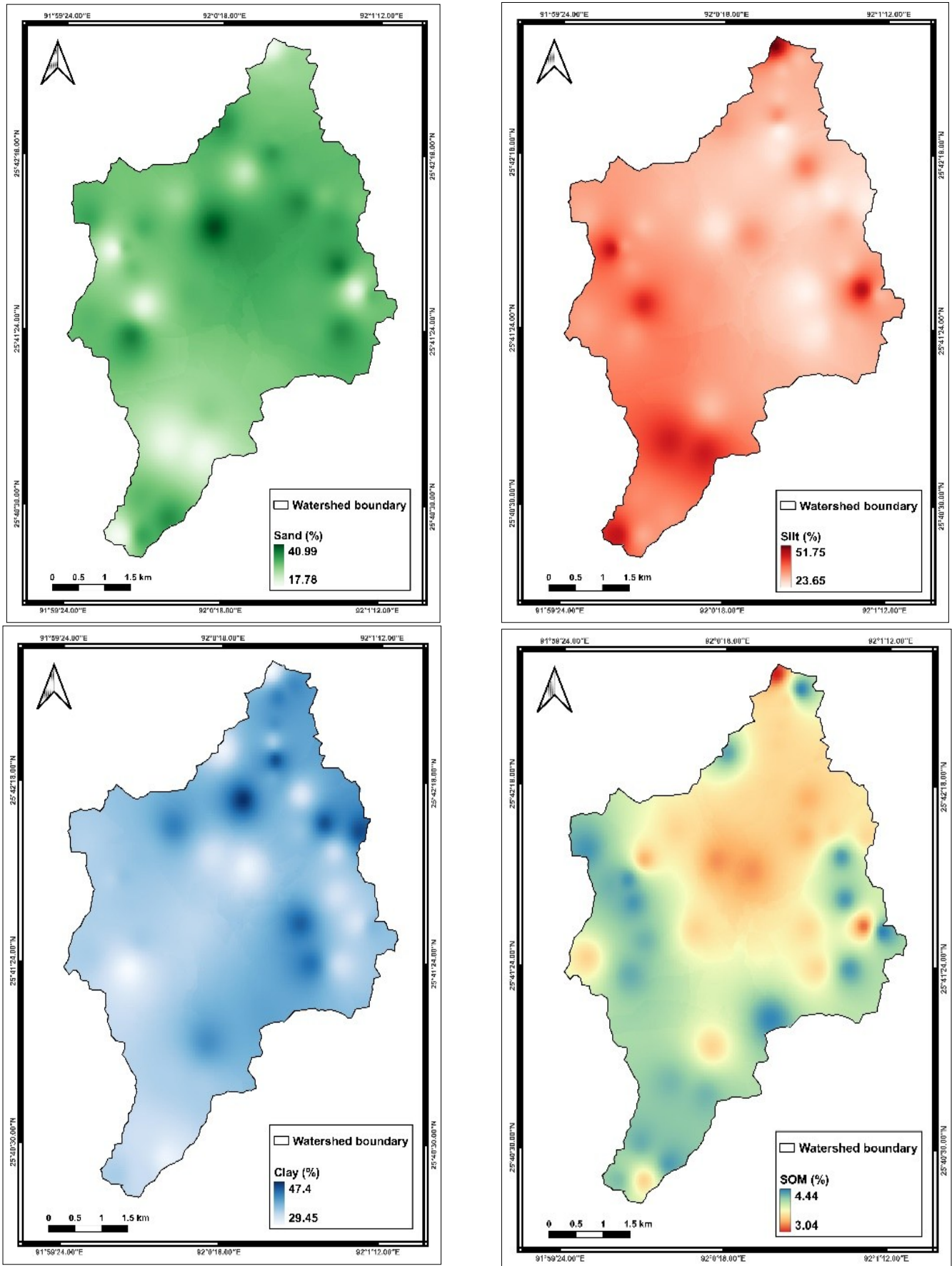


Fig. 4. Soil properties map of the study area. **a.** Sand (%), **b.** Silt (%), **c.** Clay (%), **d.** Soil organic matter (%) (prepared using ArcGIS10.8.2).

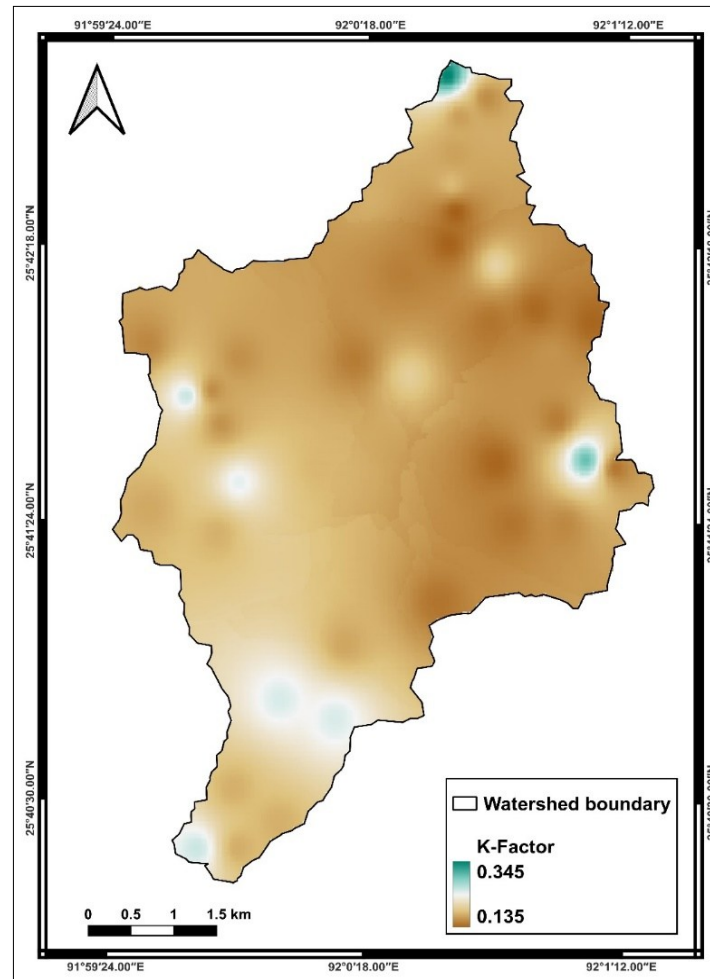


Fig. 5. K-factor map of Umsarang micro-watershed (prepared using ArcGIS 10.8.2).

rainfall likely amplify the expression of K-factor variability, particularly in agricultural lands with reduced organic matter and weaker aggregation. These findings highlight the important influence of localized edaphic characteristics on the susceptibility of soils in the Umsarang micro-watershed to erosive processes.

Correlation between soil properties and soil erodibility factor (K) under forest land-use studies (LUS)

The K factor exhibited strong negative correlations with $r = -0.863$, clay ($r = -0.032$) and soil organic matter ($r = -0.878$), while showing a highly significant positive correlation with silt content ($r = 0.989$) (Table 3). These relationships indicate that soils with higher sand, clay and organic matter tend to have lower erodibility, whereas an increase in silt content substantially enhances the susceptibility of soils to erosion. The negative association of K with organic matter suggests that organic-rich forest soils possess better structural stability, higher aggregate formation and improved infiltration, which collectively reduce detachment and transport by runoff (32, 33). Similarly, sand- and clay-rich soils exhibit stronger particle cohesion and aggregate stability that resist erosive forces. In contrast, silt particles due to their intermediate size and poor cohesion are more prone to detachment under raindrop impact and surface runoff, leading to greater soil loss (34). Thus, our study reflects the inherent instability of silt-dominated soils, where hydrological fluxes, limited binding agents and weak aggregation jointly enhance the erodibility potential. Nevertheless, beyond particle size distribution, aggregate stability, land management practices and rainfall intensity play crucial roles in determining erosion response (35, 36). Reduced residue retention and repeated tillage in agricultural fields weaken aggregate stability, thereby

Table 3. Correlation between the pedological characteristics of forest LUS and the K factor of the Umsarang micro-watershed

Variables	K	SOM	Sand	Silt	Clay
K	1				
SOM	-0.878**	1			
Sand	-0.863**	0.579*	1		
Silt	0.989**	-0.851**	-0.901**	1	
Clay	-0.032	0.404	-0.465	0.036	1

Note: SOM: Soil organic matter; **Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level.

increasing susceptibility to erosion even under similar textural conditions.

Correlation between soil properties and soil erodibility factor (K) under agricultural LUS

The K-factor exhibited significant negative correlations with sand ($r = -0.663$), clay ($r = -0.653$) and SOM ($r = -0.828$), while showing a strong positive association with silt content ($r = 0.979$) (Table 4). These results indicate that soils with higher sand, clay and organic matter contents are less erodible, whereas silt enrichment markedly increases susceptibility to erosion. The inverse relationship between K and sand reflects the higher particle mass and hydrodynamic stability of sand grains, which require greater shear energy for detachment and are associated with enhanced macroporosity that promotes infiltration and reduces runoff (37, 38). Likewise, the negative association with clay underscores the cohesive and aggregating properties of fine particles, which strengthen soil structure and improve resistance to detachment (39).

SOM demonstrated the strongest negative influence on K, reaffirming its central role in improving soil aggregation, structural stability and resistance to erosive forces. Through its binding and adhesive properties, SOM enhances interparticle cohesion, improves pore connectivity and fosters microbial activity that contributes to the formation of stable macroaggregates, ultimately reducing both detachment and sediment transport (40, 41). Conversely, the positive correlation between silt content and erodibility emphasizes the inherent instability of silt-dominated soils. Due to their intermediate particle size (0.002–0.05 mm) and limited cohesive strength, silt particles are easily detached by raindrop impact and shear stress from overland flow. Their low colloidal activity and poor organic binding capacity render them highly mobile once entrained, contributing significantly to sediment yield and surface soil loss (5, 42, 43).

Table 4. Correlation between the pedological characteristics of agriculture LUS and the K factor of the Umsarang micro-watershed

Variables	K	SOM	Sand	Silt	Clay
K	1				
SOM	-0.828**	1			
Sand	-0.663**	0.282	1		
Silt	0.979**	-0.769**	-0.627**	1	
Clay	-0.653**	0.729**	-0.099	-0.713**	1

Note: SOM: Soil organic matter; **Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level.

Conclusion

The study revealed clear differences in soil properties and erodibility between forest and agricultural lands in the Umsarang micro-watershed. Forest soils, with balanced texture, higher organic matter and greater aggregate stability, exhibited lower and more uniform K-factor values, whereas agricultural soils showed reduced organic matter, altered texture and greater variability in K, indicating higher erosion susceptibility. The negative relationships of K with sand, clay and organic matter and its positive association with silt, underscore the combined role of soil texture and organic matter in controlling soil erodibility. These findings underscore the importance of management practices that enhance SOM and structural stability, particularly in cultivated areas. Based on the spatial identification of erosion-prone zones, site-specific soil conservation measures such as residue retention, incorporation of cover crops, reduced tillage, contour farming and agroforestry systems are strongly recommended for agricultural lands. Adoption of these practices can improve aggregation, reduce runoff and soil loss and sustain long-term crop productivity. Furthermore, the spatial and statistical insights generated in this study provide a useful framework for watershed-level planning and support future research incorporating direct K-factor measurements, long-term monitoring and integration of slope and rainfall effects to further refine erosion mitigation strategies and strengthen farmer livelihoods in hilly regions.

Acknowledgements

The authors extend their sincere gratitude to the authorities of the School of Natural Resource Management, CPGS-AS, Umiam, Meghalaya and the Northeastern Space Applications Centre (NESAC), Umiam, Meghalaya, for providing the opportunity, support and facilities to conduct the experiment.

Authors' contributions

PP made the objective, carried out the experiment and finalized the manuscript. SS¹ guided during the experiment and checked the results. RS participated in the sequence alignment and drafted the manuscript. The statistical analysis was done by KJB and BKH. NJS and AKS edited the manuscript. SS² and BT prepared the final draft. All authors have read and approved the final manuscript. [SS¹-Sanjay Swami; SS²- Shubham Singh]

Compliance with ethical standards

Conflict of interest: The authors declare that they have no conflict of interests regarding the publication of this paper.

Ethical issues: None

References

- Sodoke S, Andam-Akorful SA, Amuah EEY, Amoah EG, Anokye K, Nang DB, et al. GIS-based assessment of soil erosion impact and mitigation strategies for sustainable agriculture in Ghana's most vulnerable region. *Environ Sustain Indic.* 2025;25:100551. <https://doi.org/10.1016/j.indic.2024.100551>
- Demir S, Akdogan Y, Oguz I, Kocyigit R. Comparison of the K factor in different areas on the slope. *J New Results Sci.* 2021;10(1):46–53.
- Kumar R, Mishra SN, Pandey R, Panwar VP. Estimation of soil erosion risk and vulnerable zone using the revised universal soil loss equation and geographic information system approaches. In: Azam M, Chakraborty R, Pal SC, editors. *Modern Cartography Series. Vol. 12.* Academic Press; 2024. p. 597–626.
- Owens PN. Soil erosion and sediment dynamics in the Anthropocene: a review of human impacts during a period of rapid global environmental change. *J Soils Sediments.* 2020;20(12):4115–43. <https://doi.org/10.1007/s11368-020-02815-9>
- Olaniya M, Bora PK, Das S, Chanu PH. Soil erodibility indices under different land uses in Ri-Bhoi district of Meghalaya (India). *Sci Rep.* 2020;10(1):14986. <https://doi.org/10.1038/s41598-020-72070-y>
- Mishra PK, Rai A, Abdelrahman K, Rai SC, Tiwari A. Land degradation, overland flow, soil erosion and nutrient loss in the Eastern Himalayas, India. *Land.* 2022;11(2):179. <https://doi.org/10.3390/land11020179>
- Ed-daoudy L, Lahmam N, Benmansour M, Afilal H, Damnati B. Hydric erosion rates in Raouz watershed, Morocco: RUSLE, GIS and remote sensing. *Remote Sens Appl Soc Environ.* 2023;32:101056. <https://doi.org/10.1016/j.rsase.2023.101056>
- Zahoor S, Wani AA, Gatoo AA, Islam MA, Murtaza S, Masoodi TH, et al. Soil erosion vulnerability assessment in the eco-sensitive Himalayan region using modeling approach. *J Indian Soc Remote Sens.* 2024;52(6):1347–60. <https://doi.org/10.1007/s12524-024-01874-6>
- Das A, Ghosh PK, Yadav GS, Layek J, Babu S, Singh R, et al. Conservation agriculture in North-Eastern Hill region of India: potential and opportunities for sustainable development. *J Agric Phys.* 2021;21(1):113–34.
- Choudhury BU, Nengzouzam G, Ansari MA, Islam A. Causes and consequences of soil erosion in northeastern Himalaya, India. *Curr Sci.* 2022;122(7):772–89. <https://doi.org/10.18520/cs/v122/i7/772-789>
- Wischmeier WH, Smith DD. Predicting rainfall erosion losses: a guide to conservation planning. *Agriculture Handbook No. 537.* Washington (DC): U.S. Department of Agriculture; 1978.
- Renard KG, Foster GR, Weesies GA, McCool DK, Yoder DC. Predicting soil erosion by water: a guide to conservation planning with the revised universal soil loss equation (RUSLE). *Agriculture Handbook No. 703.* Washington (DC): U.S. Department of Agriculture; 1997.
- Wischmeier WH, Johnson CB, Cross BV. A soil erodibility nomograph for farmland and construction sites. *J Soil Water Conserv.*

- 1971;26:189–93.
14. Auerswald K, Fiener P, Martin W, Elhaus D. Use and misuse of the K factor equation in soil erosion modeling: an alternative equation for determining USLE nomograph soil erodibility values. *Catena*. 2014;118:220–5. <https://doi.org/10.1016/j.catena.2014.01.008>
 15. Radziuk H, Świtoniak M. Soil erodibility factor (K) in soils under varying stages of truncation. *Soil Sci Annu*. 2021;72(1):134621. <https://doi.org/10.37501/soilsa/134621>
 16. Abiye W, Dengiz O. Digital mapping of soil erodibility factor in response to land use change using machine learning models. *Environ Syst Res*. 2025;14(1):14. <https://doi.org/10.1186/s40068-025-00402-w>
 17. Dutta D, Bandopadhyay S, Baruah U, Sarkar D, Singh SK, Maji AK, et al. Soil erosion in Meghalaya. *NBSS Publ No*. 160. Nagpur: NBSS&LUP (ICAR); 2014. 29 p.
 18. Jena RK, Padua S, Ray P, Ramachandran S, Bandyopadhyay S, Deb Roy P, et al. Assessment of soil erosion in sub-tropical ecosystem of Meghalaya, India using remote sensing, GIS and RUSLE. *Indian J Soil Conserv*. 2018;46(3):273–82.
 19. Das S, Bora P, Katre P. Determining and mapping of soil erodibility index for Nongpoh watershed. *Indian J Hill Farming*. 2019;32(1).
 20. Badavath N, Sahoo S, Samal R. Assessing soil erosion risk in Meghalaya, India: integrating geospatial data with RUSLE model. *Environ Dev Sustain*. 2024;1–36.
 21. Piper CS. *Soil and plant analysis*. Bombay: Hans Publishers; 1966.
 22. Walkley A, Black IA. An examination of the Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Sci*. 1934;37(1):29–38.
 23. Tirkey AS, Pandey AC, Nathawat MS. Use of satellite data, GIS and RUSLE for estimation of average annual soil loss in Daltonganj watershed of Jharkhand (India). *J Remote Sens Technol*. 2013;1(1):20–30. <https://doi.org/10.18005/JRST0101004>
 24. Smith JL, Halvorson JJ, Papendick RI. Using multiple-variable indicator kriging for evaluating soil quality. *Soil Sci Soc Am J*. 1993;57(3):743–9. <https://doi.org/10.2136/sssaj1993.03615995005700030020x>
 25. Wang G, Gertner G, Liu X, Anderson A. Uncertainty assessment of soil erodibility factor for revised universal soil loss equation. *Catena*. 2001;46(1):1–14. [https://doi.org/10.1016/S0341-8162\(01\)00158-8](https://doi.org/10.1016/S0341-8162(01)00158-8)
 26. Perez-Rodriguez R, Marques MJ, Bienes R. Spatial variability of the soil erodibility parameters and their relation with the soil map at subgroup level. *Sci Total Environ*. 2007;378(1–2):166–73. <https://doi.org/10.1016/j.scitotenv.2007.01.044>
 27. Vaezi AR, Bahrami HA, Sadeghi SHR, Mahdian MH. Spatial variability of soil erodibility factor (K) of the USLE in North West of Iran. *J Agric Sci Technol*. 2010;12(2):241–52.
 28. Shi K, Liao J, Zou X, Chen HY, Delgado-Baquerizo M, Wanek W, et al. Forest development induces soil aggregate formation and stabilization: implications for sequestration of soil carbon and nitrogen. *Catena*. 2024;246:108363. <https://doi.org/10.1016/j.catena.2024.108363>
 29. Lal R. Tillage and agricultural sustainability. *Soil Tillage Res*. 1991;20(2–4):133–46. [https://doi.org/10.1016/0167-1987\(91\)90036-W](https://doi.org/10.1016/0167-1987(91)90036-W)
 30. Panagea IS, Apostolakis A, Berti A, Bussell J, Čermak P, Diels J, et al. Impact of agricultural management on soil aggregates and associated organic carbon fractions: analysis of long-term experiments in Europe. *Soil*. 2022;8(2):621–44. <https://doi.org/10.5194/soil-8-621-2022>
 31. Xu C, Lin TC, Yang Z, Liu X, Xiong D, Chen S, et al. Forest conversion effects on soil organic carbon are regulated by soil aggregate stability and not by recalcitrance: evidence from a reforestation experiment. *Catena*. 2022;219:106613. <https://doi.org/10.1016/j.catena.2022.106613>
 32. Henderson GS. Soil organic matter: a link between forest management and productivity. In: McFee WW, Kelly JM, editors. *Carbon forms and functions in forest soils*. Madison (WI): Soil Science Society of America; 1995. p. 419–35. <https://doi.org/10.2136/1995.carbonforms.c19>
 33. Samdaliri H, Jourgholami M, Salajegheh A, Sohrabi H, Latterini F, Venanzi R, et al. Runoff and sediment response to different fire intensities in a Hyrcanian mixed broadleaved forest ecosystem. *Land Degrad Dev*. 2025;36:5405–18. <https://doi.org/10.1002/ldr.70014>
 34. Li J, Luo B, Liu B, Wei X, Zhong S, Wei C. Raindrop-impact-induced ejection characteristics of surface particles for soils with a textural gradient. *Catena*. 2023;223:106930. <https://doi.org/10.1016/j.catena.2023.106930>
 35. Wang L, Guo M, Chen Z, Zhang X, Zhou P, Liu X. Quantifying the contributions of factors influencing the spatial heterogeneity of soil aggregate stability and erodibility in a Mollisol watershed. *Catena*. 2024;239:107941. <https://doi.org/10.1016/j.catena.2024.107941>
 36. Gupta S, Borrelli P, Panagos P, Alewell C. An advanced global soil erodibility (K) assessment including the effects of saturated hydraulic conductivity. *Sci Total Environ*. 2024;908:168249. <https://doi.org/10.1016/j.scitotenv.2023.168249>
 37. Luo T, Liu W, Xia D, Xia L, Guo T, Ma Y, et al. Effects of land use types on soil erodibility in a small karst watershed in western Hubei. *PeerJ*. 2022;10:e14423. <https://doi.org/10.7717/peerj.14423>
 38. Othmani O, Khanchoul K, Boubehziz S, Bouguerra H, Benslama A, Navarro-Pedreño J. Spatial variability of soil erodibility at the Rhirane catchment using geostatistical analysis. *Soil Syst*. 2023;7(2):32. <https://doi.org/10.3390/soilsystems7020032>
 39. Alqadhi S, Mallick J, Talukdar S, Alkahtani M. An artificial intelligence-based assessment of soil erosion probability indices and contributing factors in the Abha-Khamis watershed, Saudi Arabia. *Front Ecol Evol*. 2023;11:1189184. <https://doi.org/10.3389/fevo.2023.1189184>
 40. Rehman MA, Abd Rahman N, Ibrahim ANH, Kamal NA, Ahmad A. Estimation of soil erodibility in Peninsular Malaysia: a case study using multiple linear regression and artificial neural networks. *Heliyon*. 2024;10(7):e28579. <https://doi.org/10.1016/j.heliyon.2024.e28854>
 41. Wu Y, Jia G, Yu X, Rao H, Peng X, Wang Y, et al. Response of soil nutrients and erodibility to slope aspect in the northern agro-pastoral ecotone, China. *Soil*. 2024;10(1):61–75. <https://doi.org/10.5194/soil-10-61-2024>
 42. Deore SB, Shinde MG, Atre AA, Gavitt BK, Kadam SA, Durgude AG, et al. Estimation of soil erodibility for soil conservation in upper Godavari sub basin of India. *Int J Res Agron*. 2024;7(11):102–s7. <https://doi.org/10.33545/2618060X.2024.v7.i11b.1949>
 43. Wang Y, Ruan J, Li Y, Kong Y, Cao L, He W. Soil macropore and hydraulic conductivity dynamics of different land uses in the dry-hot valley region of China. *Water*. 2023;15(17):3036. <https://doi.org/10.3390/w15173036>

Additional information

Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

Reprints & permissions information is available at https://horizonpublishing.com/journals/index.php/PST/open_access_policy

Publisher's Note: Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc
See https://horizonpublishing.com/journals/index.php/PST/indexing_abstracting

Copyright: © The Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited (<https://creativecommons.org/licenses/by/4.0/>)

Publisher information: Plant Science Today is published by HORIZON e-Publishing Group with support from Empirion Publishers Private Limited, Thiruvananthapuram, India.