

Assessment of Soil Erodibility in the Mont Rolland Dam and Lac de Guiers Watersheds (Senegal)

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Abstract

Water erosion and associated sedimentation threaten the sustainability of reservoirs and surface water resources in Senegal. Because soil-loss estimates using USLE, RUSLE and USPED depend directly on the soil erodibility factor K, the selected K formulation can substantially affect model outputs. This study compares six approaches—Wischmeier, EPIC, Römken-Renard, Torri-Poesen-Borselli, Auerswald *et al.*, and the Römken-Renard relationship using a Shirazi-derived geometric mean diameter—using 20 samples from the Mont Rolland Dam watershed and 28 samples from the Lac de Guiers watershed. With the updated calculations, mean K at Mont Rolland ranges from 0.01014 for the Römken-Renard relationship with Shirazi-derived Dg to 0.05007 for Auerswald *et al.*; EPIC and Wischmeier yield similar means (0.03639 and 0.03618, respectively). At Lac de Guiers, mean K ranges from 0.01079 for Römken-Renard to 0.02274 for the Shirazi-derived Dg implementation; Torri-Poesen-Borselli gives 0.01291 and has the lowest relative dispersion (CV = 6.09%). Wischmeier and Auerswald remain strongly correlated in both watersheds ($r = 0.963$ at Mont Rolland and $r = 0.988$ at Lac de Guiers), whereas several other inter-method relationships differ between sites. The updated results confirm that K is strongly method-dependent and support multi-method sensitivity analysis and local validation before selecting K for erosion modeling.

Keywords

Soil Erodibility Factor K, Soil Loss, Water Erosion

1. Introduction

Water erosion is one of the main processes responsible for soil degradation and

sediment transport at the watershed scale. It causes the detachment and downstream transport of soil particles, organic matter and nutrients. It also contributes to the siltation of rivers, lakes, and reservoirs, as demonstrated by Lal [1] and Kinnell [2]. In regions where water resources are under increasing pressure, these processes can simultaneously affect soil conservation, the storage capacity of hydraulic structures, and the long-term sustainability of water resources.

This issue is particularly important in Senegal, where increasing demand for drinking water and agricultural uses is placing greater pressure on major groundwater and surface water resources. The Hors de Diass aquifer, which makes an important contribution to the water supply of Dakar and its surrounding areas, is experiencing a decline in groundwater levels. The Mont Rolland dam watershed is located within the recharge area of this aquifer. However, water erosion on the hillslopes and sediment accumulation in the reservoir may reduce the hydrological functions of the watershed. These processes are therefore important issues to consider in measures aimed at protecting and recharging the aquifer.

Lac de Guiers is one of Senegal's main freshwater reserves and a strategic resource for drinking water supply, irrigated agriculture, and ecosystems. It provides a significant share of the water supplied to Dakar and its surrounding areas. It is also expected to meet increasing water demand, particularly through water-transfer projects toward inland areas of the country. Protecting this resource requires consideration of several degradation processes, including watershed erosion, sediment inputs, siltation, and deterioration of water quality. Mont Rolland Dam and Lac de Guiers watershed have different soil, geomorphological, and hydrological conditions, but they share a common challenge: improving the understanding and control of erosion and sediment transport processes to support the long-term protection of water resources.

The spatial assessment of these processes can be carried out using models such as the Universal Soil Loss Equation (USLE), the Revised Universal Soil Loss Equation (RUSLE), and the Unit Stream Power-based Erosion Deposition model (USPED). However, their application depends on several parameters whose accuracy directly affects estimated soil loss. Among these parameters, the soil erodibility factor K represents the intrinsic susceptibility of soil to detachment and transport by rainfall and runoff, according to the work of Wischmeier and Smith [3] as well as Renard *et al.* [4]. Its determination mainly depends on soil particle-size distribution, organic matter content, structure, and permeability.

Soil erodibility datasets and maps are available at global and regional scales. However, their spatial resolution and level of generalization may limit their use for detailed assessments of local watersheds. In addition, several empirical and semi-empirical formulations have been developed to estimate K from soil properties. These formulations do not use the same variables or functional relationships and may therefore produce substantially different K values for the same soil. The choice of the K formulation is thus a potential source of uncertainty in estimating soil loss and sediment transport with USLE, RUSLE, or USPED. A comparison

based on local soil data is therefore needed before selecting a K formulation for spatial erosion modelling.

In this context, the present study compares six approaches for estimating the K factor, including those of Wischmeier [3], EPIC [5], Renard *et al.* [4], Torri-Poesen-Borselli method [6], Auerswald *et al.* [7], and the Römken-Renard relationship using the geometric mean particle diameter D_g derived according to the approach of Shirazi *et al.* [8] [9]. The analysis is based on geotechnical investigations conducted in the two watersheds, including 20 soil samples from Mont Rolland Dam watershed and 28 samples from the Lac de Guiers watershed. The parameters required by the different formulations are derived from particle-size distributions, organic matter content, soil structure observations, and *in situ* infiltration measurements using a double-ring infiltrometer. Additional interpolation or estimation is limited to parameters that cannot be obtained directly. These values are explicitly identified to assess their potential influence on the results.

The main objective of this study is to quantify and compare the variability in K values produced by the six approaches and to evaluate their behaviour under two contrasting soil conditions. The study also aims to identify the methods that are most consistent with local soil characteristics and to provide a basis for spatial mapping of the K factor in both watersheds. In a subsequent stage, the spatially distributed K values will be integrated into the USPED model to estimate erosion and deposition processes. The Mont Rolland dam watershed is particularly useful for this purpose because available bathymetric data provide an independent estimate of sediment accumulation in the reservoir. Comparing simulated sediment transport with observed sediment volumes will therefore provide a validation criterion for assessing the different K formulations. The method showing the best agreement with these observations may then be further examined for estimating soil loss in the Lac de Guiers watershed, while accounting for the differences in soil characteristics between the two study areas.

2. Study Area

This study focuses on two watersheds in Senegal that exhibit different hydroclimatic and geomorphological conditions: the Mont Rolland Dam watershed and the Lac de Guiers watershed (**Figure 1**). The first, located in the Thies region, lies southwest of the village of Tiwin Tanghor. The area of the watershed directly influenced by the dam is approximately 311 hectares. It is part of a larger hydrographic network covering approximately 129.98 km², which feeds Lake Tanma. Its topography is quite rugged, with elevations ranging from 30 to 118 meters, which promotes the accumulation of runoff and the transport of sediments toward the dam. Over the period from 2005 to 2025, the average annual rainfall is approximately 475 mm. This terrain contributes to soil erosion and the gradual filling of the dam.

The Lac de Guiers, meanwhile, is located in northern Senegal, primarily in the Saint-Louis and Louga regions (**Figure 2**). The lake is a large natural depression,

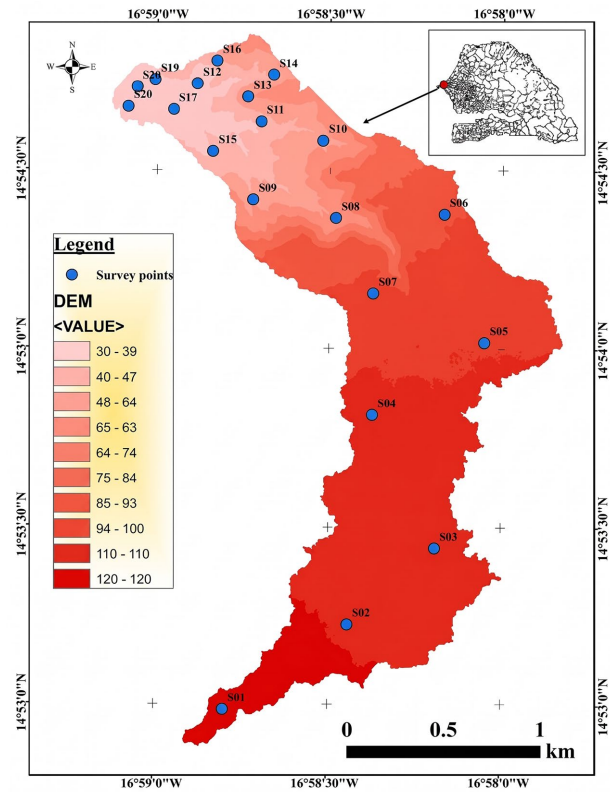


Figure 1. Topographic map of the Mont Rolland Dam watershed.

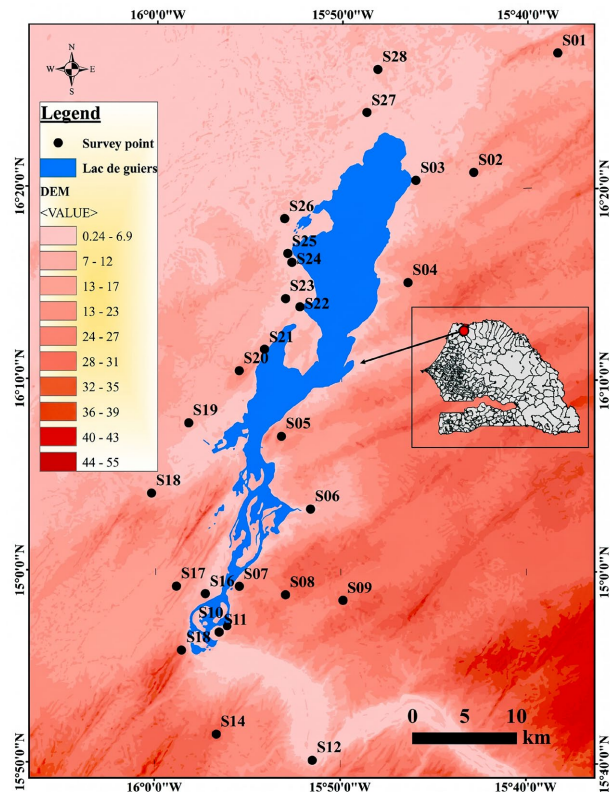


Figure 2. Topographic map of the Lac de Guiers watershed.

fed mainly by the Senegal River via the Taouey Canal. This watershed is characterized by relatively gentle topography, a variety of sandy and clayey formations, and a relatively arid Sahelian climate. The runoff and erosion processes occurring there can generate significant sediment inputs into the lake, which is an essential resource for drinking water supply, irrigated agriculture, and the maintenance of local ecosystems.

3. Materials

Soil erodibility characterization in the Mont Rolland Dam and Lac de Guiers watersheds is based on geotechnical studies conducted both in the field and in the laboratory, supplemented by in situ infiltration measurements. Samples collected at various sampling points were analyzed to determine the key physical characteristics essential for evaluating the erodibility factor K . In the laboratory, equipment was used to perform particle-size analyses, which made it possible to quantify the proportions of sand, silt, and clay. In addition, other devices were used to obtain additional parameters necessary for soil characterization. Field observations, as well as photographs of the samples, also played a crucial role in identifying their structure and surface condition. The infiltration capacity of the soils was measured directly on-site using a double-ring infiltrometer [10] [11], consisting of two concentric metal cylinders driven into the ground and supplied with water. By monitoring the decrease in the water level over time, it is possible to estimate the infiltration rate, with the outer ring limiting lateral flow. All of these geotechnical and hydrodynamic data serve as an empirical basis for calculating and comparing the K -factor using various empirical formulas. Soil infiltration was measured in situ using a double-ring infiltrometer operated under falling-head conditions [12]. The device consisted of concentric steel rings, 15 cm and 33 cm in internal diameter and 20 cm high, inserted approximately 4 - 5 cm into the soil. The outer ring was used to reduce lateral flow beneath the inner ring and promote predominantly vertical infiltration. Water-level changes were measured using millimetre-graduated scales fixed inside both rings. The initial ponding depth was approximately 15 cm.

4. Methodology

The methodology is based on an experimental approach that combines field investigations, geotechnical laboratory analyses, and a comparative calculation of the erodibility factor K . This approach is applied to soils in the watersheds of the Mont Rolland Dam and Lac de Guiers to assess the spatial variability of their susceptibility to water erosion.

Prior to the field investigations, the main soil units within the two study areas were identified from available national soil maps. These mapped soil units provided the initial basis for planning the field investigations and selecting representative sampling areas. During field reconnaissance, this preliminary soil-unit identification was verified and complemented by direct observations of surface

conditions and local soil characteristics. Sampling locations were then selected to ensure that each identified soil unit was represented by at least one sampling point, while also accounting for the diversity of surface conditions encountered in the field. At each sampling location, apparent soil texture, soil structure, vegetation or organic debris, surface condition, and visible signs of erosion were examined and documented. Surface soil samples were collected mainly from the 0 - 20 cm layer, which is directly exposed to rainfall, runoff, and erosion processes. Twenty samples were collected and analyzed in the Mont Rolland Dam watershed and twenty-eight (28) samples in the Lac de Guiers watershed.

At the same sampling locations, infiltration tests were conducted in situ using a double-ring infiltrometer. At each sampling location, three infiltration tests were performed within a radius of approximately 5 m. The two rings were filled simultaneously and maintained at comparable initial water levels. Under falling-head conditions, the decrease in water level in the inner ring was recorded as a function of time. Successive filling-infiltration cycles were performed until quasi-steady conditions were reached. Quasi-steady state was assumed when the slopes of the water-level-time relationships for two successive cycles differed by less than 5%, following the criterion used by Arriaga *et al.* [12]. The final stable cycle was retained for calculation.

The quasi-steady infiltration rate q_s was determined from the absolute slope of the water-level decline in the inner ring during the final stable cycle. Since q_s represents the measured infiltration flux under ponded conditions, it was converted to field-saturated hydraulic conductivity K_s using the relationship proposed by Reynolds *et al.* [11] and applied to falling-head double-ring measurements by Arriaga *et al.* [12]:

$$Kfs = \frac{q_s}{\frac{H}{dC_1 + aC_2} + \frac{1}{\alpha(dC_1 + aC_2)} + 1} \quad (1)$$

where q_s is the quasi-steady infiltration rate (cm/s), H is the mean ponding depth during the final cycle (cm), a is the inner-ring radius (cm), d is the ring insertion depth (cm), α is the inverse macroscopic capillary length (0.12 cm^{-1}), C_1 and C_2 are dimensionless quasi-empirical constants. Following Reynolds *et al.* [11], $C_1 = 0.316\pi$ and $C_2 = 0.184\pi$ for $d \geq 3 \text{ cm}$ and $H \geq 5 \text{ cm}$.

The resulting field-saturated hydraulic conductivity K_s was converted to the permeability class p used in the Wischmeier K-factor equation according to the classification presented in Table 1, following the permeability-class framework associated with the Wischmeier soil-erodibility nomograph [3] [4].

The collected samples were subsequently analyzed in the laboratory. The analyses included particle-size distribution by sieving, in accordance with standards NF EN 933-1 and NF P 94-057, as well as organic matter content using the calcination method XP P 94-047. The particle-size distribution curves make it possible to identify the proportions of the various particle size classes required for erodibility calculations, particularly for the sand, silt, and clay fractions. For samples

containing a significant fine fraction, the particle size analysis is supplemented by a sedimentometric analysis. The results are then combined with data on organic matter content and visual observations that help assess soil structure. The results were analyzed by calculating the normalized fractions of clay (<0.002 mm), silt (0.002 - 0.050 mm), sand (0.050 - 2 mm), and very fine sand (0.050 - 0.100 mm). The soil structure code (s) and permeability class (p) were also determined for each sample. The geotechnical reports also highlight a wide range of textures, ranging from fine sands and silty sands to sandy silts and more clayey soils, which requires an evaluation of the K factor for each sample.

Table 1. Permeability Classes used to assign the Wischmeier permeability code p from field-saturated hydraulic conductivity K_f s [3] [4].

Code p	Descriptive Class	Hydraulic Permeability or Conductivity Interval
1	Fast	>150 mm/h
2	Moderate to fast	50 - 150 mm/h
3	Moderate	15 - 50 mm/h
4	Slow to moderate	5 - 15 mm/h
5	Slow	1 - 5 mm/h
6	Very slow	<1 mm/h

Based on the collected data, the erodibility factor K was calculated individually for each sample using several methods. The Wischmeier-Smith method [3] is based primarily on the erodible grain size fraction, organic matter, and soil structure and permeability classes. The EPIC formulation [5] relies primarily on the contents of sand, silt, clay, and organic carbon. The Römken-Renard method [4] determines K based on the mean geometric particle diameter D_g . The formulations by Torri, Poesen and Borselli [6] and by Auerswald *et al.* [7] are also applied using the available granulometric and organic parameters. The results of each method are converted to a single unit of the International System of Units to facilitate comparison of the values. The final step involves examining the variability of the estimates obtained. For each sample, the K values derived from the different methods are compared using descriptive statistics, absolute and relative deviations, inter-method ratios, and, where relevant, correlation analyses. This analysis identifies the formulations most sensitive to texture, organic matter, structure, and infiltration, while assessing their consistency for soils in both basins. The ultimate goal is to propose a single value or a range of K s that is sufficiently representative to improve the parameterization of the USLE, RUSLE, and USPED models applied to the Mont Rolland Dam and Lac de Guiers watersheds.

5. Description of the Geotechnical Results for the Mont Rolland Dam Watershed

Field sampling followed by laboratory analyses was conducted in the Mont Rolland Dam watershed. The geotechnical studies carried out in the Mont Rolland Dam

area, involving 20 samples (S01 through S20), reveal substantial variability in soil characteristics. The identified materials consist mainly of silty sands, sandy silts, gravels, and lateritic gravels, with the occasional presence of calcareous formations and lateritic concretions. The grain-size analysis shows that silty textures dominate: nine samples are classified as fine silt. Three as silt, three as fine clayey silt, three as sandy silt, one as silty sand, and one as very fine silt. Certain samples, such as S13, exhibit particularly high silt content, while S08 is distinguished by its notable proportion of sand. Organic matter varies significantly among the samples, with levels ranging from approximately 3.3% to 11.5%, which can affect structural stability and, consequently, erodibility. Infiltration measurements corroborate this marked spatial variability, with values ranging from 20 mm/h for S18 to 2,550 mm/h for S06, while S08 and S09 also exhibit very high infiltration rates. The predominance of silty fractions, combined with variations in organic matter, texture, and infiltration, suggests different susceptibilities to water erosion. This justifies the need to determine the K-factor for each sample before mapping it within the watershed. A summary of the particle-size analyses, organic matter estimates and infiltration data for the Mont Rolland Dam watershed is presented in **Appendix Table A1**. The following graph (**Figure 3**) presents the classification of materials according to the USDA (United States Department of Agriculture) textural triangle [13].

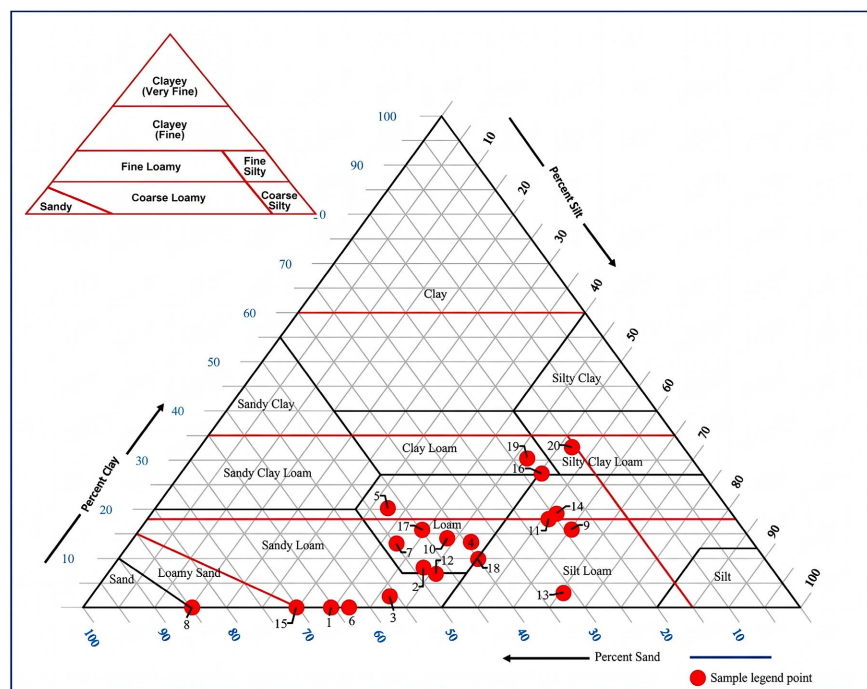


Figure 3. USDA textural triangle for the soil of the Mont Rolland Dam watershed.

6. Description of the Geotechnical Results for the Lac de Guiers

Geotechnical studies conducted on the 28 soil samples (S01 through S28) collected from the Lac de Guiers watershed reveal a high degree of heterogeneity in proper-

ties that may influence soil erodibility. The grain-size analysis, combined with the plotting of the samples on the textural triangle (**Figure 4**), indicates a predominance of sandy and sandy-silty textures, with the majority of samples falling into the categories of sand, silty sand, and sandy silt. However, a few samples, such as S28, contain a significant proportion of fine particles and are distinguished by their position in the silt range. Organic matter content also varies, being generally low in sandy soils and higher in certain fine-textured soils. Infiltration measurements taken in the field confirm this diversity: infiltration rates range from 36 to 816 mm/h, with the highest values generally observed in sandy materials, while soils richer in fine particles exhibit more limited infiltration. This variability—in terms of both grain size, structure, and hydrodynamics—leads to notable differences in susceptibility to detachment and runoff. The results therefore suggest that the erodibility of soils in this watershed cannot be represented by a single value for the K factor. They highlight the need for a localized and comparative assessment of K using multiple formulations, such as those by Wischmeier, EPIC, Römken-Remard, Torri-Poesen-Borselli, and Auerswald, to determine the method best suited to the region's specific pedological characteristics. A summary of the grain-size analyses, organic matter estimates and infiltration data for the Lac de Guiers watershed is presented in **Appendix Table A2**. The following graph (**Figure 4**) shows the classification of the materials according to the USDA textural triangle.

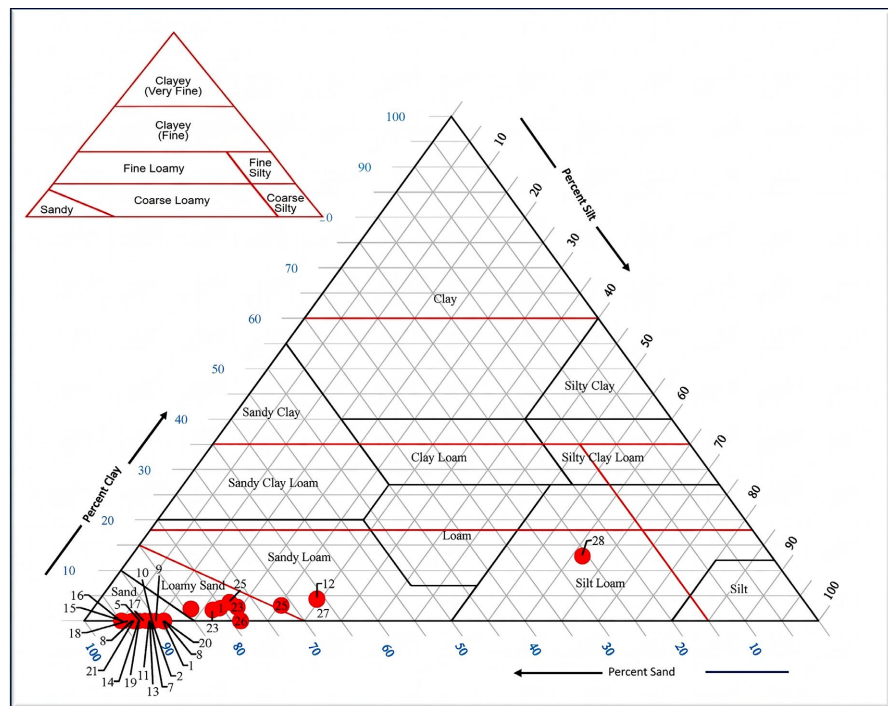


Figure 4. USDA soil textural triangle for the Lac de Guiers watershed.

7. Methods for Calculating the K Factor

Soil loss in watersheds is estimated using the original RUSLE formula (Equation (2) [3] [4]). It includes several factors that must be quantified.

$$A = R * K * LS * C * P \quad (2)$$

where

- A = Average annual soil loss (t/ha/year);
- R = Precipitation erosivity factor (MJ·mm/ha·h·year);
- K = Soil erodibility factor (t·ha·h/ha·MJ·mm);
- LS = Slope length and slope factor (dimensionless);
- C = Cover management factor (dimensionless);
- P = Support-practice factor.

Among these parameters is the soil erodibility factor K . Several methods are used to calculate the erodibility factor K , which has the unit $\text{t}\cdot\text{ha}\cdot\text{h}\cdot\text{ha}^{-1}\cdot\text{MJ}^{-1}\cdot\text{mm}^{-1}$ in SI units.

7.1. Erodibility Factor K , as Proposed by Wischmeier

The classic Wischmeier and Smith equation [3] determines the K factor using the Equation (3). The input data are particle size distribution, organic matter, and a qualitative description of structure and permeability.

$$\begin{cases} K_{W,SI} = 0.1317 \frac{2.1 \times 10^{-4} (12 - OM) M^{1.14} + 3.25(s - 2) + 2.5(p - 3)}{100} \\ M = (Si + VFS)(100 - Cl) \end{cases} \quad (3)$$

where

- $K_{W,SI}$: the K factor in SI units (t·ha·h/ha·MJ·mm);
- Si : the silt content, in %;
- VFS : the very fine sand content, in %;
- Cl : the clay content, in %;
- OM : the organic matter content, in %;
- s : the soil structure code;
- p : the permeability class.

It is important to note that Wischmeier and Smith indicate that this equation is an approximation of the nomograph and does not fully reproduce all of its components, particularly for soils with high organic matter contents. When applying the Wischmeier nomograph, organic matter contents exceeding 4% were therefore capped at 4%, corresponding to the maximum value represented in the original nomograph. This approach prevents extrapolation of the empirical relationship beyond the range for which it was originally calibrated [7].

The permeability class p is defined as follows (Table 1).

The soil structure code s is defined in the following table (Table 2).

Table 2. Soil structure code.

Code	Structure
1	Very fine, granular
2	Fine, granular
3	Medium or coarse. Granular
4	Massive, lamellar, or blocky

7.2. EPIC Erodibility Factor K

The EPIC method [5], [14] estimates the K factor using the following Equation (4). This formula uses grain size characteristics and organic carbon estimated from the organic matter content. Permeability is not taken into account.

$$\begin{cases} K_{EPIC,SI} = 0.1317 F_{sand} F_{cl-si} F_{orgC} F_{hisand} \\ F_{sand} = 0.2 + 0.3 \exp[-0.0256 SAN (1 - SIL/100)] \\ F_{cl-si} = [SIL / (CLA + SIL)]^{0.3} \\ F_{orgC} = 1 - 0.25C / [C + \exp(3.72 - 2.95C)] \\ F_{hisand} = 1 - 0.7 SN_1 / [SN_1 + \exp(-5.51 + 22.9 SN_1)] \\ SN_1 = 1 - SAN/100 \\ C = OM/1.724 \end{cases} \quad (4)$$

where

- *SAN*: the sand content (%);
- *SIL*: the silt content (%);
- *CLA*: the clay content (%) with sand 0.05 to 2 mm, silt 0.002 to 0.05 mm et clay < 0.002 mm [15];
- *C*: the organic carbon content;
- *OM*: organic matter content (%).

7.3. Römken-Renard Erodibility Factor K

The Römken-Renard formula [16] is given by the equation (5). It requires the soil's particle size distribution and knowledge of the sand, silt, and clay fractions.

$$\begin{cases} K_{R,SI} = 0.0034 + 0.0405 \exp \left[-0.5 \left(\frac{\log_{10}(D_g) + 1.659}{0.7101} \right)^2 \right] \\ D_g = \exp \left(\sum_{i=1}^n f_i \ln(d_i) \right) \\ d_i = \sqrt{d_{\min,i} d_{\max,i}} \\ \sum f_i = 1 \end{cases} \quad (5)$$

where

- f_i : mass fraction of class i , expressed as a decimal;
- d_i : representative diameter of the class, in mm;
- n : is equal to 3, corresponding to the three soil fractions: clay, silt, and sand.

To determine the geometric mean particle diameter D_g , the USDA classifications assigned representative mean diameters of 0.001 mm for clay particles (less than 0.002 mm), 0.026 mm for silt particles (ranging from 0.002 to 0.050 mm), and 1.025 mm for sand particles (from 0.050 to 2.000 mm). These figures reflect the arithmetic means of the size limits for each category [4] [8].

7.4. Römken-Renard Erodability Factor K Using Shirazi-Derived Geometric Mean Diameter

The K factor is calculated using Equation (4) of Römken-Renard with a Shirazi-derived geometric mean diameter D_g . It should be noted that Shirazi *et al.* [8] [9] adopt a different approach to characterizing soil texture. The approach of Shirazi *et al.* defines the mean geometric diameter D_g as a weighted geometric mean of the particle size distribution, whereas the Römken-Renard approach uses this particle size parameter (between sand, silt, and clay) to establish a direct empirical relationship between D_g and the erodability factor K . The approach by Shirazi *et al.* could be extended to coarse-grained soils by incorporating fractions > 2 mm as additional grain size classes in the weighted calculation of D_g , and then using this generalized D_g in the equation for estimating K , subject to validation or recalibration of this relationship for soils rich in coarse particles. Soils in the Mont Rolland Dam watershed are characterized by a high content of coarse particles. This characteristic explains the choice to calculate K using the Römken-Renard equation, but with D_g determined according to the Shirazi approach, in order to compare the resulting values with those obtained using the other soil erodability estimation equations.

7.5. Torri-Poesen-Borselli Erodability Factor K

The Torri-Poesen-Borselli formula [6], [17] is given by the Equation (6). This method provides a K value compatible with the USLE/RUSLE. The factor 0.1317 is used to obtain a result in SI units. The formula is based primarily on texture and organic matter. It does not directly consider the structure or permeability of aggregates.

$$\left\{ \begin{array}{l} K_{T,SI} = 0.0293(0.65 - D_g + 0.24D_g^2) \dots \\ \dots * \exp\left(-0.0021 \frac{OM}{Cl} - 0.00037 \frac{OM^2}{Cl^2} - 4.02Cl + 1.72Cl^2\right) \\ D_g = \sum_{i=1}^n f_i \text{Log}_{10}(\sqrt{d_i d_{i-1}}) \\ S_G = \sum_{i=1}^n f_i \left[\text{Log}_{10}(\sqrt{d_i d_{i-1}}) - D_g \right]^2 \end{array} \right. \quad (6)$$

In this formulation:

- f_i is the content of class i , ranging from 0 to 1 as indicated by Torri *et al.* [17];
- d_i is the representative geometric diameter in mm (with Clay: $d_{i-1} = 0.00005$ mm, $d_i = 0.002$ mm, silt: $d_{i-1} = 0.002$ mm, $d_i = 0.050$ mm, Sand: $d_{i-1} = 0.050$ mm, $d_i = 2$ mm [17]);
- D_g is the mean diameter, expressed in mm;
- OM is the organic matter fraction. It ranges from 0 to 1;
- Cl is the clay fraction, ranging from 0 to 1.

7.6. Auerswald *et al.*'s Erodability Factor K

The formula by Auerswald *et al.* [7] follows an algorithm divided into several steps

presented below.

Step 1: Effect of particle size

$$\begin{cases} si & f_{Si} + vfSa < 70\% & K_{A,SI} = 2.77 \times 10^{-5} [(f_{Si} + vfSa)(100 - f_{Cl})]^{1.14} \\ si & f_{Si} + vfSa \geq 70\% & K_{A,SI} = 1.75 \times 10^{-5} [(f_{Si} + vfSa)(100 - f_{Cl})]^{1.14} \dots \\ & & \dots + 0.0024(f_{Sa} - vfSa) + 0.16 \end{cases} \quad (7)$$

Step 2: Effect of organic matter

$$\begin{cases} si & f_{OM} < 4\% & K_2 = (12 - f_{OM})/10 \\ si & f_{OM} \geq 4\% & K_2 = 0.8 \end{cases} \quad (8)$$

Step 3: Effect of structure and permeability

$$\begin{cases} si & K_1 K_2 > 0.2 & K_3 = K_1 K_2 + 0.043(A - 2) + 0.033(P - 3) \\ si & K_1 K_2 \leq 0.2 & K_3 = 0.091 - 0.34 K_1 K_2 + 1.79(K_1 K_2)^2 \\ & & + 0.24 K_1 K_2 A + 0.033(P - 3) \end{cases} \quad (9)$$

Step 4: Effect of coarse fragments

$$\begin{cases} si & f_{rf} < 1.5\% & K_A = K_3 \\ si & f_{rf} \geq 1.5\% & K_A = K_3 [1.1 \exp(-0.024 f_{rf}) - 0.06] \end{cases} \quad (10)$$

where

- f_{Si} is the silt content, in %;
- $vfSa$ is the percentage of very fine sand;
- f_{Cl} is the clay content, in %;
- f_{Sa} is the total sand content, in %;
- f_{OM} is organic matter, in %;
- A is the aggregation or structure class;
- P is the permeability class;
- f_{rf} is the coverage of coarse fragments, expressed as a percentage. Coarse-fragment cover was not evaluated; therefore, f_{rf} was set to 0.

Clay (Cl) is defined as particles smaller than 0.002 mm, while silt (Si) comprises particles ranging from 0.002 to 0.050 mm. Very fine sand ($vfSa$) falls within the 0.050 to 0.100 mm category, and sand, excluding very fine sand (Sa), includes particles from 0.100 to 2.000 mm. As a result, the total fraction of silt and very fine sand ($Si + vfSa$) spans from 0.002 to 0.100 mm, in agreement with the findings of Auerswald *et al.* [7].

8. Presentation and Analysis of Results

8.1. Case of Lac de Guiers Watershed

For the Lac de Guiers watershed, twenty-eight (28) samples (S01 to S28) were analysed. The soil erodibility factor K , expressed in SI units as t·ha·h/(ha·MJ·mm), was estimated using six methods: Wischmeier, EPIC, the corrected 2002 Torri-Poesen-Borselli formulation, Römken-Renard, Auerswald *et al.*, and Römken-Renard with Shirazi-derived D_g . The results show a very strong similarity between

Wischmeier and Auerswald, while EPIC, Römken-Renard and Römken-Renard with Shirazi-derived D_g broadly reproduce a consistent spatial organisation with different absolute K levels. Torri-Poesen-Borselli differs markedly from the other five methods (**Table 3**).

Table 3. Summary results for the 28 samples.

Sample	Wischmeier	EPIC	Torri-Poesen-Borselli	Römken-Renard	Auerswald <i>et al.</i>	Römken-Renard with Shirazi-derived D_g
S01	0.00942	0.01724	0.01306	0.00830	0.00943	0.01891
S02	0.01259	0.01606	0.01284	0.00795	0.01112	0.01880
S03	0.01630	0.01776	0.01320	0.00845	0.01584	0.02257
S04	0.02455	0.02748	0.01381	0.01165	0.02445	0.02270
S05	0.00319	0.01454	0.01241	0.00745	0.00559	0.02141
S06	0.02636	0.01855	0.01333	0.00862	0.02641	0.02226
S07	0.01241	0.01554	0.01271	0.00779	0.01093	0.01985
S08	0.00077	0.01403	0.01223	0.00738	0.00450	0.01962
S09	0.01111	0.01538	0.01270	0.00811	0.00967	0.01948
S10	0.01463	0.01508	0.01261	0.00789	0.01465	0.02287
S11	0.00969	0.01541	0.01258	0.00799	0.00954	0.02207
S12	0.03149	0.02918	0.01413	0.01915	0.03156	0.03554
S13	0.01213	0.01495	0.01261	0.00785	0.01066	0.02124
S14	0.00530	0.01369	0.01226	0.00749	0.00643	0.01835
S15	0.00000	0.01328	0.01190	0.00705	0.00247	0.01646
S16	0.00000	0.01338	0.01191	0.00700	0.00251	0.01705
S17	0.01041	0.01491	0.01253	0.00764	0.00902	0.01869
S18	0.00000	0.01386	0.01208	0.00712	0.00261	0.01714
S19	0.00183	0.01478	0.01248	0.00758	0.00495	0.01913
S20	0.00523	0.01697	0.01306	0.00823	0.00666	0.01982
S21	0.00000	0.01371	0.01212	0.00729	0.00261	0.01768
S22	0.01937	0.01697	0.01326	0.01012	0.01791	0.02153
S23	0.02133	0.02160	0.01383	0.01104	0.02041	0.02458
S24	0.02699	0.02705	0.01444	0.01564	0.02706	0.02919
S25	0.01531	0.02168	0.01342	0.01248	0.01493	0.02398
S26	0.02363	0.02353	0.01400	0.01271	0.02325	0.02777
S27	0.03655	0.03124	0.01439	0.01888	0.03663	0.03536
S28	0.06058	0.04434	0.01150	0.04330	0.06944	0.04267

As reflected by the specific formulations, Wischmeier incorporates texture, organic matter, structure and permeability. Auerswald *et al.* also incorporates

these parameters together with coarse fragments. Römken-Renard is mainly based on the geometric mean particle diameter D_g . In this analysis, Shirazi is applied using a full D_g that includes all particle-size fractions retained in the calculation.

The comparative statistical analysis of the results from Lac de Guiers is summarized in the following table (**Table 4**).

Table 4. Comparative statistics for the K factor at Lac de Guiers.

Method	Mean	Median	Minimum	Q1	Q3	Maximum	Standard deviation	CV (%)
Wischmeier	0.01469	0.01227	0.00000	0.00472	0.02191	0.06058	0.01365	92.96
EPIC	0.01901	0.01580	0.01328	0.01472	0.02162	0.04434	0.00716	37.67
Torri-Poesen-Borselli	0.01291	0.01271	0.01150	0.01237	0.01335	0.01444	0.00079	6.09
Römken-Renard	0.01079	0.00805	0.00700	0.00756	0.01119	0.04330	0.00721	66.81
Auerswald <i>et al.</i>	0.01540	0.01079	0.00247	0.00622	0.02112	0.06944	0.01416	91.91
Römken-Renard with Shirazi-derived D_g	0.02274	0.02133	0.01646	0.01888	0.02315	0.04267	0.00622	27.34

In this table, Q1 refers to the first quartile (25% of the K values are less than or equal to Q1). Q3 refers to the third quartile (75% of the K values are less than or equal to Q3). CV (equal to $100 \times \text{standard deviation}/\text{mean}$) measures the relative dispersion of the values relative to their mean.

The mean K values vary considerably among the six methods. The highest mean value is obtained with Römken-Renard using the Shirazi-derived D_g , at 0.02274. EPIC gives a mean value of 0.01901. Auerswald *et al.* and Wischmeier yield similar values of 0.01540 and 0.01469, respectively. Torri-Poesen-Borselli gives a mean value of 0.01291. The lowest mean value is obtained with Römken-Renard, at 0.01079. The selected formulation therefore substantially affects the absolute K value (**Figure 5**).

The Römken-Renard relationship with Shirazi-derived D_g yields the highest mean K (0.02274) and a relatively low coefficient of variation (27.34%). Torri-Poesen-Borselli now has the lowest relative dispersion (CV = 6.09%), whereas Wischmeier and Auerswald *et al.* show the largest relative dispersion (92.96% and 91.91%, respectively) (**Figure 6**).

Wischmeier and Auerswald *et al.* remain close in mean value (0.01469 and 0.01540) and exhibit similarly broad between-sample dispersion. By contrast, Torri-Poesen-Borselli is tightly clustered around its mean, while the Shirazi-derived D_g and EPIC series are more compressed than Wischmeier and Auerswald (**Figure 7**).

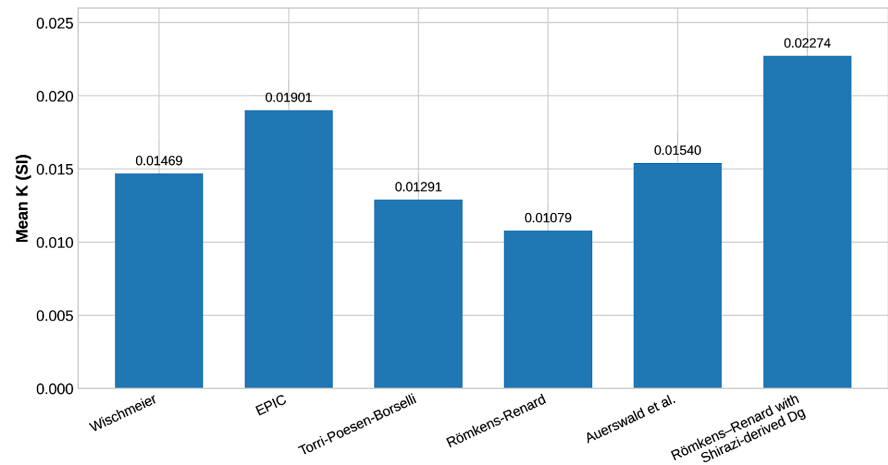


Figure 5. Average value of K for Lac de Guiers.

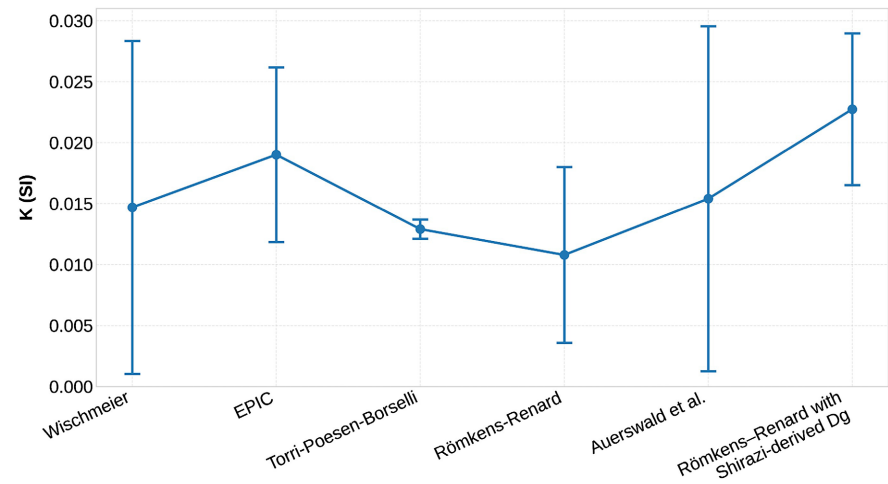


Figure 6. K-means and ± 1 standard deviation interval for Lac de Guiers.

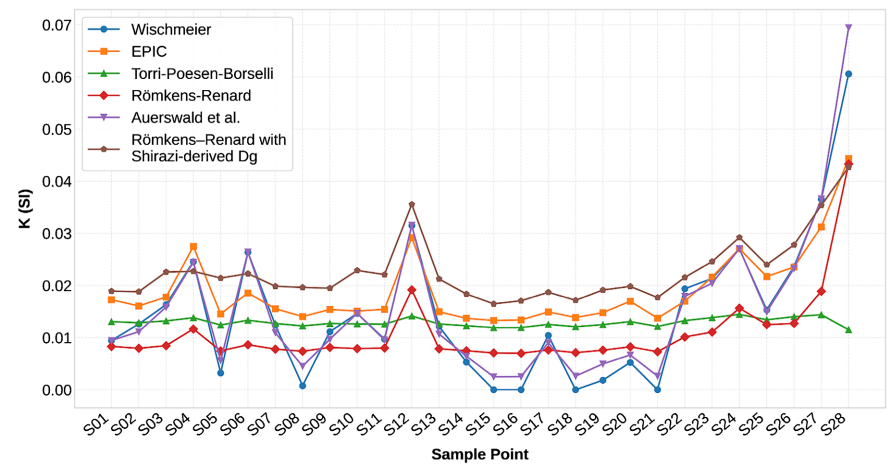


Figure 7. Erodibility factor K in SI units for the 28 test sites according to five methods.

The 28-sample profile shows that S28 reaches the maximum for Wischmeier, EPIC, Römken-Renard, Auerswald *et al.*, and the Römken-Renard with Shirazi-

derived D_g implementation. In contrast, Torri-Poesen-Borselli varies within a narrow interval (0.01150 - 0.01444), with its maximum at S24 (**Figure 8**).

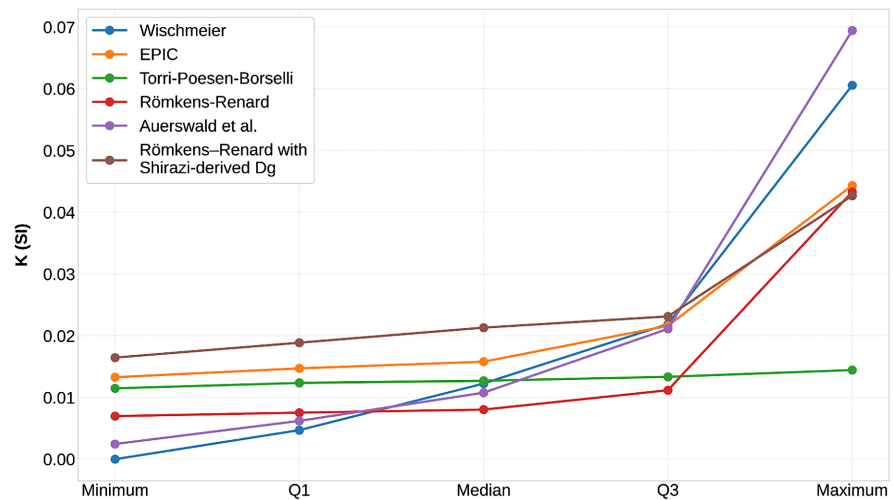


Figure 8. Min-Q1-Median-Q3-Max distribution profile for Lac de Guiers.

The distribution profile confirms that the Shirazi-derived D_g implementation maintains a relatively high lower bound (minimum = 0.01646), whereas Wischmeier and Auerswald *et al.* span much wider ranges. Torri-Poesen-Borselli is the most compact series, with values between 0.01150 and 0.01444 (**Table 5** and **Figure 9**).

Table 5. Correlation between the methods for Lac de Guiers.

Method	Wischmeier	EPIC	Torri-Poesen-Borselli	Römken-Renard	Auerswald <i>et al.</i>	Römken-Renard with Shirazi-derived D_g
Wischmeier	1.000	0.937	0.422	0.878	0.988	0.920
EPIC	0.937	1.000	0.389	0.933	0.956	0.940
Torri-Poesen-Borselli	0.422	0.389	1.000	0.074	0.316	0.407
Römken-Renard	0.878	0.933	0.074	1.000	0.932	0.902
Auerswald <i>et al.</i>	0.988	0.956	0.316	0.932	1.000	0.932
Römken-Renard with Shirazi-derived D_g	0.920	0.940	0.407	0.902	0.932	1.000

In **Figure 9**, r represents the Pearson correlation coefficient (r). It measures the strength and direction of the linear relationship between the K values obtained with two methods. Its value ranges from -1 to $+1$. Values close to $+1$ indicate a strong positive relationship, values close to 0 indicate a weak linear relationship, and values close to -1 indicate a strong negative relationship. For example, $r = 0.988$ indicates a very strong positive correlation between two methods.

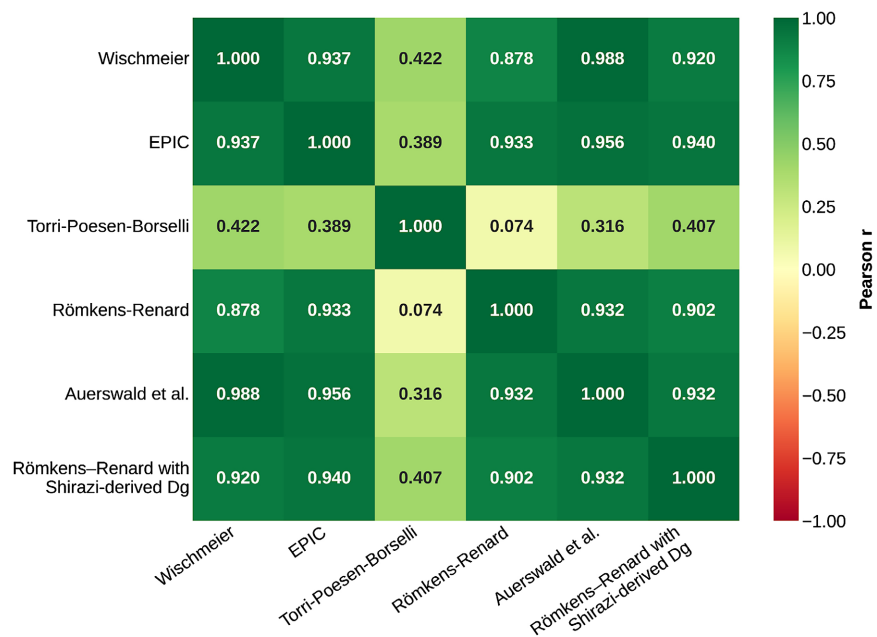


Figure 9. Pearson correlation matrix (r) for the six methods in the Lac de Guiers watershed.

The strongest relationship is observed between Wischmeier and Auerswald *et al.* ($r = 0.988$). High positive correlations are also obtained between EPIC and Auerswald *et al.* ($r = 0.956$), EPIC and Römken-Renard with Shirazi-derived Dg ($r = 0.940$), EPIC and Römken-Renard ($r = 0.933$), and Auerswald *et al.* and Römken-Renard ($r = 0.932$). In contrast, Torri-Poesen-Borselli shows weaker correlations with the other methods, with r values ranging from 0.074 to 0.422.

Römken-Renard with Shirazi-derived Dg gives the highest mean K value among the six methods, with a mean of 0.02274. It also maintains a comparatively high lower bound. Its correlations with Wischmeier, EPIC, Römken-Renard, and Auerswald *et al.* range from 0.902 to 0.940. These strong positive correlations indicate that this method broadly preserves the spatial variation observed with the other methods, although it produces different absolute K values.

The correlation analysis identifies a closely related group comprising Wischmeier, EPIC, Römken-Renard, Auerswald *et al.*, and Römken-Renard with Shirazi-derived Dg. These methods generally show strong positive correlations despite differences in their mean K values and dispersion. Torri-Poesen-Borselli shows a more distinct spatial response and a very low relative dispersion. Sample S28 is identified by five of the six methods as having the highest K value. These differences show that the choice of K formulation can be an important source of uncertainty in USLE, RUSLE, and USPED erosion estimates.

The Torri-Poesen-Borselli K values range from 0.01150 to 0.01444. This narrow range is consistent with the low relative dispersion observed for this method. The results also show that the Torri-Poesen-Borselli formulation produces a different pattern of K variation compared with the other methods. This difference should be considered when selecting and interpreting K values for subsequent erosion modelling.

Some discrepancies between the methods may result from differences in their mathematical formulations and from assumptions required for specific input parameters. For the Auerswald *et al.* method, the coverage by coarse fragments is considered negligible, and f_{ff} is therefore assumed to be 0%. This assumption may influence the resulting K values. For the Wischmeier method, the organic matter content is capped at 4% in accordance with the nomograph. Consequently, differences in K values among the six methods should be interpreted in relation to both their formulations and the treatment of their input parameters.

8.2. Case of the Mont Rolland Dam Watershed

The erodibility factors K (in SI units: t·ha·h/(ha·MJ·mm)) for the 20 samples S01 through S20 were analyzed (see **Table 6** and **Figure 10**) using six approaches: Wischmeier, EPIC, Torri-Poesen-Borselli (2002 corrigendum), Römken-Renard, Auerswald *et al.*, and Römken-Renard with Shirazi-derived D_g . Including the Römken-Renard implementation with a Shirazi-derived D_g broadens the comparative assessment by evaluating the sensitivity of the Römken-Renard relationship to an alternative characterization of particle-size distribution.

Table 6. Summary results for the 20 samples.

Sample	Wischmeier	EPIC	Torri-Poesen-Borselli	Römken-Renard	Auerswald <i>et al.</i>	Römken-Renard with Shirazi-derived D_g
S01	0.03297	0.03100	0.00090	0.04363	0.04348	0.00371
S02	0.03755	0.03610	0.01162	0.02599	0.04952	0.00944
S03	0.04041	0.03506	0.00000	0.04072	0.05331	0.00403
S04	0.03861	0.03828	0.01177	0.01098	0.05094	0.00359
S05	0.02249	0.03098	0.03017	0.01484	0.02966	0.00393
S06	0.03423	0.03184	0.00000	0.04389	0.04516	0.00375
S07	0.03397	0.03321	0.02904	0.02353	0.04482	0.00463
S08	0.01304	0.01717	0.00000	0.02820	0.01655	0.00340
S09	0.03844	0.04402	0.02443	0.00404	0.06329	0.04379
S10	0.03504	0.03648	0.03057	0.01318	0.04624	0.04026
S11	0.04206	0.04244	0.01612	0.00417	0.06922	0.00359
S12	0.04033	0.03730	0.01156	0.02540	0.05320	0.03633
S13	0.05366	0.04576	0.00000	0.00960	0.07789	0.00400
S14	0.05254	0.04274	0.03863	0.00392	0.08337	0.00669
S15	0.03013	0.02879	0.00011	0.04015	0.03975	0.00714
S16	0.02766	0.04076	0.02638	0.00353	0.03648	0.00341
S17	0.03412	0.03438	0.02581	0.01487	0.04502	0.00386
S18	0.05396	0.03944	0.00030	0.01352	0.07121	0.01049
S19	0.03113	0.03942	0.03350	0.00350	0.04108	0.00340
S20	0.03125	0.04255	0.03928	0.00341	0.04123	0.00340

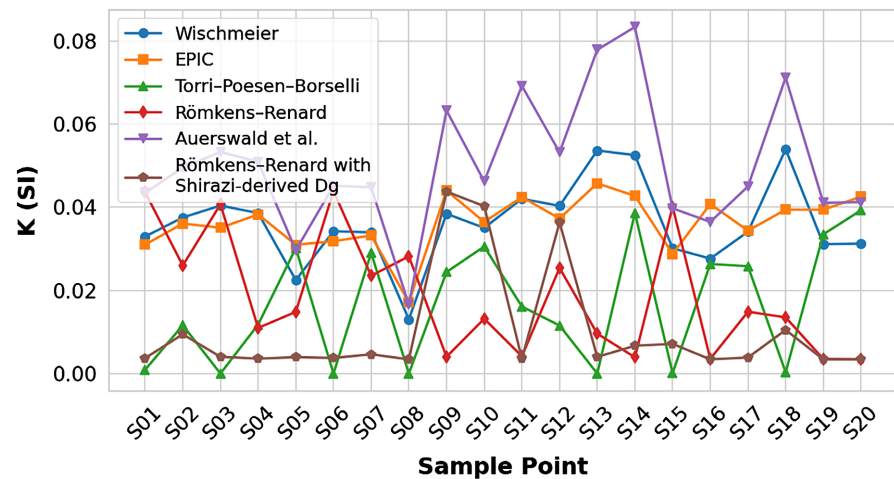


Figure 10. Variation in K values depending on the samples and the calculation method.

Descriptive analysis shows a marked method effect on the magnitude of K (**Table 7** and **Figure 11**). The highest mean is obtained with Auerswald *et al.* ($K = 0.05007$). EPIC (0.03639) and Wischmeier (0.03618) yield similar mean values, followed by Römken-Renard (0.01855), Torri-Poesen-Borselli (0.01651), and the Shirazi-derived D_g implementation (0.01014). Relative dispersion is lowest for EPIC (CV = 18.11%) and highest for the Shirazi-derived D_g implementation (CV = 129.53%).

Table 7. Comparative statistics for the K-factor at the Mont Rolland dam watershed.

Method	Mean K	Median	Min.	Q1	Q3	Max.	Standard deviation	CV
Wischmeier	0.03618	0.03464	0.01304	0.03122	0.04035	0.05396	0.00994	27.5%
EPIC	0.03639	0.03689	0.01717	0.03287	0.04118	0.04576	0.00659	18.1%
Torri-Poesen-Borselli	0.01651	0.01395	0.00000	0.00026	0.02932	0.03928	0.01455	88.1%
Römken-Renard	0.01855	0.01418	0.00341	0.00414	0.02654	0.04389	0.01448	78.0%
Auerswald <i>et al.</i>	0.05007	0.04570	0.01655	0.04120	0.05581	0.08337	0.01625	32.5%
Römken-Renard with Shirazi-derived D_g	0.01014	0.00397	0.00340	0.00359	0.00771	0.04379	0.01314	129.5%

The Min-Q1-Median-Q3-Max profile confirms that the methods differ in both central tendency and dispersion. EPIC has the smallest standard deviation (0.00659), whereas Auerswald *et al.* has the largest absolute standard deviation (0.01625). For the Shirazi-derived D_g implementation, the mean (0.01014) is substantially higher than the median (0.00397), reflecting a right-skewed distribution driven by a small number of high values (**Figure 11** and **Figure 12**).

Based on the updated coefficients of variation, relative dispersion increases from EPIC (18.11%) to Wischmeier (27.48%), Auerswald *et al.* (32.46%), Römken-Renard (78.01%), Torri-Poesen-Borselli (88.11%), and the Shirazi-derived D_g implementation (129.53%) (**Figure 13**). Torri values for S03 and S06 are numerically close

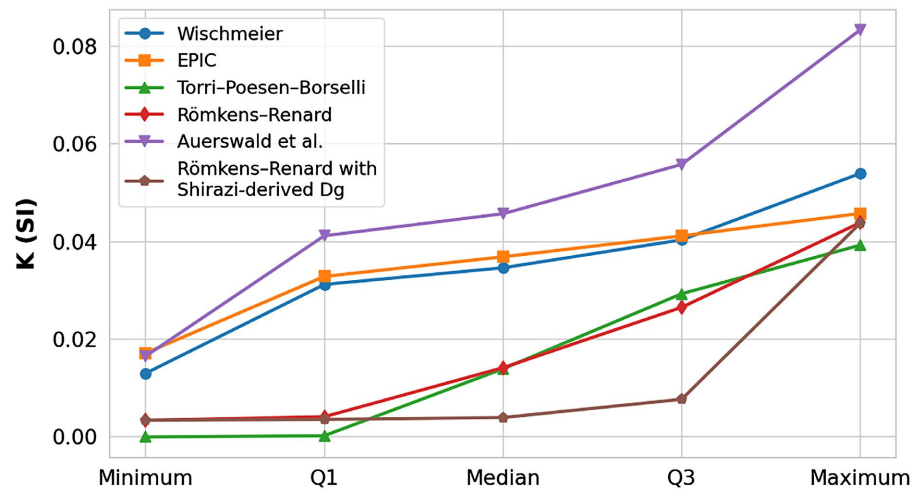


Figure 11. Min-Q1-Median-Q3-Max distribution profile for Mont Rolland Dam watershed.

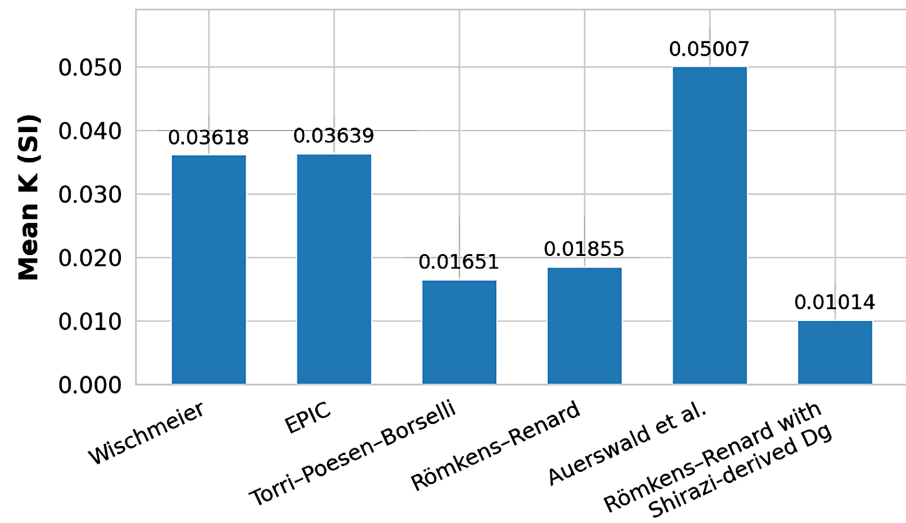


Figure 12. Mean K value—Mont Rolland Dam watershed.

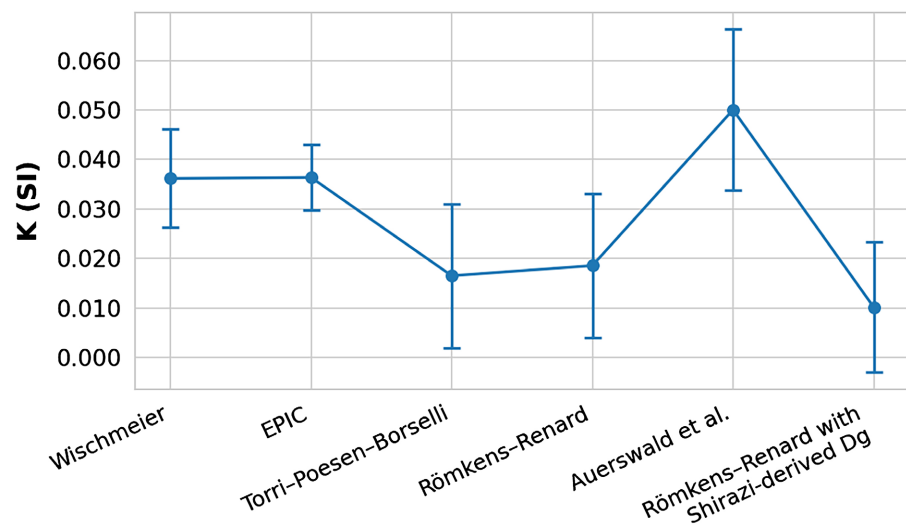


Figure 13. Mean K and ± 1 standard deviation interval.

to zero and should be interpreted as responses of the formulation to these combinations of input parameters rather than as a physical absence of soil erodibility.

Pearson correlations (**Table 8** and **Figure 14**) show very strong agreement between Wischmeier and Auerswald *et al.* ($r = 0.963$). EPIC is also positively correlated with Auerswald *et al.* ($r = 0.752$) and Wischmeier ($r = 0.720$). By contrast, Römken-Renard is negatively correlated with EPIC ($r = -0.675$) and Torri-Poesen-Borselli ($r = -0.693$). The Shirazi-derived D_g implementation has only weak correlations with the other methods ($|r| \leq 0.212$).

Table 8. Correlation matrix.

Method	Wischmeier	EPIC	Torri-Poesen-Borselli	Römken-Renard	Auerswald <i>et al.</i>	Römken-Renard with Shirazi-derived D_g
Wischmeier	1.00	0.72	-0.10	-0.23	0.96	0.14
EPIC	0.72	1.00	0.39	-0.67	0.75	0.21
Torri-Poesen-Borselli	-0.10	0.39	1.00	-0.69	-0.01	0.15
Römken-Renard	-0.23	-0.67	-0.69	1.00	-0.34	-0.14
Auerswald <i>et al.</i>	0.96	0.75	-0.01	-0.34	1.00	0.18
Römken-Renard with Shirazi-derived D_g	0.14	0.21	0.15	-0.14	0.18	1.00

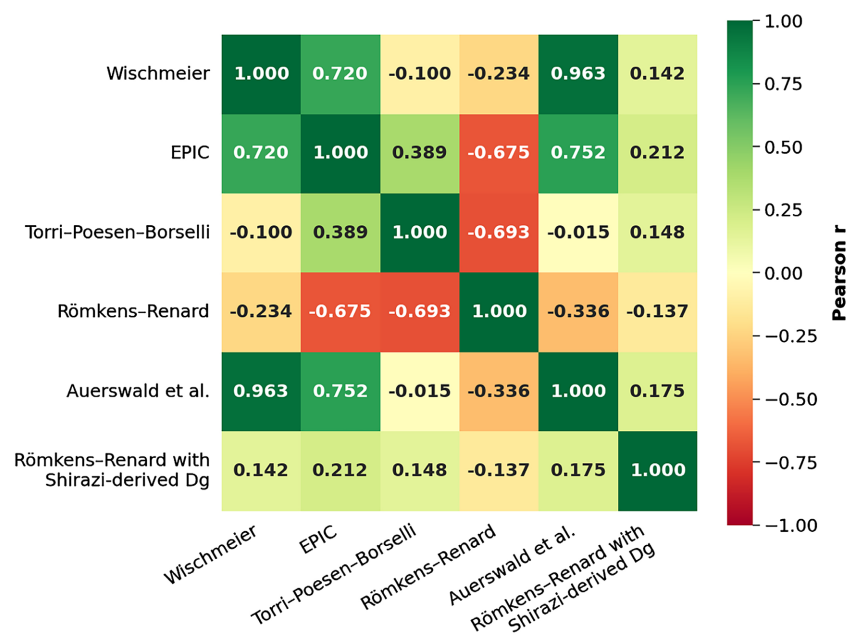


Figure 14. Pearson correlation matrix (r) for the six methods in the Mont Rolland Dam watershed.

The correlation matrix confirms that the methods do not preserve the same relative ranking of the Mont Rolland samples. Together with the differences in mean and dispersion, this demonstrates strong methodological sensitivity of K and reinforces the need to test the effect of the selected formulation in subsequent erosion modelling.

9. Conclusions

This comparative study confirms that soil erodibility cannot be represented by a K value considered independently of its estimation method. The results show substantial method effects in both watersheds. At Lac de Guiers, mean K ranges from 0.01079 to 0.02274, whereas at Mont Rolland it ranges from 0.01014 to 0.05007. The magnitude, dispersion, and relative ranking of samples therefore depend strongly on the formulation used.

The comparison does not support a single site-wide ordering common to all six approaches. At Lac de Guiers, Wischmeier and Auerswald *et al.* show very similar spatial patterns ($r = 0.988$), while Torri-Poesen-Borselli produces a narrower range of K values and weaker correlations with the other methods. At Mont Rolland, Wischmeier and Auerswald *et al.* are also strongly correlated ($r = 0.963$), whereas the other formulations show substantially different patterns of variability. These results confirm that the choice of K formulation constitutes an important source of uncertainty in subsequent erosion modelling.

The Römken-Renard relationship using a Shirazi-derived geometric mean diameter was included as a comparative approach to evaluate the sensitivity of K estimates to an alternative characterization of particle-size distribution. Although fractions greater than 2 mm were incorporated into the calculation of the generalized D_g , the present study does not demonstrate that this treatment provides a more accurate estimate of soil erodibility. Similarly, the coarse-fragment-cover term included in the Auerswald *et al.* formulation could not be evaluated because surface coarse-fragment cover was not measured and was therefore fixed at $frf = 0$. The influence of coarse fragments on soil erodibility consequently requires specific field characterization and further validation.

The conclusions of this study primarily apply to the sampled soils and to the soil conditions represented by the sampling design. Therefore, rather than selecting a single K equation solely on the basis of its mean value or conventional use, a multi-method sensitivity analysis is recommended for subsequent RUSLE or USPED applications. Independent field observations are required to determine which formulation best represents actual erosion processes under local conditions.

For the Mont Rolland Dam watershed, the available sedimentation information provides an opportunity for such validation. A subsequent comparison between simulated soil loss and observed sediment accumulation in the reservoir may help assess the predictive performance of the different K formulations. Sediment volumes, runoff information, and other field-based erosion indicators should there-

fore be used, where available, to calibrate and validate the modelling framework before extrapolating the selected K formulation to the Lac de Guiers watershed.

Author Contributions

Conceptualization, S.B.; methodology, S.B. and M.B.; geotechnical investigations, S.B.; validation of results, M.B., M.C., and S.N.; writing—original draft preparation, S.B.; writing—review and editing, S.B., M.C., S.N. and M.B.; manuscript validation, M.C., S.N., and M.B. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

Table A1. Geotechnical measurements in the Mont Rolland Dam Watershed.

Sample	Dmax (mm)	Passing ≤					Organic Matter Content MO (%)	Infiltation Rate (mm/h)	Permeabil- ity Class p	Structure Code s	Soil texture
		63 mm (%)	20 mm (%)	2 mm (%)	63 µm (%)	2 µm (%)					
S1	40.0	100.0	73.7	37.3	16.2	1.2	3.3	60	2	2.0	Sandy Loam
S2	5.0	100.0	100.0	91.7	58.0	7.4	5.1	110	2	2.0	Loam
S3	40.0	100.0	70.7	39.0	21.5	0.9	5.5	160	1	3.0	Sandy Loam
S4	2.0	100.0	100.0	99.6	73.2	13.2	8.2	180	1	3.0	Loam
S5	5.0	100.0	100.0	97.8	60.0	19.8	5.5	120	2	2.0	Sandy Clay Loam
S6	40.0	100.0	79.5	35.2	16.5	0.9	6.1	2550	1	3.0	Sandy Loam
S7	2.0	100.0	100.0	99.3	59.9	12.9	4.6	70	2	3.0	Loam
S8	20.0	100.0	92.6	11.6	2.5	0.8	11.5	1088	1	3.0	Sand
S9	31.5	100.0	74.3	59.6	55.1	9.5	7.4	1457	1	1.0	Silt Loam
S10	31.5	100.0	77.8	60.8	42.3	8.6	5.0	264	1	3.0	Loam
S11	16.0	100.0	100.0	89.3	79.5	16.1	9.9	514	1	3.0	Silt Loam
S12	20.0	100.0	91.3	76.0	49.4	5.2	4.4	70	2	2.0	Loam
S13	31.5	100.0	90.3	26.8	23.1	0.8	6.1	280	1	1.0	Silt Loam
S14	16.0	100.0	100.0	76.9	69.8	14.7	5.3	40	3	4.0	Silt Loam
S15	31.5	100.0	87.2	49.6	18.5	1.3	3.3	320	1	3.0	Sand
S16	8.0	100.0	100.0	92.0	83.9	25.1	9.6	230	1	2.0	Silty Clay Loam
S17	8.0	100.0	100.0	98.7	65.0	15.6	6.1	80	2	3.0	Loam
S18	12.5	100.0	100.0	84.3	62.0	8.3	11.5	20	3	4.0	Sandy Loam
S19	8.0	100.0	100.0	93.3	83.7	28.3	6.5	140	2	3.0	Silty Clay Loam
S20	0.2	100.0	100.0	100.0	98.5	32.6	3.6	290	1	3.0	Silty Clay Loam

Table A2. Geotechnical measurements in the Lac de Guiers Watershed.

Sample	Dmax (mm)	Passing ≤				MO (%)	Infiltration rate (mm/h)	Permeability Classe p	Structure Code s	Soil texture
		20 mm (%)	2 mm (%)	63 µm (%)	2 µm (%)					
S01	1 mm		100	13.4	0.7	0.6	190	1	3	Sand
S02	1 mm		100	11.9	0.5	0.8	200	1	4	Sand
S03	1 mm		100	14.2	0.6	1	100	2	3	Sand
S04	1 mm		100	24.4	2.6	1	110	2	4	Sandy Loam
S05	0.5 mm		100	9.4	0.4	0.7	417	1	2	Sand
S06	1 mm		100	15.3	0.3	1.3	120	2	3	Sand
S07	0.5 mm		100	11.1	0.5	0.7	459	1	4	Sand

Continued

S08	0.2 mm		100	8.7	0.7	0.6	545	1	2	Sand
S09	0.5 mm		100	12.1	1.1	1.4	359	1	4	Loamy Sand
S10	0.5 mm		100	11.2	0.9	1.2	536	1	2	Loamy Sand
S11	0.5 mm		100	11.4	1.2	0.7	276	1	2	Sand
S12	0.5 mm		100	41.9	4.6	10.3	64	2	4	Sandy Loam
S13	0.5 mm		100	11.1	0.8	1.3	356	1	4	Sand
S14	0.5 mm		100	9.2	0.8	1.4	415	1	3	Sand
S15	0.5 mm		100	6.9	0.6	0.6	505	1	1	Sand
S16	0.5 mm		100	6.8	0.4	0.6	379	1	1	Sand
S17	0.5 mm		100	10.5	0.3	1.2	336	1	4	Sand
S18	0.5 mm		100	7.7	0.2	0.6	637	1	1	Sand
S19	0.5 mm		100	9.9	0.6	0.5	579	1	2	Sand
S20	0.5 mm		100	13.4	0.4	1.2	688	1	2	Sand
S21	0.5 mm		100	8.2	0.7	0.8	816	1	1	Sand
S22	1 mm		100	19.3	2.4	4.5	48	3	4	Loamy Sand
S23	0.5 mm		100	22.9	2.1	2.6	60	2	4	Loamy Sand
S24	1 mm		100	35.2	3.1	7.2	50	2	4	Sandy Loam
S25	2 mm	100	97.7	25.9	3.7	8.2	50	2	3	Sandy Loam
S26	0.5 mm		100	27.5	2.8	3.4	50	2	4	Sandy Loam
S27	0.2 mm		100	41.7	4.2	2.7	66	2	4	Sandy Loam
S28	0.2 mm		100	90.8	12.8	8.1	36	3	4	Silt Loam