Sediment yield from a tropical mountainous watershed by RUSLE model: An insight for sediment influx into the tropical estuary

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Abstract: Sediment yield is the possible volume of sediments that a basin is capable of delivering to its watershed outlet. It is a function of the topography of the drainage basin, climate, including precipitation, land use- land cover, soil characteristics, and other factors associated with the rate of soil formation and its transportation. Modeling sediment yield from a watershed enables quantitative computing estimates of sediments generated from a watershed. The Revised Universal Soil Loss Equation (RUSLE) is an efficient model for the assessment of annual soil loss from a basin using remotely sensed data in the Geographical Information System (GIS) platform. In the present study, the assessment of sediment yield from the Gangolli river basin of Karnataka, located on the central west coast of India, is carried out based on satellite data, processed in the GIS platform following the RUSLE model. The basin has a relief of 1360 m and a total catchment area of 1,51,927 hectares, spread on the western face of the Western Ghat region of the South Kanara district. The basin is located in a tropical environment and experiences a hot humid climate and annual precipitation of ~ 355 cm. Physiographically, the basin is divided into three subdivisions; the high-relief mountainous region of the Western Ghats, the residual hilly region with low relief, and the coastal plains. The basin has a high circularity Index (0.25) and a moderately high elongation ratio (0.51). The total actual sediment yield from the basin has been estimated to be 1,98,774.06 tons/yr-1 and the potential yield is 12,32,868.17 tons/yr-1, implying high sediment flux into the estuarine system. The results of this study help to strategize inland soil conservation planning as well as estuarine management.

Keywords: RUSLE, Sediment yield, Tropical catchment, Hypsometry, Gangolli watershed

1. Introduction

Globally, tropical rivers and some large rivers of the subtropical region contribute ~80% of sediments to the world's oceans (Eisma, 1988; Milliman, 1991) of which ~92% of the sediments are trapped in estuaries and nearshore (Gibbs, 1981; Schubel and Kennedy, 1984). This sediment is then utilized in the formation of estuarine islands, spits, beaches, dunes, and modification in the bottom bathymetry, which leads to many sediment-related problems such as siltation of the estuarine channel (Gopinathan and Quasim, 1971; Kuang et al., 2014), spit growth across river mouths (Hegde et al., 2012, Pradhan et al., 2015), narrowing and migration of river mouths, and morphological changes in estuarine islands (Kumar et al., 2010; 2012). These problems can be addressed by studying the quantum and sources of sediments arriving at the estuarine system. Different approaches include studying hydrographic conditions across the estuaries (Hegde et al., 2004), sediment sink and movement in the estuarine beaches (Hegde et al., 2007, 2009; Nayak et al., 2010; Karapurkar et al., 2022), provenance and sediment transport pathways are determined through heavy mineral constituent studies (Shalini et al., 2019; Paltekar et al., 2021). Lalomov (2003), Frihy (2007), and Shalini et al. (2019) based on the mineralogical and geochemical studies of heavy minerals from the estuarine beach sands identified alongshore currents as well as offshore sources for sediments on the modern shores. The presence of paleo-beaches off the coast (Rao and Wagle, 1997) is identified as one of the potential sources. Tamura et al. (2010) recognized fluvial sediment input sources on tropical monsoon-influenced beaches. Hitherto, the role of the fluvial influx of sediments from a mountainous tropical catchment to the estuarine system has not been emphasized. Assessment of fluvial input of sediment load from the catchment becomes a very difficult task due to its strong dependency on rainfall input, land use land cover change, and variations in soil conservation practices (Lam-Hoai et al., 2006). Lack of sediment discharge data at the watershed outlet and large-scale variations in topology leads to an improper understanding of sediment source and budget, which hinders the management of sediment-related issues such as siltation.

Sediment influx into the estuarine system can come from different sources to the estuary from its catchment, alongshore drift finally entering into the estuary by tidal surges, or from offshore sources (Shankar and Manjunatha, 1997; Evans et al., 2001; Dai et al., 2018; Kinsela et al., 2022). There are several methods to assess and compute the sediments coming from the basin, viz Universal Soil Loss Equation (USLE), Modified Universal Soil Loss Equation (MUSLE), and Revised Universal Soil Loss Equation (RUSLE). RUSLE is an efficient user-friendly model for estimating sediment yield. The parameters required can easily be obtained using remotely sensed data and it can take into account more complex combinations of tillage practices and cultivation practices as well as a wider variety of slope forms and is successfully employed for catchments of tropical mountain systems (Renard, 1997; Ganasri & Ramesh, 2016; Markose & Jayappa, 2016). The Results of the RUSLE model in combination with GIS can generate long-term results of soil erosion estimation, even for the steep slope regions when the physical parameters are known (Rangsiwanichpong et al., 2018; Ullah, 2018).

Soil erosion models Integrated with GIS and remote sensing technology are considered the most powerful tools to measure soil erosion and sediment yield at various spatial scales. Estimation of soil loss using conventional methods are both costly and time-consuming (Amin and Romshoo, 2019) especially for tropical mountain watersheds due to inadequate gauged discharge data, forest cover, and inaccessibility. In the present study, an attempt is made to assess sediment yield from the Western Ghats' mountainous tropical catchment using the RUSLE model. Although many rivers originating from the Western Ghats, flowing across the Central west coast of India and joining the Arabian Sea experience many sediment-related problems like siltation in navigational channels, the potential of the sediment yield from the catchment in siltation is not understood and the results are not integrated with the morphometric characteristics of the watershed for possible management options.

Therefore, the objective of the present study is to estimate the volume of sediments that can be released by the basin, annually and the process responsible for high erosion in mountainous tropical catchment giving high sediment yield, which is capable of delivering maximum sediments into the estuarine environment.

For this purpose, the Gangolli River basin of Kundapur Taluk in the Udupi District of Karnataka is selected. Among the other coastal districts of Karnataka, Udupi is a rapidly urbanizing area, therefore large-scale land use land cover modification is taking place, such as urbanization due to highway projects, railway projects, and watershed projects like the Chakra dam. The proposed Nethravati diversion scheme is likely to alter land use and land cover of the adjacent river basin (Djoukbal et al., 2018).

2. Study area

The Gangolli River basin (Latitudes 13^0 30' to 13^0 55'N and longitudes 74^0 40' to 75^0 10'E) is a major drainage system of Kundapur Taluk with a total drainage area of 1513.04 km^2, in Udupi district, Karnataka state, India, that debauches its sediment and water load into the Arabian sea through the Gangolli estuary (Figure 1**)**. The basin experiences a tropical environment, a hot and humid climate, and an annual rainfall of 300-350cm. Of this, 85% of the precipitation is received from the southwest monsoon from June to September and the remaining 15% of the precipitation is received throughout the northeast and inter-monsoon months. Maximum discharge through the river is observed during the monsoon season. The average temperature of the region is 26.5^0C and it experiences typical maritime weather.

The Gangolli River system is a multichannel watershed with the Kollur River, the Chakra River, and the Haladi River as the major tributaries of the Gangolli. The Haladi, Chakra, and Kollur (Souparnika) rivers originate at an altitude of 760 m above MSL at Kaveri, 820 m above MSL near Kattinahole, and 1100 m above MSL at Kodachadri, Kollur respectively, in the Western Ghats. The Haladi River flows northwesterly from its origin for about 83 km, whereas the Chakra and Kollur Rivers flow southwesterly for about 68 km and 70 km respectively, and join together near Kundapur and finally flow as the Gangolli River before its discharge into the Arabian Sea. The major tributaries of the Haladi River are the Varahi, Dasanakatte, and Kubja Rivers and the tributaries of the Chakra River include the Savehaklu Hole, and Kattinahole whereas the Kollur River has the Halkal Hole, the Jadkal hole and the Souparnika hole as major tributaries.

Several reservoirs (Bhadra, Savehaklu, and Mani) are developed on the major tributaries of the river which also work as entrapment for sediments. The river Kollur flows along the Maravathe coast parallel to the shore for 300m without meeting the sea, then takes a sharp turn landward and further flows southwards to intersect with the river Haladi at Gangolli, forming a confluence point before debauching its water-sediment load into the Arabian Sea. The river forms a wide estuary with a braided confluence system and finally forms a narrow river mouth before it enters the Arabian Sea.

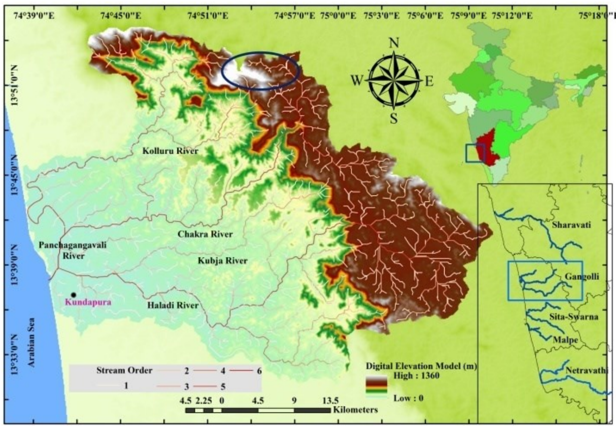

Figure 1. Location map of the Gangolli watershed.

3. Methodology

3.1. Morphometric analysis

Morphometric analysis of the drainage basin is carried out for the basin as summarized in table 1. For the generation of the Hypsometric curve, the Digital Elevation Model (DEM) of the study area is obtained from Shuttle Radar Topographic Mission (SRTM) (data obtained from usgs.gov.in dated 2005), using the Hydrology tool of ArcGIS 10.3. The same data is utilized to derive drainage and slope maps of the basin to generate a percentage hypsometric curve as given by Strahler (1954a).

3.2. Working of the RUSLE model

Sediment yield (A) in the RUSLE model (Renard, 1997) is expressed as:

$$A = R \times K \times LS \times C \times P \quad (1)$$

Where R is the Rainfall Erodibility factor, an expression of soil loss from an area due to the frequency, intensity, and duration of rainfall; K is the Soil Erodibility Factor which is determined by the texture of the soil and represents the susceptibility of soil to erosion by the impact of rain and runoff.; LS is the Topographic Factor that determines the rate of infiltration and runoff over the ground surface; C represents Cover Management Factor (C). It depends on the degree of coverage such that it is protected from the direct impact of precipitation and hence splash erosion; P is the Conservation Practice Factor determined by the land use and land cover pattern. Various data used in the present study are presented in Table 1. A brief workflow of the methodology is given in figure 2.

Table 1. Type of data used in the study.

Data Type	Source	Details
SRTM Data	www.usgsglovis.org	Digital elevation model; 2000; 30m resolution
Landsat 8	www.usgsglovis.org	Multispectral image; 12th February 2015; 30m resolution
Rainfall Data	Indian Meteorological Department, Bangalore	Rainfall data for period 1985-2014; Kundapur rain gauge station
Soil map	The National Bureau of Soil Survey and Land Use Planning, India	Soil map for the year 2003; scale: 1:2,50,00,000

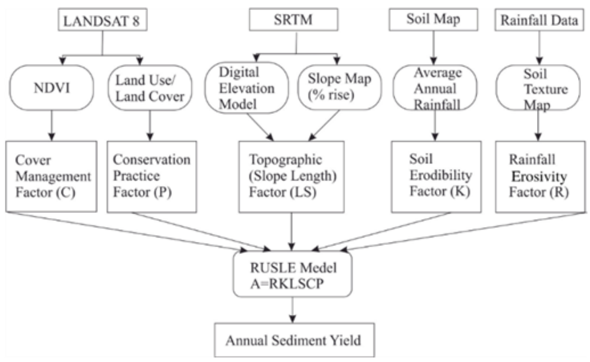

Figure 2. Workflow chart for the RUSLE model

3.2.1 Rainfall Erodibility Factor (R)

Rainfall Erodibility Factor (R) is determined by Babu et al. (2004) over the Indian subcontinent bears a relation of:

$$R = 81.5 + 0.38\,Ra \quad (2)$$

where Rα is the average annual rainfall in mm.

Rainfall data for the study area were collected from the Kundapur rain gauge for the period 1985 to 2015 and were used to determine average annual precipitation (355 cm for the study area). The Rainfall Erodibility Factor (R) is computed following the above relation.

3.2.2. *Soil Erodibility Factor (K)*

Soil Erodibility Factor (K) is dependent on the texture of the soil, organic matter content, structure, and permeability (Wischmeier and Smith, 1978) and is given by the equation:

$$K = 27.66 \times m^{1,14} \times 10^{-8} \times (12 - a) + 0.0043 \times (b - 2) + 0.0033 \times (c - 3) \quad (3)$$

where,

m is (silt%+sand%*(100-clay%)),

α is organic content (%),

b is the structure code used in classifying soils and

c is the soil permeability class.

Details of b and c are provided in table **2**. A soil map of the study area prepared by the National Bureau of Soil Survey and Land Use Planning (NBSS & LUP), India is used.

Table 2. Details of soil structural codes and soil permeability class as given by Wischmeier and Smith (1978).

b/c	Soil structural code	Soil Permeability class
1	Very fine granular	Very slow
2	Fine granular	Slow
3	Medium or coarse granular	Slow to moderate
4	Blocky, Platy, or massive	Moderate
5		Moderate to rapid
6		Rapid

3.2.3 Topographic Factor (LS)

Topographic factor (LS) is calculated using the following equation given by Ganasri and Ramesh, 2016:

$$LS = \left[\frac{Q_a M}{22.13}\right] \times (0.065 + 0.045 \times S_g + 0.0065 \times S_g^2) \quad (4)$$

where,

Q_a is the flow accumulation map,

M is the cell size,

S_g is slope rise in percentage

3.2.4 Cover Management Factor (C)

The Cover Management Factor is derived usingNormalized Differential Vegetation Index (NDVI) map of the region generated using LANDSAT-8 image where,

$$NDVI = \frac{\text{NIR Band} - \text{RED Band}}{\text{NIR Band} + \text{RED Band}} \quad (5)$$

NDVI values exhibit a non-collinear relationship with that of the C-factor. It is assumed close to 1 for the densely vegetated area and 0 for barren or water-logged areas. The majority of the area in the basin is occupied by forested land followed by water bodies and the minor area is covered by agricultural land, barren land, and suburban area. Considering the above conditions, the C-factor is obtained using the equation proposed by Jong et al. (1998).

$$C = 0.431 - 0.805 \times NDVI \quad (6)$$

3.2.5 Conservation Practice Factor (P)

The Conservation Practice Factor (P) depends on the type of land use/land cover in the region. Perfect soil conservation is represented by a value of 0, and 1 represents no conservation in the region. Land use land cover map of the area is generated using the same LANDSAT 8 image processed in a GIS environment.

3.2.6 Method for calculating Potential and Actual Sediment Yield

Actual Sediment Yield analysis is carried out following Renard 1997 as given by equation 1 and is called the Revised Universal Soil Loss Equation (RUSLE). The results obtained were processed and classified using ArcGIS 10.3. The classifications used are based on the natural slope break function, following which the areal coverage of each class is quantified. To determine the Potential Sediment Yield from the basin upon complete loss of vegetation is quantified by eliminating Cover Management Factor from the RUSLE equation (Figure 3). Hence the resulting equation can be expressed as:

$$A = R \times K \times LS \times P \quad \textbf{(7)}$$

The results were then classified upon importing the class breaks from that used for Actual Sediment Yield and Potential Sediment Yield quantified.

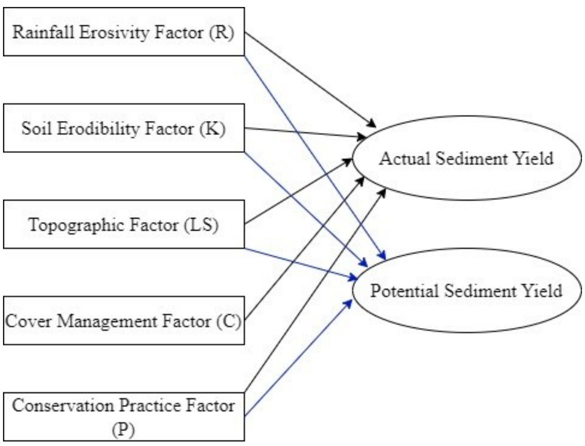

Figure 3. Workflow chart depicting the difference between actual and potential sediment yield calculation

4. Results

4.1 Morphometric parameters

The watershed of the river Gangolli is characterized by a dendritic drainage pattern, typical of humid tropical drainage basins. River Haldi and River Kollur are fifth-order streams whereas River Chakra is the fourth-order stream. River Kubja which forms the major tributary of river Haladi flows roughly parallel to river Chakra and is also a fourth-order stream. River Chakra originates on the eastern face of the Western Ghats and flows due west whereas the river Kubja originates on the western face of the Western Ghats, and flows roughly parallel to the course of river Chakra then after. River Kollur originates on the western face and river Haldi on the Eastern face of the Western Ghats. East-West is the most dominant trend of streams followed by North-South, suggesting strong structural control on the morphometry of the drainage system (Figure 4). Similar observations come from Subrahmanya (1996), Ajaykumar et al. (2017), and more. Higher-order streams show deep, narrow valleys and entrenching processes in the coastal and midlands.

Morphometry data for the Gangolli indicates that the basin is elongated with a high elongation ratio (0.51) (Schumm, 1956), a low Circularity ratio of 0.25, and a Form Factor value of 0.21 (Sukristiyanti et al., 2018). The drainage density of the basin (0.35km/km^2) is however low due to seasonal rainfall (June to October) and residual hills in coastal plains. High relief of the basin (1360m) suggests increased runoff and minimum infiltration (Akhil et al., 2022). The relief ratio of the basin (15.46m/km) together with the high ruggedness number (458.55) are suggestive of elevated runoff, hence high erosive potential.

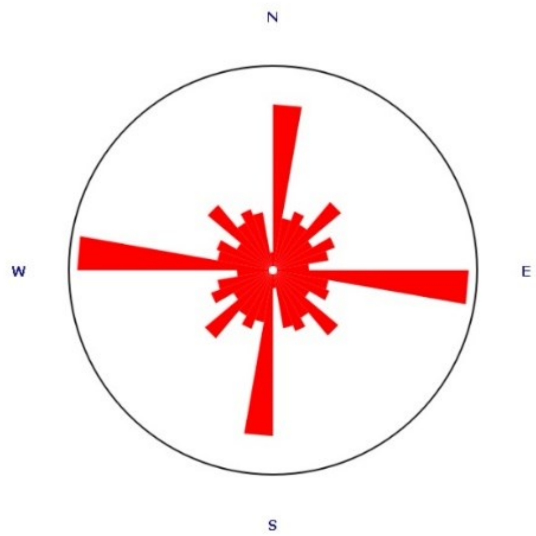

Figure 4. Rose diagram showing the dominant trends of stream flow

4.2 Hypsometric curve

The hypsometric curve for the drainage basin is generated at an interval of 25m following **Strahler (1952)**. The curve has shown a coefficient of determination of 0.849 (**Figure 5**). The hypsometric curve showed five phases of its nature based on the slope and the corresponding area.

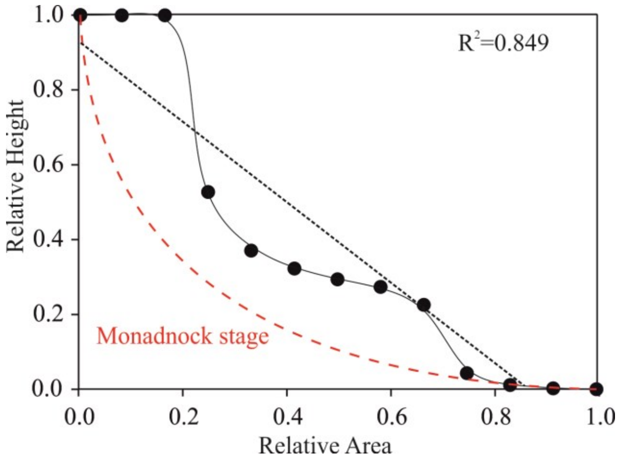

Figure 5: Hypsometric curve for the Gangolli river basin

Three steeper slopes are seen in the hilly regions of the Western Ghats (1360 to 875m and 725 to 350m) and the coastal plains (175 to 0m) with two phases of gentler slopes separating the three steep phases. Steeper phases which comprise 23.36% of the total basin area facilitate high runoff and low infiltration resulting in high sediment yield. The basin is in an inequilibrium stage as indicated by the hypsometric curve (Strahler 1954b).

4.3 Rainfall Erosivity Factor (R)

Rainfall is the major force facilitating the erosion of a landscape. Rainfall in the western tropical Indian coast increases towards the western face of the Western Ghats from the coastal plains. Continuous rainfall data helps to estimate a more representative value of R for a region.
Since the rainfall data from the study area is from one station, average rainfall over 30 years has been considered. The region under study has an average annual rainfall of 355cm during the period 1985-2015 and the value of R is worked out to be 2905.92 MJ mm ha^{-1} hr^{-1} $year^{-1}$.

4.4 Soil Erodibility Factor (K)

The soil erodibility Factor for the present study is obtained from the soil map of the area (Figure 6). The values of soil erodibility for soils in the region range from 0.001 to 0.1 (Figure 7). The mountainous region of the Western Ghats and residual hills are occupied by clayey (0.001 to 0.008) and Gravelly clay (0.003 to 0.01) soils with minor rocky outcrops (0.002). Coastal areas are occupied by diverse textured soils, dominated by Sandy over loamy around fluvial channels (0.07 to 0.08) Gravelly clay, followed by loamy over sandy (0.036), sand (0.1), and mud (0.01). With an increase in the sand portion of the soil, its susceptibility to erosion is increased. Clays however resist erosion due to cohesive forces among particles.

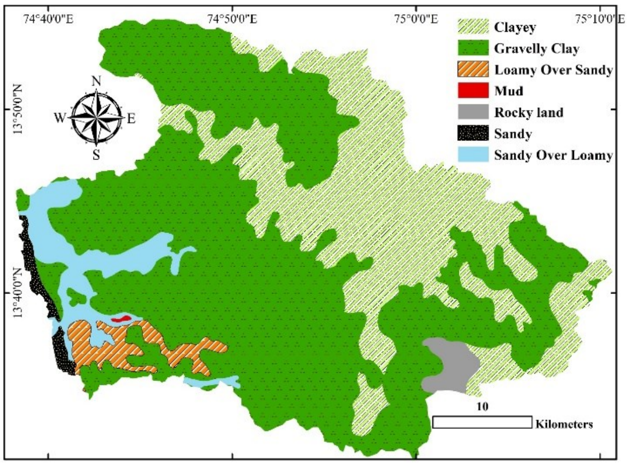

Figure 6: Soil map of the watershed derived from Karnataka soil cover map (2003) prepared by The National Bureau of Soil Survey and Land Use Planning, India on a scale of 1:2,50,00,000

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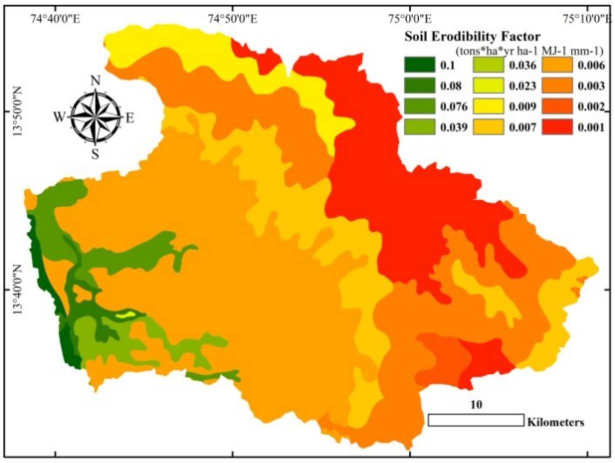

Figure 7: Soil Erodibility Factor (K) map

4.5 Topographic Factor (LS)

The study area has higher Topographic factor values in the Western Ghats (4.25 to 135.74) an attribute of a large elevation drop within a small area. It decreases further west towards the residual hills (0.53 to 4.25) and coastal plains (0 to 0.53) of the catchment (Figures 8 and 9). Since the streams draining higher relief areas have high velocity, they are capable of eroding more than those flowing in the lower reliefs in the coastal plains.

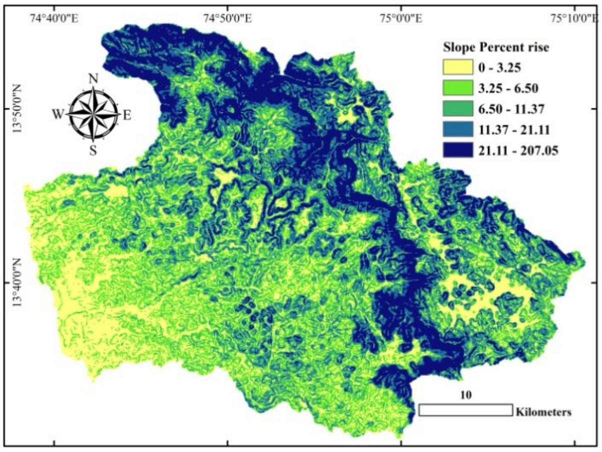

Figure 8. Slope map of the basin

4.6 Cover Management Factor (C)

The results (Table 3) suggest forest in the area is the dominant land cover (71.96%) followed by agricultural and fallow land (23.38%) (Figure 10).Value of C range from 0 to 0.59 for the study area (Figure 11). Higher values indicate water bodies, agricultural land, or poor vegetal cover. The evergreen and semi-evergreen forest-covered areas show lower C values. The direct impact of rain on the surface is thus reduced and prevents soil from being eroded due to flash erosion caused by precipitation.

Table 3. Classification of land use land cover.

Sr. No.	Class Name	Area (ha)	Area (%)
1	Water Body	6190.2	4.09
2	Forest land	73705.6	48.65
3	Scanty vegetation	33795.4	22.31
4	Suburban Area	2136.87	1.41
5	Barren Land	228.78	0.15
6	Agricultural Land	35433.1	23.39
Total		**151490***	**100**

* The observed difference between total areas of the basin pertains to geometric approximation.

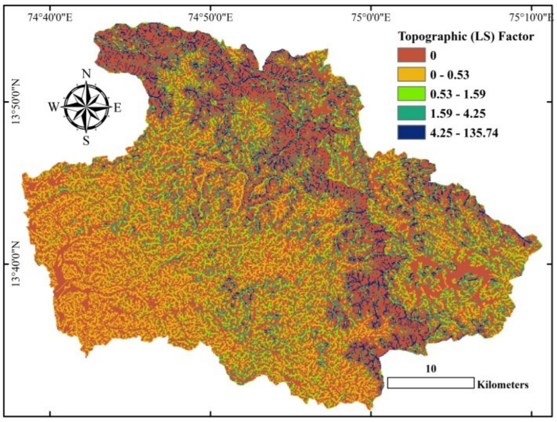

Figure 9.Topographic factor (LS) map

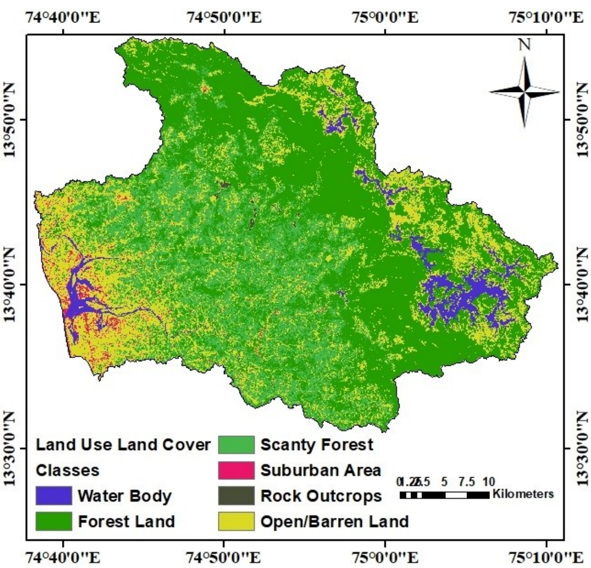

Figure 10. Land use land cover of Gangolli basin

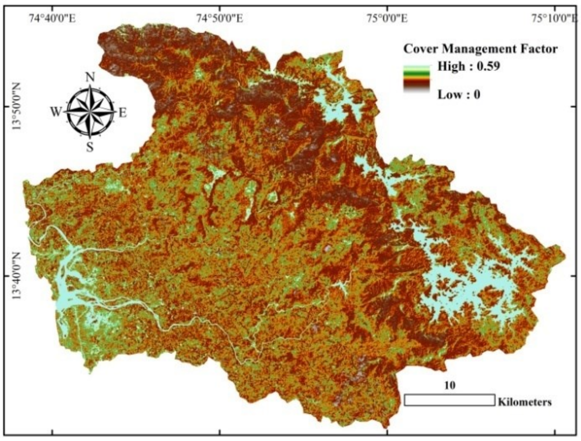

Figure 11. Crop Management factor (C) map4.7 Conservation Practice Factor (P):

Total forested land in the area together with thick and scanty vegetation account for 71.96%, whereas, of the remaining area 23.38% is covered by agricultural land, 4% by water bodies and the remaining is minor built-up land and barren area. Of the 71.96% vegetation cover, 48.65% is permanent forest land that occupies steep slopes of the Western Ghats. Hence P is considered to be 0.5 (USDA Handbook 1981). Due to the forest cover, the effect of the increase in velocity of runoff over steep slopes of the Western Ghats is reduced.

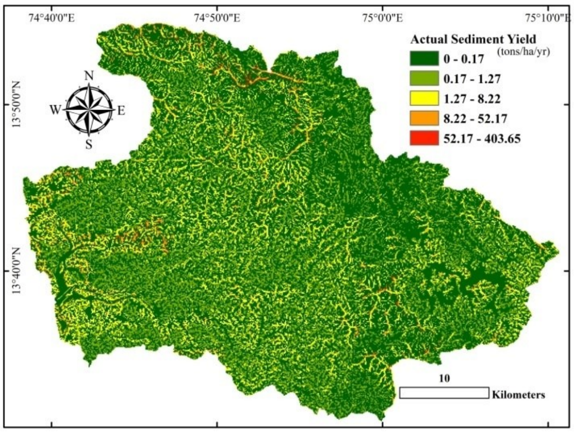

Figure 12. Map showing the actual sediment yield of the watershed

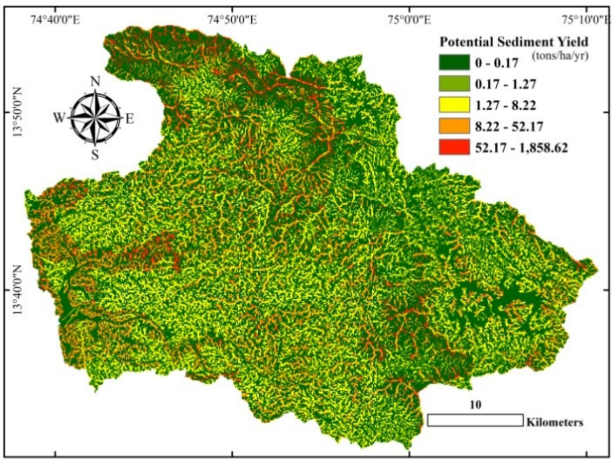

Figure 13. Map showing the potential of the watershed to yield sediments

.8 Sediment influx in the estuarine environment

The estimated sediment influx into the Gangolli estuary through the catchment using the RUSLE model revealed an annual sediment discharge of 1,98,774.06 tons (Table 4) (Figure 12). High erosive potential zones are located in the coastal plains of the basin, where most of the agricultural and urban areas exist. In the absence of the Cover Management factor, using the RUSLE model, the estimate reveals that the basin is capable of releasing 12,32,868.17 tons (Table 5) of sediments into the estuarine environment annually (Figure 13). Upon comparing the actual soil loss with the potential soil loss of the study area, it is clear that the basin is capable of releasing 10,34,094.11 tons of soil more in the absence of vegetation cover. The land use land cover map reveals that the erosive hotspots are concentrated around the estuary/lower catchment where the agricultural area and the sub-urban areas lie.

5. Discussion

A hot and humid climate facilitates soil formation processes in the tropical region, while the high precipitation and relief help in the transportation of sediments to the sea. The Gangolli River has a shorter flow length and hence has high erosive strength. This is reflected in deep entrenching valleys and high sediment output through the catchment outlets of the nearby rivers (Ganasri & Ramesh, 2016).

Higher erosive strength combined with high basin relief (1360m), high drainage density (0.35km/km^2), and high ruggedness number (458.55) and cohesive sediments in the high relief regions leads to increased sediment yield, lowered infiltration, and high runoff. These factors thus together overcome lower circularity (0.25) and high elongation (0.51) of the basin (Gajbhiye et al., 2014).

The present study revealed an estimate of 1,98,774.06 tons of annual sediment yield through the Gangolli basin of an area of 151357.08 hectares with an average sediment yield of 1.12 tons/ hectare area of the basin. Basins with a low circularity ratio have high channel storage and low sediment yield–delivery ratio (Singh et al., 2009, Bhagwat et al., 2011). Elongation ratios nearer to 1.0 are typical of regions of very low time of concentration resulting in peak flow and flood (Bhagwat et al., 2011). Since the river has a low Circularity ratio and high elongation ratio, sediment influx to the estuarine environment is high.

The sediments are mostly concentrated in the nearshore region and continental shelf, with only ~8% of the terrestrial sediment input reaching the deep ocean (Gibbs, 1981; Schubel & Kennedy, 1984). The release of sediments into the estuarine environment, coupled with sediment influx/out fluxes through tidal surges are evident from the morphological changes in the estuarine islands and their banks (Mahapatra et al., 2014). Sediment yields through the basin hence help in the effective management of the estuarine and coastal morphology.

The potential of the basin to yield sediments in the absence of vegetation cover in the area using RUSLE (Renard, 1997) gave an estimate of 12,32,868.17 tons of sediments that can be delivered into the Gangolli estuary. This suggests an average of 10,34,094.11 tons of sediments is annually held by the vegetation cover in the basin. Therefore, any change in land use land cover in the basin will alter the quantum of sediments that can be yielded from the basin.

Table 4. Categorization of the actual degree of soil erosion, and soil loss

Erosion Categories	Class Interval	Area (ha)	Area (%)	Soil Loss (tons yr-1)
Very slowly eroding	0-0.17	89,795.87	59.33	1.18
Slightly eroding	0.17-1.27	34,925.87	23.08	22,694.86
Moderately eroding	1.27-8.22	22,567.62	14.91	84,915.63
Highly eroding	8.22-52.17	3,867.49	2.56	69,683.84
Severely eroding	>52.17	200.23	0.13	21,478.55
Total		**1,51,357***		**1,98,774.06**

*The observed difference between total areas of the basin pertains to geometric approximation.

Table 5. Categorization of potential degree of soil erosion, and soil loss

Erosion Categories	Class Interval	Area (ha)	Area (%)	Soil Loss (tons yr-1)
Very slowly eroding	0-0.17	89,748.15	59.30	18.6
Slightly eroding	0.17-1.27	5,511.11	3.64	5,330
Moderately eroding	1.27-8.22	30,341.80	20.05	1,42,503.9
Highly eroding	8.22-52.17	21,646.54	14.30	5,24,948.8
Severely eroding	>52.17	4,109.48	2.72	5,60,066.8
Total		**1,51,357***		**12,32,868.17**
Sediments held by basin				**10,34,094.11**

*The observed difference between the total areas of the basin pertains to geometric approximation.

6. Conclusion

Extensive coastal conservation projects like seawall construction and breakwater construction along the Maravanthe coast imply beach erosion problems. At the same time, training of the river mouth with breakwaters and dredging to maintain the navigational depth in the estuarine channel indicates siltation. The building of several dam reservoirs and vented dams in the upstream basin has rendered low fluvial sediment influx to the coastal environment. These observations necessitate the estimation of sediment yield through the basin. This study employed the Revised Universal Soil Loss Equation to model the soil yielded from the Gangolli watershed. The basin yielded 1,98,774.06 tons of soil during the year 2015. In the complete absence of vegetation cover, the basis has the potential of yielding 12,32,868.17 tons/yr soil. With continued deforestation, erosion of soil will concentrate along the residual hills and coastal plains. This huge quantity of sediments can reduce the storage capacity of reservoirs upstream as well contribute to the siltation of the estuarine navigable channel. Knowledge of the quantum of sediment yield through the basin will provide valuable insight and a basis for the management of estuary and the adjacent beaches.

Watersheds with fairly good permanent vegetation cover, low relief, and well-developed soil cover for a high infiltration rate with low runoff, and low elongation ratio with favorable conservation practices will thus yield lower sediments in a given tropical climate. Whereas a decrease in forest covers, high relief with lower flow length leads to higher susceptibility of soil to erosion in the same climate. Availability of temporally distributed sediment discharge data at the outlet of a river, rainfall data over the basin, and field surveyed soil texture data can help to predict an accurate estimate of sediment yield through a basin. The present study is based on readily available data in the public domain and with limited ground-truth surveys. The study concludes that the Revised Universal Soil Loss Equation is an efficient and effective method for estimating sediment yield through a tropical river basin.
This study helps in understanding the role of vegetation cover in conserving soil and the potential of fluvial sediments in controlling the configuration of the coast. RUSLE has proved to be an effective tool in the quantification of sediment yield through the watershed. It is an efficient method to locate erosional hotspots and hence its management. A yearly sediment yield estimation is required to establish the trend in.

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