

# **A Study on Hydrosedimentological Process In Prediction and Comparison of Soil Erosion & Sediment Yield with Influence of Spatiotemporal Changes of Land Use-Land Cover Classifications Using Remote Sensing & Gis Technology Based ‘Sateec’ Model**

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**ABSTRACT:** Soil erosion is the first step in the sedimentation processes which consist of erosion, transportation and deposition of sediment. Controlling sediment loading requires the knowledge of the soil erosion and sedimentation. Also an accurate and effective approach for prediction of Sediment Delivery Ratio (SDR) is important in controlling sediments which is usually not measured for sustainable natural resources development and environmental protection. The goal of this study is to quantitatively analyze soil erosion & sediment yield from Slope-based and Area-based SDRs with two different Land Use-Land Cover (LU/LC) maps with a 10 years distant of 2004-2013. To compute effectively suitable spatial and non-spatial data required such as Land use-Land Cover, soil data, DEM, and Rainfall data with higher accuracy for ‘Karha’ watershed. In this paper, a Hydrosedimentological approach of ‘Soil Assessment Tool for Effective Erosion Control’ (SATEEC) model to predict Soil Erosion and Sediment load using Remote Sensing & GIS Technology. Spatial information utilized to prepare input data and Geographic Information System (GIS) is used to compute the volumetric factors in the model. The total annual average soil erosion obtained 9,91,842 (t/ha/yr) from 2004-05 LU/LC map and 12,91,360 (t/ha/yr) using 2013-14 LU/LC map. The average sediment yield obtained from slope based method SDR were 1,45,856 (t/yr), 1,89,899 (t/yr) with 2004-05&2013-14 LU-LC maps respectively. Similarly the average sediment yield obtained using Area-Based SDR equations are 1,70,773(t/yr) and 2,22,344(t/yr) using 2004-05&2013-14 LU-LC maps. The SATEEC model results reveals that USDA-SCS method of SDR deliver higher soil erosion and sediment yield from both 2004-05& 2013-14 Land use-Land Cover maps.

**KEYWORDS:** Hydrosedimentation, SATEEC, Sediment, Erosion, SDR, GIS

## **I. INTRODUCTION**

GIS technologies could provide a powerful tool to model the soil erosion for their spatial analysis and prediction. Many previous [1], [2] and [3] studies explained that by using GIS the collection, manipulation and analysis of the environmental data on soil erosion can be done much more efficiently. In their studies, [4] concluded that the erosion degree in the area ranges from very slight to very severe, depending on land status. Erosion was found to occur slightly in the forestland but was more severe in the dry and shrub lands especially in areas with slope more than 15% [4]. while [5] explained that the result of simulation depending on model selection and measurement accuracy. Sediment prediction can be done by calculating SDR and calculation is important for realistic prediction of total sedimentation base on erosion calculation in watershed. Accurate prediction of sediment delivery ratio is an important and effective approach to predict sediment yield which is usually not measured. Presently available prediction models are not generally applicable to a particular watershed [6]. SDR can be affected by a number of factors including sediment source, texture, nearness to the main stream, channel density, basin area, slope, length, land use/land cover, and

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rainfall-runoff factors. There is no precise procedure to estimate SDR, although the USDA has published a handbook in which the SDR is related to drainage area [7].

In this study we proposed a method to analyze the potential of soil erosion in the Karha catchment using Geographic Information System (GIS) combining with Universal Soil Loss Equation (USLE) method embedded in SATEEC Model. Incorporating many improvements from the original model, an updated USLE was presented in Agriculture Handbook No. 537 [8]. Further successive efforts to improve the USLE has been made by researchers in the last 3 decades [9], resulting in numerous models including: the Modified Universal Soil Loss Equation (MUSLE) developed by Williams in 1975, the Areal Nonpoint Source Watershed Environmental Simulation [ANSWERS] [10], the Guelph Model [11], the Unit Stream Power- based Erosion Deposition [USPED] [12], and the Revised Universal Soil Loss Equation [RUSLE] [13]. The RUSLE is an empirical erosion model designed to predict the long-time average annual soil loss (A) carried by runoff from specific field slopes in specified cropping and management systems as well as from rangeland areas. Result of this analysis then used to calculate the value of Sediment Delivery Ratio (SDR) and compared with empirical equation proposed by Renfro, Vanoni and USDA. The methods and results presented in this paper rely heavily on the application of GIS to predict Soil Erosion and Sediment Yield with Spatio-Temporal changes of Land use-Land Cover maps using RS&GIS based SATEEC GIS System Model.

## II. STUDY AREA

Karha river basin in Maharashtra State, is a part of Neera basin which is a sub-basin of Bhima river basin. Karha is the principal river of the Karha basin. The river originates in the hills of Sahyadri, upstream of village Garade and flows through Purandar hills, plateau region of Kade Pathar, plains of Baramati region of Pune District and then joins river Neera. The basin is landlocked between Upper Bhima basin and the remaining Neera basin. The river is seasonal in nature, flows in monsoon months only. The river is intermittent since i.e. stream flow falls to zero most of the time, especially during non-monsoon period. It is one of the driest watersheds of the Bhima basin classified under drought-prone zone. The commencement of the hydrologic year for the Karha basin in the month of June, when groundwater is at its lowest water level. The catchment area depict with SATEEC model of Karha basin was 1334 km<sup>2</sup>. The location map of the Karha basin is shown in Fig. 1.

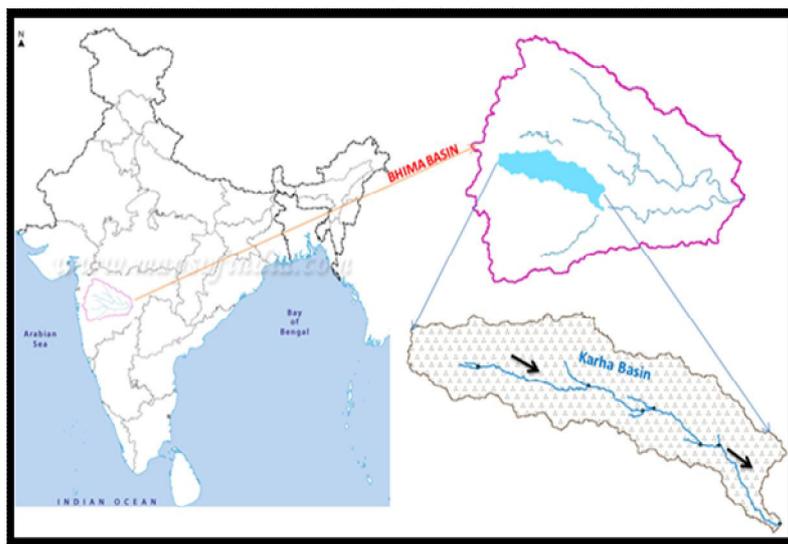


Fig. 1 Location Map of 'Karha' Watershed

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## III. MATERIALS NEEDED

- Digital Elevation Model (DEM)
- Land Use – Land Cover (LU-LC) Map
- Soil Map
- Rainfall Data

### Digital Elevation Model (DEM)

The use of GIS in environmental engineering has seen an unprecedented growth in the recent past. GIS software captures geographic data for manipulation, viewing, and analysis [14]. The increased popularity of GIS technology and availability of Digital Elevation Models (DEM) has led to wide recognition of using DEMs in studies of surface processes including prediction of the spatial extent of gross soil loss rates. Additionally, the automated generation of drainage networks has become increasingly popular with powerful analytical functions in GIS and with the increased availability of DEMs [15]. It is through the distribution of soil that the land surface changes over the long term and so the ability to link sediment transfer with DEM changes [16]. A CARTOSAT-1 DEM downloaded from 'BHUVAN-ISRO Geoportal gateway' website and changes its spatial reference and converted into grid format by assigning a spatial resolution of 24 m in ArcGIS environment as shown in Fig. 2.

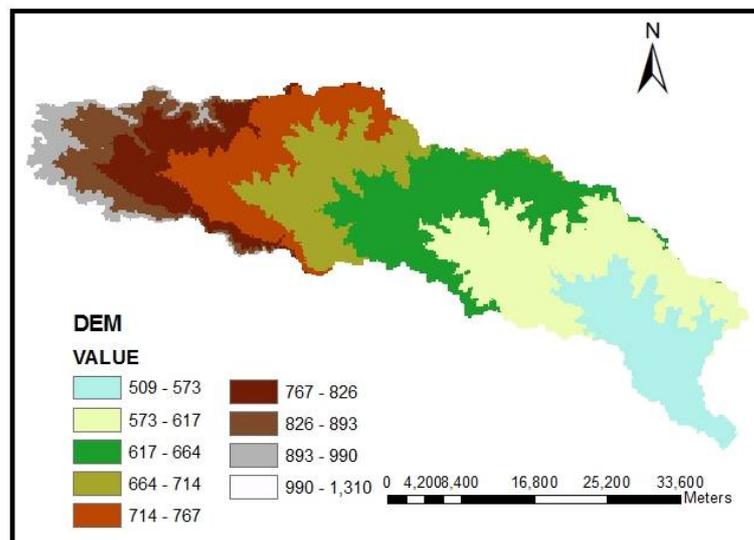


Fig. 2 Digital Elevation Model of 'Karha' Watershed

### Land Use-Land Cover Map (LULC)

This study mainly dealt with estimation of soil erosion and sediment yield with different temporal resolution of the land use/ land cover maps. For this LU/LC data a request has been made for BHUVAN-ISRO web site [17] for the year 2003-04 and 2014-15. The required data has been supplied through the user mail and was down loaded. The LU/LC map supplied having decimal degree coordinate system. It was clipped/sub-set in ArcGIS environment using the Water Management Area (WMA) boundary of the Karha watershed (Figure 1) and later it was projected to UTM projection by specifying a grid cell size of 24 m for accurate computation of physiographic parameters.

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## LULC- 2004-05 Map

The land use-land cover map supplied by BHUVAN-NRSC classified into 13 types in karha basin. The maximum area of 557.53 km<sup>2</sup> covered under Current Fallow, Which is 42 % of the total area. And the minimum and least area of Evergreen forest class covered with 0.003 km<sup>2</sup> area which is a very least percentage of the area covered in the Karha basin in the year 2004-05. The land use-Land cover map of 2004-05 is shown in Fig. 3. All 4 types of crop lands having an area of 518.88 km<sup>2</sup> and all 3 types of forest land covered 0.613 km<sup>2</sup>, water bodies with 7.5 km<sup>2</sup> area.

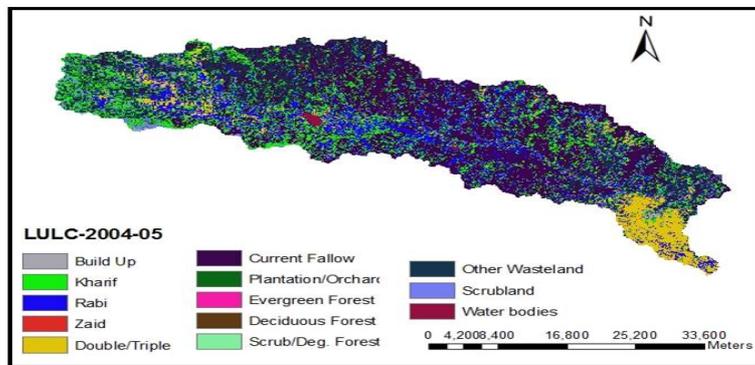


Fig. 3 Land Use-Land Cover Map – 2004-05

## LULC- 2013-14 Map

The BHUVAN-NRSC classified map covered under 13 types similar to the 2004-05 classified map in karha basin. The maximum area of 590.64 km<sup>2</sup> covered under current Fallow, which is 44% of the total area. And the minimum and least area of 0.003 km<sup>2</sup> covered which is similar area under 2004-05 land use-land cover map. The land use-Land cover map of 2013-14 is shown in Fig. 4. The major varieties of crop lands of Kharif, Rabi, Zaid, Double/Triple having an area of 270.45 km<sup>2</sup> and forest types of Evergreen, deciduous, Degraded forest lands covered with 0.563 km<sup>2</sup> and water bodies with an area of 15.56 km<sup>2</sup>

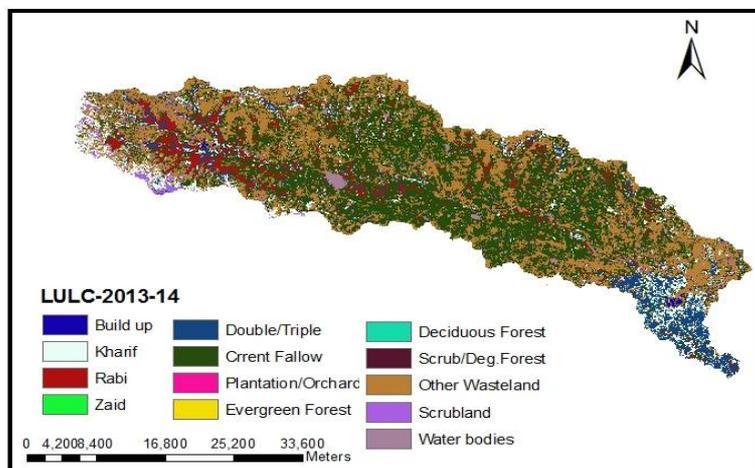


Fig. 4 Land Use-Land Cover Map – 2013-14

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A typical comparison table prepared between Land use-Land cover types of the year 2004-05 & 2013-14. This table clearly demarcate the increase or decrease in areas of various land cover types after a 10 years period of 2004-05 LU/LC map. Land cover types of Build up, Current Fallow, Other Wasteland and Water bodies area increased from 2004-05 map. The other land cover types of all Crop type lands, plants, scrubland are decreased when compare with 2004-05 map as shown in Fig.5.

LU/LC TYPE	Area, sq.km		Increase/Decrease of Area in the year 2013-14
	2004-05	2013-14	
Build up	2.56	2.61	Increased by 0.05 Km <sup>2</sup>
Current Fallow	557.53	590.64	Increased by 33.11 Km <sup>2</sup>
Deciduous Forest	0.39	0.39	-NIL-
Double/Triple	107.2	76.22	Decreased 30.98 Km <sup>2</sup>
Evergreen Forest	0.003	0.003	-NIL-
Kharif	230.26	102.0	Decreased 128.26 Km <sup>2</sup>
Other Wasteland	180.54	419.09	Increased 238.55 Km <sup>2</sup>
Plant/Orchard	0.7	0.61	Decreased 0.09 Km <sup>2</sup>
Rabi	177.10	90.74	Decreased 86.36 Km <sup>2</sup>
Scrub/Deg.Forest	0.22	0.17	Decreased 0.05 Km <sup>2</sup>
Scrubland	66.14	35.2	Decreased 30.94 Km <sup>2</sup>
Water bodies	7.5	15.56	Increased 8.06 Km <sup>2</sup>
Zaid	4.32	1.49	Decreased 2.83 Km <sup>2</sup>

Fig. 5 A comparison Table of LU-LC Map-2004-05&2013-14

### Preparation of SOIL DATA

The soils data used to run N-SPECT is taken from the U.S. Department of Agriculture's (USDA) Food and Agricultural Organization (FAO) database [18] specifications are necessary before the data can be loaded into RINSPE Model. The raw FAO soil map is sub-set into the area of interest and writing the correct soil texture descriptions of Karha basin is shown in Fig. 6.

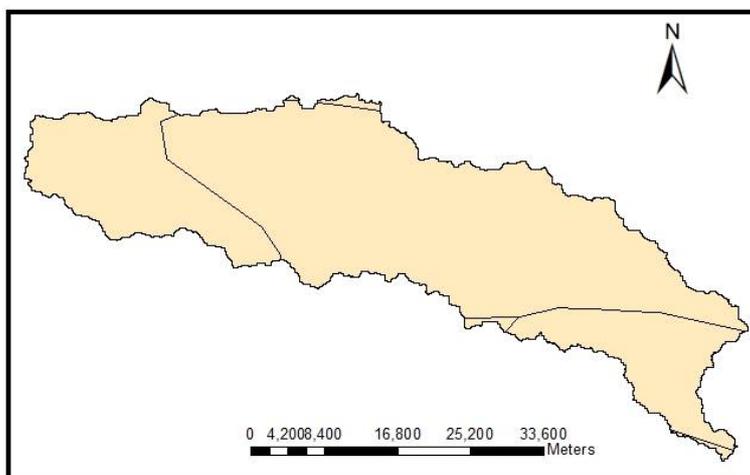


Fig. 6 A Raw Food and Agricultural Organisation(FAO) Soil Map of Karha Basin

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## Rainfall Data

The karha watershed contains 7 rain gauge stations of Tapewadi, Saswadi, Tekadi, Malshiras, Jejuri, Morgaon, and Barhanpur having a rainfall data of 30 years from 1994-2014. The point location map rain gauges covered in Karha basin is shown in Fig. 7.

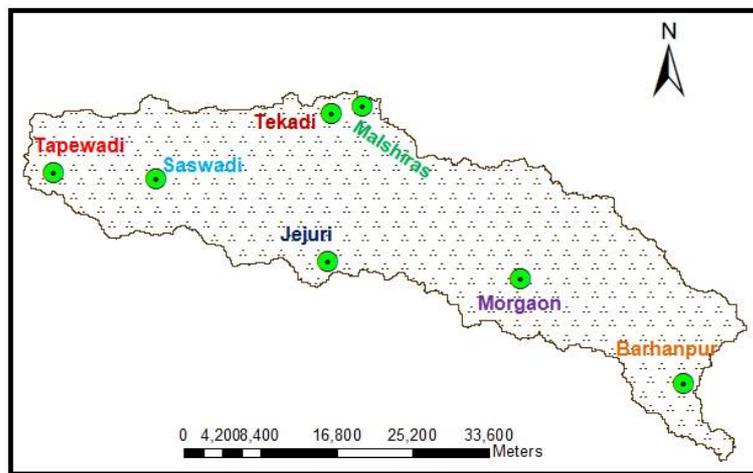


Fig. 7 Rain gauge stations covered in Karha Basin

## IV. METHODOLOGY

The basic equation which embedded in SATEEC model to predict soil erosion and sediment yield was Revised Soil Universal Soil Loss Equation (RUSLE). The RUSLE model has advantages because the data requirements are not too complex or unattainable, it is relatively easy to understand, and it is compatible with GIS [19]. Numerous studies integrating the RUSLE model combined with GIS techniques to analyze the spatial extent of gross soil loss rates have been successfully performed in the past two decades [20], [21], [22], and [23]. Both USLE and RUSLE compute the average annual erosion expected on field slopes and are shown in equation (1)

$$A = R \times K \times L \times S \times C \times P \dots \dots \dots Eqn (1)$$

Where:

- A = computed spatial average soil loss and temporal average soil loss per unit of area, expressed in the units selected for K and for the period selected for R. In practice, these are usually selected so that A is expressed in ton·acre-1·yr-1, but other units can be selected (that is, ton·ha-1·yr-1)
- R = rainfall-runoff erosivity factor—the rainfall erosion index plus a factor for any significant runoff from snowmelt (100ft·tonf·acre-1·yr-1)
- K = soil erodability factor – the soil-loss rate per erosion index unit for a specified soil as measured on a standard plot, which is defined as a 72.6-ft (22.1-m) length of uniform 9% slope in continuous clean-tilled fallow
- L = slope length factor—the ratio of soil loss from the field slope length to soil loss from a 72.6-ft length under identical conditions
- S = slope steepness factor—the ratio of soil loss from the field slope gradient to soil loss from a 9% slope under otherwise identical conditions
- C = cover management factor – the ratio of soil loss from an area with specified cover and management to soil loss from an identical area in tilled continuous fallow

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P = support practice factor—the ratio of soil loss with a support practice like contouring, strip-cropping, or terracing to soil loss with straight-row farming up and down the slope

L and S factors stand for the dimensionless impact of slope length and steepness, and C and P represent the dimensionless impacts of cropping and management systems and of erosion control practices. Over the years, the USLE and RUSLE became the standard tool for predicting soil erosion not only in the U.S., but also throughout the world [23].

### Rainfall-runoff Erosivity, R Factor

The rainfall–runoff erosivity factor is defined as the mean annual sum of individual storm erosion index values, EI30, where E is the total storm kinetic energy and I30 is the maximum rainfall intensity in 30 minutes. Wischmeier and Smith (1978) [8] recommended that at least 20 years of rainfall data be used to accommodate natural climatic variation. Related to the rainfall runoff erosivity factor each data point needs to be interpolated spatially to make the same grid cell size as the other thematic maps: DEM, Soil Map, Land use-Land Cover map, and Topographic map. The rainfall Erosivity factor, R-factor is computed using the equation (2)

Equation used to Calculate Rainfall Erosivity Factor.....Eqn (2)

$$R = 0.0483 * P^{1.610}$$

Where P =annual precipitation (mm)

After preparation of a rainfall data for each station, the shape file is converted in to a raster map using raster calculator in spatial analyst tools. This point map of rainfall is interpolate to raster map using Inverse Distance Weighted (IDW) method and converted into a grid map. In the case of the average annual Rainfall Runoff Erosivity Factor(R-factor), the maximum value is 63 at Tapewadi and Barhanpur rainfall gauge stations and the minimum value is 10 at Jejuri and Takedi rain gauge stations as shown in Fig.8.

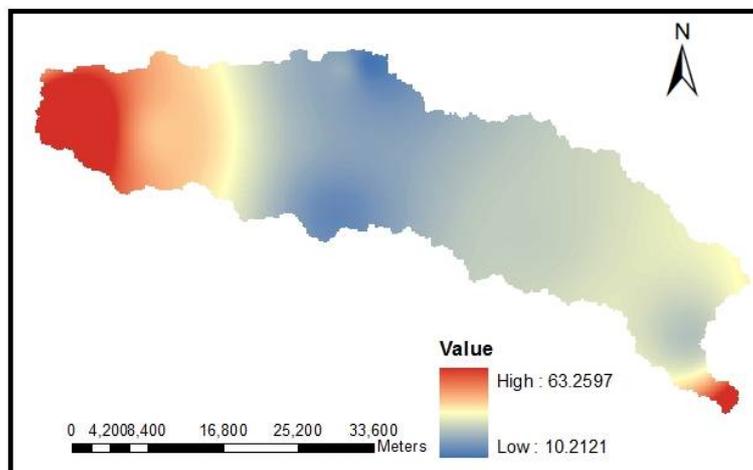


Fig. 8 Rain Erosivity, R-factor Map of Karha Basin

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## Soil Erodibility, K Factor

The K factor represents the (1) susceptibility of soil or surface material to erosion, (2) transportability of the sediment, and (3) amount and rate of runoff given in a particular rainfall input, as measured under a standard condition [24]. The K factor indicates susceptibility of a soil to sheet and rill erosion by water. The K factor is one of the six factors used in the RUSLE to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The primary data acquisition method for the determination of the spatially based ‘K-factor’ for soil erosion modelling is soil surveys. Soil surveys are made to provide information about soils in a specific area. The soil classification map was used to generate a ‘K-factor’ map for all of the watersheds. Figure 9 presents the spatial distribution of the K factor values used in the GIS application of the RUSLE model.

## Topographic Factor, LS Factor

The topographic factors of the RUSLE model include the slope length factor (L) and the slope gradient factor (S). The L and S factors represent the effects of slope length (L) and slope steepness (S) on the erosion of a slope. The combination of the two factors is commonly called the “topographic factor.” The L factor is the ratio of the horizontal slope length to the experimentally measured slope length of 22.1 meters. The S factor is the ratio of the actual slope to an experimental slope of 9 percent. The L and S factors are designed such that they are one when the actual slope length is 22.1 and the actual slope is 9 percent. Programmatic methods for calculation with GIS analysis was performed to estimate the ‘LS factor’ using the digital elevation model for the site. SATEEC computed the ‘LS factor map’ based on DEM and the method suggested by equation (3) [25].

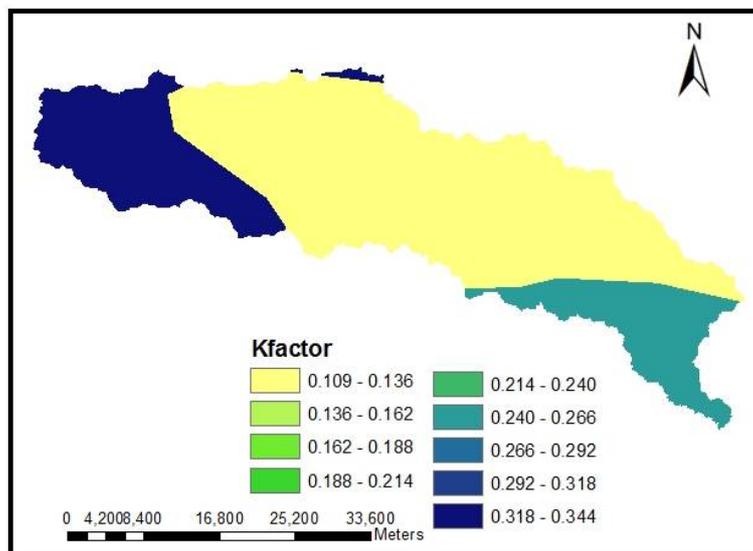


Fig. 9 Soil Erodability, K-factor Map of Karha Basin

The length of hill slope in the USLE experimental plots ranged from 10.7 m (35ft) to 91.4 m (300 ft), thus, it was recommended to use of slope lengths less than 122 m (400 ft) because overland flow becomes concentrated into the rills in less than 122 m (400 ft) under natural condition [26]. A CARTOSAT-I DEM utilized to derive ‘LS’-factor map from SATEEC model as shown in Fig. 10

$$LS = (A/22.13)^{0.6} * (\sin \theta/0.0896)^{1.3} \dots\dots\dots \text{Eqn (3)}$$

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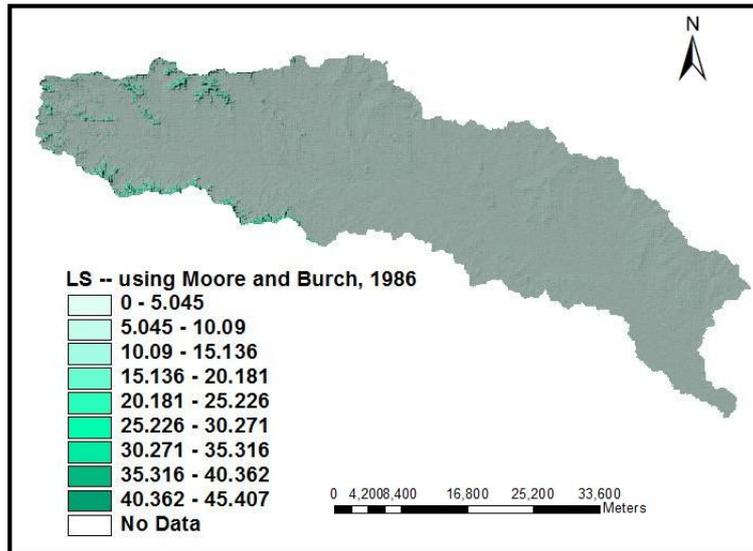


Fig.10 Topographic factor, 'LS-factor' Map of Karha Basin

**Cover Management, C-Factor:** The C factor represents the effect of plants, soil covers, soil biomass, and soil disturbing activities on soil loss and is the cropping management factor normalized to a tilled area with continuous fallow [27]. The C-factor values used for this analysis ranged between 0.11 and 1.0. The prepared C-factor map for both LU/LC years as shown in Fig.11.

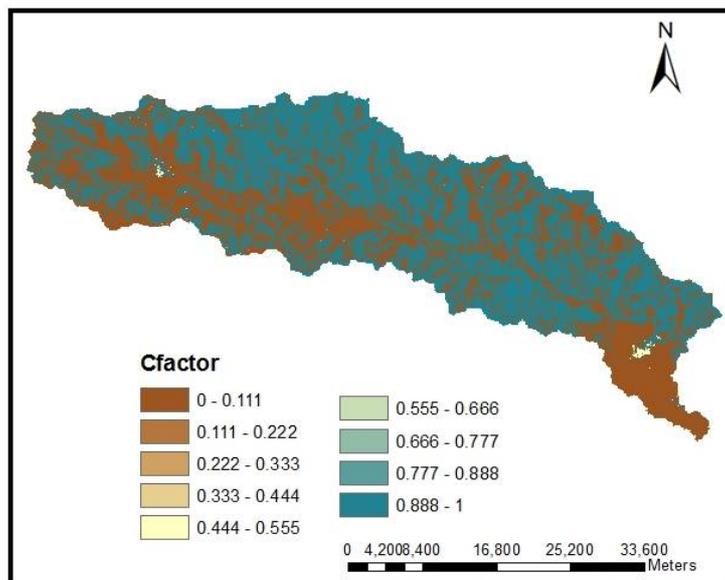


Fig. 11 Cover Management, C-factor Map of Karha Basin

## Support Practice , P-Factor

The Support Practice Factor (P) in RUSLE is defined as the ratio of soil loss with a specific support practice to the corresponding soil loss with straight row upslope and downslope tillage. The P-factor accounts for control practices

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that reduce the erosion potential of the runoff by their influence on drainage patterns, runoff concentration, runoff velocity, and hydraulic forces exerted by runoff on soil. The support practice factor is calculated based on the relation between terracing and slope in the paddy field areas and is estimated according to the relation both contouring and slope in the crop field areas. The prepared p-factor map from LU/LC map of the year 2004-05&2013-14 as shown in Fig.12.

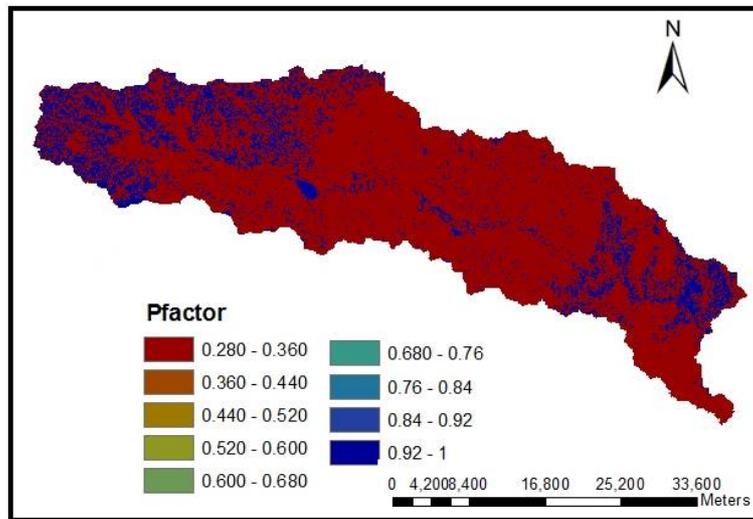


Fig. 12 Support practice, P-factor Map of Karha Basin

### Sediment Delivery Ratio (SDR)

The term sediment delivery has been widely used to represent the resultant of various processes involved between on-site erosion and downstream sediment yield [28]. The concept of sediment delivery ratio can be defined as the ratio of sediment delivered at the catchment outlet ( $t/ km^2 /yr$ ) to the gross erosion within the basin ( $t/ km^2 /yr$ ). The SDR is effectively an index of sediment transport efficiency [21]. The *SDR* is a dimensionless scalar that denotes the ratio of the sediment yield (*Y*) at a given stream cross-section to the gross erosion (*AT*) from the watershed upstream of the measuring point [27] and is represented as:

$$SDR= Y/ AT$$

Methods to estimate the SDR can be roughly grouped into three categories [21]. The first category involves specific sites where sufficient data are available such as sediment yield and stream flow data, which allow for methods using sediment rating curve-flow duration or reservoir sedimentation to be used. The second category attempts to build models based on fundamental hydrologic and hydraulic processes. The third category uses empirical relationships which relate SDR to morphological characteristics of the watershed, such as the catchment area [21]. Three primary SDR equations are used in this study: Boyce (1975), Vanoni (1975), and USDA-SCS (1979). Sediment yields can be quantified using the SDR, expressed as the percent of gross soil erosion by water that is delivered to a particular point in the drainage system. Presently available prediction models are not generally applicable to a particular watershed.

**Boyce (1975)** [29] established a relationship between sediment delivery ratio and drainage area by compiling and analyzing sediment yield observation from five areas in continental US. Equation 1 presents the power function:

$$SDR = 0.3750 * A^{-0.2382} \quad (A \text{ in } km^2) \dots \dots \dots \text{Eqn. (4)}$$

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**Vanoni (1975)** [30] developed data from 300 watersheds throughout the world to develop an equation by the power function. This equation is considered a more generalized one to estimate the SDR (Kim, 2006). Equation 2 presents the power function developed by Vanoni (1975):

$$SDR = 0.4724 * A^{-0.125} \quad (A \text{ in } mi^2) \dots \dots \dots \text{Eqn.(5)}$$

The **USDA SCS (1979)** [31] developed a SDR model based on data from the Blackland Prairie, Texas. Equation 3 presents the power function developed by SCS (1979):

$$SDR = 0.5656 * A^{-0.11} \quad (A \text{ in } mi^2) \dots \dots \dots \text{Eqn (6)}$$

The data utilized and sequential order of utilization of these input data and procedure to run SATEEC model is explained in brief using a flow-chart as shown in Fig:13.

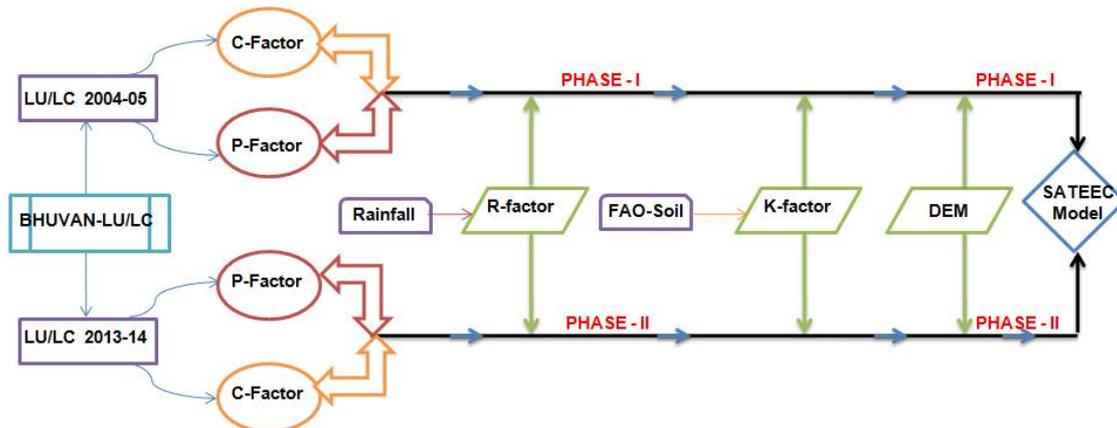


Fig. 13 Flow-Chart of Methodology

### OverView of SATEEC GIS System

The “Sediment Assessment Tool for Effective Erosion Control” (SATEEC) is one of them with several enhanced modules for sediment yield estimation at a watershed scale with higher accuracies in sediment evaluation. The SATEEC system has been applied for various soil erosion studies because it is available in GIS interface and is freely downloadable from the SATEEC website (<http://www.EnvSys.co.kr/~sateec>). The SATEEC system was developed in 2003 [32] and has been upgraded with various enhanced modules incorporated into the system [33], [34]. It has been applied to various watersheds with diverse purposes [35], [36], [37]. The overview of SATEEC GIS System Model is shown in Fig.14.

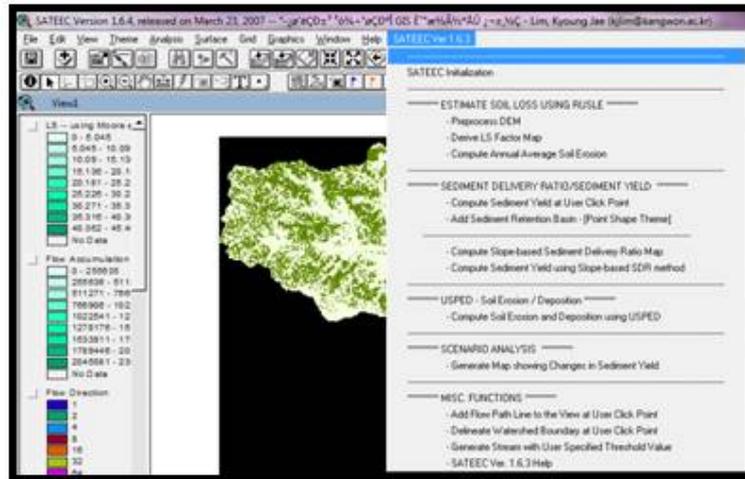


Fig. 14 Overview of SATEEC Model

## V. MODEL APPLICATION & DISCUSSIONS

After preparation of all necessary input thematic maps in the form of R-factor, k-factor, C-factor, P-factor and DEM to derive 'LS factor' maps, the SATEEC GIS System model was successfully run in two phases. Phase-I, by considering Land use-Land Cover Map of 2004-05 with other thematic maps for RUSLE parameters, and for Phase-II with land use-Land Cover map of 2013-14 along with other relevant parametric maps for RUSLE. The SATEEC model run in two different phases by considering two different Land-use-Land cover maps to compute sediment yield using Vanoni, Boyce and USDA-SCS methods in two phases with same LS factor maps using Moore&Burch method. The results obtained for two phases are discussed separately in the following paragraphs.

**Phase-I:** The input data for RUSLE parameter of Crop cover-Cfactor and Practice-Pfactor are prepared using 2004-05 land use-land cover map, deriving LS factor with Cartosat-DEM using Moore&Burch for estimation of soil erosion. A slope based SDR using Vanoni, Boyce and USDA-SCS methods to compute Sediment yield. The Total Annual Average Soil erosion obtained 9,91,842 (t/ha/yr) using LU/LC map of year 2004-05. The sediment yield computed from Vanoni, Boyce and USDA-SCS methods were 190778, 67121 and 254442 (t/yr) from Area-based SDR equations. The average sediment yield from these 3 methods was 170773 (t/yr). With simple analysis, USDA-SCS method of SDR deliver higher Sediment yield from 2004-05 Land use-Land Cover map.

**Phase-II:** The Crop cover Management-Cfactor and Crop cover Practice-Pfactor are prepared with a 10 years period gap of 2013-14 land use-land cover map, deriving LS factor with Cartosat-DEM using Moore&Burch for estimation of soil erosion. Area based SDR using Vanoni, Boyce and USDA-SCS methods to compute Sediment yield. The SATEEC model predicted Average Annual Soil erosion 1,91,360 (t/ha/yr). The sediment yield 248389, 87391, and 331252 (t/yr) obtained from Area-based SDR methods of Vanoni, Boyce and USDA-SCS. The average sediment yield from these three methods was 222344 (t/yr). With simple analysis, USDA-SCS method of SDR deliver higher Sediment yield obtained from 2013-14 Land use-Land Cover map.

### Comparison of Phase-I & Phase-II:

The SATEEC model results for both years reveals that Area-based method of USDA-SCS deliver higher sediment yield of 3,31,252 (t/yr) from 2013-14 Land use-Land cover map. The average sediment yield obtained from Area-based SDR methods was 2,22,344 (t/yr). The Boyce (1975) method deliver lowest sediment yield for both 2004-05 & 2013-14 LU/LC maps. The Sediment Delivery Ratio (SDR) values are same for both the year of land use-land cover maps. The average annual soil erosion obtained from 2013-14 LU/LC map is 12,91,360 (t/ha/yr), which is higher value than

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2004-05 LU/LC map. Ultimately, the table values reveals that the higher SDR values gives higher sediment yield for the three area based SDR methods to get higher sediment yield. The SATEEC model also runs to differentiate the sediment yield from 2004-05 & 2013-14 and use-Land cover maps for slope based Sediment Delivery Ratio (SDR). This approach also reveals that 2013-14 land cover types deliver higher sediment yield than the older LU/LC map. By considering both SDR methods of Area-based Vanoni, Boyce and USDA-SCS and Slope-based SDR methods to predict sediment yield obtained higher from 2013-14 LU/LC maps.

## VI. CONCLUSIONS

The SATEEC model performed in two phases by considering spatiotemporal changes of land use-land cover maps for estimation of soil erosion and sediment yield. To estimate sediment yield the SDR parameter computed based on Slope-Based and Area-Based methods of Vanoni, Boyce and USDA-SCS. The soil erosion estimated from 2004-05 LU/LC map was 9,91,842 (t/ha/yr) and 12,91,360 (t/ha/yr) from 2013-14 LU/LC map. It reveals that 2013-14 LU/LC map deliver higher soil erosion by 23 %. One of the conclusions from this study is that all 4 crop types of fields decreased in area by 248.43 km<sup>2</sup> causes increase in soil erosion which leads to increase in sediment yield for the year 2013-14 LU/LC map. The other conclusion is that the higher sediment yield obtained for 2013-14 LU/LC map considering Area based USDA-SCS method by 23.19% comparing with other Vanoni and Boyce methods. Similarly using 2013-14 LU/LC map considering slope based method deliver higher percentage of sediment load by 23.19%. The precious conclusion of this study is that, though different methods utilised to compute sediment yield, higher percentage of sediment yield obtained from 2013-14 LU/LC map. This study affirm that a hydrosedimentological disequilibrium caused by decrease in all four types of crop lands in the year 2013-14 LU/LC map comparing with 2004-05 LU/LC map and increased in Build Up land, Current Fallow, Other Wasteland and Water bodies. The hydrosedimentological approach using SATEEC GIS System model reveals that the USDA-SCS method is most useful to compute sediment yield for engineers and hydrologists for planning and design of Hydrological structures.

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