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Soil Erosion and Sediment Analysis of Tawa Reservoir, District Narmadapuram M.P. using Remote Sensing and GIS

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Abstract

Soil erosion and sediment problem is becoming severe due to the efect of land degradation, soil fertility and agricultural production. It is one of the serious environmental problems
embedded with the sandy-clay-loam. RUSLE model is used to calculate rainfall erosivity (R), Soil erodibilty (K), and topographic factor (LS), cover management(C) and support practice (P). The sediment analysis input are taken from NASA Power Data and processed in ArcGIS and ArcSWAT software. It is found that the values of above parameters are ranging from 5022.6 to 5798.73 (R), 0.1135 to 0.1403 (K), 0 to 385.033 (LS), 0.083 to 0.858 (C) and 0.20 to 0.89 (P) res to } ẹ(T ʿ " א of " א r ! 0 " 4 ʿ ɜ̈m ɔ)m M 2 ɜ̈m M of " א
Reservoir is 8, 28,505 (ty-) and 2, 31,283 (ty-). An updated LULC map of the study area is prepared using Sentinel-2 10 m resolution having features like water bodies, agricultural land, barren land, built up land and forest. The output of both the map i.e. actual and potential is classifed into 5 categories. The efect of the drainage density has also shown

Keywords: ArcSWAT; RUSLE model; Sediment erosion

Introduction

Soil erosion occurs as a result of changes in agricultural practices, agricultural intensi cation, land degradation and global climate change [1]. Soil erosion is the major problem for a river basin as it removes nutrient that is essential for the growth of the plants and increases sedimentation of the river channel and reservoirs [2]. e soil erosion process is modi ed by biophysical environment comprising soil, climate, terrain, ground cover and interactions between them. Important terrain characteristics influencing the mechanism of soil erosion are slope, length, aspect and shape. Substantial efforts have been spent on the development of soil erosion models [3]. Soil erosion

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$$R = \sum_{i=1}^{12} 1.735 * 10^{\left(1.5 log \frac{pi^2}{P} - 0.8188\right)}$$ Where $_i$

(i.e. 15-20 tons per hectare) and very high (i.e. >25 tons per hectare) as shown in (Figure 4) and (Table 3). It is observed that study area shows an annual soil loss of 231238 t of soil to be eroded annually in all the categories alarming the situation and severity of the soil loss.

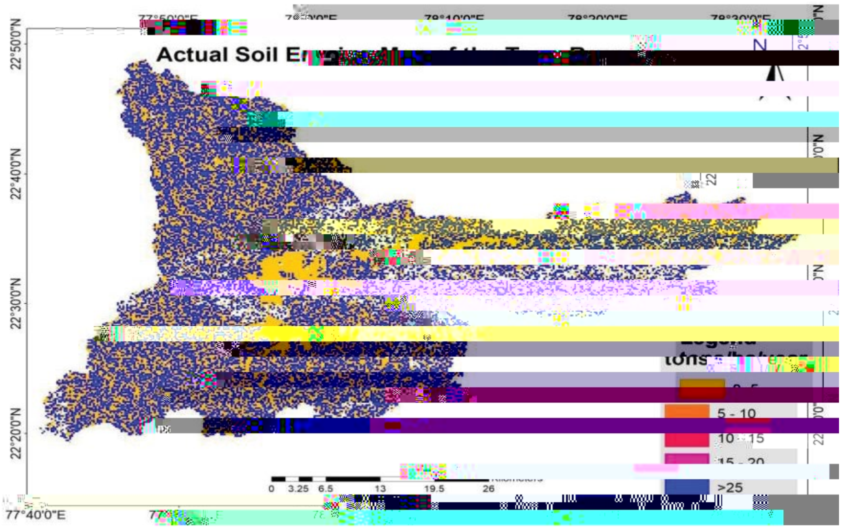

Figure 5: Actual soil erosion map of the Tawa reservoir.

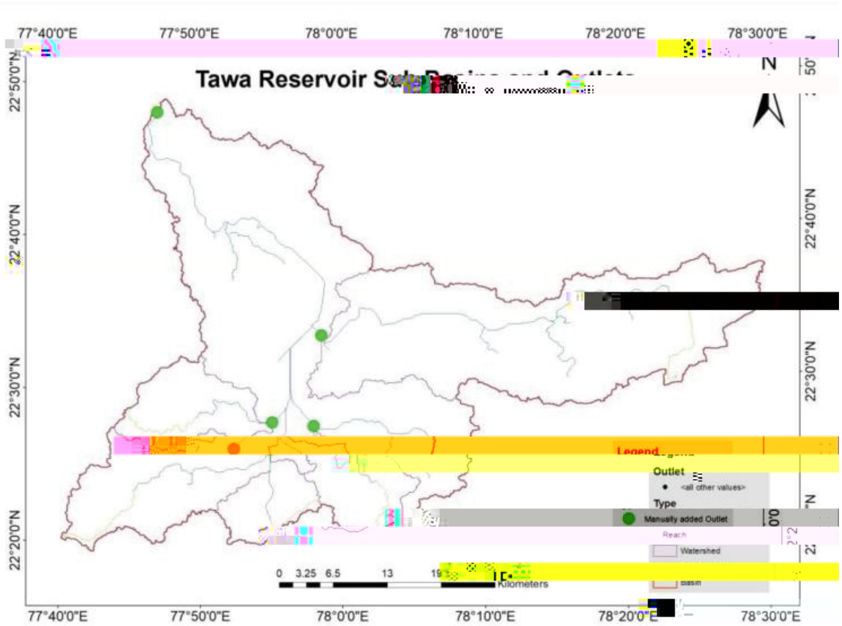

Figure 6: Sub basins and outlets of the Tawa reservoir.

S. No	Year	Rainfall(mm)	Discharge (cm3/s)	Sediment(tons)
1	2010	602	866.584686	10737471.58
2	2011	1,185	1215.01652	1176631.42
3	2012	1170	1102.883453	9469605.265
4	2013	1637.3	1522.39-∃	-

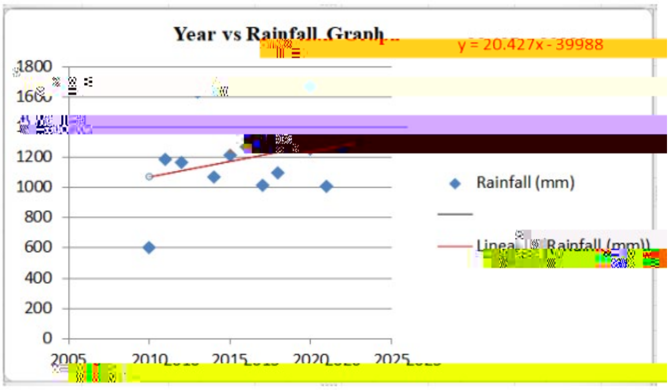

Figure 7(a): Graph plotted for showing the variation of rainfall with the year.

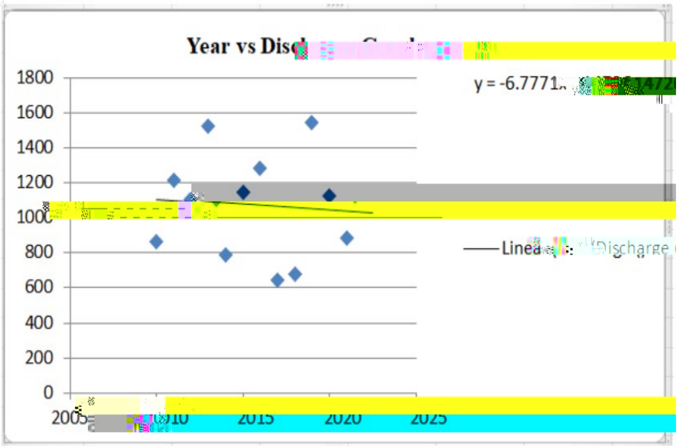

Figure 7(b): Graph plotted for showing the variation of discharge with the year.

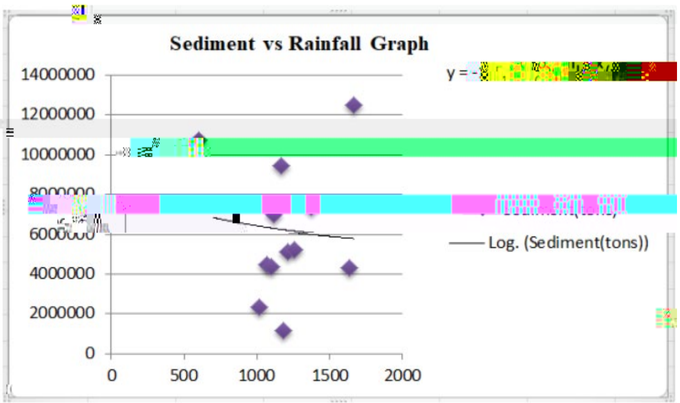

Figure 7(c): Graph plotted for showing the variation of rainfall with the sediment.

Table 7: Analysis, variation and nature of the data obtained from the Arc SWAT.

S. No	Graph Plotted Between	Equation	Nature of Graph
1	Year and Rainfall	Y=20.427x-39988	Linearly Increasing
2	Year and Discharge	Y=-6.7771x+14726	Linearly Decreasing
3	Sediment and Rainfall	Y=-1E+6ln(x)+1E+07	Logarithmic Decreasing
4	Discharge and Sediment	Y=9.1581-17648x+1E+07	Increasing with the Quadratic Nature

associated with the slope where the topographic factor represents the influence of slope steepness and length on erosion. The patterns of soil erosion have been similar in both the potential and actual soil erosion;

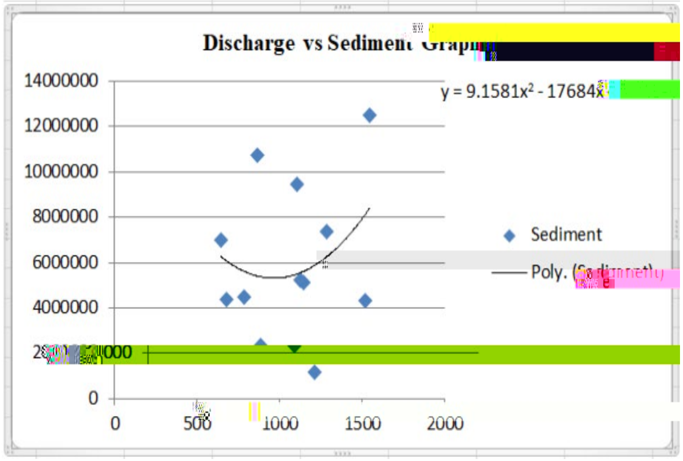

Figure 7(d): Graph plotted for showing the variation of sediment with the discharge.

however, the magnitude is relatively higher in potential soil erosion. RUSLE is a straightforward and empirically based model that has the ability to predict long term average annual rate of soil erosion on slopes using data on rainfall pattern, soil type, topography, crop system and management practices. However, it is important to adequately track how man has changed the use of land through time, particularly for farming, deforestation, and other activities that encourage soil erosion [19, 17]. To create a cogent conservation and land management strategy with effective execution, this knowledge of soil erosion is very helpful.

Conclusion

The present study is undertaken with the purpose to emphasize the merit of Remote Sensing and GIS techniques in analyzing soil erosion and sediment analysis for the study area constituting Tawa Reservoir. To fulfil the objective the boundary of the study area and watershed delineation is done. The area of watershed is reported as 2, 02, 240 ha and of the perimeter 3, 59,158m. After that the RUSLE model is being used to estimate the soil erosion. For the applicability of the RUSEL model the various thematic maps like Rainfall Erosivity Factor(R), Soil Erodibilty Factor (K), Slope Length and steepness factor (LS), Crop Management Factor (C) and Support Practice Factor (P) is generated in the raster format. The empirical soil erosion model RUSLE integrated with GIS & RS technology is a very suitable and effective method in a simple, easy, and scientific way for the quantitative assessment of soil losses. It has applicability to spatially visualize and identify the erosion risk and Hazards zone on a local as well as regional scale which is crucial for watershed systems and administrative units. It provides a best management approach to formulate appropriate planning and policy for implementing optimal resource practices to sustain land resources, soil conservation, and avert environmental degradation. The outputs of the la81(p)12(s)12(7w T*[(s81(p)12(s)128(los)5gw T*[(s)-(a)6 s)i(nfi)ed7(U4)12(t)-6(a)1 Dfter the of

3. Beskow S, Mello CR, Norton LD, Curi N, Viola MR, et al. (2009) Soil erosion