AN APPROACH TO QUANTIFY SEDIMENT YIELD IN VAST AREAS

Mohammed. Akhter Ali, Mohammed. Qamar Iqbal Khan***

***Geography Dept. Osmania University, Hyderabad, A.P., INDIA. E.mail: mohdakhterali@yahoo.com**
****Dept. of Agriculture and Soil, A.P Govt., Hyderabad, A.P., INDIA. E.mail: mqik@yahoo.com**

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ABSTRACT:

Loss of fertile soil by erosion is undoubtedly much higher than weathering and soil formation. A number of studies on estimation of sediment yield have been conducted and many such studies will be planned in future. All these studies are usually carried out in selected watersheds or river basins. A need of country wide Sediment Yield Index (SYI) on a periodical basis is needed. Remote sensing technology has immense potential to yield results in time and cost effective manner. In a study on SYI of a sub- watershed in Rangareddy District, A.P, the IRS LISS III and LISS I data were used to identify this soil and land use characteristics. It was revealed that the SYI had, by and large, similar values in both the cases. This was due to omissions and inclusions of certain spatial units in a mapping process under specific resolution and map scales, thereby providing a scope of covering large areas in a given time frame.

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INTRODUCTION

Soil loss due to erosion is a continuous process that brings down the soil productivity. The sediment gets deposited in tanks and reservoirs, eventually reducing designed storage capacity. The rate of soil loss is judged by the Sediment Yield Index (SYI), which can be derived through various empirical formulae. Areas under high SYI can be prioritized by dividing it into hydrologic unit of required levels and characterized duly deriving SYI.

Though the knowledge of SYI of each and every part of the land is essential to assess the rate of soil loss, it could not be attempted for entire country due to the enormous work involved. Instead, the study is being concentrated in the catchments of important reservoirs.

Remote Sensing has provided ways and means to target larger areas in shorter time span of wide range of data products with different spatial resolutions. The amount of tine and work involved in remote sensing varies with the spatial resolution and scale of satellite data that is used for the study. The level of information derived, of course, depends on the spatial resolution and scale. The information generated is however qualitative, that helps in interpretation of high priority areas. In this study, SYI of sub watershed has been derived through different levels of spatial resolution and map scales to know their effect in prioritization of watersheds. The results provide a scope of selecting a high spatial resolution with a smaller scale to cover entire country with SYI data without compromising the interpretability of prioritization in a time and cost effective manner.

STUDY AREA

The study area is a sub watershed, viz, Bachpally Sub Watershed under Yeliminedu Micro watershed, situated in Ranga Reddy District, Andhra Pradesh, between 16°59' to

17º24' N Latitude and 78º24' to 78º41' E Longitude. Climate of the area is semi arid, receiving about 660 mm rainfall annually.

MATERIALUSED

Following material was used in the study:

SOI toposheet No. 56K/8 & 12
IRS LISS I Data (1:250,000 Scale)
IRS LISS III Data (1:50,000 scale)

METHODOLOGY

Physiographic units were delineated in the sub watershed as observed in IRS LISS I Data (1:250,000 Scale) and IRS LISS III Data (1:50,000 scale) Soils of the sub watershed were characterized for soil texture, depth, erosion, Ph and other features like rock outcrops and salinity. Soils were characterized as per USDA Soil Survey Manual (Soil Survey Staff, 1995) Weightage value and delivery ratio was assigned to each physiographic unit as per the guidelines of AIS&LUS (1991) Management practices under different soil conditions were identified. The SYI was derived by the following equation.

$$SYI = \{ \Sigma(Ai \times Wi \times Di) / AW \} \times 100$$

Where,
Ai = Area of ith mapping unit
Wi= Weightage value of ith mapping unit
Di = delivery ratio assigned to ith mapping unit
n = No. of mapping unit
AW = Total area of the watershed.

RESULTS AND DISCUSSION

Soil characteristics were interpreted for each of the physiographic units delineated on LISS- I and LISS- III data. The LISS-I data enabled to delineate a physiographic unit (Table 1) while 20 units could be delineated on LISS-III data (Table 2). Weightage value and delivery ratio were assigned to each of the physiographic units based on the factors like slope erosion, soil depth, texture and management practices. The weightages values successively ranged from 7 (Valley Fill) to 20 (Hill). Similarly, the delivery ratio successively ranged form 0.55 (Valley Fill) to 0.90 (Hill). The SYI of the sub watershed was arrived at 874 from the LISS-I data in 1:250,000 Scale, which corresponds to 'Low priority' watershed. The SYI obtained form LISS-III data at 1:50,000 Scale was 837, which also corresponds to 'Low Priority' watershed. Though the number of physiographic units in LISS-I data are only 7 as against 20 in LISS-III data, the SYI arrived is similar in both types of data sets. Though the LISS-III data with 23.5 m resolution has higher capability of discriminating soil features, similar results for LISS-I data can be attributed to omissions and inclusions of certain soil characteristics due to lack of discrimination in mapping in LISS-I data. The loss of weightage value and delivery ratio due to omission of existing features is supposed to be compensated by inclusion of certain soil features. The finding of the study gives a scope of using a low-resolution satellite data for the purpose of determining SYI in time and cost effective manner.

CONCLUSION

As the volume of mapping work involved in visual interpretation of the 1:50,000 scale is 25 times more compared to 1:250,000 scale, the use of low resolution and small-scale data provides an opportunity to plan countrywide prioritization of watersheds without sacrificing the objectives. This approach is however recommended only for derivation of SYI but not for the resource mapping for land use planning / land management.

REFERENCES:

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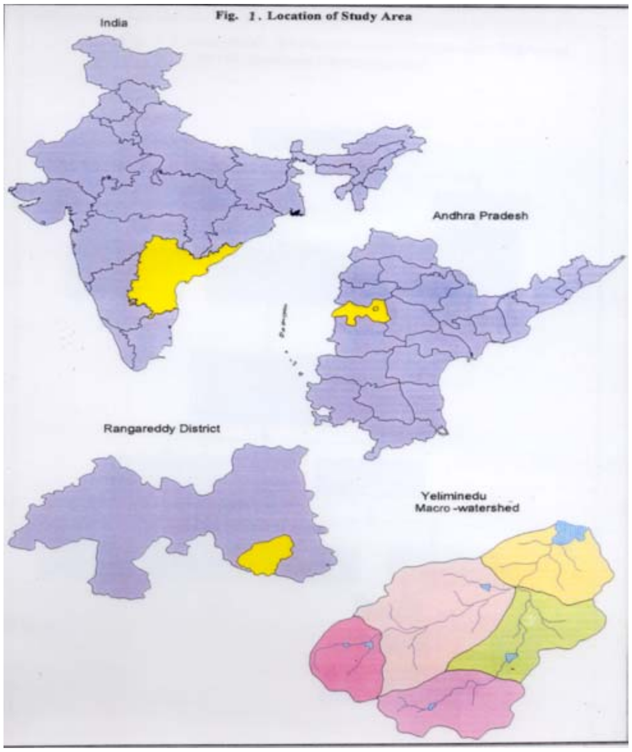

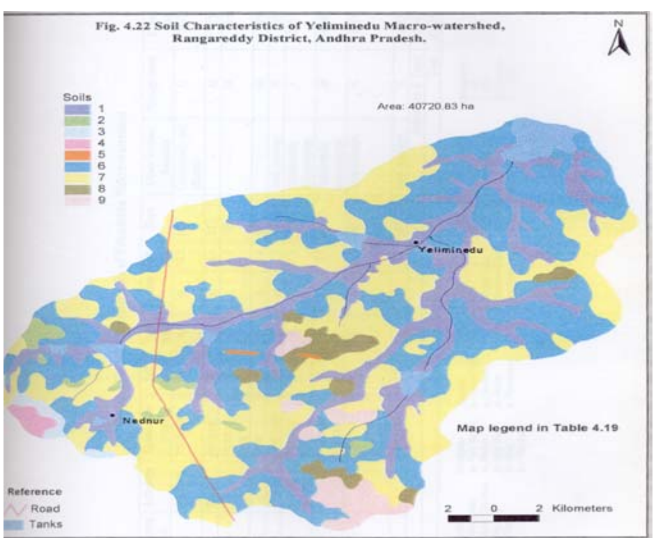

Table 1: Computation of Sediment Yield Index of Bachpalli Sub-watershed using LISS-I data

Mapping Unit	Lithology	Geomorphography	Area (ha)	Weightage Value	Weightage Product	Delivery Ratio	Gross Sediment Yield
1.	Alluvium	Valley Fill	833.81	9	7504.29	0.55	4127.36
2.	Basalt	Pediment	313.95	13	4081.35	0.60	2448.81
3.		Piedmont Slope	295.63	15	4434.45	0.70	3104.16
4.		Mesa	275.05	13	3575.65	0.60	2145.4
5.	Granitic gneiss	Pediplain-shallow	1740.52	15	26107.80	0.75	19580.5
6.		Pediplain-moderate	1577.00	13	20501.00	0.70	14350.7
7.		Pediment InselbergComplex	51.80	17	880.60	0.80	704.48
	Habitation A& Tanks		222.91				
	Total		5310.67				

Sedimentary Yield Index = 874.

Table 2: Computation of Sediment Yield Index (S Y I)* of Bachpalli Sub - watershed using IRS- LISS- III data.

Mapping Unit	Lithology	Geomorphography Extent			Extent	Weightage Value	Weightage Product	Delivery Ratio	Gross Sediment Yield
		Level – 1	Level – 2	Level – 3					
1	Alluvium	Valley fill	Non sodic		882.02	9	7938.18	0.55	4365.999
2			Sodic	Slight	138.82	9	1249.38	0.50	624.690
3				Moderate	54.55	9	489.96	0.55	269.478
4				Strong	26.63	10	266.30	0.60	159.780
5	Basalt	Pediment	Nearly level		467.24	13	6074.12	0.55	3644.472
6			Very gently sloping		524.84	14	7347.76	0.65	4776.044
7		Piedmont slope	Gently sloping		451.66	15	6774.90	0.70	4742.430
8			Moderately sloping		293.55	17	4990.35	0.75	3742.430
9		Mesa	Top		68.30	13	887.90	0.60	3742.763
10			Peripheral slope		104.98	16	1679.68	0.70	532.740
11	Quartz	Linear ridge			15.93	19	302.67	0.75	1175.776
12	Dolerite	Dyke ridge			8.28	18	149.04	0.80	227.003
13	Granitic geneiss	Valley	Nearly level		245.63	11	2701.93	0.55	119.232
14			Very gently sloping		28.93	12	347.16	0.60	1486.062
15		Pediplain	Shallow		854.24	15	12813.60	0.75	208.296
16			Moderate		833.97	13	10841.61	0.70	9610.200
17		Pediment			17.87	16	285.92	0.75	7589.127
18		Pediment-Inselberg Complex			54.43	17	925.31	0.80	214.440
19		Inselberg			8.44	18	151.92	0.85	740.248
20		Residual hill			7.56	20	151.20	0.90	129.132
Tanks & Habitation					222.91				136.080
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S Y I = 837.29