Soil Loss Assessment in an Ungauged Dam Catchment Using RUSLE Model: A Case Study of Maruba Dam, Machakos, Kenya

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Introduction

- Soil erosion is a major cause of land degradation and is a serious threat to food security and agricultural sustainability (top soil loss (10 mm/yr) << soil formation (1 mm/yr)
- Siltation has compromised the function of Maruba dam
- Spatial data on erosion rates within the dam catchment is missing
- Decision makers and planners lack the basis for initiating SWC and management plans
- Such data helps to plan and prioritize restoration of the catchment health
- Enhance sustainable socio-economic activities as agricultural production while keeping the health of the catchment in mind

Study Objectives

Overall objective

To assess soil erosion rate or hazard at Maruba dam catchment

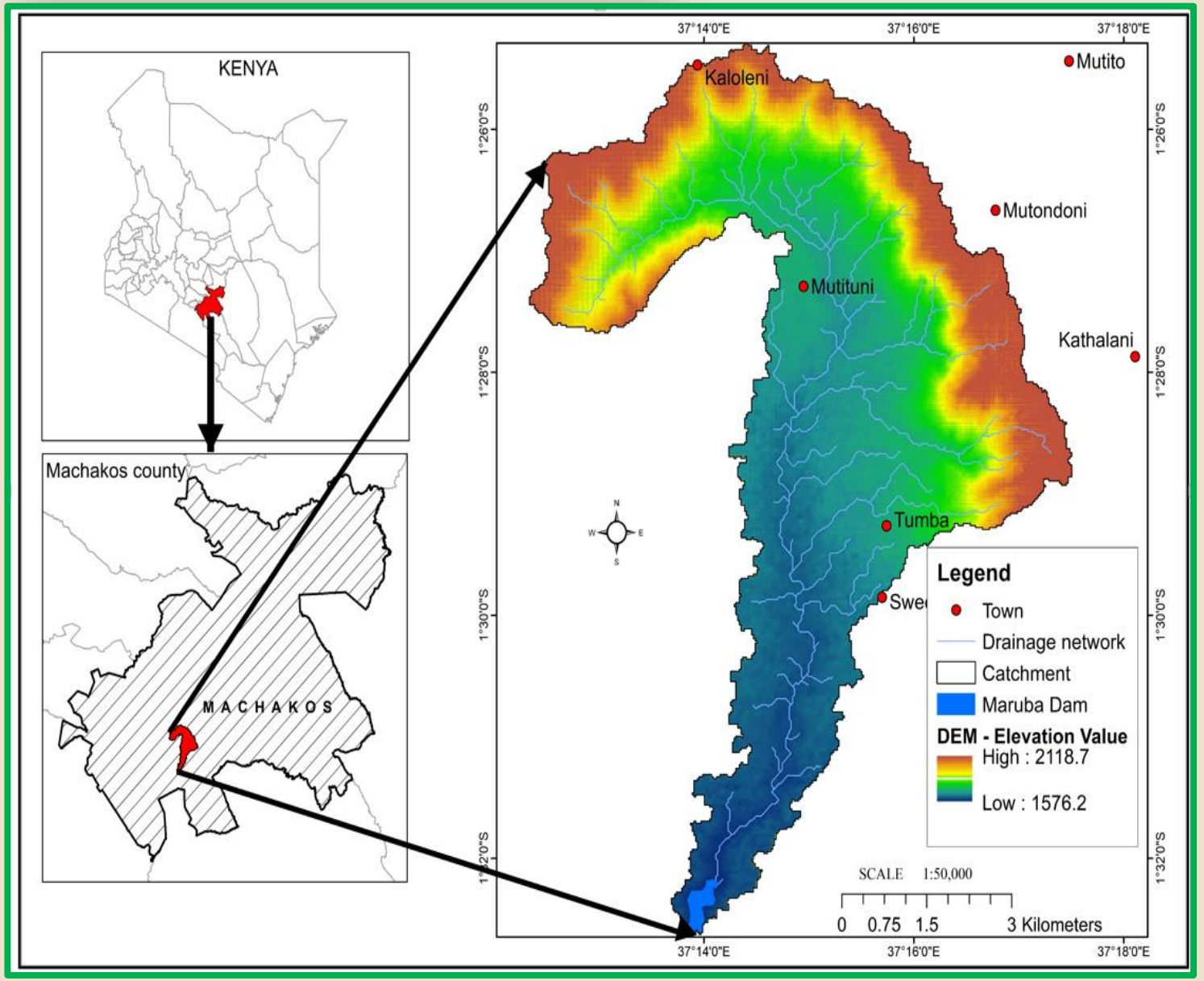
Specific objectives

1. To derive the RUSLE model parameters
2. To generate a soil erosion hazard map for the dam catchment
3. To quantify sediment yield in the catchment

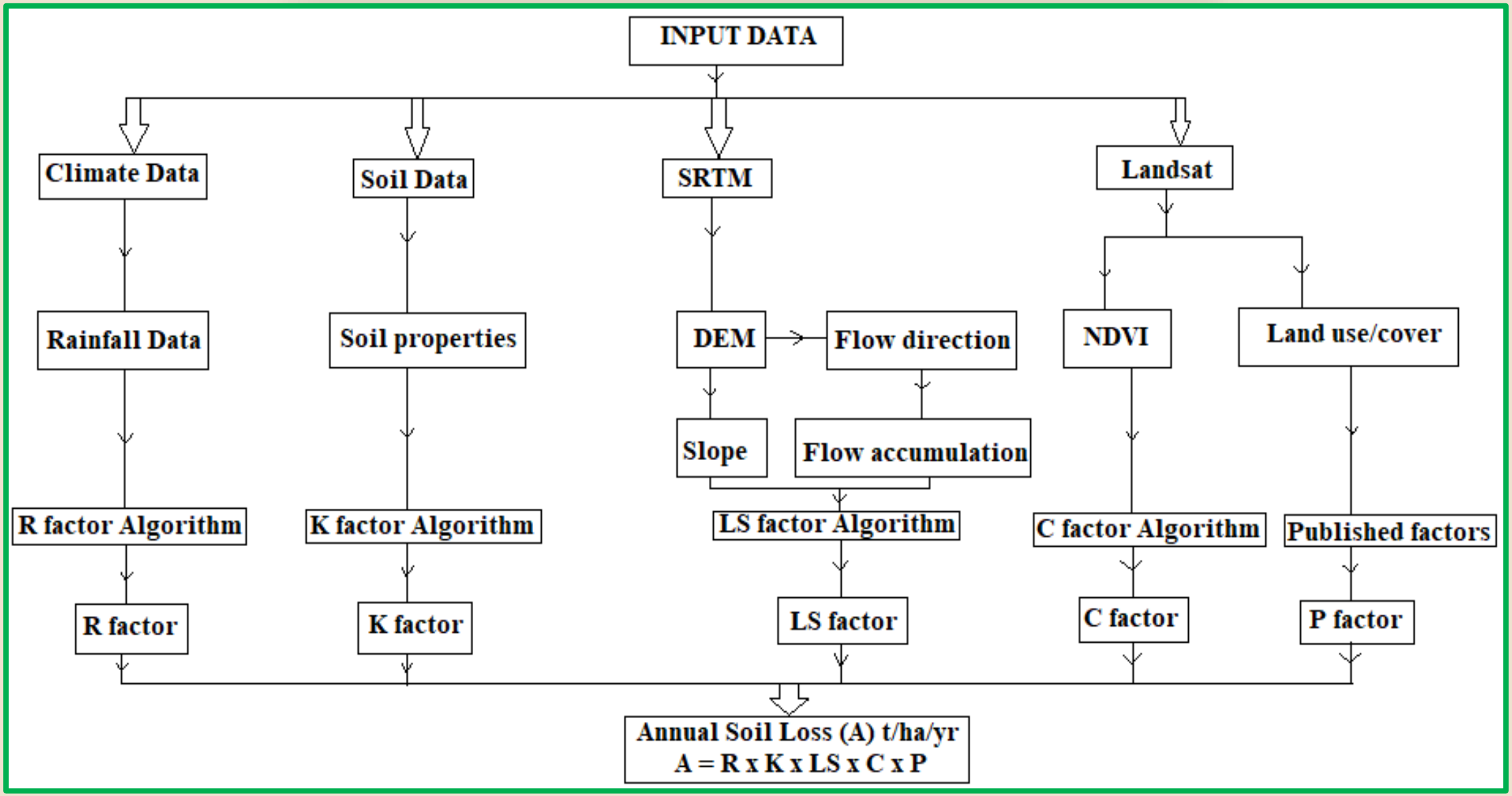
Materials and Methods

Study site

- Maruba dam catchment is situated in Machakos County, Kenya
- It lies between 37 °12′ 0" to 37 °20′ 0" E and 1 °24′ 0" to 1 °34′ 0" S and has an area of 49 km²



Materials and Methods cont'd



Materials and Methods cont'd

Algorithms:

- R algorithm: $R = 117.6\ (1.00105^{MAR})$ for < 2000 mm
- K factor algorithm: $K = 27.66m^{1.14} * 10^{-8} * (12 - a) + 0.0043(b - 2) + 0.0033(c - 3).$
- LS factor algorithm: $LS = \left(\frac{Q_a M}{22.13}\right)^y x\ (0.065 + 0.045\ x\ S_g + 0.0065\ x\ S_g^2$
- C factor algorithm: $C = 0.1\left(\frac{-NDVI + 1}{2}\right)$
- P factor values:

Land use	Percentage slope	P-factor
Agriculture (cultivated land)	0.00 – 5.00	0.10
	5.00 – 10.00	0.12
	10.00 – 20.00	0.14
	20.00 – 30.00	0.19
	30.00 – 50.00	0.25
	50.00 – 100.00	0.33
Other land	All	1.00

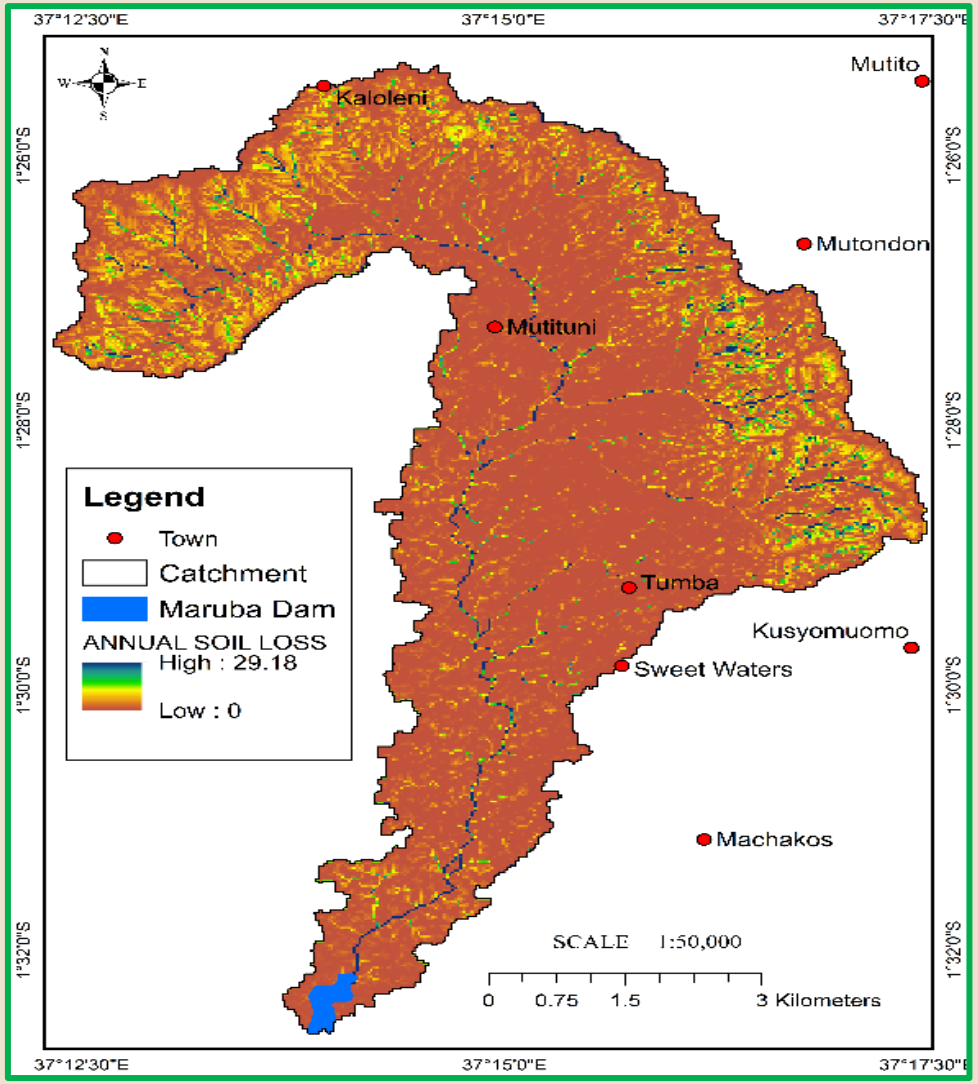
Sediment Delivery Ratio (SDR):

SDR = SY/E

$SDR = A^{-02}$

Results and Discussions

- The average annual loss of soil ranges from 0 to 29 ton/ha/year and a mean of 0.9708 t ha^{-1} yr^{-1}



Results and Discussions cont'd

- Soil loss classes

Erosion Categories	Numeric Range (t ha^{-1} yr^{-1})	Soil Loss Proportions (%)
Very Low	0 - 2	78.52
Low	2 - 5	11.04
Moderate	5 - 10	8.28
High	10 - 15	2.14
Very High	15 - 20	0.02
Extremely High	20 - 30	0.01
		100

Results and Discussions cont'd

Average total erosion (t yr^{-1})	Catchment area (ha)	SDR (dimensionless)	Sediment yield (t yr^{-1})
4,754.44	4897.45	0.1828	869.11

Conclusion and/Recommendations

- The application of RUSLE model facilitates sustainable land use planning
- GIS and RS are key inputs in deriving RUSLE factors at an appreciable cost and in practical manner considering the constraints in data availability
- Undulating nature of terrain and unsustainable land uses have compromised the health of the catchment
- Soil erosion is significant in the catchment
- The study recommends that there is need to design appropriate land management measures that would slowdown the amount of soil loss in the study area
- The study recommends enhancing land cover by use of grass ways and adoption of simple soil conservation structures such as terraces and contours

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