Introduction

- Monroe County is a county located in the U.S. state of Indiana.
- Monroe has a total area of 411.32 square miles (1,065.3 km²), of which 95.91% is land and 4.09% is water.

- Soil erosion is a process of physical degradation of the landscape over time.
- Water and wind are the main agents responsible for soil erosion.

Methodology

Rainfall erosivity factor (Factor R)

- Rainard and Fremund (1994) developed a function to estimate the rainfall erosivity as a function of the mean annual precipitation (mm) in the Continental U.S.: 
  \[ R = 0.04830 \cdot P^{1.31} \] 
  Unit: MJ/mm/(ha yr).
- The factor R is calculated and added to the attribute table of the precipitation polygons. After that, it was used the tool “Polygon to Raster” to generate the Factor R.

Rainfall erosivity factor (Factor R) and calculated using the equation:

\[ R = 0.04830 \cdot P^{1.31} \]

Soil erodibility factor (Factor K)

- K factor is soil erodibility factor which represents both susceptibility of soil to erosion and the rate of runoff, as measured under the standard unit plot condition. Unit: ft²/ha-MJ/mm.
- Soils high in clay imply low K values (0.05 to 0.15) imply resistant to detachment.
- Coarse textured soils (e.g. sandy soils) imply low K values (0.05 to 0.2) because of low runoff even though these soils are easily detached.
- Medium textured soils (e.g. silt loam soils) imply moderate K values (0.25 to 0.4) because they are moderately susceptible to detachment and they produce moderate runoff.
- Soils having a high silt content imply high K values (> 0.4) most erodible of all soils and easily detached; tend to crust and produce high rates of runoff.

Soil erodibility factor (Factor K) and calculated using the equation:

\[ K = a + b \cdot \text{Precipitation} \]

Topographic factor (Factor LS)

- The effect of topography on soil erosion is accounted for by the LS factor in RUSLE.
- The equation is shown below:
  \[ LS = \frac{X}{22.1} \cdot S \] 
  Where:
  - X = slope length (m)
  - S = slope gradient (%)
- The values of X and S can be derived from Digital Elevation Model (DEM).
- To calculate the X value, Flow Accumulation was derived from the DEM after conducting Fill and Flow Direction processes in ArcGIS.
- \[ X = \text{Flow accumulation} \cdot \text{Cell size} \]

Cover management factor (Factor C)

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Support practice factor (Factor P)

- The values of P factor were estimated by using Dawen et al. table and then were added to the attribute table of the cropland layer.
- The Support Practice factor (P) represents the impact of support practices on soil erosion rates.
- In this study only considers P values due to types of land cover, using values suggested by Dawen et al. (2003).

Results and Discussions

Rainfall erosivity factor (Factor R)

- R represents the potential of the rain in a particular area to produce erosion. According to the department of agronomy of Purdue University, in Indiana, it is lowest in the northeast and highest in the southwest.

Rainfall erosivity factor (Factor R) and calculated using the equation:

\[ R = 0.04830 \cdot P^{1.31} \]

Soil erodibility factor (Factor K)

- Texture is the principal factor affecting K, but soil profile, organic matter and permeability also contribute.
- It varies from 70/100 for the most fragile soil and 1/100 for the most stable soil.
- Values of 0 – 0.6 are reasonable, while higher values should be given a critical look.
- For the case of Monroe County, K ranges from 0.05 to 0.20

Soil erodibility factor (Factor K) and calculated using the equation:

\[ K = a + b \cdot \text{Precipitation} \]

Topographic factor (Factor LS)

- The major part of Monroe has up to 2 tons/ha/year of soil loss in its watersheds.
- However, it also present spots of extremely high soil loss (i.e. values higher than 91 tons/ha/year).

Soil loss in the watersheds of Monroe is calculated using the equation:

\[ A = R \cdot K \cdot LS \cdot C \cdot P \]

Where:
- A refers to soil loss in tons ha⁻¹ year⁻¹
- R refers to rainfall erosivity factor
- K refers to soil erodibility factor
- LS refers to topographic factor
- C refers to cover management factor
- P refers to support practice factor

Support practice factor (Factor P)

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Conclusion

- This study demonstrates that the RUSLE combined with GIS provides great advantage to analyze multi-layer of data spatially and estimates soil loss rate over areas.
- The result of the analysis demonstrated that the soil loss rate in Monroe’s watersheds ranges from 0 to 35.474,540.00 ton/ha/year.
- The major part of Monroe County presents low erosion potential (up to 2 tons/ha/year), however there are spots of extremely high soil loss (i.e. values higher than 91 tons/ha/year).