Integrating PyQGIS & Geospatial Technology for Soil Erosion Modelling using Revised Universal Soil Loss Equation (RUSLE)

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Preface

We are delighted to share this study named "*Integrating PyQGIS & Geospatial Technology for Soil Erosion Modelling Using Revised Universal Soil Loss Equation (RUSLE)*". This study summarises the findings of our research, which aimed to provide a system for predicting soil erosion in a particular area utilising geospatial technologies and the Revised Universal Soil Loss Equation (RUSLE).

Soil erosion is a major environmental issue that can have a negative impact on farming, water resources, and biodiversity. Soil erosion prediction is critical for the long-term management of soil assets. The Revised Universal Soil Loss Equation (RUSLE) is a frequently used empirical model for predicting soil erosion that is both simple and effective.

We provide a novel way for implementing the RUSLE model utilising PyQGIS and geospatial technology in this report. To compute the six components that lead to soil erosion, we used digital elevation models (DEM), soil maps, land use/land cover maps, rainfall data, and other relevant geospatial data. We have created a user-friendly interface that allows users to enter important data and visualise the soil erosion forecast findings.

Overall, this study is an excellent resource for scholars and practitioners interested in using PyQGIS and geospatial technologies to predict soil erosion using the RUSLE model. We hope that this effort will contribute to the long-term management of soil resources and environmental conservation.

Table of Contents

List of Figures

List of Tables

Executive Summary

This study summarises the findings of our research, which aimed to provide a system for predicting soil erosion in a particular area utilising geospatial technologies and the Revised Universal Soil Loss Equation (RUSLE). Soil erosion is a major environmental issue that can have a negative impact on agriculture, water resources, and biodiversity. Soil erosion prediction is critical for the long-term management of soil resources.

To calculate the six elements that contribute to soil erosion in the RUSLE model, we employ digital elevation models (DEM), soil maps, land use/land cover maps, rainfall data, and other relevant geospatial data. We have created a user-friendly interface that allows users to enter important data and visualise the soil erosion forecast findings.

Our findings suggest that PyQGIS and geospatial technology can be used to successfully implement the RUSLE model for predicting soil erosion. Our technique predicts soil erosion accurately, and the user interface makes it simple for non-experts to utilise the model. This effort adds to the long-term management of soil resources and environmental protection. We recommend that future research concentrate on enhancing the model's accuracy by including new data sources.

Study area

The Upper Krishna Basin is a critical area in the Indian states of Maharashtra and Karnataka. It is over 27,000 square kilometres in size and is located in the Western Ghats region. The basin is surrounded on the west by the Sahyadri Range and on the east by the Eastern Ghats. The Krishna River is the region's principal water source, used for agriculture, hydropower generation, and drinking water delivery.

The Upper Krishna Basin has a tropical monsoon climate with distinct wet and dry seasons. The monsoon season begins in June and lasts through September, when the region receives the majority of its rainfall. The region's yearly rainfall averages roughly 1,300 mm. The temperature in the basin fluctuates from 15°C to 35°C, with the highest recorded temperature in May.

The geography of the Upper Krishna Basin is varied, ranging from Rocky Mountains to flat plains. The topography is mostly hilly and rolling, reaching a maximum elevation of about 1,300 metres above sea level. The region is extremely rich in biodiversity, with numerous indigenous plant and animal species.

The region's economy is predominantly agricultural, with a strong emphasis on horticulture and cash crops including sugarcane, grapes, and pomegranates. The region also includes several major and small hydroelectric power facilities that generate electricity.

The Upper Krishna Basin, on the other hand, suffers numerous environmental issues, including soil erosion, deforestation, and water pollution. The terrain of the region, along with high-intensity rainfall during the monsoon season, makes it especially prone to soil erosion. The region's soil erosion has lowered soil fertility, increased sedimentation in rivers, and degraded water quality.

In conclusion, the Upper Krishna Basin is an important region in Maharashtra and Karnataka, India, with diverse topography, significant biodiversity, and a predominantly agricultural economy. Many environmental issues confront the region, including soil erosion, deforestation, and water pollution. Geospatial technology and the Revised Universal Soil Loss Equation (RUSLE) can be used to predict and manage soil erosion in the region, thereby helping to the sustainable management of soil resources and environmental protection.

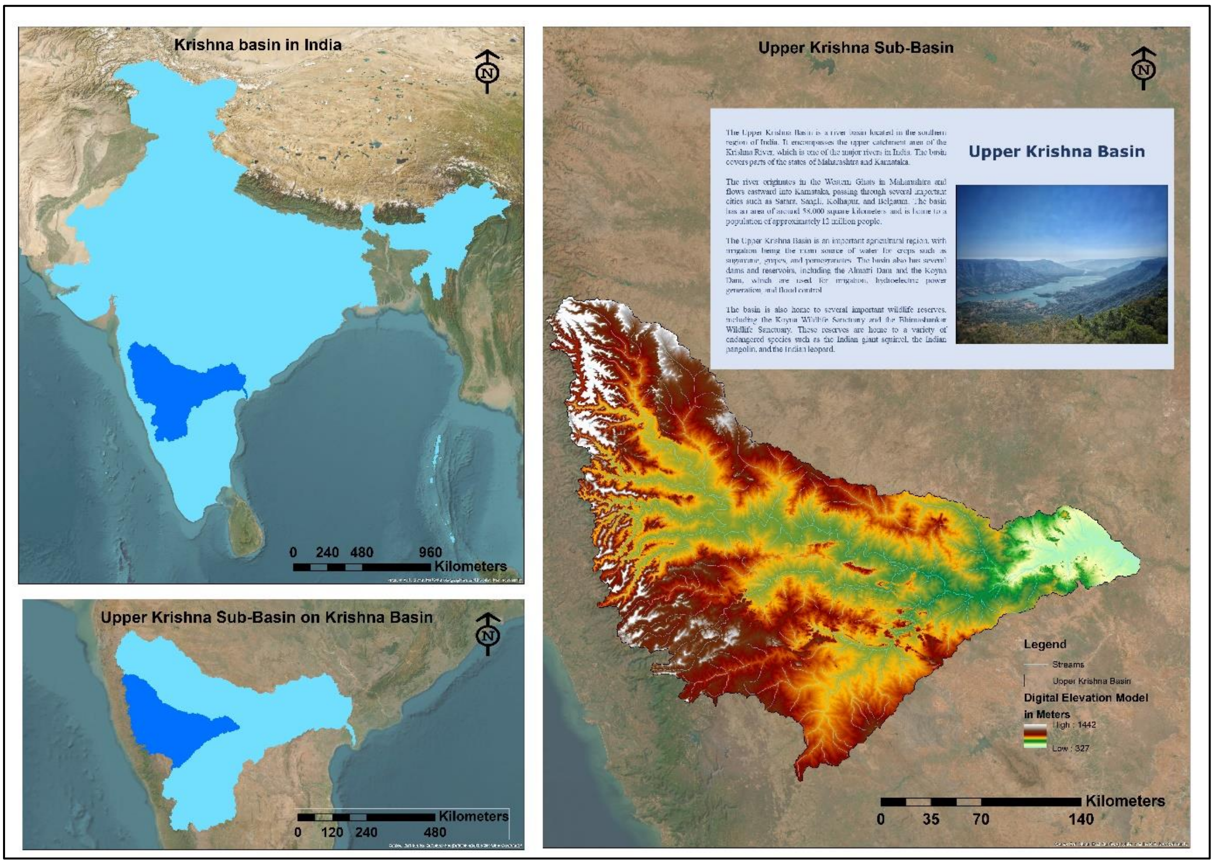


Figure 1:- Study area map of Upper Krishna Basin

Soil loss at Upper Krishna basin

The Upper Krishna Basin in Maharashtra and Karnataka, India, is a region plagued by soil erosion. The application of GIS technologies and the Revised Universal Soil Loss Equation (RUSLE) allows for the prediction and management of soil erosion in the region. According to our findings, the expected soil loss in the Upper Krishna Basin is roughly 2.02 tonnes per acre per year.

This level of soil loss is worisome because it can result in decreased soil fertility and productivity, increased sedimentation in rivers and streams, and downstream flooding. Soil loss can also contribute to decreasing water quality, which can have an impact on agriculture and drinking water supplies in the region. As a result, there is an urgent need in the region for sustainable soil management practises.

The RUSLE model, built with PyQGIS and geospatial technologies, is a useful tool for predicting soil erosion and assessing the efficacy of various soil conservation practises. The output of the model can be used to prioritise areas for soil conservation activities and indicate areas where soil erosion mitigation measures are required.

Overall, the Upper Krishna Basin's estimated soil loss of 2.02 tonnes per acre per year underscores the region's need for appropriate soil management practises. The RUSLE model, when combined with GIS technology, provides an effective tool for predicting and regulating soil erosion in the region, thereby helping to the long-term management of soil resources and environmental protection.

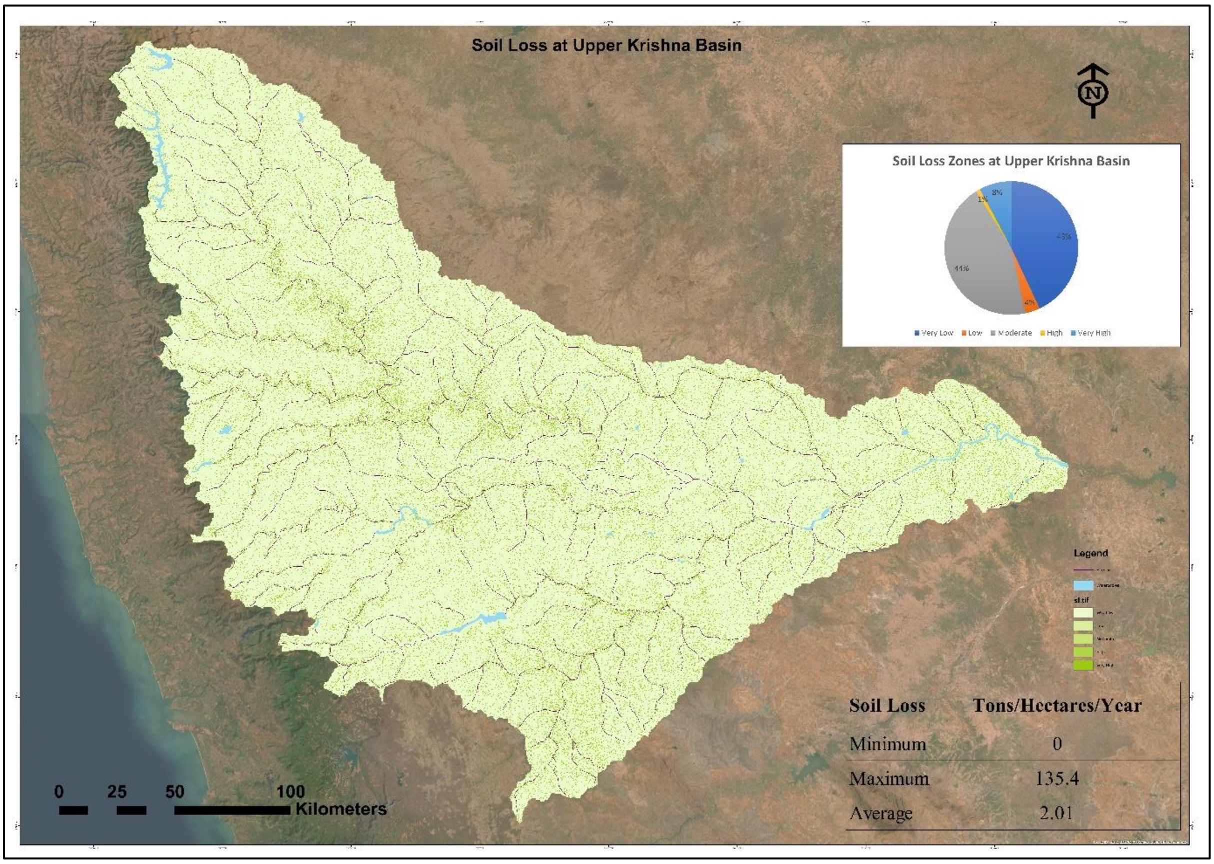


Figure 2:- Soil loss at Upper Krishna Basin

Introduction

Soil erosion is a major environmental issue that affects many locations across the world, including India's Upper Krishna Basin in Maharashtra and Karnataka. The Upper Krishna Basin is vital to the state's economy, owing to its agricultural and hydroelectric power producing operations. However, the region is confronted with serious environmental issues, such as soil erosion, deforestation, and water pollution.

Soil erosion is the removal of soil from the land surface caused by water, wind, or other causes. Soil erosion can reduce soil fertility and productivity, which can have serious economic consequences for agriculture-based countries. Furthermore, soil erosion can cause flooding and sedimentation in rivers, lowering the quality of the water supply.

The Revised Universal Soil Loss Equation (RUSLE) is a commonly used model for estimating soil erosion in many different regions across the world. RUSLE calculates soil loss by taking into account a variety of elements such as rainfall intensity and distribution, soil erodibility, slope length, slope gradient, vegetation cover, and land management practises. Remote sensing, Geographic Information Systems (GIS), and Global Positioning System (GPS) technology can give reliable data for input into the RUSLE model.

The purpose of this study is to discuss the findings of our research, which intended to establish a system for forecasting and managing soil erosion in the Upper Krishna Basin utilising the RUSLE model and GIS technology. The study estimates soil loss in the region and evaluates various soil conservation practises to reduce soil erosion.

The primary objectives of this report are to

- ❖ Assess the soil loss in the Upper Krishna Basin using a geospatial technique based on the RUSLE model.
- ❖ Analyse the factors influencing soil loss in the region.

The report provides valuable insights into the extent and magnitude of soil loss, which can be used by policymakers and land managers to develop effective strategies for soil conservation and reservoir management.

Figure 3:- Krishna River (Major flowing river throughout basin)

Factors considered for Revised Universal Soil Loss Equation

The Revised Universal Soil Loss Equation (RUSLE) model is an empirical model used to estimate soil loss caused by water erosion. The model takes into account various factors that influence soil erosion, including rainfall erosivity, soil erodibility, slope length and steepness, cover management, and erosion control practices. The RUSLE model is used in combination with geographic information system (GIS) data to compute soil loss at a regional scale. The following factors are considered for the RUSLE model using GIS:

Rainfall erosivity: This factor considers the effect of rainfall intensity and distribution on soil loss. GIS data on precipitation and its distribution are used to calculate the rainfall erosivity factor.

Soil erodibility: This factor represents the susceptibility of soil to erosion. It is influenced by soil characteristics such as texture, organic matter content, and structure. Soil texture data are obtained from soil surveys, and organic matter content and soil structure data are derived from satellite imagery.

Slope length and steepness: These factors describe the influence of slope on soil erosion. The slope length and steepness data are obtained from digital elevation models (DEMs).

Cover management: This factor considers the effect of land use and vegetation cover on soil loss. Land use data are obtained from satellite imagery, and vegetation cover data are derived from satellite imagery and ground surveys.

Erosion control practices: This factor represents the effect of erosion control measures such as contour ploughing, terracing, and grass strips. Information on erosion control practices is obtained from ground surveys.

By considering these factors, the RUSLE model using GIS can provide an accurate estimation of soil loss in a region and can be used to develop effective soil conservation strategies.

Geographic Information System

GIS can be defined as - A System which involves collecting/capturing, storing, processing. manipulating, analysing, managing, retrieving and displaying data (information) which is, essentially, referenced to the real-world or the earth (i.e., geographically referenced). The fundamental components of spatial data in a GIS are points, lines (arcs), and polygons. When topological relationships exist, you can perform analysis, such as modeling the flow through connecting lines in a network, combining adjacent polygons that have similar characteristics and overlaying geographic features.

Geographical Information System (GIS)" has emerged as powerful tool which has potential to organize complex spatial environment with tabular relationships. The emphasis is on developing digital spatial database, using the data sets derived from precise navigation and imaging satellites, aircrafts, digitization of maps and transactional databases.

In simple words GIS is defined as Creation of maps with the help of Satellite Images and making them intelligent by attaching attributes to the digitized drawing.

Geographical Information Systems (GIS), Global Positioning System (GPS) in combination of Total Station Survey helps to assist utilities with mapping and recording the location of network assets. GIS provides a basic plan of urban roads and water networks. However, most of the data in GIS has been derived by digitizing maps and location data for water networks.

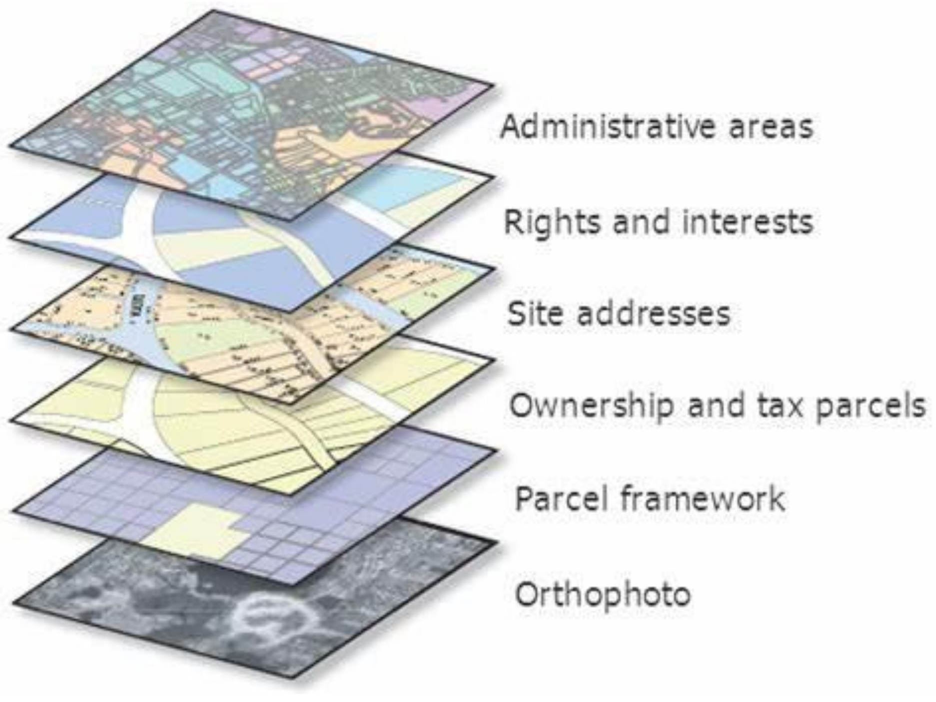


Fig 9: - Data Captured in various layers in basic form point, line & polygon from reality

Merits of Geographic Information System as a tool

- Quick overview of location.
- It allows us to make better decisions based on geography.
- GIS software runs on computers ranging from powerful server to software on the mobile phone.
- The data viewing on this digital map is easier than spreadsheets.
- GIS tools help to visualize geographic data as maps, graphs or charts. Hence patterns and trends can easily be identified unlike spreadsheets.
- he functions of GIS (Geographical Information System) include data entry, data display, data management, information retrieval and analysis.
- A data model in GIS is mathematical construct which represents geographical objects or surfaces as data.
- There are three common representations of spatial data used in GIS viz. vector, raster and triangulated. Each of these are used for particular kinds of information and their analysis.
- GIS is one of the forms of geospatial technology. The other examples include GPS, satellite remote sensing and geofencing.

Geographic Information System for RUSLE Model

Geographic Information System (GIS) plays a crucial role in the application of the Revised Universal Soil Loss Equation (RUSLE) model. The RUSLE model is a spatial model, and GIS provides the necessary tools to incorporate spatial data and perform spatial analysis. The following are the steps involved in using GIS for the RUSLE model:

Data collection: The first step is to collect the necessary spatial data, including digital elevation models (DEMs), satellite imagery, soil surveys, and land use maps. These data are obtained from various sources, including government agencies, research institutions, and private companies.

Data pre-processing: The next step is to preprocess the data to make it suitable for the RUSLE model. This includes data conversion, data cleaning, and data integration. For example, satellite imagery is processed to extract vegetation cover data, and soil survey data are converted into a format suitable for GIS analysis.

RUSLE model parameterization: The RUSLE model parameters are estimated using the GIS data. For example, the rainfall erosivity factor is calculated using precipitation data, and the soil erodibility factor is estimated using soil survey data.

RUSLE model application: The RUSLE model is applied to the GIS data to estimate soil loss in the region of interest. The model takes into account various factors, including slope, land use, vegetation cover, and erosion control practices. The output is a map of estimated soil loss in the study area.

Model validation: The final step is to validate the RUSLE model using field measurements of soil loss. This is done to ensure the accuracy of the model and to identify areas where the model may need to be improved.

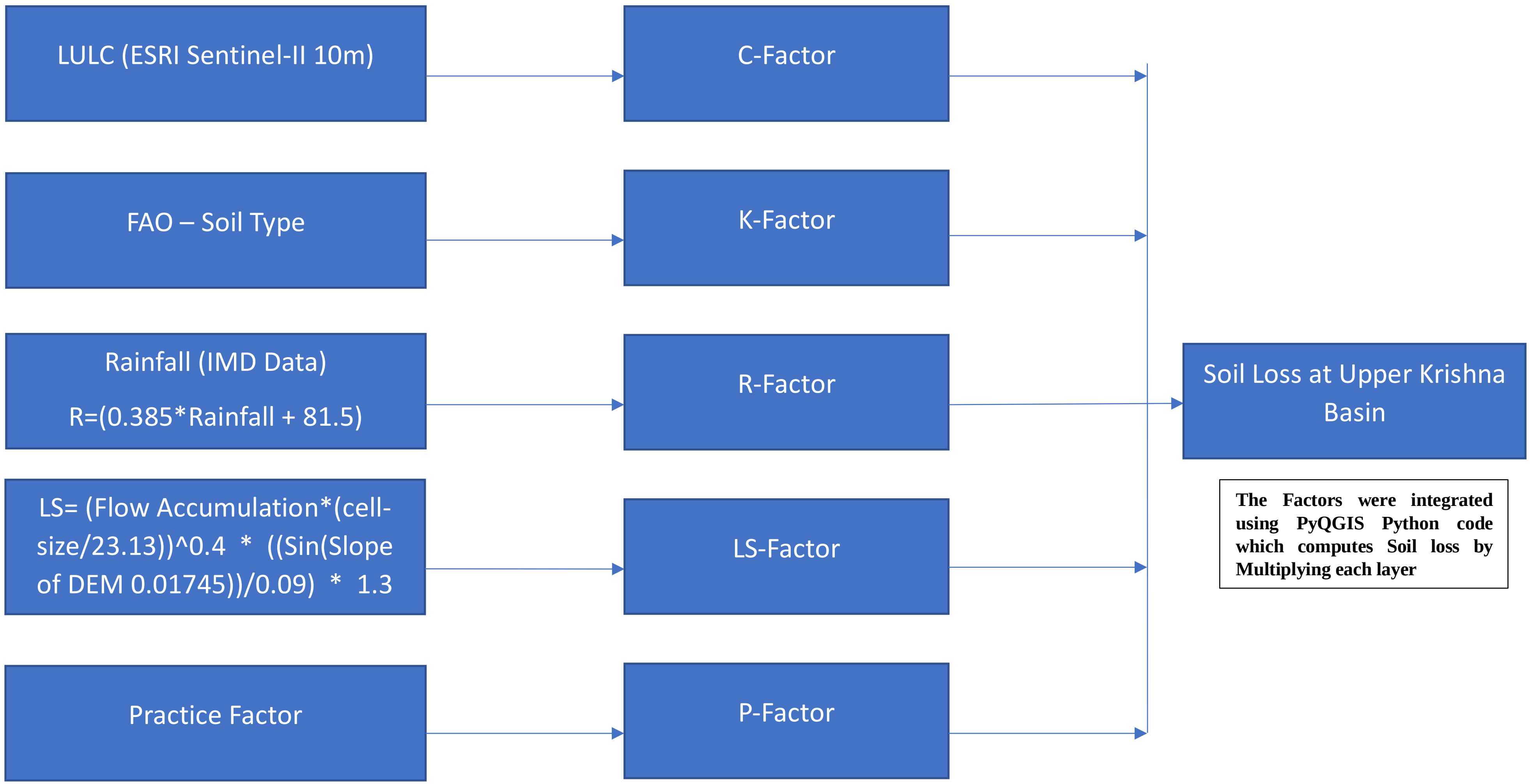
PyQGIS Python Library

PyQGIS is a Python package that implements the QGIS application programming interface (API) in Python. PyQGIS allows developers to use the Python programming language to create custom plugins and scripts for QGIS. In our study, we used PyQGIS to simulate soil erosion in the Upper Krishna Basin using the Revised Universal Soil Loss Equation (RUSLE) model.

PyQGIS is a library that contains modules for accessing and manipulating geographical data, such as vector and raster layers. We used PyQGIS modules to import the RUSLE model's input data layers, which included slope, rainfall, vegetation cover, and soil erodibility. The PyQGIS modules were also utilised to alter the input data layers in order to construct the RUSLE model's parameters.

In conclusion, PyQGIS was critical in implementing the RUSLE model and assessing soil conservation practises in the Upper Krishna Basin. PyQGIS provided a robust collection of tools for accessing and manipulating geographical data, making it a great foundation for constructing custom geospatial applications. The usage of PyQGIS with the RUSLE model provides an effective means of predicting and regulating soil erosion in the region, contributing to sustainable soil resource management and environmental preservation.

Methodology



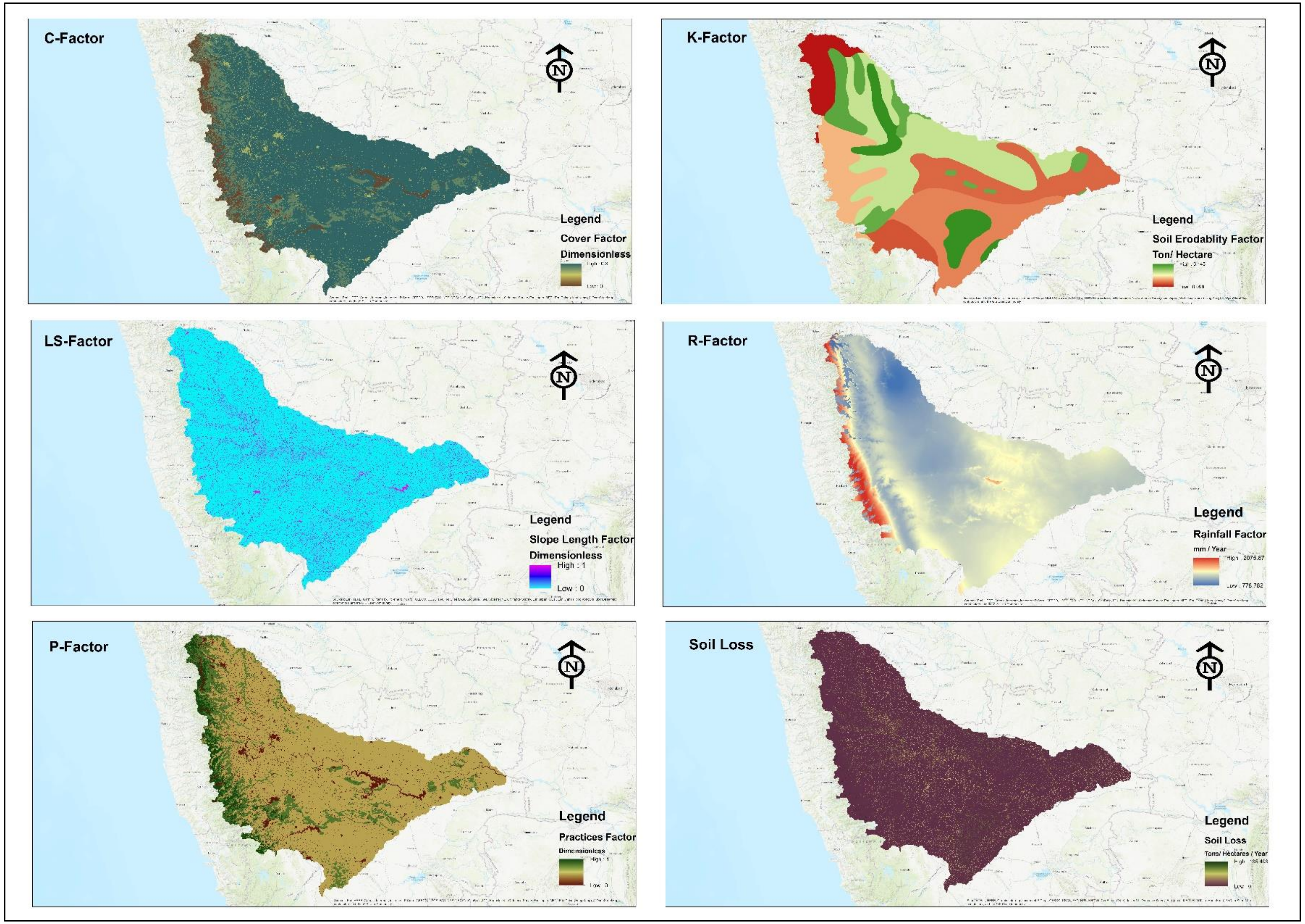


Figure 4:- Soil Loss Factors at Upper Krishna Basin

Soil Loss Parameters for RUSLE Model

1. C Factor: -

The C factor in the RUSLE (Revised Universal Soil Loss Equation) model represents the Cover and is used to estimate the amount of soil erosion caused by rainfall and runoff.

The C factor takes into account the soil's susceptibility to erosion, based on factors such as soil texture, structure, organic matter content, and permeability. A higher C factor indicates a greater potential for soil erosion, while a lower C factor indicates a lower potential for soil erosion.

The C factor is expressed as a dimensionless value between 0 and 1, with higher values indicating greater erodibility. The C factor can be estimated based on soil type, land use, and management practices. The United States Department of Agriculture (USDA) has published tables and maps that provide estimates of the C factor for different soil types and land uses, which can be used in the RUSLE model.

Table 1:- Multiple C Factor values according to Landcover type

LULC Type	Value
Cropland	0.24
Forest Dense	0.01
Grassland	0.05
Shrub Land	0.2
Bare land	0.6
Waterbody	0
Settlement	0.15

2. K Factor: -

The soil erodibility factor (K) indicates the degree of surface soil erosion. The most important parameter for determining the K factor is soil texture. In along with the permeability of the soil, organic matter, and soil structure, several elements are important when assessing the K factor. The value of K represents the rate of soil erosion per rainfall permeability index (R). The map of the soil for this study was created using the FAO digital soil map, and the K factor is derived using the formula below:

$$K = \frac{2.1 * 10 - 4\,(12 - OM)M1.14 + 3.25\,(s - 2) + 2.5\,(p - 3)}{759.4}$$

where K denotes soil erodibility (tons/Y/MJ/mm), OM denotes organic matter percentage, denotes soil structure, p denotes soil permeability, and M is a function of the main particle size fraction as provided by the following formula

$$M = (\%\ \text{Silt} + \%\ \text{Very fine sand}) \times (100\%\ \text{clay})$$

In general, sand has a low k value that indicates a rapid infiltration rate, whereas clay soil has a lower k value that indicates impedance to the area of catchment. Silt soil has a large K value due to its high crusting and high drainage rate and quantities.

3. **LS Factor**

In the revised universal sol loss equation (RUSLE), the LS factor describes the influence of slope as well as slope length upon soil erosion. It is the ratio of soil loss from a specific area of land to the quantity of soil loss from an even surface with the same vegetation and soil cover.

$$LS = (Flow\ Accumulation * (cell - size/23.13))\ \text{^}0.4 \\ * \ ((Sin(Slope\ of\ DEM\ 0.01745))/0.09) \ * \ 1.3$$

The LS component is a dimensionless quantity with a value between 0 and infinity, with greater values suggesting a higher risk of soil loss. The LS factor can be determined using digital terrain models (DEMs) or topographical maps that include slope angle and slope length information.

It should be noted that the LS factor is a location-specific characteristic that must be computed for each soil and landscape based on topographic aspects of the land surface. Furthermore, factors like land use, vegetation cover, and erosion control practises can all have an impact on the LS factor. As a result, proper measurement and evaluation of these factors are required for accurate determination of the LS factor.

4. **R Factor**

The R factor in the Revised Universal Soil Loss Equation (RUSLE) is a rainfall erosivity factor that describes the potential of rainfall to cause soil erosion. It is a measure of the kinetic energy of raindrops, which is a primary driver of soil erosion.

The R factor as mentioned in Equation is expressed in MJ mm ha-1 h-1 yr-1 units and determines the quantity of erosive power contained in a particular amount of rainfall. A greater R factor indicates rainfall is more erosive, making soil erosion more likely.

Rainfall data, which includes rainfall records, intensity of rainfall data, or rainfall simulations, can be used to calculate the R factor. Furthermore, empirical formulae or geographic information systems (GIS) may be employed to calculate the R factor from local rainfall data or to calculate R factor values for locations where direct rainfall data is unavailable.

It should be noted the R factor is a location-specific variable that must be computed for each individual place according to local rainfall variables. Furthermore, seasonality, hurricane duration, and distribution of intensity can all alter the R factor, which should be taken into account when employing the RUSLE equation to measure soil erosion.

$$R = (0.385 * Rainfall) + 87.5$$

5. **P Factor**

The conservation support practise factor (P) compares the rate of soil loss from support practises up and down the slope to that of straight-row farming up and down the slope to account for the beneficial benefits of support practises. It reduces the possibility for runoff erosion by influencing runoff concentration, drainage pattern, runoff velocity, and runoff hydraulic pressures on the soil. P-factor values for various land uses were calculated using the standard table given below. The raster calculator has been used to assign values to the various LULC classes, then the P factor map has been created. P values vary from 0 to 1, with larger values indicating ineffective conservation efforts and lower values indicating effective conservation efforts.

Table 2:- Conservation Practice Factor for various Land covers

LU/LC Class	Conservation Practice (P)
Agriculture	0.6
Forest	0.8
Fallow Land	1
River	0.1
Waterbodies	0
Medium Scrub and Trees	0.8
Open Scrub	0.9
Open Mixed Forest	0.9
Settlement	0.4
Barren Land	1

PyQGIS Script for RUSLE Model with Explanation

PyQGIS Script

```
# Import necessary libraries
from qgis.analysis import QgsRasterCalculatorEntry, QgsRasterCalculator
from pathlib import Path
# Define the raster layers for each RUSLE factor
raster_factors = {
    'R': 'E:/Upper_Krishna_Basin_RUSLE_Model/Raster_files/Soil_Loss_Factors/R_Factor.tif',
    'K': 'E:/Upper_Krishna_Basin_RUSLE_Model/Raster_files/Soil_Loss_Factors/K_Factor.tif',
    'LS': 'E:/Upper_Krishna_Basin_RUSLE_Model/Raster_files/Soil_Loss_Factors/LS_Factor.tif',
    'C': 'E:/Upper_Krishna_Basin_RUSLE_Model/Raster_files/Soil_Loss_Factors/C_Factor.tif',
    'P': 'E:/Upper_Krishna_Basin_RUSLE_Model/Raster_files/Soil_Loss_Factors/P_Factor.tif'
}
# Define the path to the output raster
output_raster = 'E:/Upper_Krishna_Basin_RUSLE_Model/Raster_files/sl.tif'
# Create a list of QgsRasterCalculatorEntry objects for each RUSLE factor
raster_entries = []
for factor, layer_name in raster_factors.items():
    layer = QgsProject.instance().mapLayersByName(layer_name)[0]
    raster_entry = QgsRasterCalculatorEntry()
    raster_entry.ref = factor
    raster_entry.raster = layer
    raster_entry.bandNumber = 1
    raster_entries.append(raster_entry)
# Define the RUSLE equation as a string
rusle_expression = "R * K * LS * C * P"
# Get the dimensions of the first input layer
output_layer = QgsProject.instance().mapLayersByName(list(raster_factors.values())[0])[0]
```

 # Create a QgsRasterCalculator object to calculate the soil loss raster

calc = QgsRasterCalculator(rusle_expression, output_raster, 'GTiff', output_layer.extent(), output_layer.width(), output_layer.height(), raster_entries)

calc.processCalculation()

Explanation of Above Script

- **Import the appropriate libraries**: For raster calculations, the '*qgis.analysis*' module from the QGIS library is imported, and the pathlib module is imported for working with file paths.
- **Create raster layers for each RUSLE factor as follows:** For each RUSLE factor, a dictionary '*raster_factors'* is formed to record the file paths of the input rasters. A Windows file path format is used to define the paths.
- **Set the path to the output raster as follows:** The file path where the output raster will be saved is stored in the string *'output_raster'*. The path is specified in the Windows file path format.
- **For each RUSLE factor, create a list of QgsRasterCalculatorEntry objects: For** each input raster layer, a list '*raster_entries*' is generated to store '*QgsRasterCalculatorEntry*' objects. For each input raster layer, a for loop is used to go over the '*raster_factors*' dictionary and generate a '*QgsRasterCalculatorEntry*' object. The '*mapLayersByName()*' function is used to retrieve the '*QgsRasterLayer*' object for each layer, and the '*QgsRasterCalculatorEntry*' object is constructed with the layer's name as the reference and the layer as the raster.
- **As a string, define the RUSLE equation:** The RUSLE equation is stored in a mathematical expression format utilising the factor names as variables in a string *'rusle_expression'*.
- **Get the first input layer's dimensions:** The variable '*output_layer*' is set to hold the *'QgsRasterLayer'* object for the first input raster layer. This is used to obtain the output raster's dimensions (width and height) and extent.
- **To compute the soil loss raster, create a QgsRasterCalculator object as follows:** The *'QgsRasterCalculator()'* constructor returns a QgsRasterCalculator object calc. The RUSLE equation string, the output raster file location, the output raster format (GeoTiff), the extent and dimensions of the output layer, and a list of QgsRasterCalculatorEntry objects for each input raster layer are all initialised in the object.
- **Carry out the calculation:** The *'QgsRasterCalculator'* object's processCalculation() function is invoked to execute the raster calculation and store the output raster to the provided file directory.

This programme computes rasters based on the RUSLE equation and a set of input rasters for each RUSLE factor. The result is a single raster layer showing the predicted soil loss in the study region, which may be used to identify high-risk erosion locations and inform soil conservation strategies.

Conclusion & Recommendations

The Upper Krishna Basin in Maharashtra and Karnataka, India, is a region plagued by soil erosion. The application of GIS technologies and the Revised Universal Soil Loss Equation (RUSLE) allows for the prediction and management of soil erosion in the region. According to our findings, the expected soil loss in the Upper Krishna Basin is roughly 2.02 tonnes per acre per year.

This level of soil loss is worisome because it can result in decreased soil fertility and productivity, increased sedimentation in rivers and streams, and downstream flooding. Soil loss can also contribute to decreasing water quality, which can have an impact on agriculture and drinking water supplies in the region. As a result, there is an urgent need in the region for sustainable soil management practises.

The RUSLE model, built with PyQGIS and geospatial technologies, is a useful tool for predicting soil erosion and assessing the efficacy of various soil conservation practises. The output of the model can be used to prioritise areas for soil conservation activities and indicate areas where soil erosion mitigation measures are required.

Overall, the Upper Krishna Basin's estimated soil loss of 2.02 tonnes per acre per year underscores the region's need for appropriate soil management practises. The RUSLE model, when combined with GIS technology, provides an effective tool for predicting and regulating soil erosion in the region, thereby helping to the long-term management of soil resources and environmental protection.

After analysing the soil erosion risk zones at the Upper Krishna Basin using the RUSLE model and GIS, the following conclusions and recommendations can be made:

Conclusion: -

- The slope, rainfall intensity, and land use/land cover were identified as the major factors contributing to soil erosion in the study area.
- The high soil erosion risk zones were found in the western and southwestern parts of the study area, which are characterized by steep slopes and intensive agriculture activities.

Recommendations: -

- Implementation of suitable conservation measures such as contour bunding, terracing, and agroforestry practices in the high-risk areas to reduce soil erosion.
- Promoting the use of organic farming practices, which can help to increase soil fertility and reduce soil erosion.
- Promoting afforestation and reforestation programs in the high-risk areas, which can help to stabilize slopes and reduce soil erosion.
- Improving the drainage systems in the study area to reduce the impact of high-intensity rainfall events on soil erosion.

Overall, the study highlights the need for a comprehensive approach to address the issue of soil erosion in the Upper Krishna Basin. The implementation of suitable conservation measures can help to reduce soil erosion and improve soil health, which can have significant positive impacts on the local environment, agriculture, and livelihoods of the people in the area.

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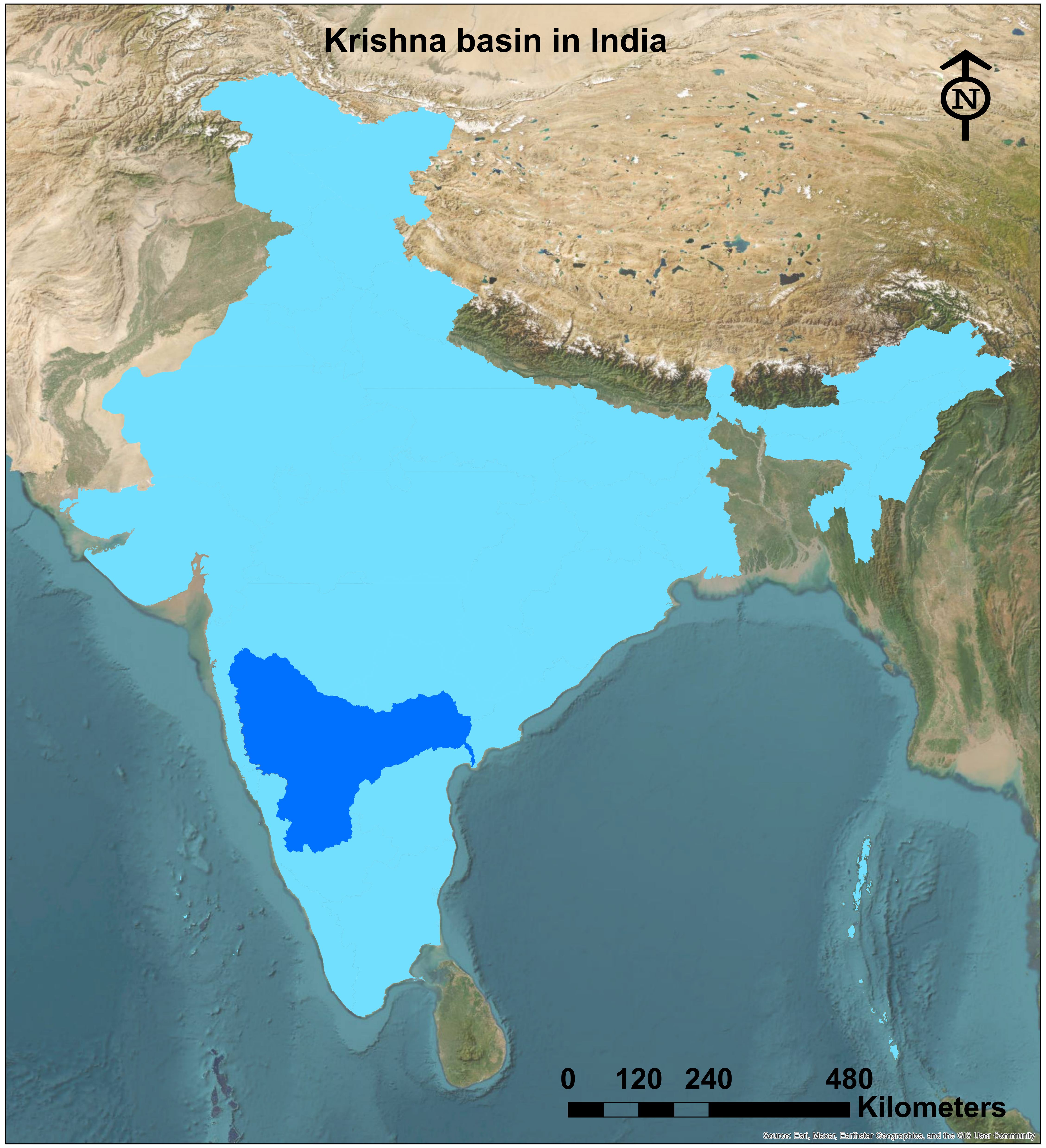
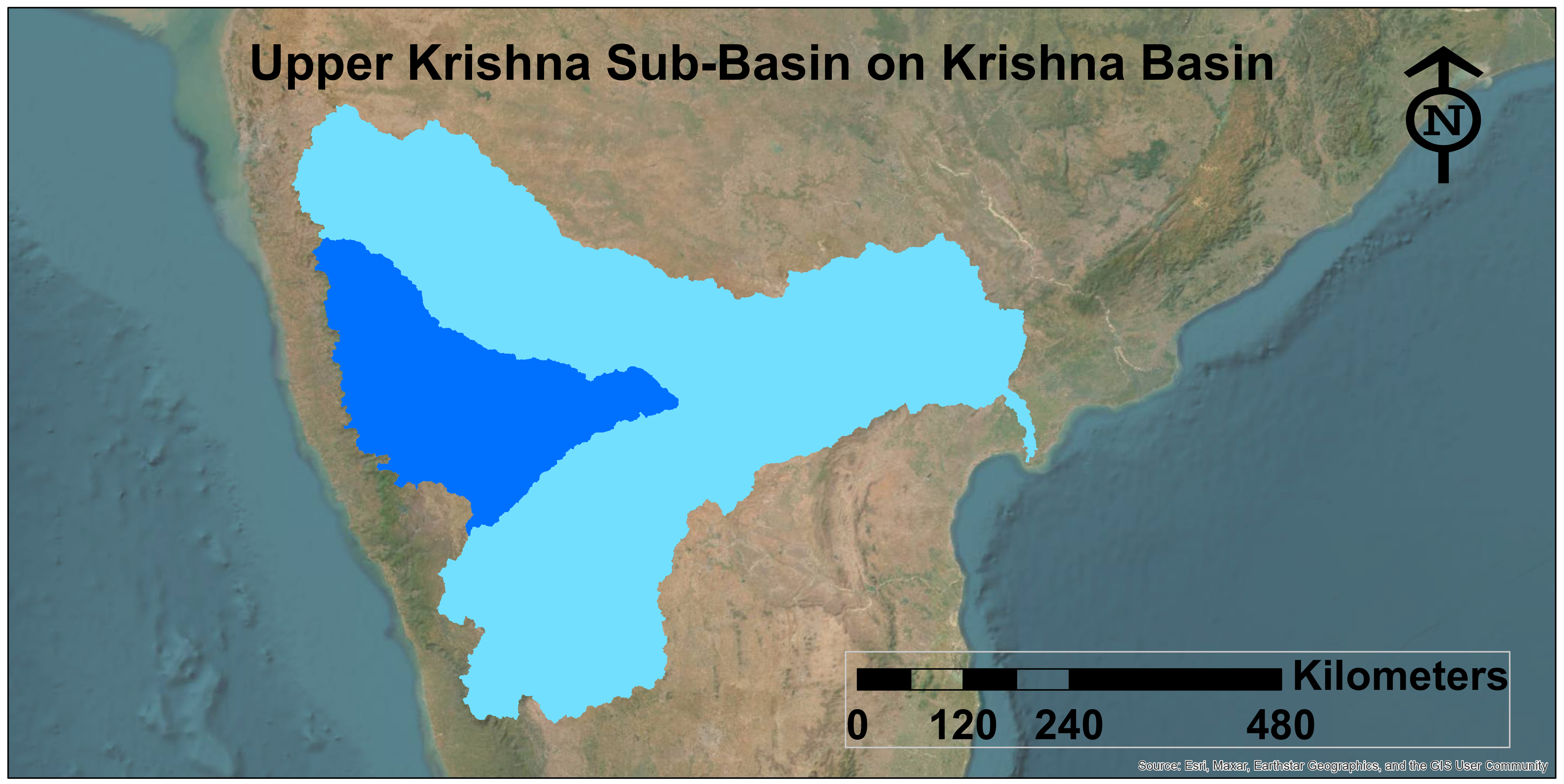
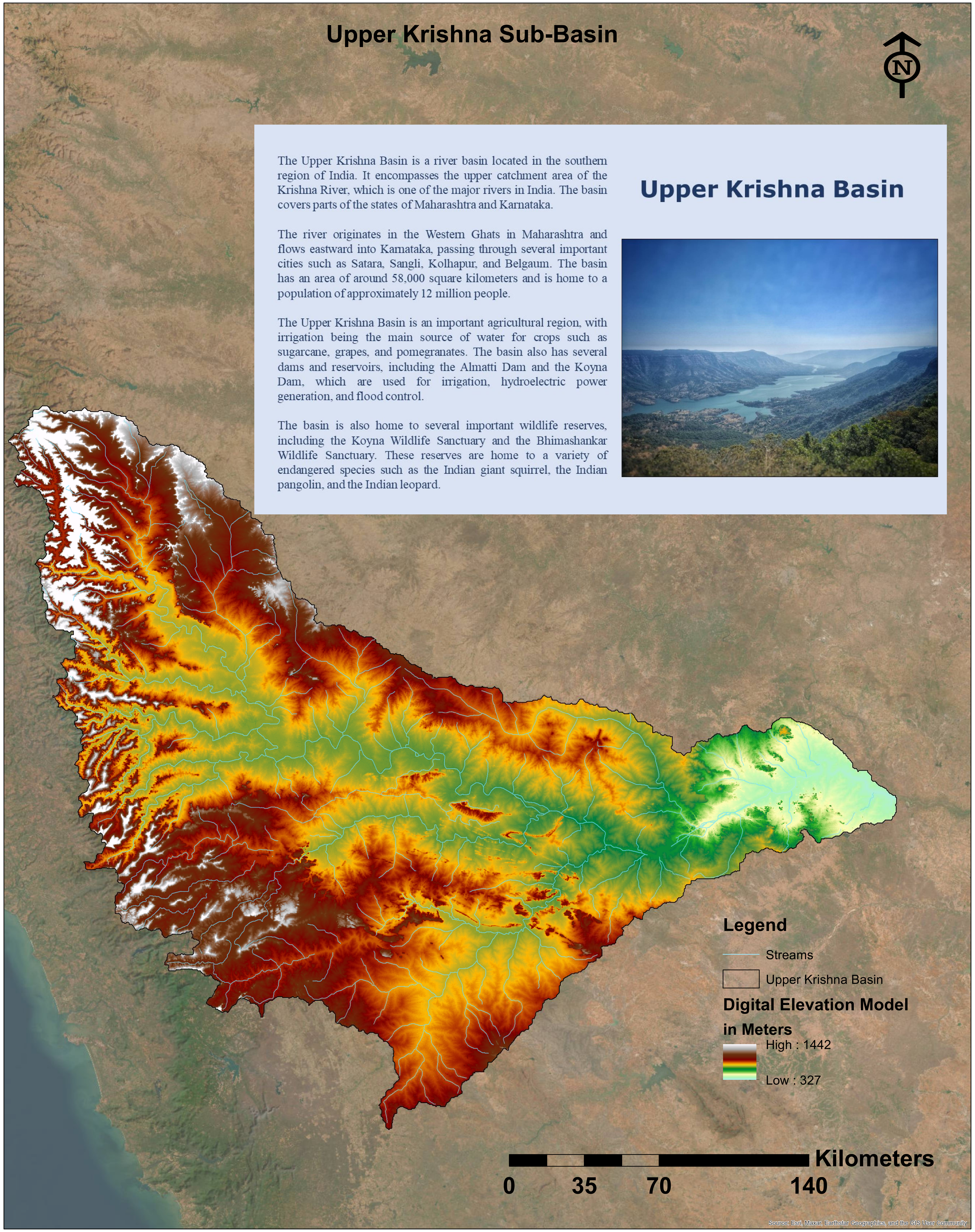
ANNEXURES







Upper Krishna Basin

The Upper Krishna Basin is a river basin located in the southern region of India. It encompasses the upper catchment area of the Krishna River, which is one of the major rivers in India. The basin covers parts of the states of Maharashtra and Karnataka.

The river originates in the Western Ghats in Maharashtra and flows eastward into Karnataka, passing through several important cities such as Satara, Sangli, Kolhapur, and Belgaum. The basin has an area of around 58,000 square kilometers and is home to a population of approximately 12 million people.

The Upper Krishna Basin is an important agricultural region, with irrigation being the main source of water for crops such as sugarcane, grapes, and pomegranates. The basin also has several dams and reservoirs, including the Almatti Dam and the Koyna Dam, which are used for irrigation, hydroelectric power generation, and flood control.

The basin is also home to several important wildlife reserves, including the Koyna Wildlife Sanctuary and the Bhimashankar Wildlife Sanctuary. These reserves are home to a variety of endangered species such as the Indian giant squirrel, the Indian pangolin, and the Indian leopard.


C-Factor
Legend
Cover Factor
Dimensionless
High : 0.6
Low : 0
K-Factor
Legend
Soil Erodablity Factor
Ton/ Hectare
High : 0.145
Low : 0.099
LS-Factor
Legend
Slope Length Factor
Dimensionless
High : 1
Low : 0
R-Factor
Legend
Rainfall Factor
mm / Year
High : 2075.67
Low : 778.782
P-Factor
Legend
Practices Factor
Dimensionless
High : 1
Low : 0
Soil Loss
Legend
Soil Loss
Tons/ Hectares / Year
High : 135.403
Low : 0

Soil Loss	Tons/Hectares/Year
Minimum	0
Maximum	135.4
Average	2.01