An Introduction and a Step-by-Step guide to QGIS along with a comprehensive study of Jorhat district through LULC, Slope, Hillshade, Contour and Aspect map

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***Abstract*—This paper features QGIS, which is an open-source GIS software chosen for this spatial analysis, along with a thorough procedure describing how the analysis must be carried out. Maps selected for the analysis include Land Use Land Cover (LULC), Slope, Hillshade, Contour, and Aspect of Jorhat district. The analytical tools enlighten on the various terrain characteristics, lending themselves to sustainable planning and resource management in the region.**

***Index Terms*— Slope map, aspect map, hillshade map, QGIS, Digital Elevation Model, toposheet.**

I. INTRODUCTION

Remote sensing is the process of collecting data about an object or fact without making any physical contact with it. In reality, it comprises the use of satellite or aircraft-based sensor technologies to detect and classify objects on Earth, such as vegetation, buildings, and water bodies etc. Geographic Information Systems (GIS) is a framework used for collecting, organizing, and examining spatial and geographic data. GIS combines many types of data and is used to study spatial locations and structures layers of information into visualizations using maps and 3D scenes. Remote sensing provides the data, and GIS organizes and examines this data to support decision-making in fields like urban planning, environmental monitoring, and disaster management.

Digital maps are essential tools to obtain spatial data. Maps help to relate various features to any given geographical location giving a good perspective for any individual to understand and interpret. Thus, they are essential for monitoring and analysing change over a period of time. The Survey of India (SOI) topographical maps are the earliest maps of India showing land-use/land-cover classification. In recent years many advancements have been made in mapping techniques to prepare maps with much more information. Remote Sensing is now recognised as an inevitable tool to view, analyze, characterize and make analysis and observations about land, water and atmospheric components. Landuse/Landcover (LULC) is considered one of the most important and handy means to study changes in the impact of human activities on the global environment as a whole.

This study used topographic maps (83J/1, 83J/2, 83J/3, 83J/5, 83J/6, 83J/7, 83J/9, 83J/10, 2011) from the Survey of India (https://surveyofindia.gov.in) along with (SRTM1N26E093V3, SRTM1N26E094V3, SRTM1N27E094V3) DEM data from USGS Earth Explorer (https://earthexplorer.usgs.gov/). The toposheets gave more detailed land-use, hydrology, and infrastructure information, while the DEM data allow terrain analysis. This can include slope, aspect, and elevation mapping. These datasets were further processed in GIS software to produce LULC maps, slope maps, aspect maps, and hillshade models, thereby providing a better understanding of the region's topography and spatial characteristics.

II. REVIEW OF LITERATURE

Basically, literature reviewing intends to frame the very broad concept of the topic under the scientific strategy that becomes very much clear and well defined. It aims at finally developing a conclusive study upon reviewing literatures written by several highly noticed researchers, followed by the summation. It allows an orientation in regard to earlier

knowledge and concepts developed through papers presented by other researchers across different subjects. This helps readers get a clearer understanding of the topic by examining both the strengths and weaknesses of the sources of information. With the availability of various resources like books, journals, theses, reports, and papers, along with digital tools such as e-libraries offering a vast collection of e-books, articles, and online journals, the process of conducting a literature review has become much more efficient and less time-consuming. Research papers of Atasoy et al. 2006, Bhattacharjya A. 2018, Campbell J.B. 2007, Carlson and Azofeifa 1999, Giridhar et al. 2007, Muttitanon and Tiipathi 2005, Yusra Abed Alkareem Alhusban 2018, Zsuzsanna et al. 2005 were the resource material for the present study. These papers threw light on the efficient use of GIS in the various domains like risk management & disaster assessment, urban planning and helps with environmental impact analysis which adds to the resourcefulness of the present study.

III. STUDY AREA

Jorhat district is located at 26.75°N 94.22°E and lies at an elevation of 381 feet above MSL (as shown in Figure 1). The Jorhat district covers a total area of about 2,859.35 sq. km. The Jorhat District is bounded by the river Brahmaputra on the north, Nagaland on the south, Sivsagar District on the east and Golaghat District on the west. The headquarters of Jorhat District is located at Jorhat and the district is divided into the following subdivisions: Jorhat East, Jorhat West, Mariani, Teok and Titabor.

Objectives

➤ To study the Land-use /Land-cover change of Jorhat District

➤ To create Slope, Aspect, Hillshade and Contour map of Jorhat District

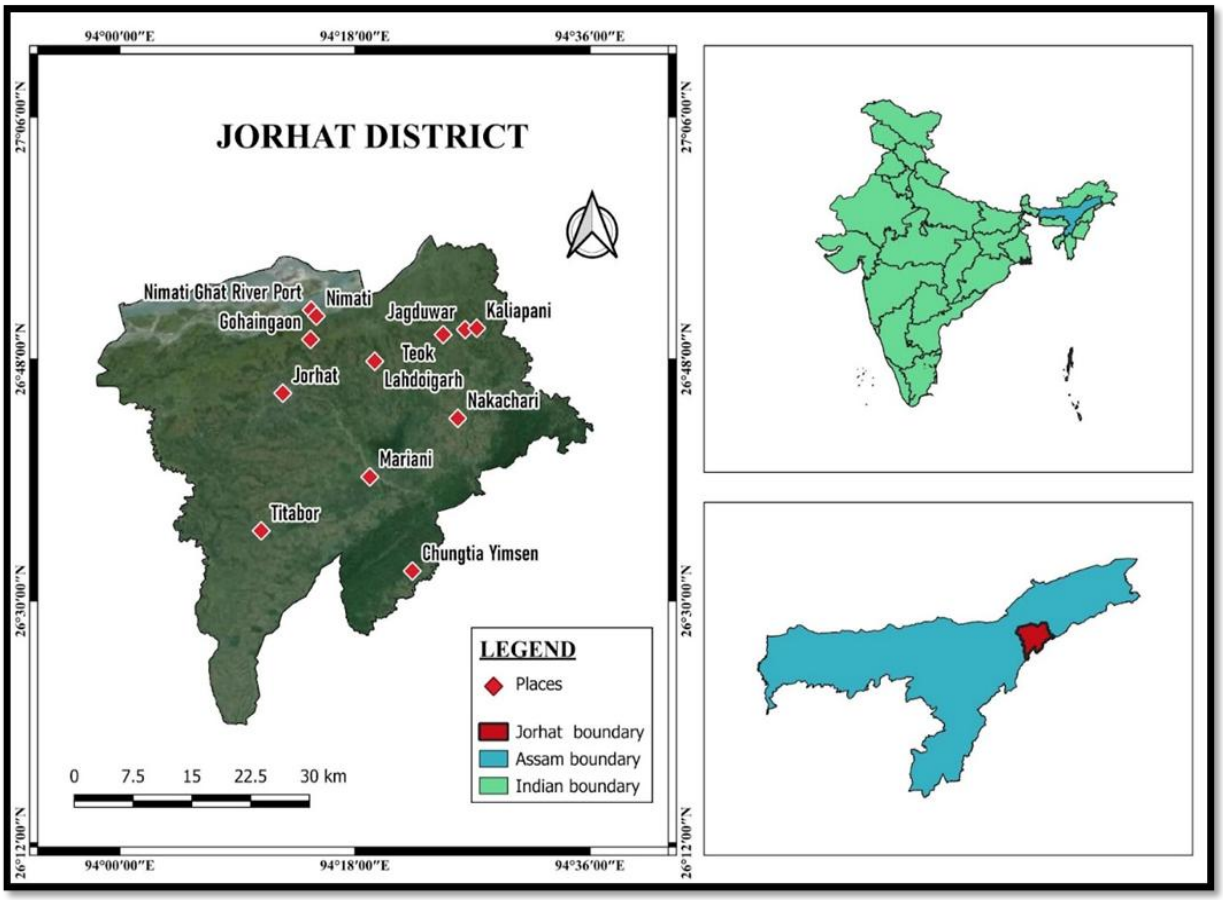


Figure 1: Location map of the study area

IV. METHODOLOGY

To perform land use land cover (LULC) analysis, process the Google Earth Pro maps to gain a clear understanding of the area. The preprocessing of LULCs involved geo-referencing four locations. Within these locations, digitize the water bodies, barren land, built-up areas, etc. Then calculated the areas and determined the latitude and longitude using QGIS software. Utilizing the SCP plugin, compute the land use land cover.

Digitization of Jorhat District by using QGIS

Step 1: Visit the Survey of India website

- Open a web browser (e.g., Google Chrome, Mozilla Firefox) and navigate to the Survey of India website.

Step 2: Click on the "Maps" tab

- On the top menu bar, click on the "Maps" tab. A dropdown menu will appear.
- Select "Open Series Maps" from the dropdown menu.

Step 3: Choose Assam as the state

- On the next page, select "Assam" as the state from the dropdown menu.

Step 4: Select Jorhat as the district

- After selecting Assam, select "Jorhat" as the district from the next dropdown menu.

Step 5: Click on the "Download" button

- Click on the "Download" button to download the Jorhat map in PDF format.

Step 6: Save the map

- Save the downloaded map to your computer or device. Make sure you have a PDF viewer installed to view the map.

QGIS & Georeferencing

QGIS is a free and open-source cross-platform desktop geographic information system (GIS) application that supports viewing, editing, and analysis of geospatial data.

Step 1: Prepare the Map

- Open QGIS software ⟶ Go to Layer in the Toolbar
- Click on Add Layer ⟶ Add Raster Layer⟶Browse the downloaded map in the Raster datasets ⟶ Click Add option
- Go to Layer ⟶ Georeferencer ⟶Open Raster, select your toposheet to georeference
- Click Add points icon to add the 1st point⟶ Enter the map coordinates (Latitude & Longitude) of the selected point
- In X/East add the Longitude of the 1st point
- In Y/North add the Latitude of the 1st point. The entered values for latitude and longitude can be seen in the GCP Table.
- Click on Add points icon for further addition of ground control points (At least add four ground control points)
- The GCP Table will display all the Latitude and Longitude of the added points. The Residual (pixels) must be less than 10 pixels in the GCP Table.
- If the Residual (pixels) criteria is not fulfilled than remove the points with higher than 10 pixels in Residual error.
- Again, add the points unless the criteria is fulfilled.
- Go to Transformation Settings ⟶In Transformation Parameters ⟶ Select “Linear” in the Transformation type
- Select “Nearest neighbour” in the Resampling method
- Select “ESPG:4326-WGS 84” in the Target CRS
- In Output settings ⟶ In Output raster: Browse for the file location to save file with “.tiff” extension
- Select “None” in Compression. Then click on “OK” after making the required changes
- Click on Start Georeferencing icon or go to File and then select “Start Georeferencing (Ctrl + G)”
- Map processing will start ⟶ “Georeferenced Successful: Raster was successfully georeferenced “will be displayed
- Either Save the CGP points or Discard it

- The georeferenced file will be loaded on the QGIS Workspace
- Move the cursor above any part of the map to check the coordinates. Coordinates of the point will be display at right bottom of the workspace.
- Open Google Earth Pro ⟶Click on File ⟶ Go to file location where georeferenced file is saved ⟶ Select “GeoTIFF(*.tif)” and then select the georeferenced file and click on “Open”
- The georeferenced file will be shown on the place, of which we have entered the latitude and longitude.

PROJECTION

- Go to your browser and open (https://www.samsamwater.com/utmzones/utmzones.kmz)
- Open the downloaded UTM Zones
- Go to File ⟶ Open⟶ Select the georeferenced file location ⟶ Select “GeoTIFF(*.tif)” and then select the georeferenced file and click on “Open”
- The added file will show the desired UTM zone
- Launch the QGIS ⟶ go to layers and add the georeferenced file
- In the Layers panel, right click on the georeferenced file ⟶ Then go to Export ⟶Save As
- Save Raster Layer as dialogue box appears ⟶ Select “GeoTIFF” in Format ⟶ In File name browse the location to save the file with file name “projection” and with “.tiff ” extension
- In CRS Select UTM zone 46N (the desired UTM zone)
- Click on OK keeping other options as it is.
- “Layer Exported: Successfully saved raster layer” will be displayed
- The projection file will be displayed on the Layer panel
- Add new project ⟶Select Discard in the Save Project pop up
- Go to Layer in the tool menu bar ⟶ In Raster browse for the projection file, then Add ⟶ Now, the unit is changed from degrees to meters

Step 2: Create a New Vector Layer

- Go to Layer ⟶ New ⟶ New Vector Layer or click the "Create a new vector layer" button
- Choose the layer type (e.g., polygon, line, point)
- Set the coordinate reference system (CRS)

Step 3: Start Digitizing

- Select the digitizing tool (e.g., polygon, line, point)
- Trace the map features using the mouse or a digitizing tablet
- Use snapping tools (e.g., vertex, edge) to ensure accuracy

Step 4: Map Composing

- Make sure your digitized map layer is loaded and visible in the QGIS canvas.
- Adjust the symbology and labeling as needed.

Step 5: Create a New Layout

- Go to Project ⟶ New Print Layout or click the "New Print Layout" button.
- Choose a layout name and select the paper size and orientation.
- A new window will appear. In the new window go to the add item option in the menu bar
- Then add map
- Right click and drag the mouse on the blank page, to add the map
- Move icon quantity is there, to adjust the map in the blank page accordingly.
- In the items panel, go to item properties and change the scale to fit screen.

Step 6: Add a Map Frame

- Click the "Add Map Frame" button.
- Draw a rectangle on the layout canvas to define the map frame.

- Select the study area layer as the map frame's content.

Step 7: Customize the Map Frame

- Adjust the map frame's extent, scale, and rotation as needed.
- Use the "Lock" button to lock the map frame's extent.

Step 8: Add a Legend

- Click the "Add Legend" button.
- Customize the legend's appearance, columns, and content.

Step 9: Add a Title and Labels

- Click the "Add Label" button.
- Create a title and labels for your map (e.g., study area name, scale, date).

Step 10: Add Additional Elements (Optional)

- Add images, shapes, or other elements to enhance your map (as shown in Figure 2).
- Use the "Add Image" button or copy and paste from another program.

Step 11: Customize the Layout

- Adjust the layout's margins, padding, and background color.
- Use the "Grid" button to enable a grid for precise alignment.

Step 12: Export Your Map

- Go to File ⟶Export as Image or click the "Export as Image" button.
- Choose a file format (e.g., PNG, PDF, SVG) and adjust settings as needed.

Step 13: Save Your Layout

- Save your layout to preserve your design and settings.

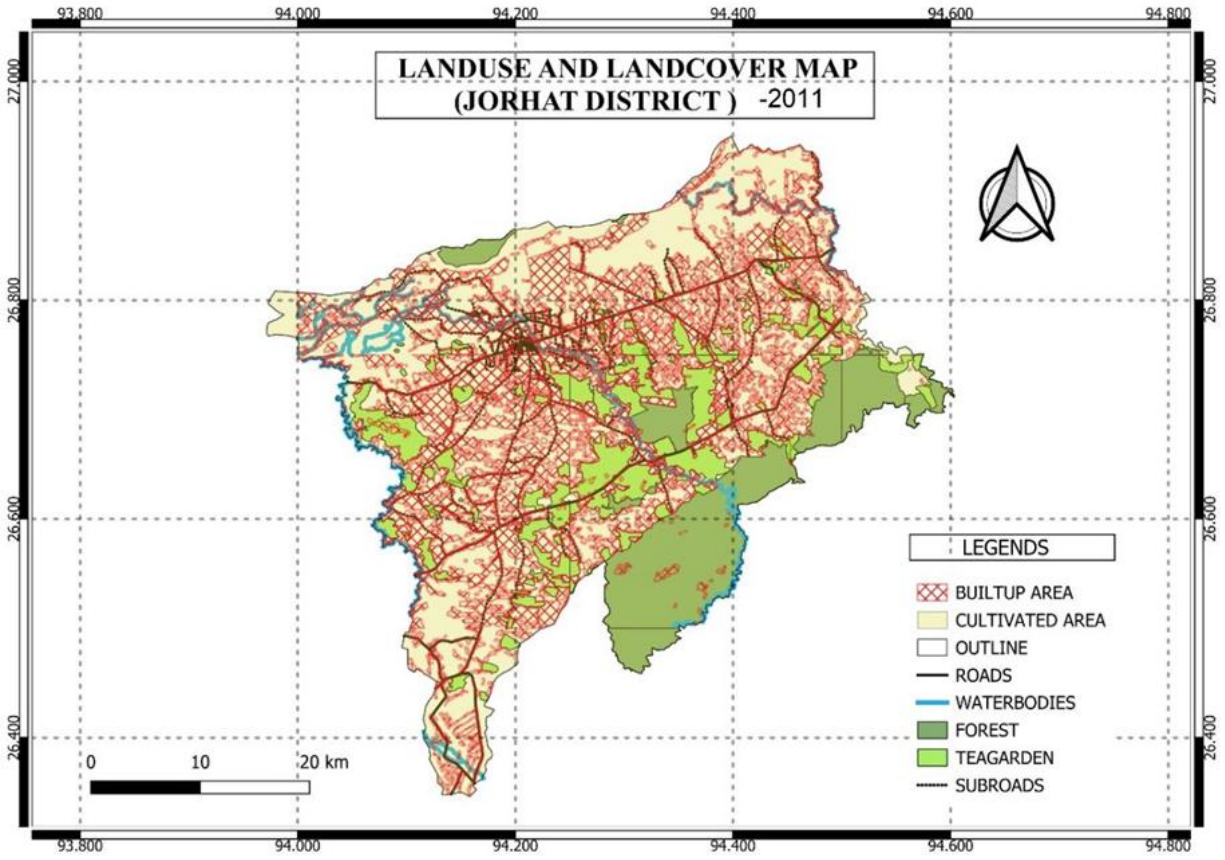


Figure 2: Landuse landcover map of Jorhat District

Contour Map

Contour Map (or Topographic Map) is a type of map that uses contour lines to represent the elevation and shape of the land's surface. These maps are widely used in geography, cartography, civil engineering, and environmental studies. Contour maps help visualize the three-dimensional shape of the terrain on a two-dimensional surface, making them valuable tools for activities such as hiking, land development, and flood risk assessment. Contour maps can also help identify features like hills, valleys, ridges, and depressions. Here are the steps to be followed in order to create a Contour Map for the given Study Area:

STEP 1: Downloading the DEM Files

- Open the USGS website (https://earthexplorer.usgs.gov) and login.
- Under the Geocoder tab, open the drop down menu for Selecting Geocoding Method and select Address/Place option from it. The Address/Place dialogue box will appear.
- In the Address/Place dialogue box, enter the keyword as “Jorhat” and click on the show button. A table containing our desired location will appear.
- Click on the required option from the table. It will automatically locate the coordinate on the map. Zoom into the map and select our desired study area.
- Open the Data Sets tab and click on Refresh. Open the Digital Elevation drop down list and from it open the SRTM drop down and select SRTM 1 Arc-Second Global.
- Open the Results tab and down all the required DEM files.

STEP 2: Loading the DEM files into QGIS

- Launch the QGIS software.
- From the Layers menu, select Data Source Manager.
- In the Data Source Manager, open the Raster tab. Under the Source section, click on the options to locate and select the DEM files and then click the Add button.
- Repeat this step for every DEM file.

STEP 3: Creating Contour Maps

- After the DEM files are loaded, go to Raster→Extraction→Contour. A Contour window will appear.
- In the Contour window, select the required Input Layer i.e. in our case the DEM files.
- Enter the value of the contour interval as 100 and click the Run button.
- A contour map for the selected DEM file will be created.
- In the Layers panel, deselect the DEM file and select the Contour shapefile. The contour lines will be visible.
- Right Click on the Contour shapefile and click on Properties.
- In the Layer Properties window, open the Symbology tab.
- From the drop down menu at the top, select Categorized.
- From the value drop down menu, select 1.2 ELEV.
- From the Color Ramp drop down menu, select any one of the gradients (in our case Spectral).
- Click on the Classify button.
- Now, open the Label tab and select Single Labels from the drop down menu.
- From the Value drop down menu, select 1.2 ELEV.
- Select a font of your choice and click Apply.
- Click the Ok button. We will be able to see the contour lines of different colors with their specific values.
- Repeat this process for every DEM file.

STEP 4: Combining the Contour shapefiles

- After all the contour maps have been created, click on Vectors→Data Management Tools→Merge Vector Layers.
- In the Merge Vector Layers window, select all the contour shapefiles in the Input Layers menu and then click on Run.
- A new shapefile named Merged will be created.

STEP 5: Cropping

- Go to Vector→Geoprocessing Tools→Clip. A Clip window will appear.

- Select the Merged file as the Input Layer and the study area outline shapefile as the Overlay Layer.
- Click on Run. After the Status bar shows Completed, a new cropped shapefile will be formed (as shown in Figure 3).

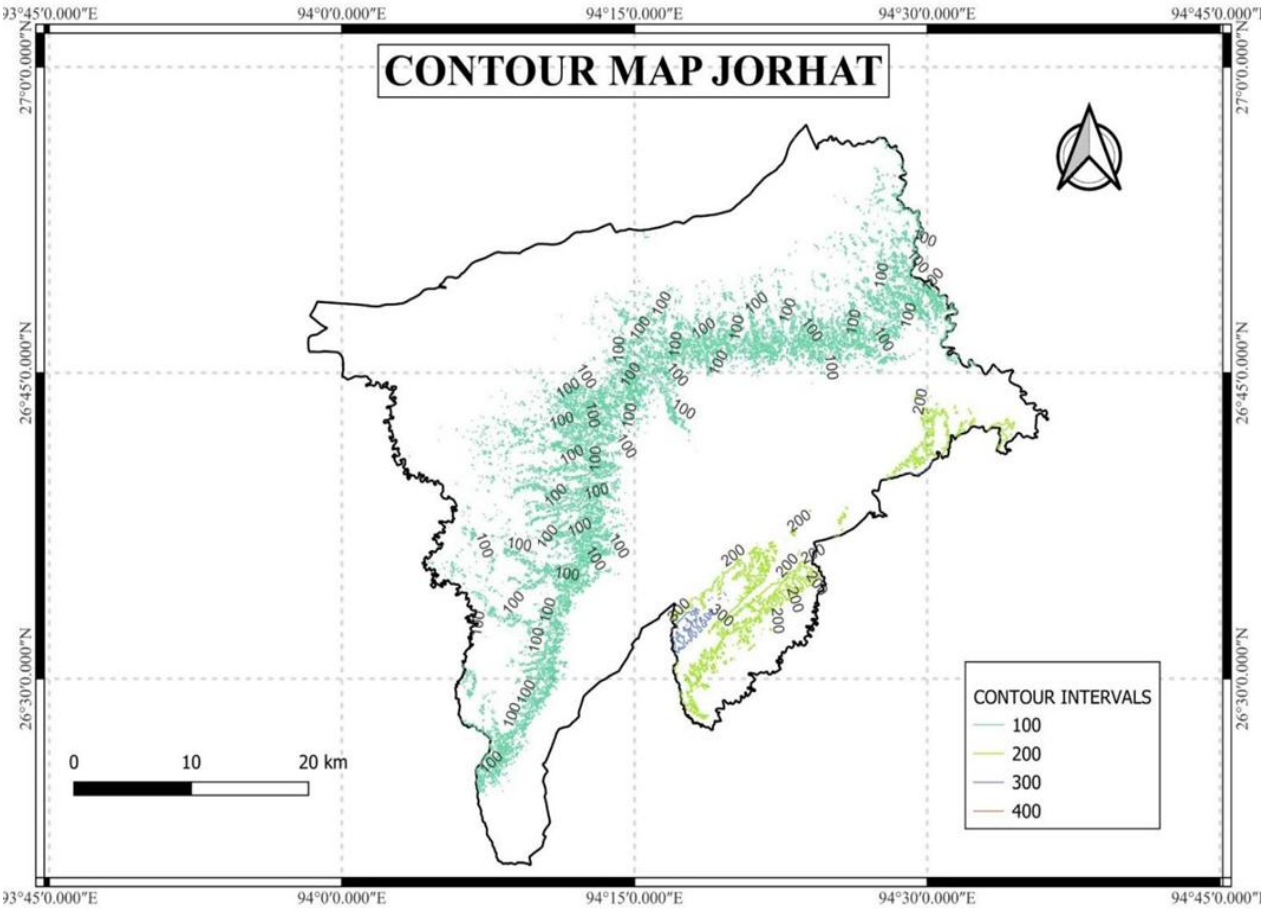


Figure 3: Contour map of Jorhat District

STEP 6: Composing

- Follow the same steps for composing as done for Study Area Map.

Slope Map

Slope Map is a graphical representation that shows the slope of the terrain in a specific area. It is typically used in geographical information systems (GIS) and topographic studies (as shown in Figure 4). On a slope map, different colors or shading patterns are used to indicate varying degrees of slope. For instance, steep areas might be shaded in dark colors, while gentle slopes are shown in lighter colors. Slope maps are crucial for land use planning, infrastructure development, and environmental management, as they help identify areas prone to erosion, landslides, or flooding.

Slope of the Study Area

Here are the steps to be followed in order to create a Slope Map for the given Study Area:

STEP 1: Downloading the DEM Files

- Open the USGS website (https://earthexplorer.usgs.gov) and login.
- Under the Geocoder tab, open the drop down menu for Selecting Geocoding Method and select Address/Place option from it. The Address/Place dialogue box will appear.

- In the Address/Place dialogue box, enter the keyword as “Jorhat” and click on the show button. A table containing our desired location will appear.
- Click on the required option from the table. It will automatically locate the coordinate on the map. Zoom into the map and select our desired study area.
- Open the Data Sets tab and click on Refresh. Open the Digital Elevation drop down list and from it open the SRTM drop down and select SRTM 1 Arc-Second Global.
- Open the Results tab and down all the required DEM files.

STEP 2: Loading the DEM files into QGIS

- Launch the QGIS software.
- From the Layers menu, select Data Source Manager.
- In the Data Source Manager, open the Raster tab. Under the Source section, click on the options to locate and select the DEM files and then click the Add button. Repeat this step for every DEM file.

STEP 3: Creating Slope Map

- Go to Raster→Analysis→Slope. A Slope window will appear.
- Select the DEM file as the input layer and check the checkbox “Slope expressed as percent instead of degrees”.
- Click on the Run button. After the algorithm is completed, close the window.

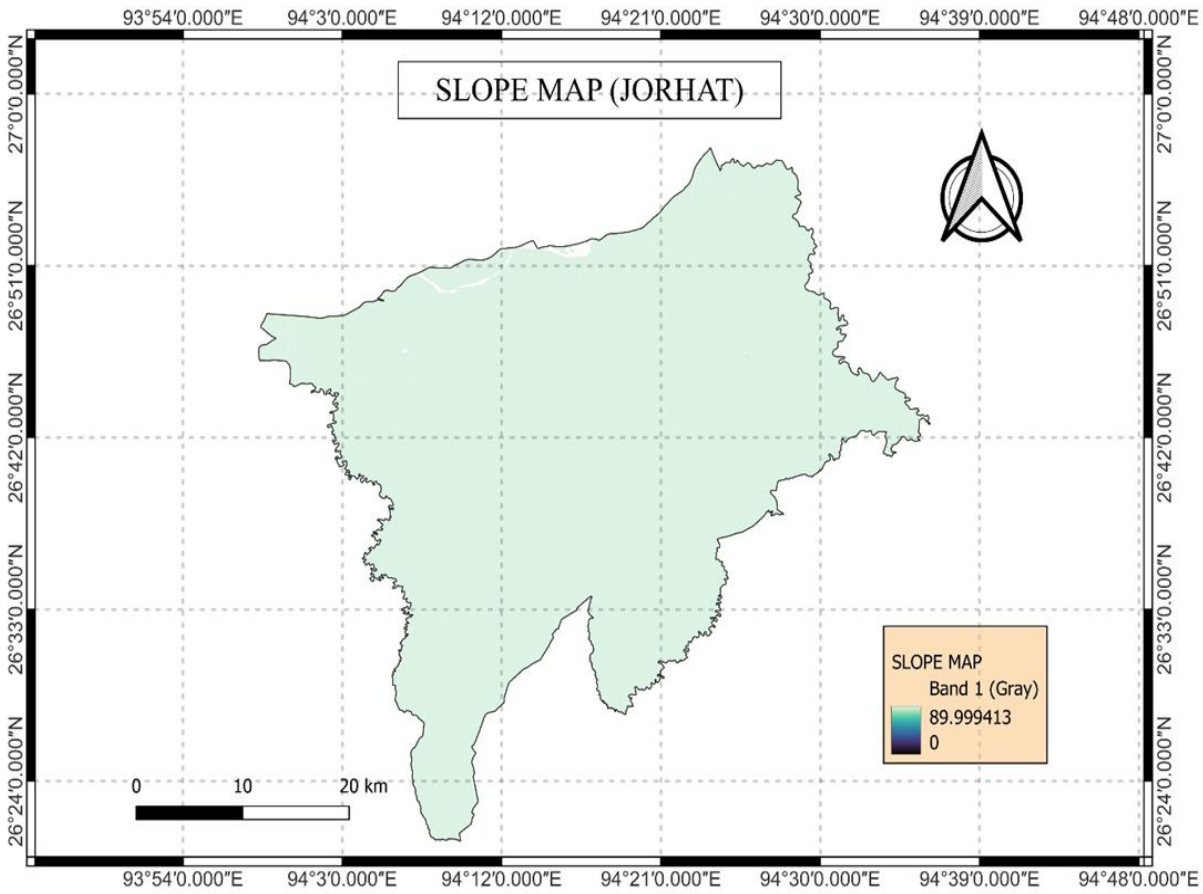


Figure 4: Slope map of Jorhat District

- In the Layers panel, deselect the checkbox for DEM file and select the Slope raster file.
- Right Click on the Slope raster file and click on Properties.
- Open the Symbology tab and under Band Rendering, select Render Type as “Single Band pseudocolor”.
- Under Min/Max Value Settings, open the Color Ramp drop down list and select Spectral.
- Click on Classify, then Apply and click Ok.
- Repeat this process for every DEM file.

STEP 4: Combining the Slope Maps

- Go to Raster→Miscellaneous→Build Virtual Raster. A Build Virtual Raster window will open.
- Select the Slope Maps as input layer and click on Ok.

STEP 5: Cropping

- Go to Raster→Extraction→Clip Raster by Mask Layer. A Clip Raster by Mask Layer window will open.
- Select the combined slope map as the Input Layer and select the study area outline shapefile as the Mask Layer.
- Click on Run.
- After the status bar shows Completed, close the window.

STEP 6: Composing

- Follow the same steps for composing as done for Study Area Map.

Hillshade Map

Hillshade is a visualization technique used in geographic information systems (GIS) to create a shaded relief representation of terrain (as shown in Figure 5). It simulates the effect of sunlight on the landscape by casting shadows based on the angle of the sun, typically considering factors like the sun's azimuth and elevation. The resulting image gives a 3D appearance to the terrain on a 2D map, making it easier to identify landforms such as ridges, valleys, and slopes.

Hillshade Map is a map that uses hillshade techniques to depict the terrain's shape and structure through shadow and light. The shading on the map helps to enhance the visual interpretation of the terrain by giving a sense of depth. Hillshade maps are often used in conjunction with other types of maps, like elevation or topographic maps, to provide a more detailed and intuitive understanding of the landscape. They are valuable in fields such as geography, urban planning, and environmental management for tasks like landform analysis and site selection.

Hillshade of the Study Area

Here are the steps to be followed in order to create a Hillshade Map for the given Study Area:

STEP 1: Downloading the DEM Files

- Open the USGS website (https://earthexplorer.usgs.gov) and login.
- Under the Geocoder tab, open the drop down menu for Selecting Geocoding Method and select Address/Place option from it. The Address/Place dialogue box will appear.
- In the Address/Place dialogue box, enter the keyword as “Jorhat” and click on the show button. A table containing our desired location will appear.
- Click on the required option from the table. It will automatically locate the coordinate on the map. Zoom into the map and select our desired study area.
- Open the Data Sets tab and click on Refresh. Open the Digital Elevation drop down list and from it open the SRTM drop down and select SRTM 1 Arc-Second Global.
- Open the Results tab and down all the required DEM files.

STEP 2: Loading the DEM files into QGIS

- Launch the QGIS software.

- From the Layers menu, select Data Source Manager.
- In the Data Source Manager, open the Raster tab. Under the Source section, click on the options to locate and select the DEM files and then click the Add button. Repeat this step for every DEM file.

STEP 3: Creating Hillshade Map

- Go to Raster→Analysis→Hillshade. A Hillshade window will appear.
- Select the DEM file as the input layer and set the Z factor as 5.
- Click on the Run button. After the algorithm is completed, close the window.
- In the Layers panel, deselect the checkbox for DEM file and select the Hillshade raster file.
- Right Click on the Hillshade raster file and click on Properties.
- Open the Symbology tab and under Band Rendering, select Render Type as "Single Band pseudocolor".
- Under Min/Max Value Settings, open the Color Ramp drop down list and select Spectral.
- Click on Classify, then Apply and click Ok.
- Repeat this process for every DEM file.

STEP 4: Combining the Hillshade Maps

- Go to Raster→Miscellaneous→Build Virtual Raster. A Build Virtual Raster window will open.
- Select the Hillshade Maps as input layer and click on Ok.

STEP 5: Cropping

- Go to Raster→Extraction→Clip Raster by Mask Layer. A Clip Raster by Mask Layer window will open.
- Select the combined Hillshade map as the Input Layer and select the study area outline shapefile as the Mask Layer.
- Click on Run.
- After the status bar shows Completed, close the window.

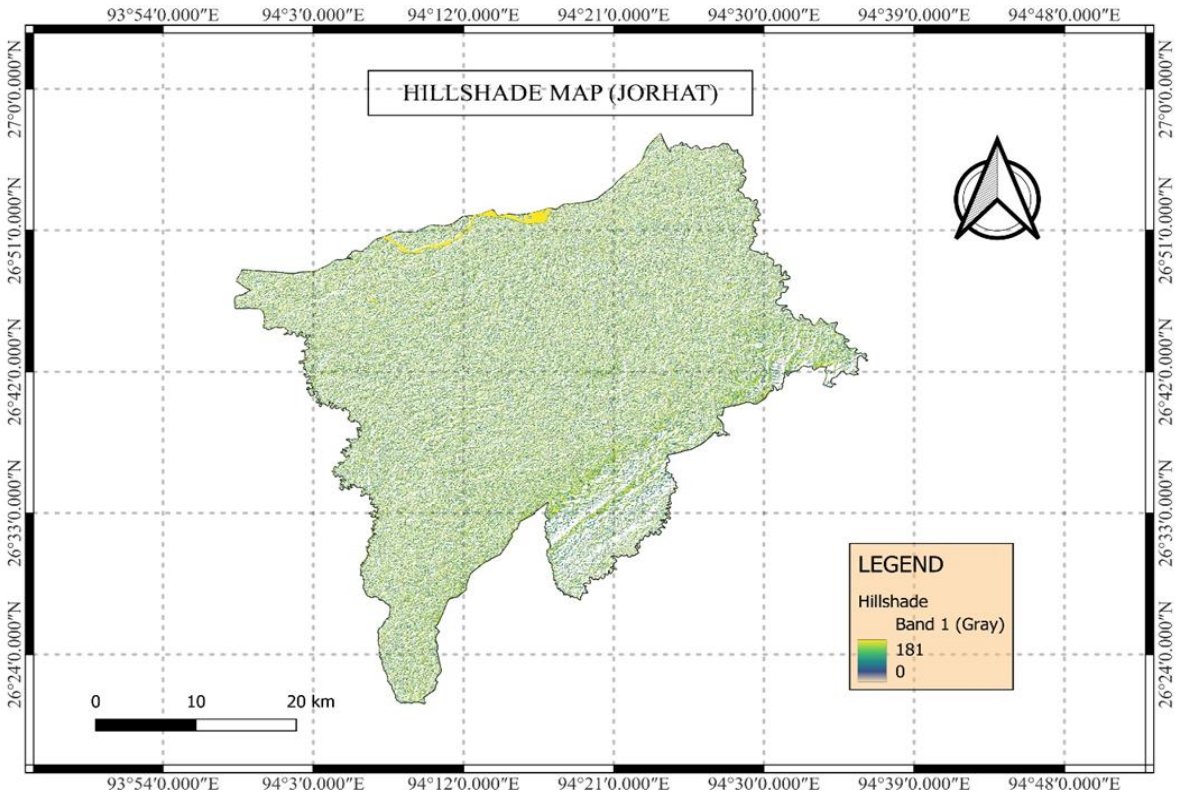


Figure 5: Hillshade map of Jorhat District

STEP 6: Composing

- Follow the same steps for composing as done for Study Area Map.

Aspect Map

Aspect refers to the compass direction that a slope faces (as shown in Figure 6). It is an important terrain attribute in geography and environmental studies, as it influences factors like sunlight exposure, wind patterns, and microclimate conditions on a slope. For example, in the Northern Hemisphere, south-facing slopes typically receive more sunlight and are warmer, while north-facing slopes are cooler and more shaded.

Aspect Map is a type of map that shows the orientation of slopes across a landscape by indicating the direction each slope faces. The map is often color-coded, with different colors representing different compass directions (e.g., north, south, east, west). Aspect maps are useful in fields like agriculture, forestry, and ecology, where the direction of slope influences vegetation growth, soil moisture, and habitat conditions. They are also important in urban planning and construction, as the aspect can affect the energy efficiency of buildings and the design of outdoor spaces.

Aspect of the Study Area

Here are the steps to be followed in order to create a Aspect Map for the given Study Area:

STEP 1: Downloading the DEM Files

- Open the USGS website (https://earthexplorer.usgs.gov) and login.
- Under the Geocoder tab, open the drop down menu for Selecting Geocoding Method and select Address/Place option from it. The Address/Place dialogue box will appear.
- In the Address/Place dialogue box, enter the keyword as “Jorhat” and click on the show button. A table containing our desired location will appear.
- Click on the required option from the table. It will automatically locate the coordinate on the map. Zoom into the map and select our desired study area.
- Open the Data Sets tab and click on Refresh . Open the Digital Elevation drop down list and from it open the SRTM drop down and select SRTM 1 Arc-Second Global.
- Open the Results tab and down all the required DEM files.

STEP 2: Loading the DEM files into QGIS

- Launch the QGIS software.
- From the Layers menu, select Data Source Manager.
- In the Data Source Manager, open the Raster tab. Under the Source section, click on the options to locate and select the DEM files and then click the Add button. Repeat this step for every DEM file.

STEP 3: Creating Aspect Map

- Go to Raster→Analysis→Aspect. An Aspect window will appear.
- Select the DEM file as the input layer.
- Click on the Run button. After the algorithm is completed, close the window.
- In the Layers panel, deselect the checkbox for DEM file and select the Aspect raster file.
- Right Click on the Aspect raster file and click on Properties.
- Open the Symbology tab and under Band Rendering, select Render Type as “Single Band pseudocolor”.
- Under Min/Max Value Settings, open the Color Ramp drop down list and select Spectral.
- Click on Classify, then Apply and click Ok.
- Repeat this process for every DEM file.

STEP 4: Combining the Slope Maps

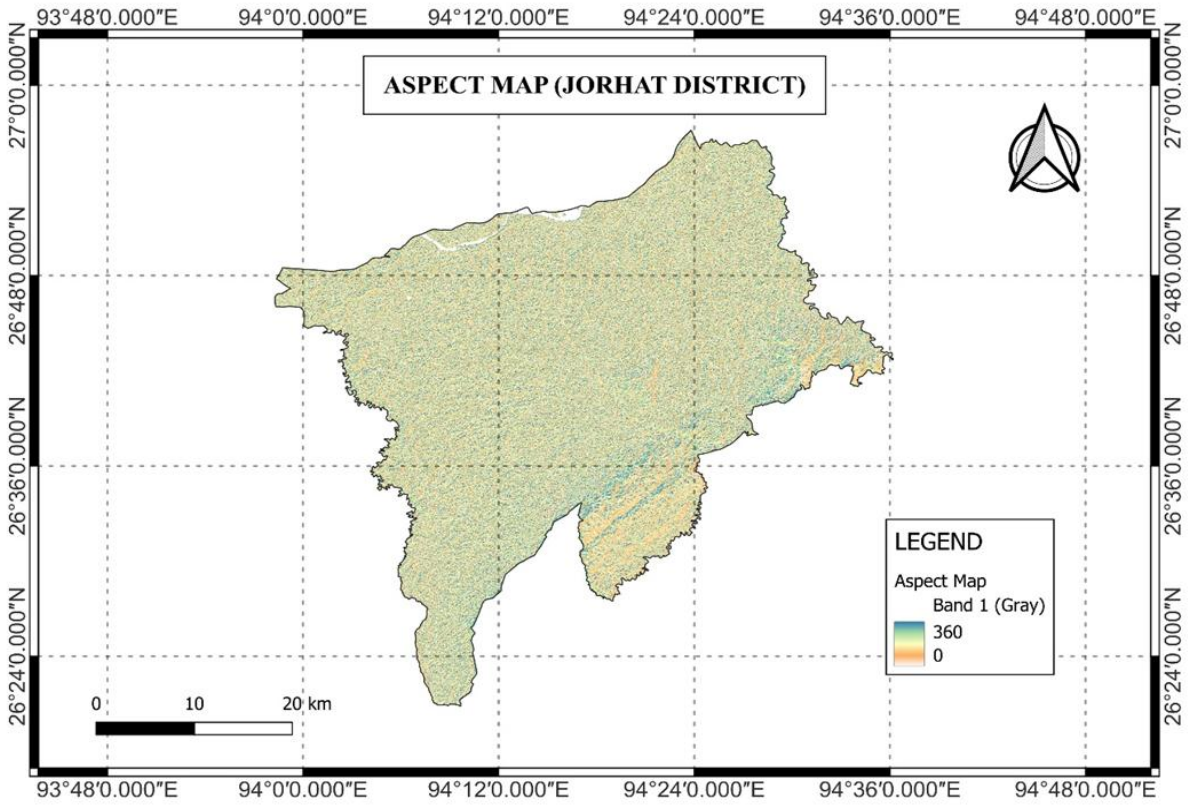
- Go to Raster→Miscellaneous→Build Virtual Raster. A Build Virtual Raster window will open.
- Select the Aspect Maps as input layer and click on Ok.

STEP 5: Cropping

- Go to Raster→Extraction→Clip Raster by Mask Layer. A Clip Raster by Mask Layer window will open.
- Select the combined Aspect map as the Input Layer and select the study area outline shapefile as the Mask Layer.
- Click on Run.
- After the status bar shows Completed, close the window.

STEP 6: Composing

Follow the same steps for composing as done for Study Area Map.



V. RESULTS AND CONCLUSION

This project successfully applied Geographic Information Systems (GIS) to analyze and map the land use and land cover (LULC), slope, aspect, hillshade, and contour of Jorhat District. These spatial analyses provided valuable insights into the physical characteristics and land use patterns of the area, offering a comprehensive understanding that can inform future land management and planning decisions.

The LULC analysis of Jorhat City revealed that the significant part of the land area is covered by agricultural lands like paddy fields and tea gardens. The Bhogdoi river, a tributary of the Brahmaputra River flows through the city of Jorhat. The Bhogdoi river has become polluted over the years. Moreover, urbanization has accelerated, leading to expansion of residential areas on the outskirts of the city. This research sheds light on key regions to preserve, build cities or grow crops. It helps decision-makers focus on steps that align with sustainable development goals.

The slope map identified the variations in terrain steepness across the study area, which is crucial for understanding soil erosion risk, agricultural suitability, and infrastructure development. About 90% of land area of the district is either nearly level or nearly level with very gentle sloping. The South Eastern portion of Jorhat district has moderate to steep slope which requires restrictions for certain types of construction and the need for erosion control measures.

The aspect map provided insights into the directional orientation of slopes, influencing microclimates and vegetation patterns. The analysis showed, which can guide agricultural practices such as selecting crop types based on sunlight exposure or optimizing solar panel placement for renewable energy projects.

The hillshade map visually enhanced the topographic features, aiding in the interpretation of landscape forms and aiding decision-makers in visualizing terrain-related planning. From the hillshade map, it is found that the terrain in the South-eastern region of the Jorhat District is at a higher altitude in comparison to the rest of the land cover of the district. This map is particularly useful for urban planning and to assess the impact of proposed developments on the environment.

The contour map offered a detailed representation of elevation changes, facilitating hydrological studies and infrastructure development. From the study of the Contour map, it has been found that the major portion of the district has a contour interval of 100m above mean sea level from NE direction to SW, representing a level plain area. Whereas a contour interval of 200-300 metres is observed in the South-Eastern portion of the district, indicating a hilly region. An understanding of elevation gradients is important for designing effective drainage systems or planning transportation routes.

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