NDWI based Change Detection Analysis of Dehradun District

# Data Used

The study is carried out using **IRS LISS III** geo-rectified data collected from the National Remote Sensing Centre (NRSC) Bhuvan geo-portal. Bhuvan provides LISS III data into tile format with 23.5-meter spatial resolution and 4 spectral bands. The study is carried out for one decade (2008-2018). Dehradun District (30.3˚N and 77.9˚E) lies in Uttarakhand State, covering a total area of 3071 Km**2**. QGIS 3 is used to process and analyse the data and create the final maps.

# Steps to calculate NDWI using QGIS

1. Data is downloaded from Bhuvan Website (ISRO) of Resoucesat II satellite with LISS III Sensor for the selected time period (2008-2018) covering the entire study area.
2. The shapefile is downloaded for the study area (Dehradun District).
3. Added all the downloaded satellite images (which are in the form of tiles, .tif format) in QGIS with the available options in toolbar: **Layer>>Add Layer>>Add Raster Layer.**
4. Stacked all the images of different bands using the toolbar options **Raster>>Miscellaneous>>Build Virtual Raster.** Steps are repeated for each tile.
5. After stacking Mosaic all the stacked images using toolbar options **Raster>>Miscellaneous>>Merge**
6. Clipped the mosaicked image with the study area shapefile using toolbar options **Raster>>Extraction>>Clip Raster by Mask Layer**
7. Then after NDWI was calculated using toolbar options: **Raster>>Raster Calculator**

## Creating NDWI Maps

1. Maps were created for the years 2008 and 2018.
2. Classification of NDWI: **Layer>>NDWI Value>>Symbology>>Band Rendering**-**Single band pseudocolor**, then raster was classified with 2 classes:
3. Pixels <0: Other classes
4. Pixels : 0 to +1: Water Body.
5. Map creation in QGIS: **Project> new print layout>create print layout title > Add item>** Add map and add other map elements (Label, Legend, Scale bar, North arrow and grid).
6. Final maps were exported in the Jpeg format.

# Application of NDWI Maps

The Normalized Difference Water Index (NDWI) is strongly related to plant water content. It is, therefore, a very good proxy for plant water stress. The early detection of water stress can prevent many negative impacts on crops. Therefore, NDWI maps have significant application in agriculture. Remote Sensing of land and the NDWI index can control irrigation in real-time, significantly improving agriculture, especially in water-scarce regions.

NDWI can be calculated as:

*For LISS-III data, the band combinations are:*

|  |  |
| --- | --- |
| **Band** | **Wavelength (micrometer)** |
| B2 (Green) | 0.52-0.59 |
| B3 (Red) | 0.62-0.68 |
| B4 (Near Infrared NIR) | 0.77-0.86 |
| B5 (Mid Infrared) | 1.55-1.70 |

The values of NDWI range between 0 and ± 1, and negative values or values close to 0 represent vegetation, whereas positive values or close to 1 represent surface water/deep water bodies. The NDWI product is dimensionless and varies from -1 to +1, depending on the hardwood content and the type of vegetation and cover. The high NDWI values correspond to high plant water content and coating of high plant fraction. Low NDWI values correspond to low vegetation content and cover with low vegetation. During periods of water stress, the NDWI rate will decrease.

The NDWI values for the study region obtained were

|  |  |  |
| --- | --- | --- |
| **YEAR** | **NDWI** | **Area of water bodies (in Sq.Kms)** |
| 2008 | 0.708 | 404.02 |
| 2018 | 0.517 | 111.53 |

NDWI values for the years 2008 and 2018 clearly depict the decrease in water bodies for 2018 and water stress. There is a 72 % reduction in water bodies as concluded from NDWI Maps.

# Complexities

The one limitation of this study was that data for the year 2008 was not available on NRSC portal for toposheet numbers H44G07 and H44G08. Therefore the data for 2009 was downloaded and used for analyses. Also, the data available for both years was not in the same time frame, 2008 data was available in the months of Oct-Novemeber, while 2018 was available in Januray-March which might be one reason for a drastic reduction in water bodies/moisture content in 2018.