Change detection of Lakes in Pokhara, Nepal using Landsat Data

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Outline of Presentation

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Pokhara, city of lakes, is second largest and most beautiful tourist place in Nepal.

Out of seven lakes, the large three: Phew, Begnas and Rupa are famous for tourist attraction, whereas the rest are small and less known.

These lakes not only provides fresh water for agriculture and aquatic products and attract tourists but also plays equally important role in terms of natural water cycle, climatic regulation, ecological and environmental balance
01 Introduction

- But, these lakes are facing challenges due to climatic and anthropogenic activities.
- As these changes are slow and takes long time, the damage unnoticed to take measures.
- Hence, long historic data provided provide concrete evidence of change, which help us understand the cause and prevent further change.
- Series of optical remotes sensors such as KOMPSAT, Landsat, SPOT, and Worldview etc. are continuously observing and capturing the earth surface since last four decades.
01 Introduction

- Surface water study and change has its own importance.
- Landsat series are the most common optical remote sensors for mapping of waterbodies.
- Numerous water extraction algorithms for optical remote-sensing images have been developed.
- Unsupervised methods, due to the ease of use, low computational cost, and the fact that less human knowledge is needed are easy and popular ones.
- NDWI, MNDWI etc. used with threshold Zero for unsupervised classification of surface waters in Landsat series data.
Objective

- Use the water indices to detect the change of lakes in Pokhara city using Landsat data of 25 years gap. Following indices were used:
  - Normalized Difference Vegetation Index (NDVI),
  - Normalized Difference Water Index (NDWI), and
  - Modified Normalized Difference Water Index (MNDWI)
- Examine the ability of water indices unsupervised for change detection.
- Detect change and compare the performance of the results among the methods.
03 Test site

- Pokhara city
- Around seven lakes.
- Geographically bounded:
  - 28° 08'2.56"N to 28° 15'9.85"N
  - 83°54'30.20"E to 84° 8'18.57"E
04 Data

- Mid resolution Landsat series satellite image. (GLOVIS)

- Similar season.

- Preprocessed for radiometric calibration and area of interest extraction.

- NDVI, NDWI and MNDWI derived.

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Sensor</th>
<th>Path/Row</th>
<th>Year</th>
<th>Resolution</th>
<th>Wavelength</th>
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<td>TM</td>
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<td>1988</td>
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<td>Band 5: 1.55–1.75</td>
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<td>Band 7: 2.08–2.35</td>
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<td>2013</td>
<td>30</td>
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<td>Band 5: 0.851–0.879</td>
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<td>Band 9: 1.363–1.384</td>
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</table>
**Method**

- **Three cases:**
  - Normalized Difference Vegetation Index (NDVI),
  - Normalized Difference Water Index (NDWI), and
  - Modified Normalized Difference Water Index (MNDWI)

- **Model developed for NDWI in ArcGIS:**

<table>
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<th>S. No.</th>
<th>Spectral indices</th>
<th>Formula</th>
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<tbody>
<tr>
<td>1</td>
<td>NDVI</td>
<td>(\frac{(NIR - Red)}{(NIR + Red)})</td>
</tr>
<tr>
<td>2</td>
<td>NDWI</td>
<td>(\frac{(Green - NIR)}{(Green + NIR)})</td>
</tr>
<tr>
<td>3</td>
<td>MNDWI</td>
<td>(\frac{(Green - SWIR)}{(Green + SWIR)})</td>
</tr>
</tbody>
</table>

ArcGIS model for unsupervised change detection based on NDWI.
06 Results and Discussion

- Change is visible but much salt and pepper effect.
- The issue could be due to threshold issue.
06 Results and Discussion

- NDWI shows much better change in surface area.
- Phewa Begnas and Rupa has more change and Dipang is shows with addition of water surface.
06 Results and Discussion

- Poor change detection, misclassified hillside shadows.
- Not perfect threshold for binary classification.
Conclusions

- For smaller lakes, mid resolution Landsat image pixels were unable to detect the water whereas for larger ones, they were successful.

- NDWI, NDVI shows better change detection than MNDWI, which shows change in larger lakes Phewa, Begnas and Rupa.

- The result can be very useful in countries like Nepal where areas cannot be field visited are difficult or the area of water related disasters like flood or debris dam.

- Similar methodology can be adopted to other specific interest based on the suitable detection indices such as built-up area, agriculture.
References


References


Thank You !!!