A Project submission

for

Applied GIS Programming

On

Accessibility Assessment of Lakes in the Chitwan National Park, Nepal

Submitted by:

Rashmi Paudel

M.Sc. Forest Information technology

Warsaw University of Life Sciences

Submitted to:

Prof. Wiktor Tracz

Warsaw University of Life Sciences

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1. Introduction

Chitwan National Park (Latitude 27˚37'0"N and Longitude 84˚25'59"E) is in Central Nepal with a core area of 932 km² and a Buffer zone of 750 km². Its altitude varies from 150 m to 815 m with the height of the valley up to the mean sea level thus, it is an inner Doon Valley (Bhusal & Devkota, 2020). National parks such as Chitwan National Park (CNP) in Nepal not only are homes to various species but also have many water sources, like lakes. The park management, tourism planning, and conservation efforts could be supported only if we get to know more about the accessibility of these lakes in relation to roads and trails (Bhuju et al., 2007).

The main aim of this project is to apply python GIS programming to process, analyze, and spatially visualize the accessibility of the water bodies (lakes) of Chitwan National Park (CNP) in relation to roads and trails inside the park creating both static and interactive maps.

2. Problem Statement

Chitwan National Park (CNP) in Nepal is a protected area with numerous lakes, roads, and trails. These lakes are essential to nature, animals, and people. However, a few lakes are located very close to roads and trails while other people are significantly farther away.

It is crucial to understand which lakes are easy to access and which are not. The kinds of lakes near roads and trails may be impacted more by people, such as visitors, boats, or pollution. Lakes far from roads may be more secure for wildlife.

It will be beneficial for this app to provide a map or information that shows us how many lakes there are near access points and how many are remote. Without this information, it's challenging for park managers to make plans to protect wildlife, conserve nature or manage tourism.

3. Objective

- To assess the number of lakes within the boundary of Chitwan National Park.
- To assess the accessibility of lakes through the infrastructure like roads and trails within the park.
- To assess the spatial patterns with the relationship between lakes and access infrastructure.

4. Methodology

4.1 Python Modules Used

- Os
- Pandas
- Geopandas
- Matplotlib
- Folium
- Matplotlib.patches

4.2 Data and source

4.2.1 Data

- CNP Park boundary shapefile
- Lake shapefile
- Road shapefile
- Trail shapefile
- Buffer zone shapefile

4.2.2 Source

Downloaded from official website of National Trust for Nature Conservation (NTNC). http://geoportal.ntnc.org.np/

4.3 Spatial queries

1. Buffering (1 km buffer of the roads and trails)
2. Intersection (intersection between the lakes and the combined buffers)
3. Union (Combined the buffers of roads and trails)

4.4 How to use the application

The interactive was created with the help of python folium library and the output can be explored as an html file. To use the application, one should:

1. Open the html file named interactive_map using any web browser (e.g., Chrome, brave).
2. The map will direct you to different areas such as the park boundary, lakes, roads, trails etc.
3. To get better experience, the toggle button on the top-right corner can be used.
4. It can zoom in and click on the features individually and explore which lakes fall under the proximity of accessible categry.

5. Findings

- Number of lakes across the park: 38
- Number of lakes within 1 km of a road or a trail: 28
- Spatial patterns: Lakes that are closer to roads or trails are more likely to be visited by people and those lakes that are remote are less likely. This can help park management plan future conservation or visitor activities.

6. Limitations

- The only lakes within CNP were studied and the nearby water bodies (river included along with lakes) outside the park were excluded.

- Only a 1 km buffer was considered, while performing more distance buffer could give finer accessibility patterns.

7. Conclusion

This project was carried out to study how Python GIS tools can help to study lakes in Chitwan National Park. As a result, it has been found that most lakes are near to road and trail network, which means they are easy to reach where small number of lakes are not easily accessible. The easier access to the lakes, the higher the human pressure is, and more conservation is seen to be required.

The static and interactive maps help to see which lakes may have more human activity and which ones are quieter. This can help the park managers to take better care of the lakes and the animals living there.

8. Recommendations

After completion of the project, the following recommendations can be proposed for the better protection and management of the lakes studied:

- Lakes with easier access are prone to more human pressure, hence, need stricter management strategies.
- Tourism activities should be planned in a way that visitors do not degrade the lakes and associate wildlife there.
- Mapping of rivers influenced by higher tourist's visit should be done for protection.

9. Figures

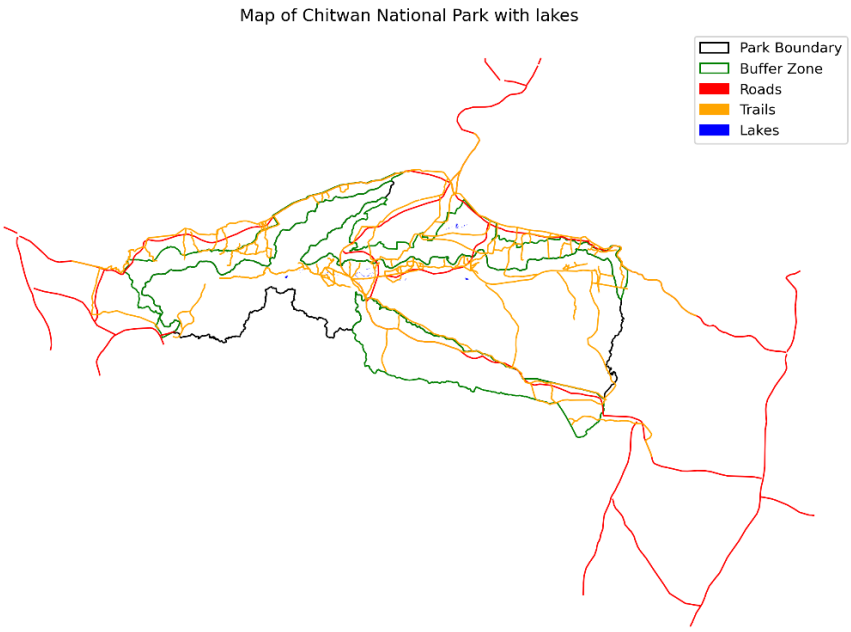

Fig.1. Raw map of the park

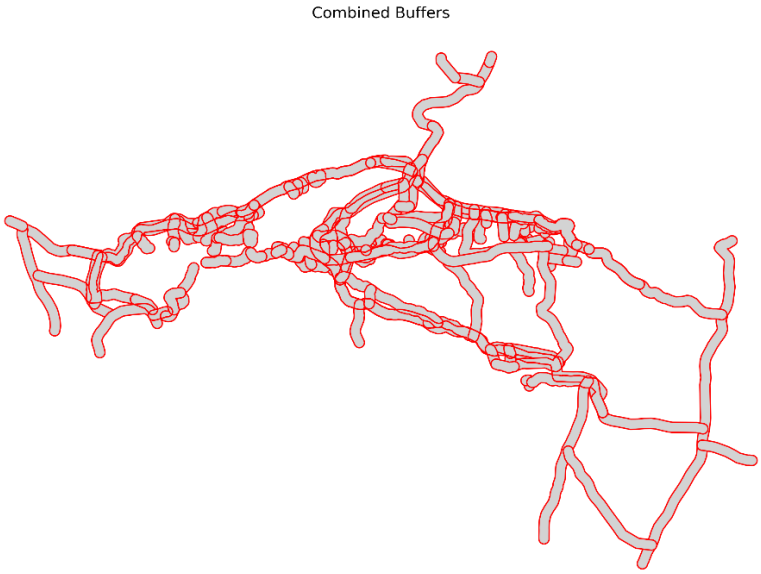

Fig.2. Combined buffer

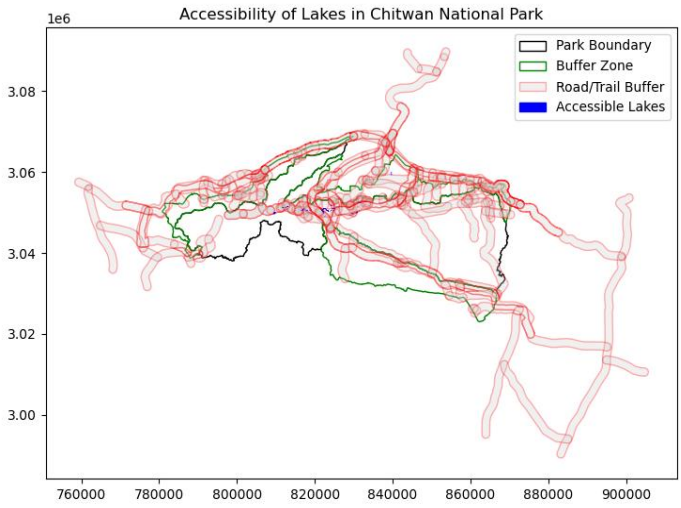

Fig.3. Static map

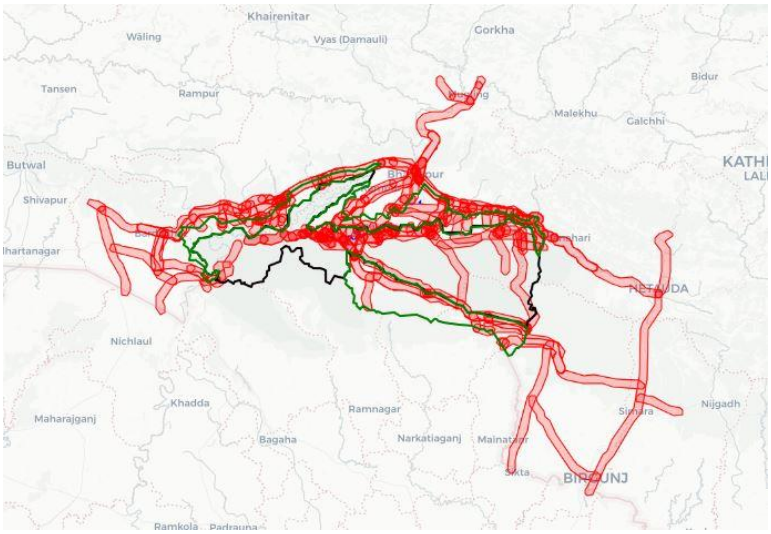

Fig.4. Interactive map

10. References

Bhusal, A., & Devkota, A. (2020). Physico-chemical characteristics of Lakes of Chitwan National Park, Central Nepal. In *Biological Forum-An International Journal* (Vol. 12, No. 1, pp. 33-39).

Bhuju, U. R., Shakya, P. R., Basnet, T. B., & Shrestha, S. (2007). *Nepal biodiversity resource book: protected areas, Ramsar sites, and World Heritage sites* (pp. xxx+-128).