Spatio-Temporal Evolution of Land Use and Carbon Stock in Gazipur, Bangladesh (2000–2020) Using the Integrated GIS-InVEST Model

Mehedi Hashan Riad[1], Asadullahil Galib Fardin[2], Md. Mafizur Rahman[3]

[1] Postgraduate Student, Department of Civil Engineering, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh.

[2] Postgraduate Student, Institute of Water and Flood Management, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

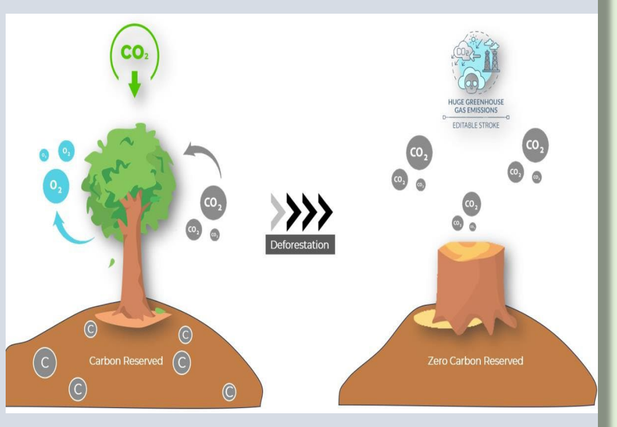
[3] Professor, Department of Civil Engineering, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh.

ABSTRACT

Carbon storage in terrestrial ecosystems fluctuates as land use changes, hence investigating the influence of land use changes on carbon storage in regional terrestrial ecosystems is critical for preserving regional carbon balance. This study investigates the spatio-temporal evolution of land use and carbon storage in Gazipur, Bangladesh, from 2000 to 2020 using the Integrated GIS-InVEST model. By analyzing Landsat satellite imagery and carbon density data, the research reveals significant land-use changes, including a decline in forested areas from 46% to 37% and an increase in developed land from 7% to 12%. These changes have led to a continuous decline in carbon storage, from **30.35 × 10^6 tons** in 2000 to **27.91 × 10^6 tons** in 2020, primarily due to the loss of high carbon-sequestration land types like forests. The findings underscore the urgent need for sustainable land management practices to mitigate carbon loss and support climate change mitigation efforts. This research provides valuable insights for policymakers and urban planners aiming to balance ecological conservation with regional development in rapidly urbanizing areas.

INTRODUCTION

- Rapid urbanization and industrialization in Gazipur, Bangladesh, have led to significant land-use changes, impacting carbon storage in terrestrial ecosystems.
- Investigate the spatio-temporal evolution of carbon storage from 2000 to 2020 using the GIS-InVEST model.



- Understanding land-use changes and their impact on carbon storage is critical for sustainable land management and climate change mitigation.

METHODOLOGY

1.Data Sources:

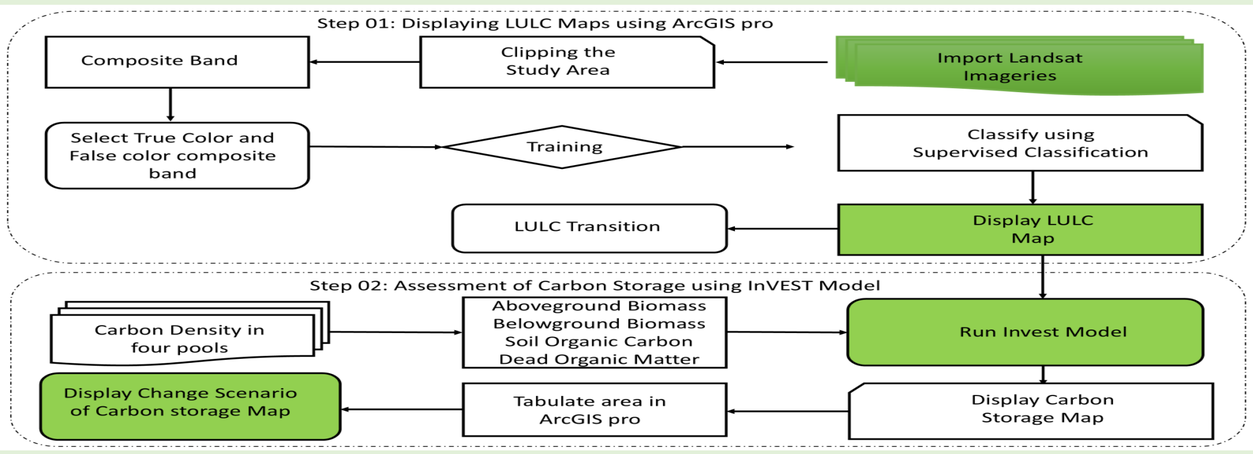
- Landsat satellite imagery (2000, 2010, 2020).
- Carbon density data from published studies.

2.Tools:

GIS is used for spatial analysis and mapping and **InVEST Model** to simulate carbon storage based on land-use changes.

3.Process:

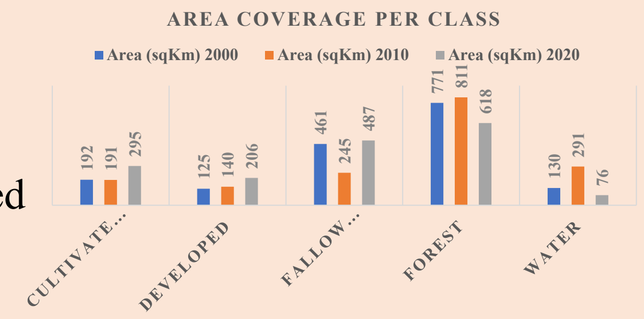
Preprocessing of satellite images (noise removal, radiometric correction, etc.). Classification of land use into five categories and calculation of carbon storage using the InVEST model.



RESULTS

Land Use Changes (2000–2020):

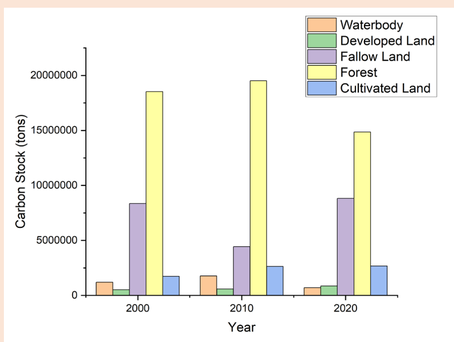
- Declined from 46% to 37% due to industrialization and developed Land Increased from 7% to 12%.

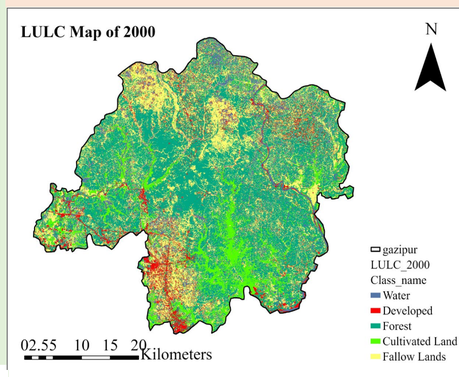


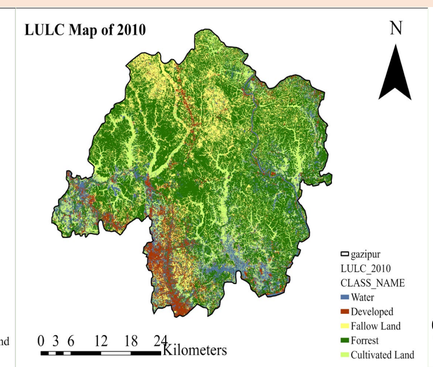
Carbon Storage Trends:

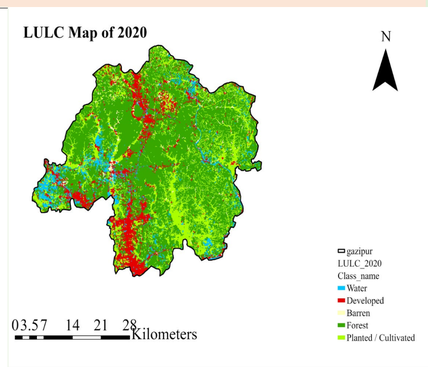
Total Carbon Stock: Declined from 30.35 × 10^6 tons (2000) to 27.91 × 10^6 tons (2020).

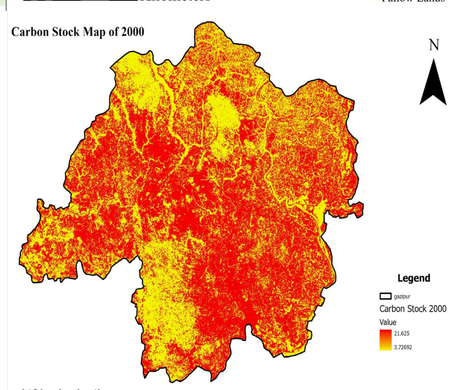
Spatial Patterns: Carbon storage is highest in forested regions and lowest in developed areas.

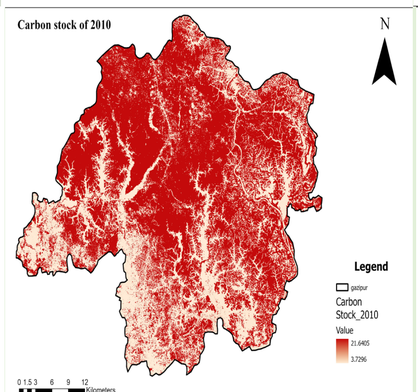


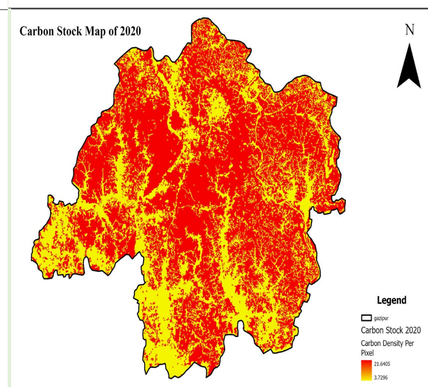












CONCLUSION

Key Takeaway:

- Land-use changes in Gazipur have led to a significant decline in carbon storage, primarily due to deforestation and urbanization.
- Conversion of forests to developed areas has led to a loss of high carbon-sequestration land types.

Recommendations:

- ❑ Integrate ecological conservation with urban planning.
- ❑ Promote sustainable land management to mitigate carbon loss and support climate change mitigation.

Email: mahadihashanriad26@gmail.com