

## Data-Driven Urban Growth Projections for Cox's Bazar, Bangladesh: Insights from Machine Learning and GIS

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### INTRODUCTION & AIM

Cox's Bazar, Bangladesh, faces unprecedented urbanization driven by population influx and large-scale refugee settlements. Understanding growth patterns and their drivers is critical for sustainable infrastructure planning and environmental management. Data-driven forecasts enable proactive planning for refugee settlements, infrastructure development, and environmental conservation in one of Asia's fastest-urbanizing regions.

#### OBJECTIVE

This research aims to apply machine learning, geospatial analysis, and remote sensing to quantify historical LULC changes from 1990 to 2020, identify and rank key urbanization drivers, project future urban expansion for 2030, 2040, and 2050, detect rapid urbanization hotspots, and support evidence-based planning and policy interventions.

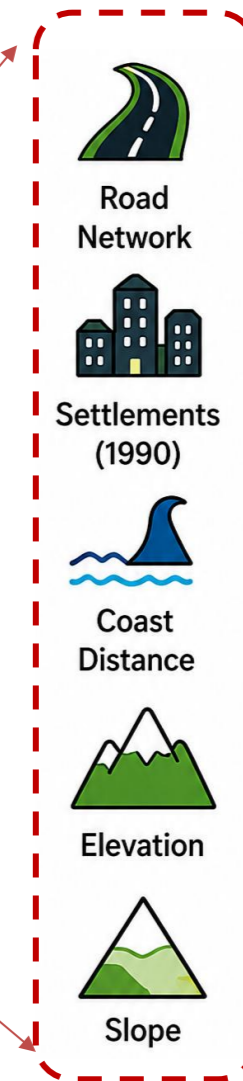
#### OBSERVED URBAN EXPANSION

- 1990: 447.5 km<sup>2</sup> (flagged as inflated)
- 2000: 277.8 km<sup>2</sup>
- 2010: 131.8 km<sup>2</sup> (likely boundary change)
- 2020: 202.6 km<sup>2</sup>

### METHOD

#### Methodology: A Multi-Phase Geospatial Approach

Land Use / Land Cover Change and Urbanization Analysis in Cox's Bazar



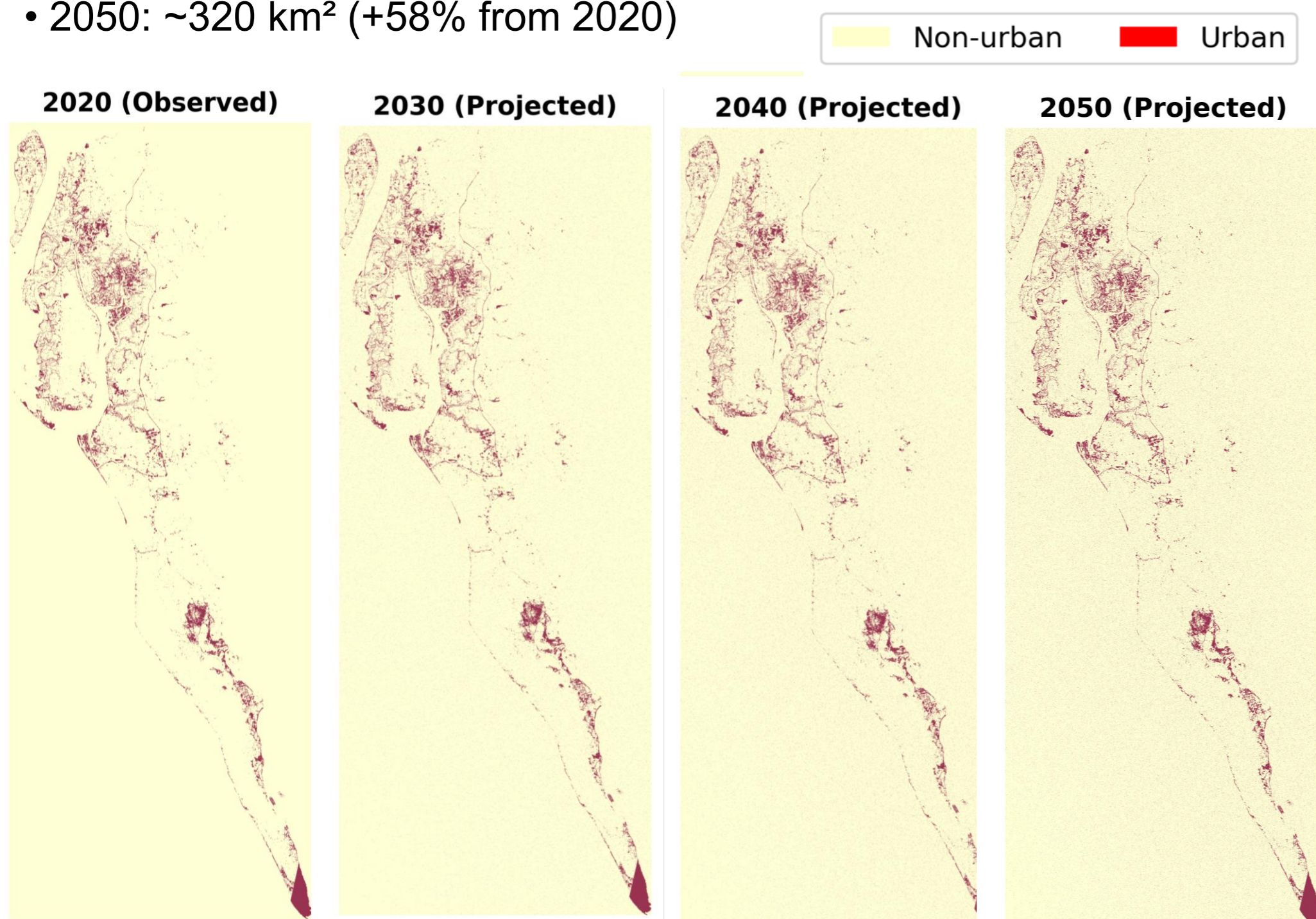
#### OUTCOMES & IMPACT



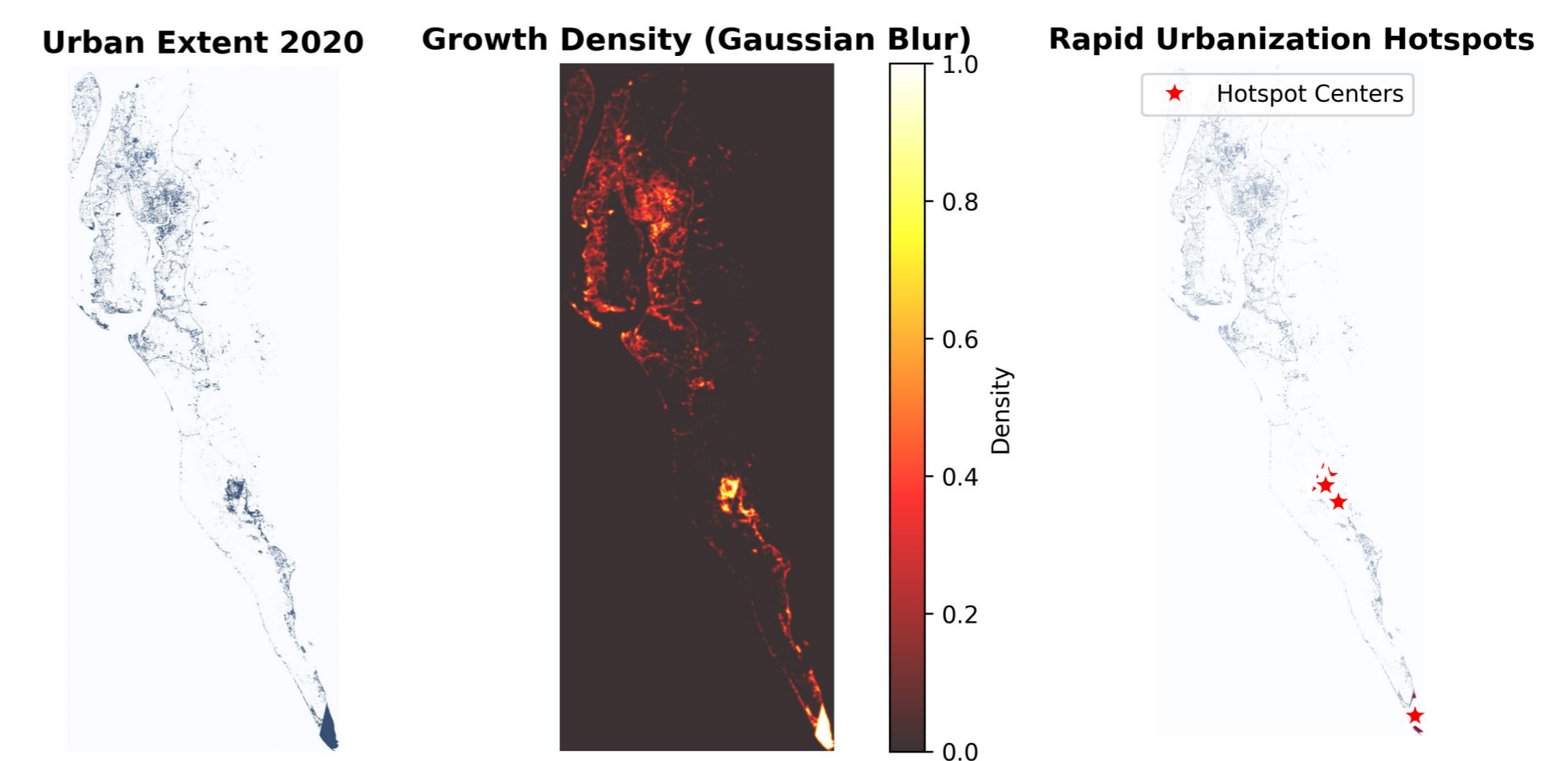
### RESULTS & DISCUSSION

Under constant transition probabilities (2010–2020 baseline):

- 2030: ~235 km<sup>2</sup> (+16% from 2020)
- 2040: ~270 km<sup>2</sup> (+33% from 2020)
- 2050: ~320 km<sup>2</sup> (+58% from 2020)



- Cox's Bazar City Proper (northeast): density peak 0.95—major commercial & administrative hub
  - Kutupalong Refugee Settlement (central): density peak 0.92—rapid intensification
  - Teknaf/Ramu (south): density peak 0.78—secondary growth nodes
- Growth is NOT dispersed; it concentrates along major transport corridors and within established.

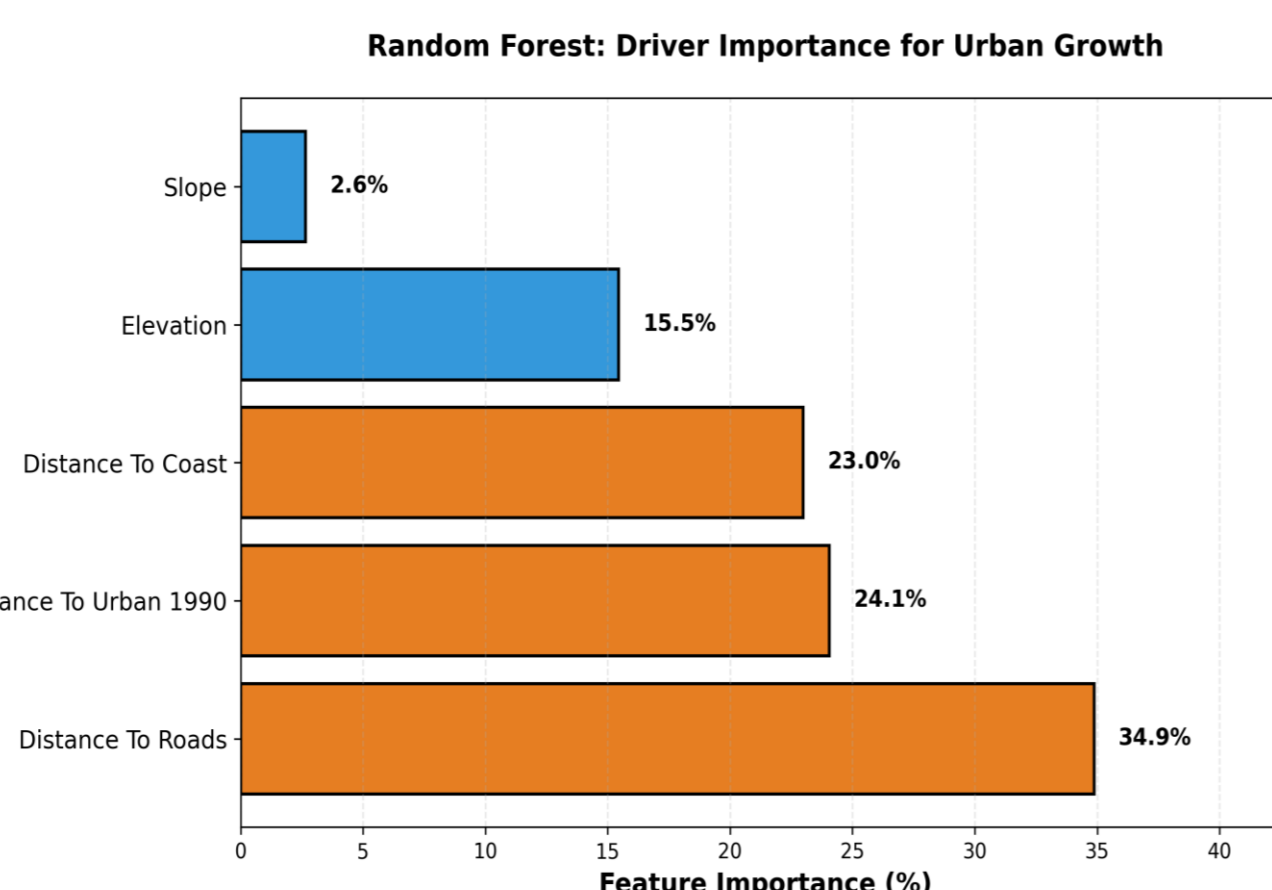


Urbanization Cores

### CONCLUSION

- ✓ Urbanization is infrastructure-led, not dispersed
- ✓ Refugee settlement zones (post-2017) show rapid intensification
- ✓ Administrative boundary changes complicate historical comparisons
- ✓ Data quality varies across decades; 1990 should be interpreted with caution
- ✓ Projections enable proactive planning for infrastructure, services, and environmental conservation

Forest/agricultural land declines correspondingly. Projections assume: (a) no major policy shifts, (b) continued population/refugee inflow, (c) stable economic drivers. Climate change impacts, humanitarian policy changes, and infrastructure investments may significantly alter trajectories.



### FUTURE WORK / REFERENCES

NEAR-TERM (2025–2026):

- Annual monitoring
- Scenario modeling: Climate adaptation, refugee population trajectories,
- Downscaling

LONG-TERM (2027+):

- Integration with climate impact models
- Stakeholder workshops
- Validation: Compare 2025–2030 projections against observed change