

Abstract: Accurate urban tree canopy mapping is critical for green space planning in rapidly growing South Asian cities. This study presents a multi-scale tree cover detection framework for Pabna Municipality, Bangladesh (1,081.3 ha, 15 wards), integrating UAV photogrammetry at 3 cm ground sampling distance (GSD) and PlanetScope SuperDove 8-band satellite imagery at 3 m resolution. High-resolution UAV orthomosaics from three field sites were used for ground truth crown delineation. A systematic ablation study of eight deep learning models across four architectures U-Net (ResNet-50), SegFormer (MiT-B2), DeepLabV3+ (ResNet-50), and Mask2Former (Swin-S) trained on both RGB and RGB+ExG inputs was conducted. SegFormer MiT-B2 with RGB+ExG achieved the highest accuracy (F1 = 0.9288, IoU = 0.8671) and was deployed for city-wide inference. Results identified 285.6 ha of tree canopy (26.4% cover), with per-ward coverage ranging from 16.36% to 40.91% and a Gini coefficient of 0.1546, indicating moderate spatial inequality in urban green space distribution across Pabna city.

Objectives

- Multi-Scale Tree Crown Delineation,
- Deep Learning Model Optimization,
- City-Wide Canopy Mapping and Spatial Analysis.

Result

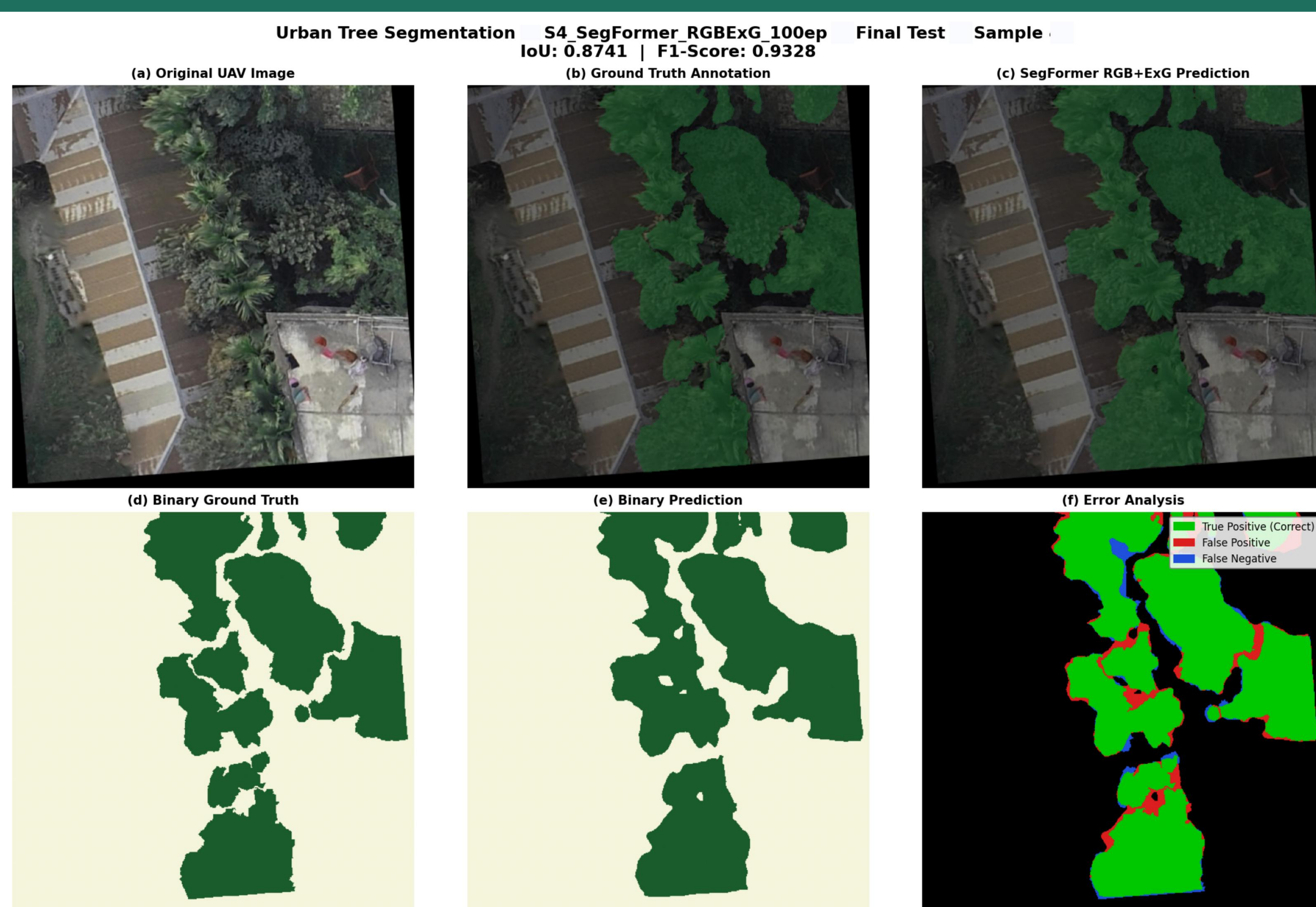


Fig: Evaluation of SegFormer (MiT-B2) on UAV-Derived RGB+ExG Imagery for Urban Tree Segmentation.

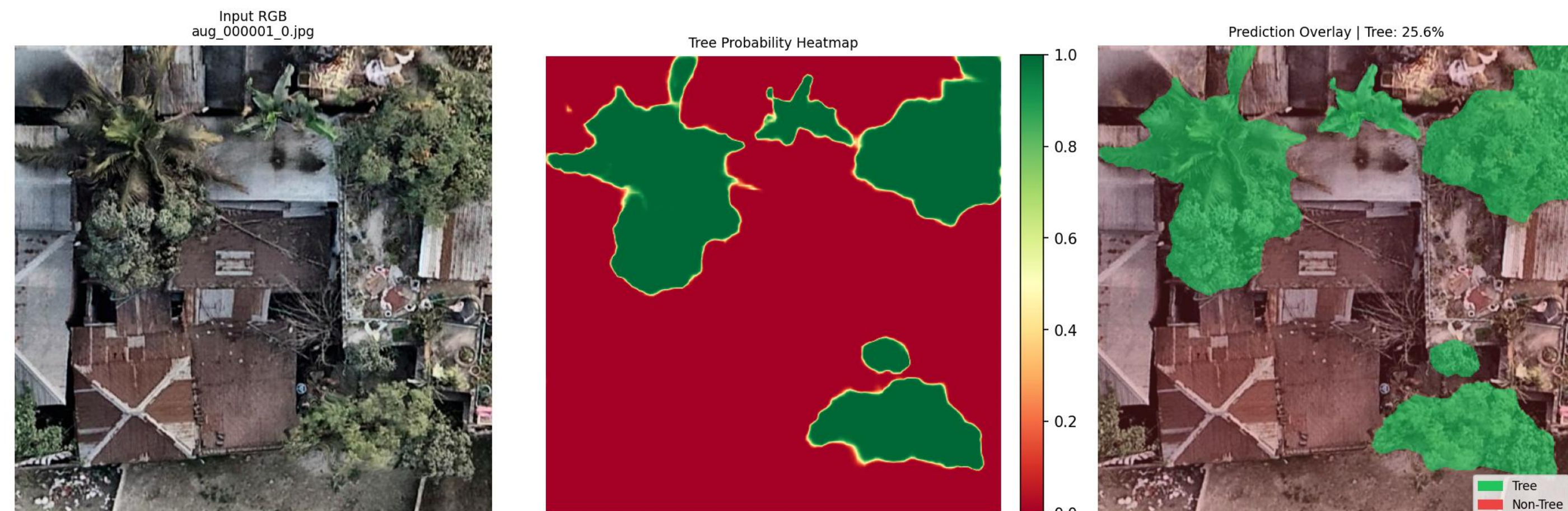


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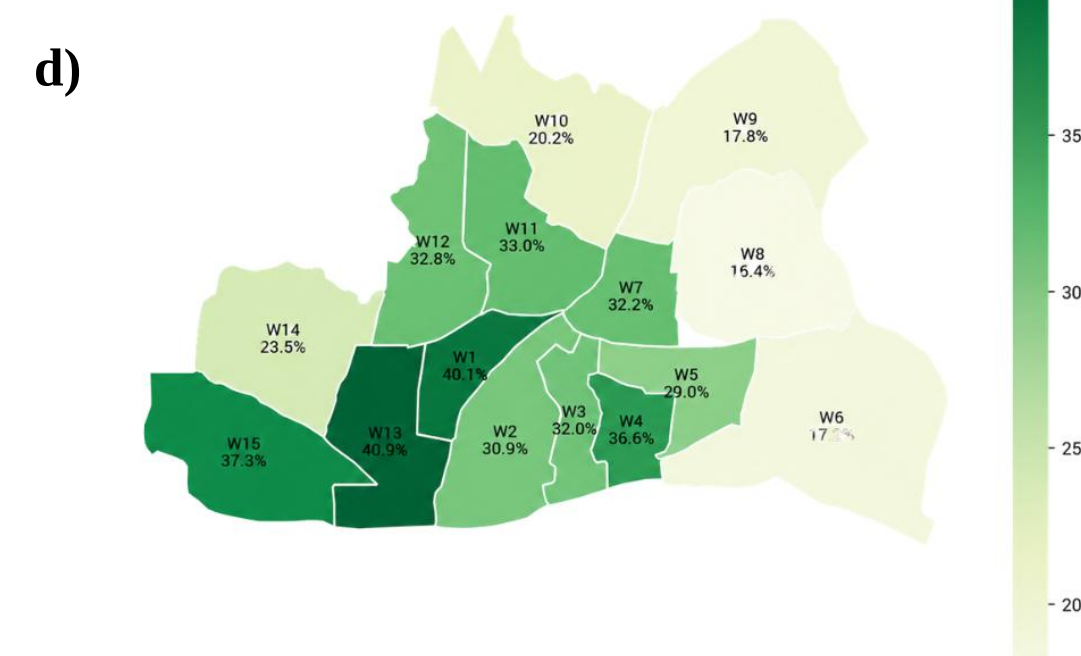
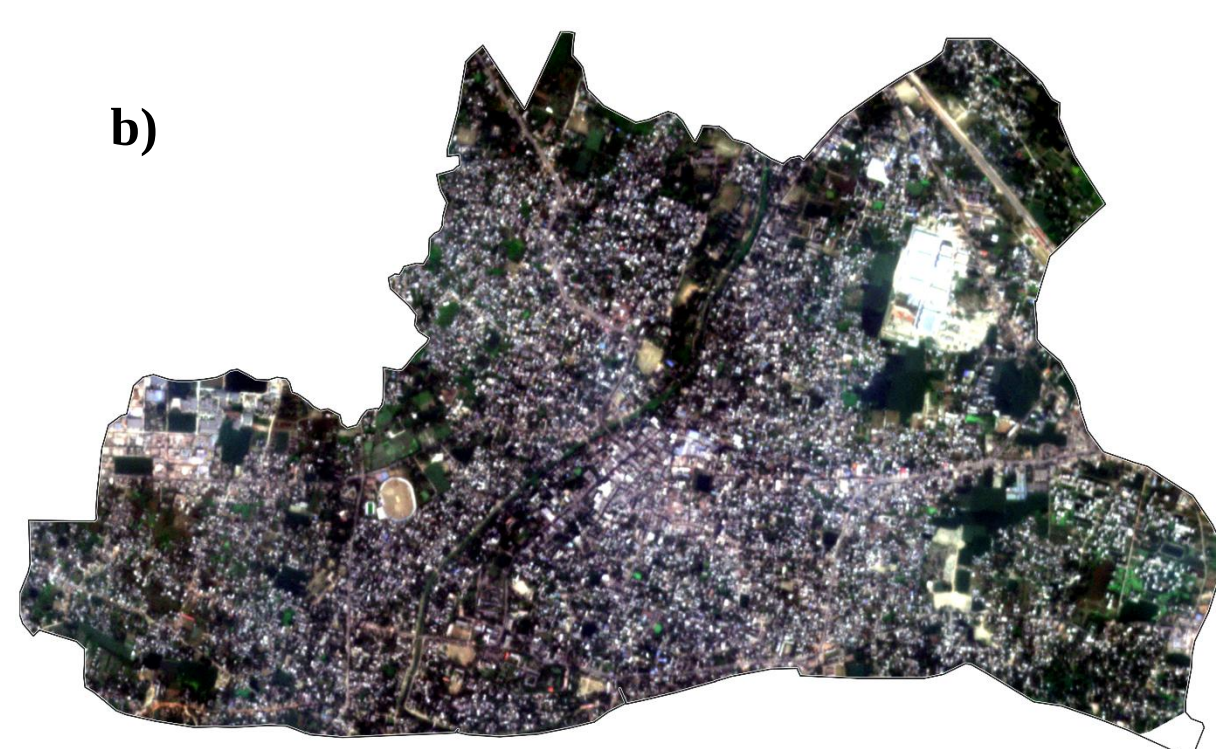
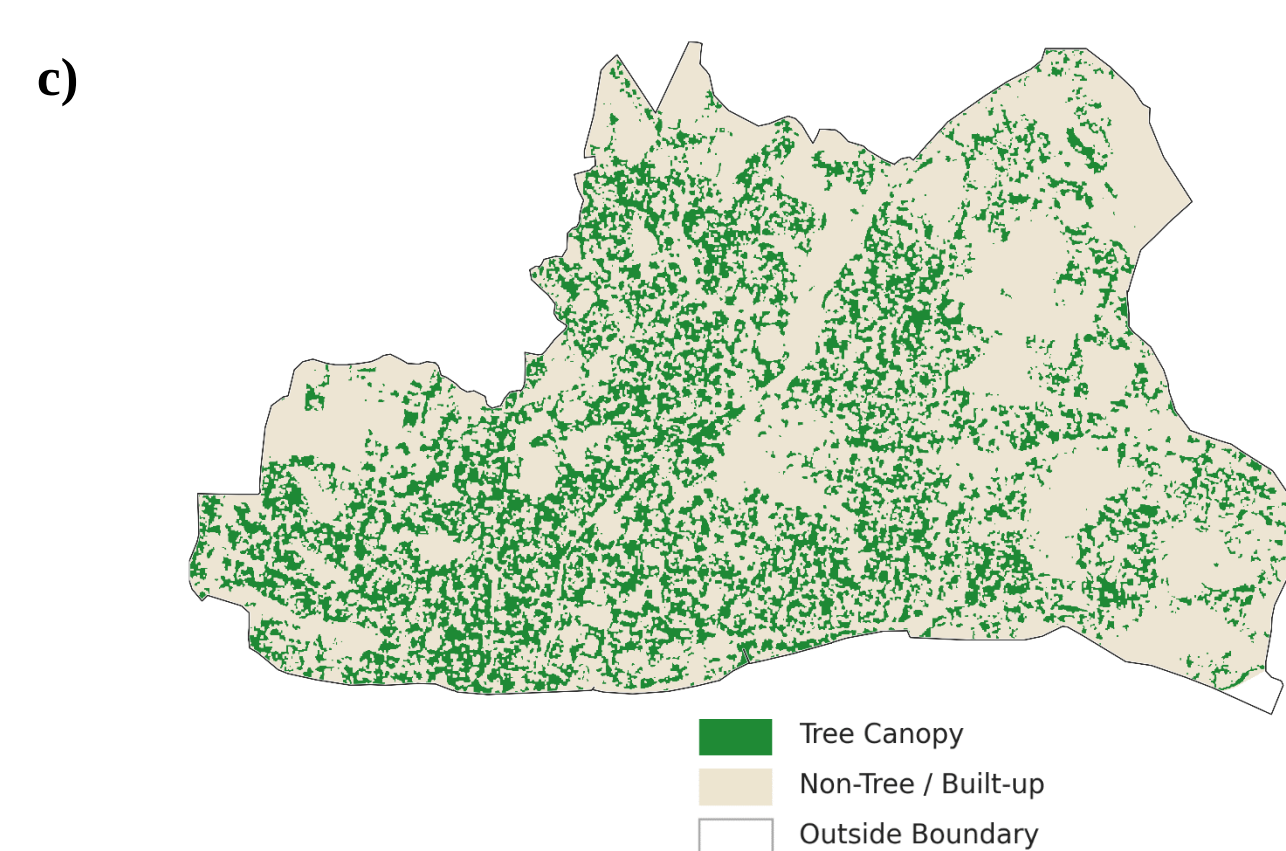
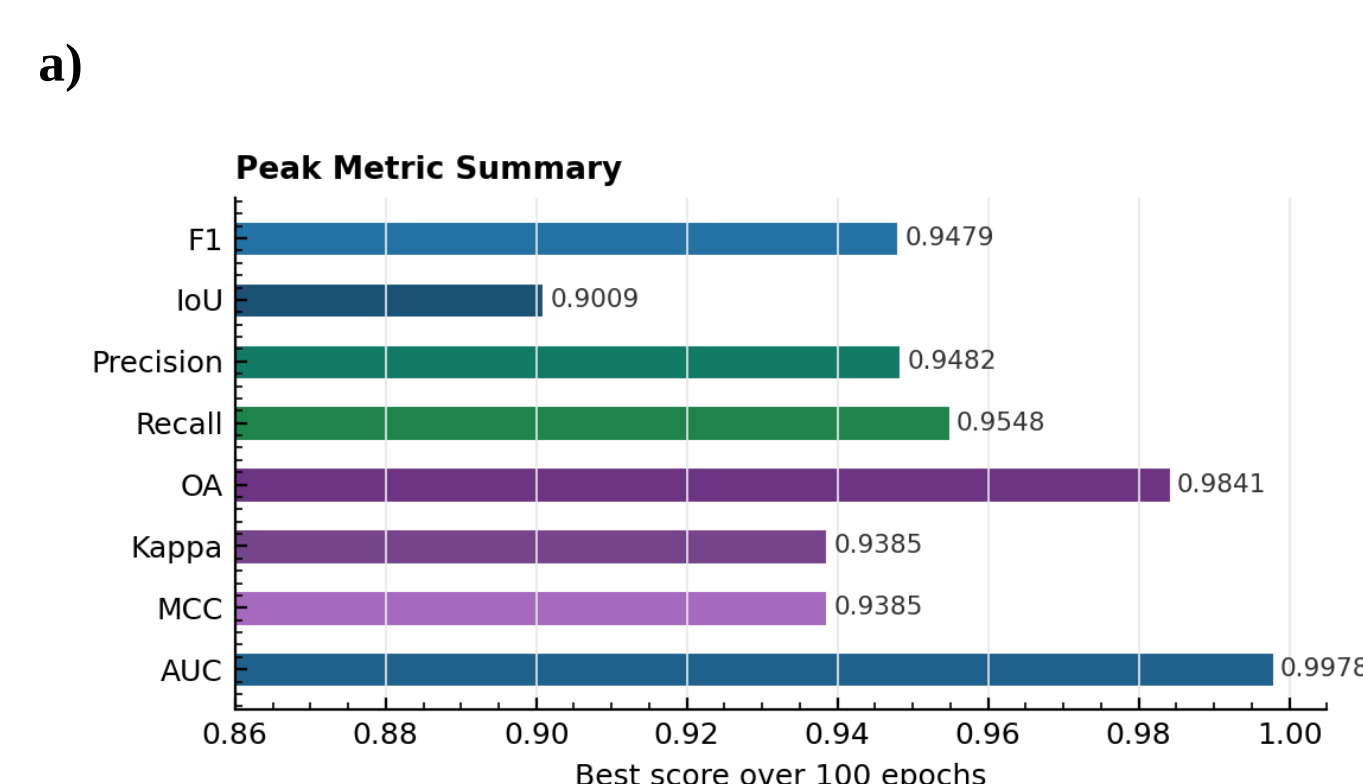


Fig: (a) Training Metric of Model, (b) PlanetScope SuperDove natural colour composite (January 12, 2026; 3 m GSD). (c) Binary tree canopy mask, total canopy cover = 285.6 ha (26.4%), (d) Tree Cover Per ward

Methodology

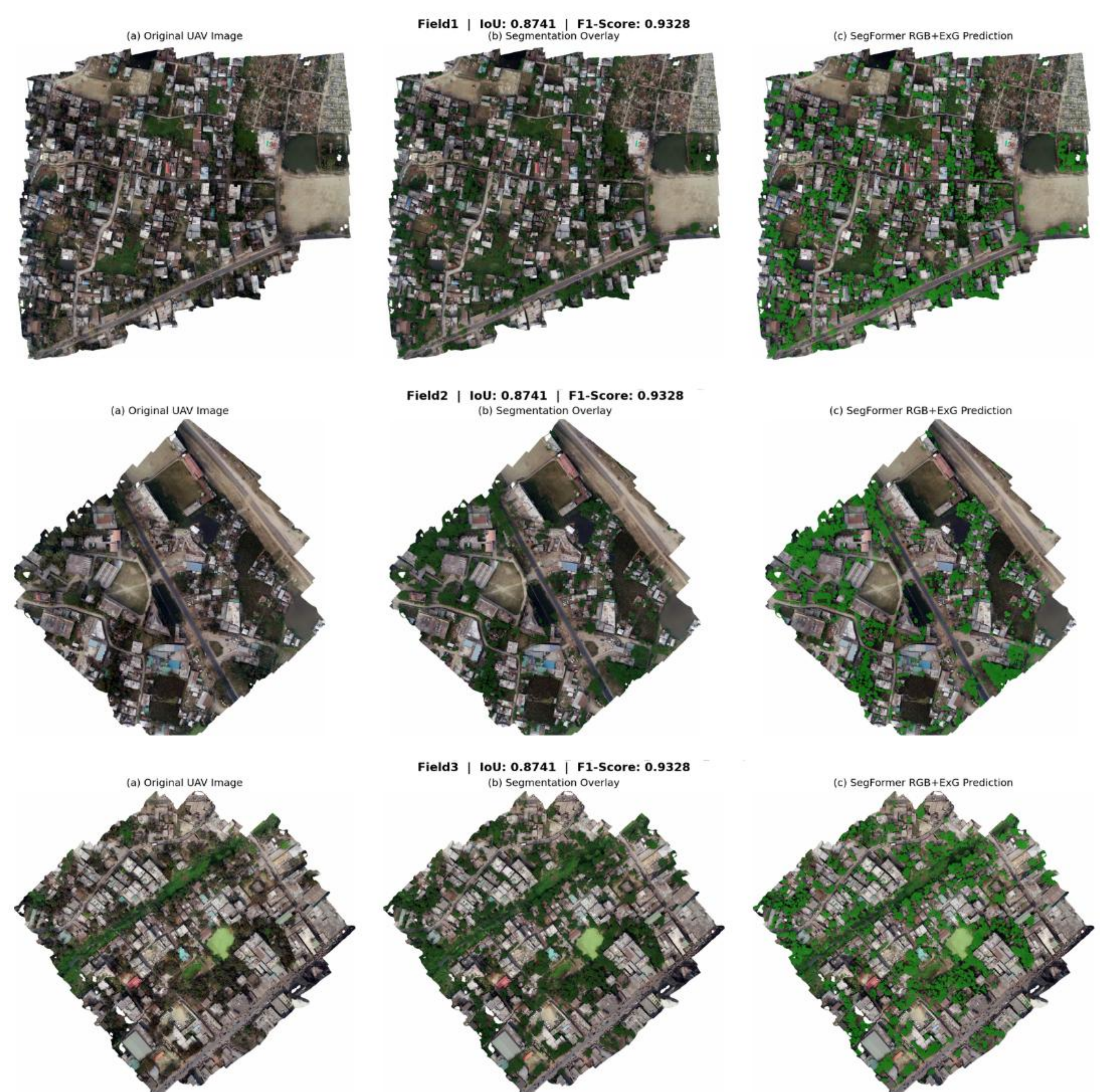
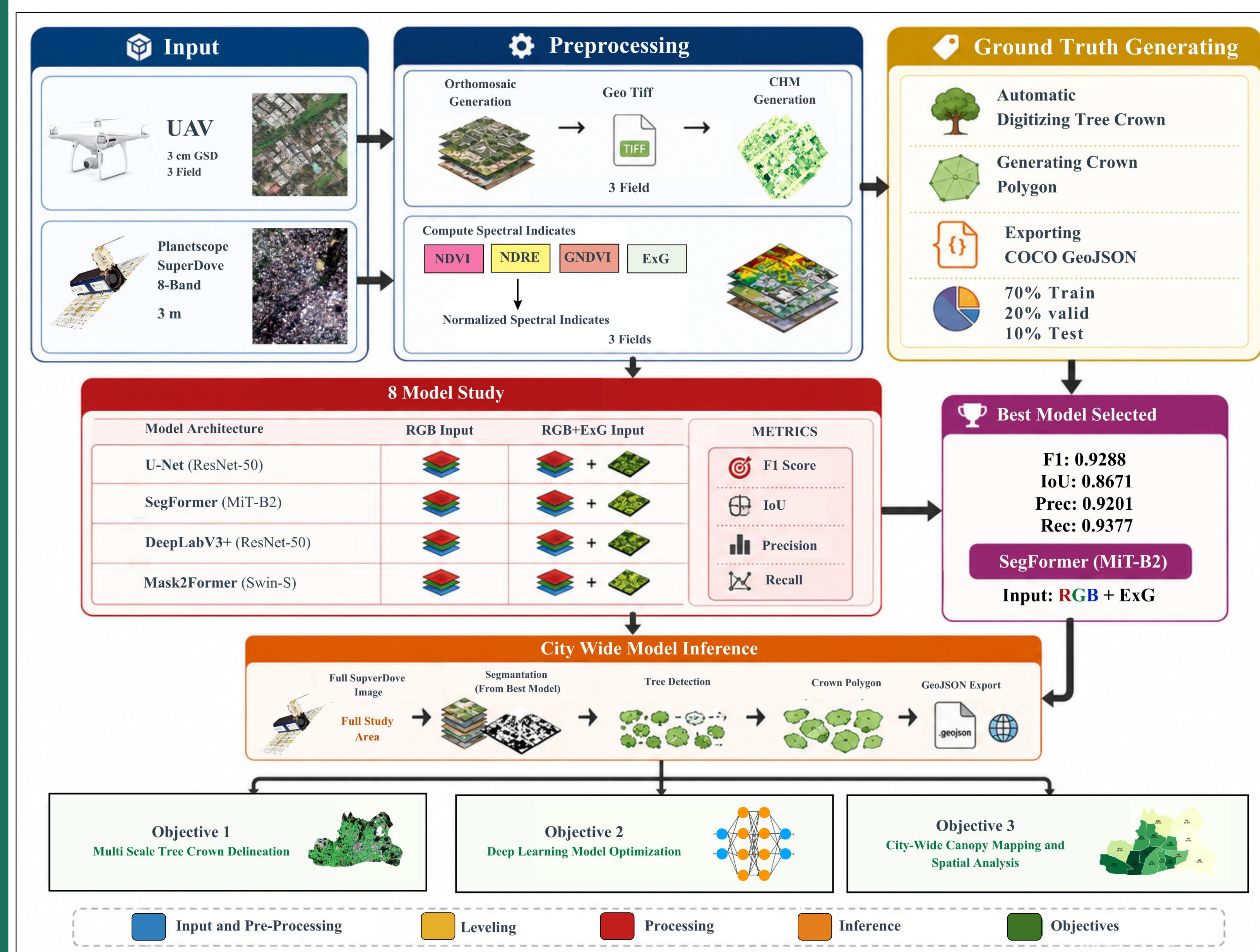


Fig: 3 Field Model Prediction and Validation

Conclusion

This study developed a multi-scale urban tree canopy mapping framework for Pabna Municipality, Bangladesh, combining UAV photogrammetry, PlanetScope SuperDove 3 m satellite imagery, and deep learning segmentation. The framework offers a scalable, cost-effective solution for urban tree inventory in data-scarce South Asian cities, with future scope for multi-temporal canopy change monitoring and LiDAR-based biomass refinement.

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