CHAPTER V
CONCLUSION

5.1 Conclusion of This Study

This study provides the first assessment of AGB and AGC stocks, alongside biodiversity, in the Banlaem mangrove forest in Nakhon Si Thammarat, southern Thailand. Findings reveal low species diversity, with only three mangrove species. This study highlights that mixed-species plots, particularly those including *Rhizophora* species, generally yield higher biomass than single-species plots. Further research could help determine how additional ecological factors influence biomass and carbon stocks in the Banlaem mangrove forest.

This study also evaluated AGB models for the Banlaem mangrove forest, finding that models incorporating VIs and the CHM significantly improved prediction accuracy. The top-performing models (Model 11 and Model 22) combined NDVI, SAVI, GNDVI, and CHM, yielding an R^2 = 0.58. This represents a novel application of UAV imagery with VIs and CHM for mangrove biomass estimation in Thailand. Although these models showed slightly lower accuracy compared to studies using satellite imagery, they align with findings from other Southeast Asian studies, demonstrating that multi-variable integration enhances model precision. Limitations included restricted UAV data collection in certain areas and low AGB correlation with the UAV-derived height model, potentially due to signal interference from dense canopy cover. Future research could improve accuracy by using LiDAR, which captures vertical structure more effectively.

This study highlights the effectiveness of UAV data and specific models (Models 11 and 22) in estimating biomass and carbon stocks in the Banlaem mangrove forest, supporting Thailand's carbon neutrality goals. The reproducible framework aids carbon assessment efforts and can inform conservation strategies in similar mangrove ecosystems. With strong community engagement through eco-tourism and tree

planting, the Banlaem community can play a vital role in carbon offset initiatives. Findings on species combinations for optimal carbon storage offer insights for authorities to enhance blue carbon management and contribute to Thailand's emission reduction targets.

5.2 Future Works

The development of the AGB model is essential for the accurate measurement of mangrove carbon stocks. In this study, the CHM showed a low correlation with AGB. Improving the CHM would enhance the accuracy of AGB estimation. The CHM was calculated by subtracting the DTM from the DSM. However, with the dense canopy of the Banlaem mangrove forest, radiation penetration between the UAV and the ground may be obstructed, negatively affecting the accuracy of both the DTM and the CHM. Incorporating the relative proportions of the tree trunk, canopy, and DSM may enhance the effectiveness of vertical structural variables used in the model, offering a cost-effective alternative to using active remote sensing data (such as LiDAR). Moreover, previous research has shown that Lorey's height, defined as the average tree height weighted by basal area, is an effective predictor of mangrove AGB (Wirasatriya et al., 2022). This approach should also be evaluated in the Banlaem mangrove forest. Therefore, developing vertical variables based on mangrove tree characteristics and integrating them with horizontal variables is essential for improving the AGB model in future studies.

Machine learning is also an alternative to use in the AGB model development. With the complex structures of the mangroves, non-linear models may effectively capture the relationship between the UAV variables and ground truth AGB. Previous studies in SEA have demonstrated the high effectiveness of algorithms such as XGBoost and SVR in estimating mangrove AGB (Jachowski et al., 2013; Rijal et al., 2023). However, using machine learning can be challenging, as it often requires knowledge of programming and data analysis.