Monitoring Biodiversity of Agroforestry Systems, using Multisensor Earth-Observation Data and Deep Learning

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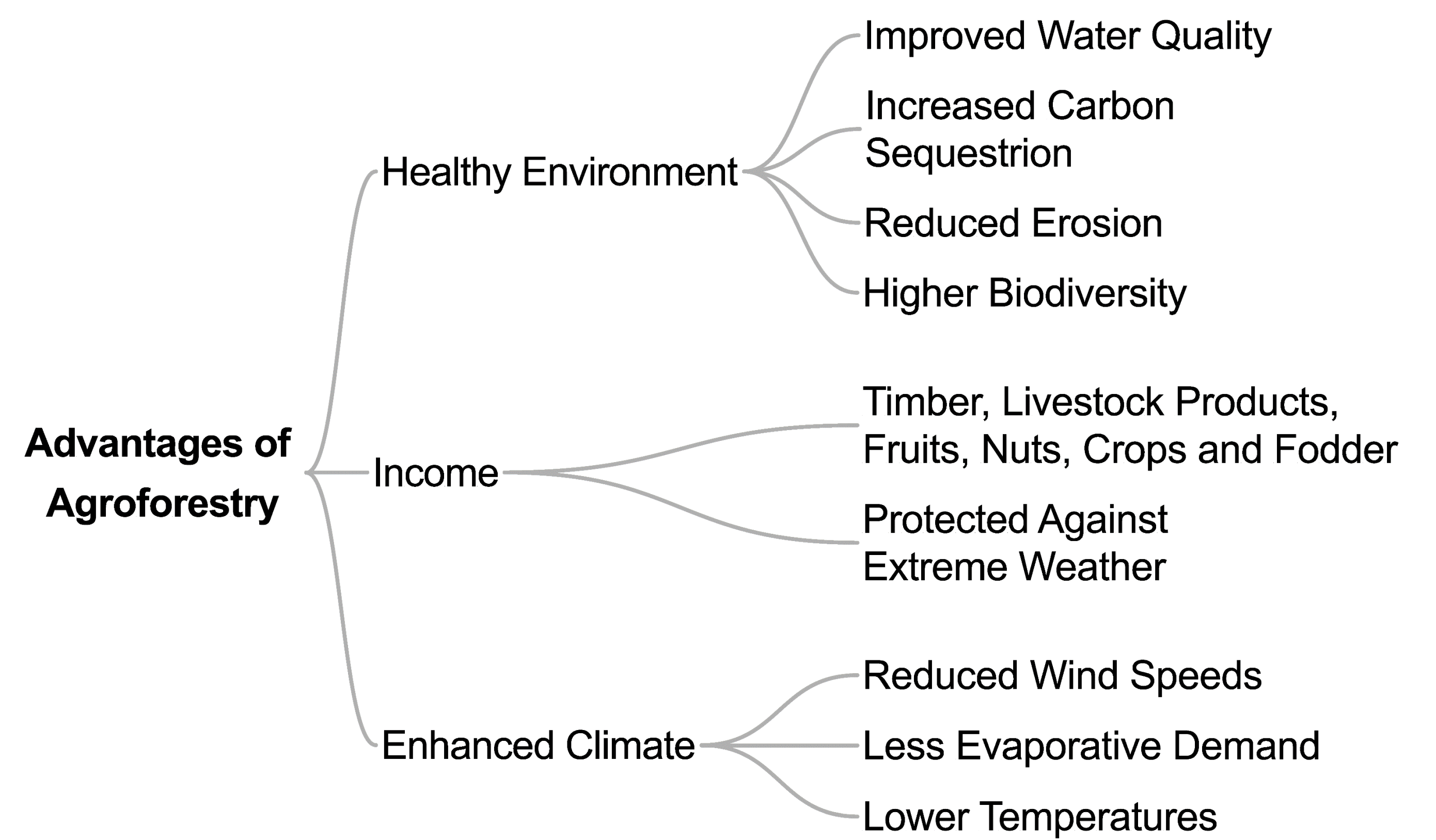**Please find the digital version, related work, and contact here:**

Background

- Agroforestry is a land management system that **deliberately combines trees, crops, and/or livestock** within the same spatial and/or temporal domain [1].

- These either **ancient or modern** farming techniques, encompassing **small-scale farms to landscapes**.

Figure 1: A flock of sheep graze on a meadow orchard near Hohenebra in the Kyffhäuserkreis district of Thuringia by Tobias Nordhausen, CC BY 2.0

Figure 2: Short rotation alley cropping system with poplars near Sacro (Germany) in summer 2014" by Dirk Freese, CC BY-SA DE 4.0.

Advantages of Agroforestry

- Healthy Environment
  - Improved Water Quality
  - Increased Carbon Sequestrion
  - Reduced Erosion
  - Higher Biodiversity
- Income
  - Timber, Livestock Products, Fruits, Nuts, Crops and Fodder
  - Protected Against Extreme Weather
- Enhanced Climate
  - Reduced Wind Speeds
  - Less Evaporative Demand
  - Lower Temperatures

Mapping Trees Outside Forests

Motivation

- Classifying trees outside forests offers a simpler approach to assessing agroforestry, given its high complexity due to variations.

- Existing studies use thresholds based on height models, near-infrared and geometrical attributes.

➥ **What capability have RGB aerial images to classify trees outside forest using semantic segmentation?**

Forest / **Trees Outside Forests**

		Patch	Linear	Tree
F1	0.88	0.73	0.74	0.75
IoU	0.84	0.59	0.63	0.61

Aerial Images

Height Model

NDVI

Landscape Model

Automatic Reference Data Creation → Pyramid Attention Network → Spatial Context Postprocessing → Final Result

North Rhine-Westphalia / Brandenburg
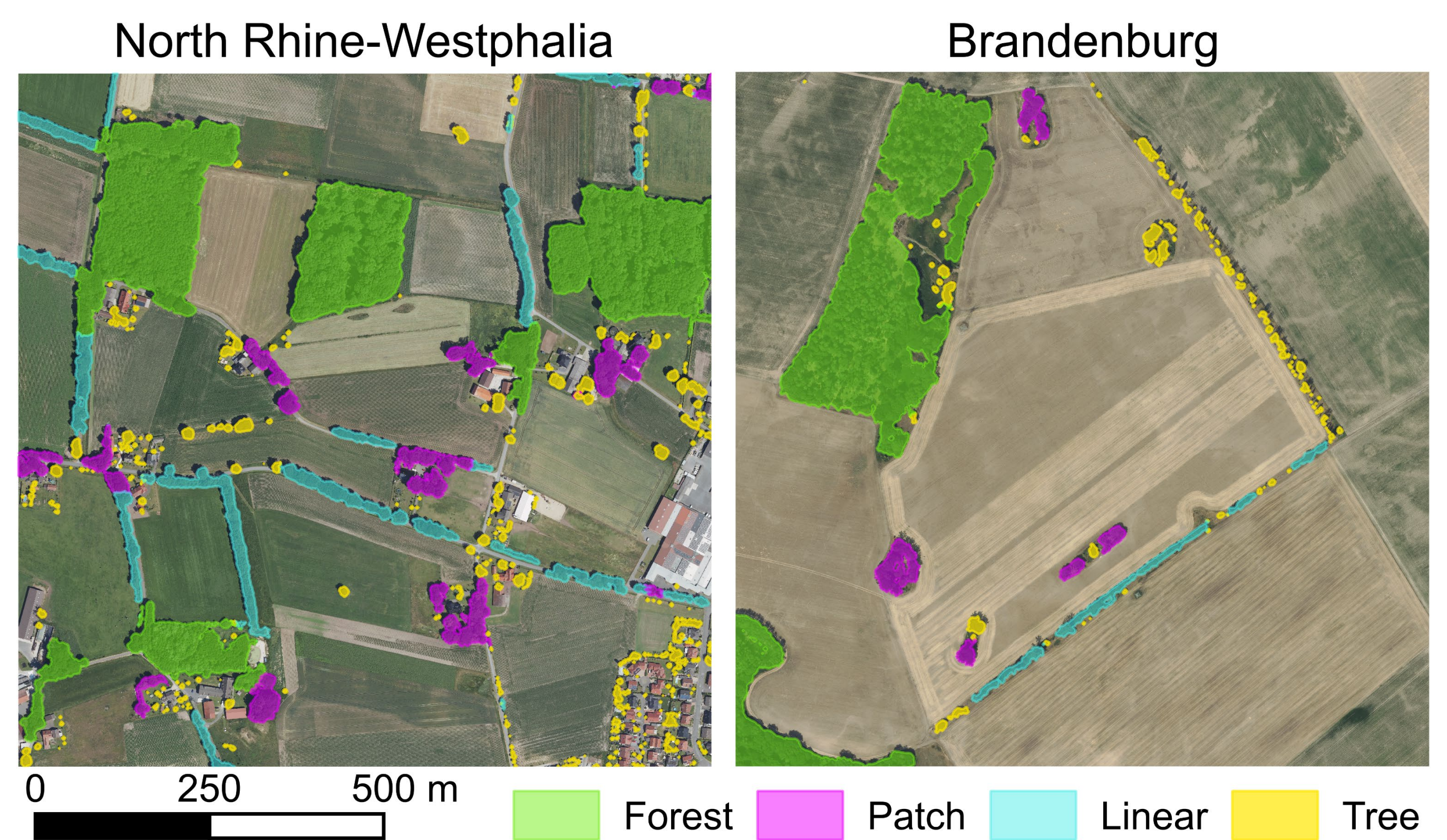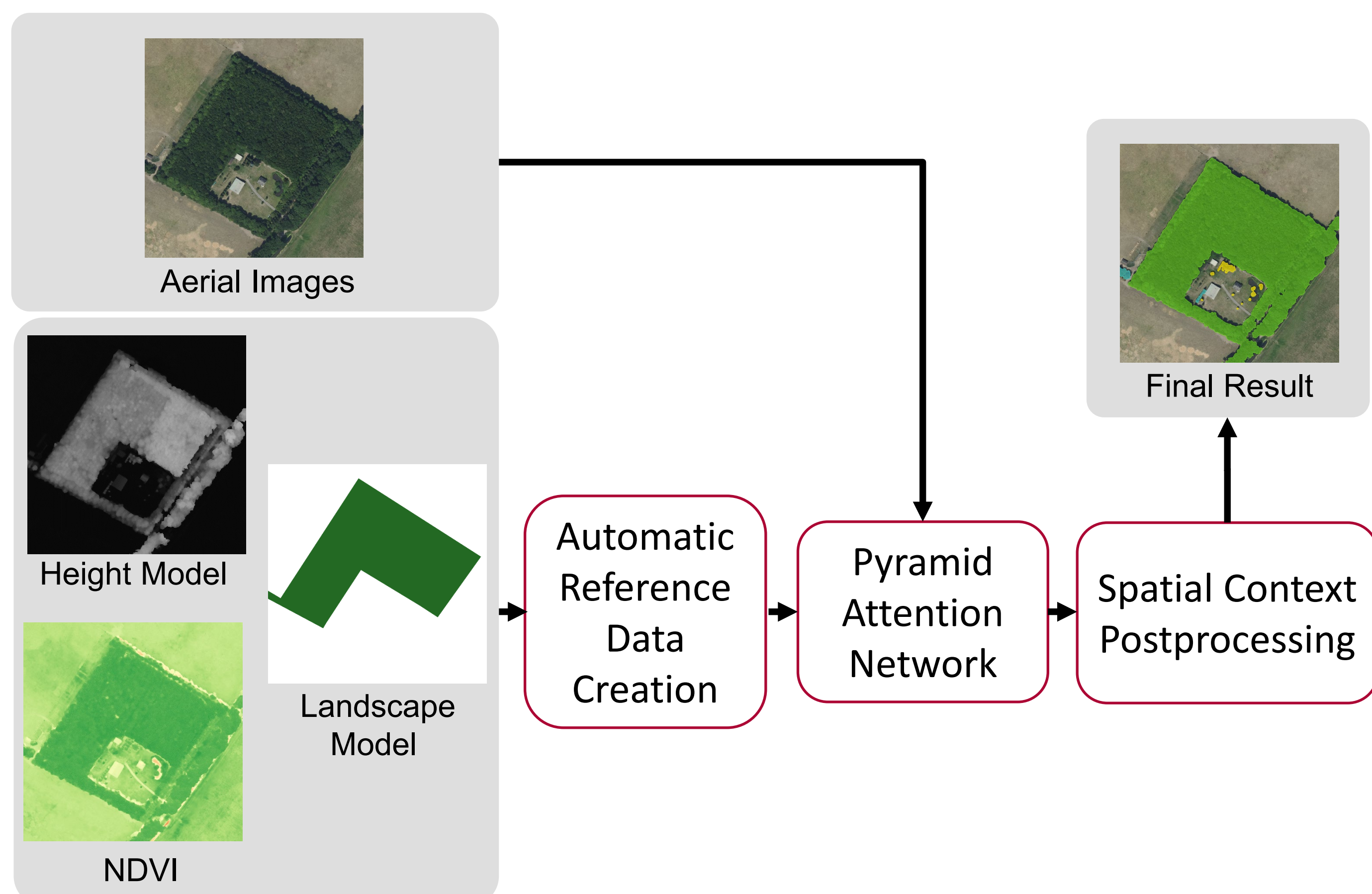
0 250 500 m

Forest / Patch / Linear / Tree

Figure 3: Results of the semantic segmentation of forest and trees outside forest classes.

Future Work

- Using aerial and satellite imagery to **map trees outside forests on large scale** in Germany.

- Biodiversity was shown to be positively influenced by the heterogeneity of the landscape. The aim of this project is to **evaluate biodiversity at landscape level**.

References

(1) Food and Agriculture Organization of the United Nations (2013). Towards the Assessment of Trees outside Forests: A Thematic Report prepared in the Framework of the Global Forest Resources.

(2) Moritz Lucas, Viacheslav Barkov, Ralf Pecenka, Martin Atzmueller, Björn Waske (2024). Mapping Trees outside Forests using Semantic Segmentation, IGARSS 2024 - 2024 IEEE International Geoscience and Remote Sensing Symposium [Under Review].