

Participatory mapping of forest plantations in the Southern Highlands of Tanzania with Open Foris and Google Earth Engine

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Introduction

Growing amount of the global demand on forest related services such as timber, wood fiber and fruits are produced in planted forests, especially in tropical regions where forest plantations have expanded during the last 25 years (Payn et al. 2015). However, spatially explicit information on plantation distribution is seldom available constraining the effective estimates of environmental and socio-economical impacts of the growing plantation cover.

Objectives

The main objective of this research is to use open-source software Open Foris, Google Earth and Google Earth Engine combined with participation of Tanzanian experts in the mapping effort to:

- Establish an estimate of the overall amount and distribution of forest plantations in the region of the Southern Highlands in Tanzania.
- Observe how well the structured participation combined with visual image interpretation and automated image classification supports forest plantation mapping with open-source data and solutions and what type of experience the mapping is for the local participants.
- Discuss the applicability of the methods and mapping for regional scale land and forest planning and management and for monitoring purposes.

Materials and methods

- The plantation mapping was based on freely available global geospatial datasets and satellite images of Google Earth Engine combined with participatory reference data collection with Open Foris tools (<http://www.openforis.org/>)
- In the first stage of the mapping process (FIG1), the geospatial datasets were obtained and pre-processed, and a preliminary binary plantation/non-plantation mask was created by the authors on top of the previous work at FAO
- In the second stage, a large reference sample set was interpreted using high resolution images of Google Earth and Bing maps and assigned to land cover/forest classes by 22 local experts in a participatory mapping campaign which took two weeks including training of the experts
- Collected training data was used to test various classification methods
- Plantation map in 30m resolution was produced for the study area.

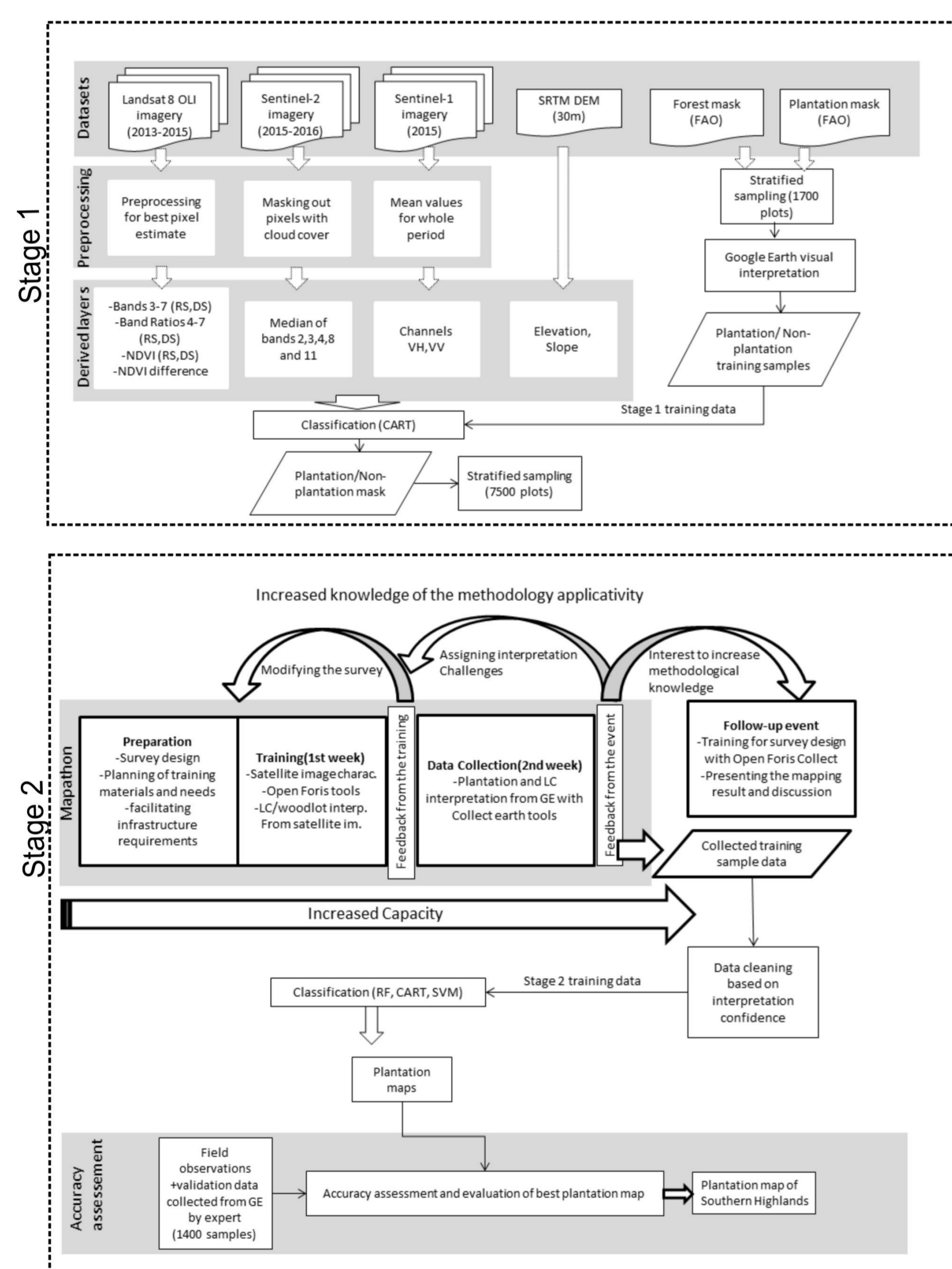


FIG1. The overall study approach

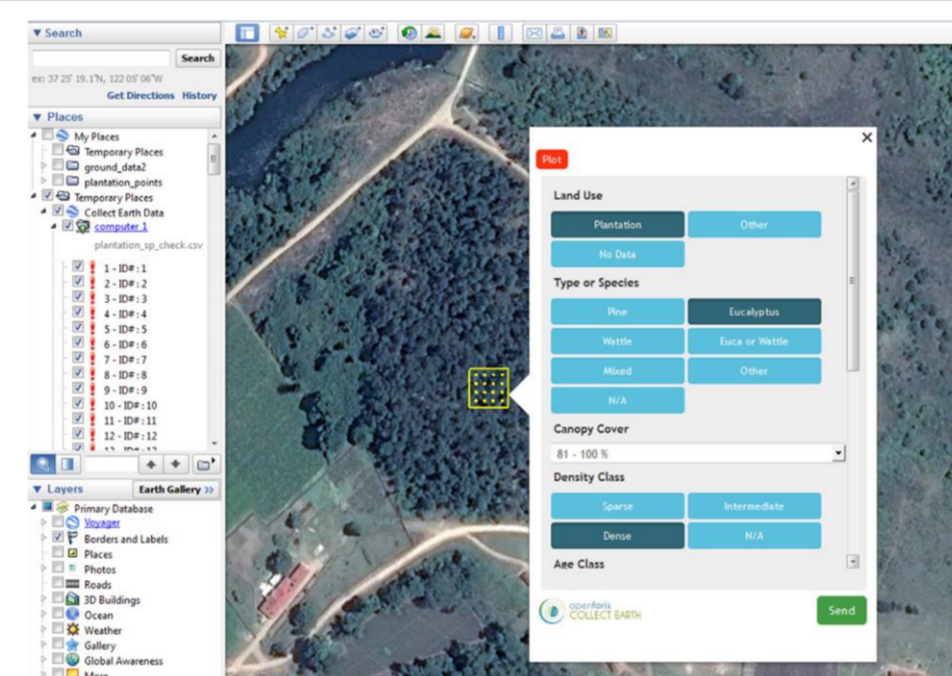


FIG2. Open Foris Collect Earth interface



FIG3. Local experts interpreting the Google Earth images at UDSM, Dar Es Salaam

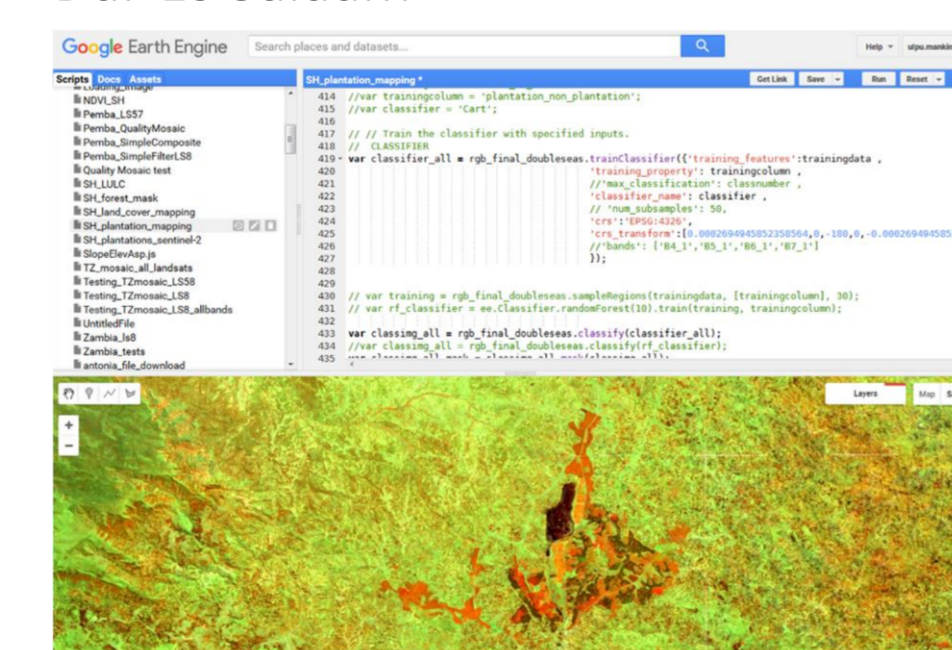


FIG4. Google Earth Engine Code Editor Interface.

Results

- Local experts interpreted 6866 samples (1534 plantations, 5332 other) in one week's time with overall agreement of 68% against field reference.
- Based on our participatory mapping, using Random Forest classifier there are $240\,000 \pm 87\,000$ hectares of planted forests in the region of the Southern Highlands, with overall accuracy $85 \pm 2\%$
- Over 80% of the plantations are less than a hectare in size, covering only 14% of the total plantation area.

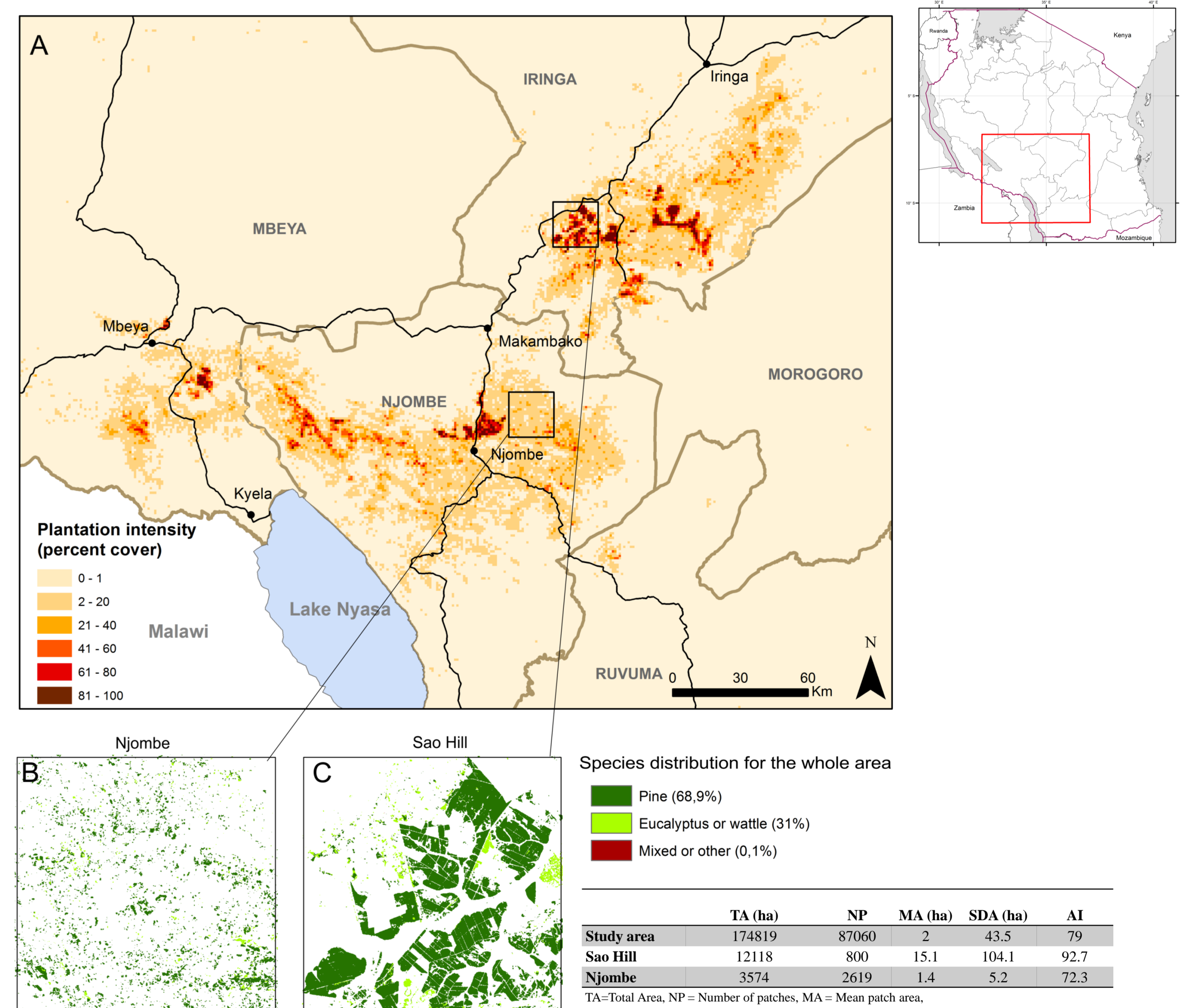


FIG5. Plantations are concentrated in the Southern highlands range from Iringa to Njombe and from Njombe to Mbeya A). Spatial distribution and composition of the plantations varies between area dominated by smallholder woodlots (B, Njombe) and areas dominated by industry-scale plantations (C, Sao hill) visualized in 20km squares.

Conclusions

- The participatory mapping campaign was an effective way to share knowledge and to collect large set of samples in a short time period. On top of that, the campaign was a learning process for the participants increasing their capacity on remote sensing and image interpretation and an investment for the future.
- The mapping process improved the plantation area estimates of Southern Highlands revealing the abundance of small and scattered woodlots
- Based on our experiences, the methodology used in this research holds potential in improving subnational and regional land cover mapping and monitoring, especially in dynamic and data scarce regions, like Tanzania.

References

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