Policy Brief:
Project no. 10-068 LIFE. REDD-PLUS – Inclusion of degradation in baselines
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Executive summary

Our global climate system is changing and there is now broad agreement among climate scientists that changes are most likely human induced and primarily caused by CO2 emissions to the atmosphere. One important source of carbon emissions is human destruction of forests. This has led to the establishment of a globally accepted forest based climate change mitigation system with the purpose to Reduce Emissions from Deforestation and forest Degradation while at the same time establish forest enhancement, sustainable management of forests, and forest conservation (REDD+). A study from Tanzania tests various indirect approaches for monitoring forest destruction using optical satellites and spatial modeling. The approaches suggest to map the infrastructure used for degradation rather than the actual change in forest canopy cover. This offers a way to delineate intact forest land and to model and estimate carbon emissions from forest destruction in the non-intact forest land – thereby simplifying monitoring and reducing monitoring costs.

Introduction

This project was established to identify major degradation activities in dry Forests in Tanzania and to understand the relationship between spatial patterns of major forest degradation activities and signs of human infrastructure and settlements as well as land cover measured with remote sensing. Furthermore we aimed to operationalize an indirect remote sensing approach for modelling biomass loss from degradation activities by use of the best available data and to suggest options for estimations of degradation levels from commercial forest degradation activities when spatial models do not apply. The last objective of the study was to explore opportunities for direct remote sensing based quantification of relative changes in forest disturbance in historical periods.

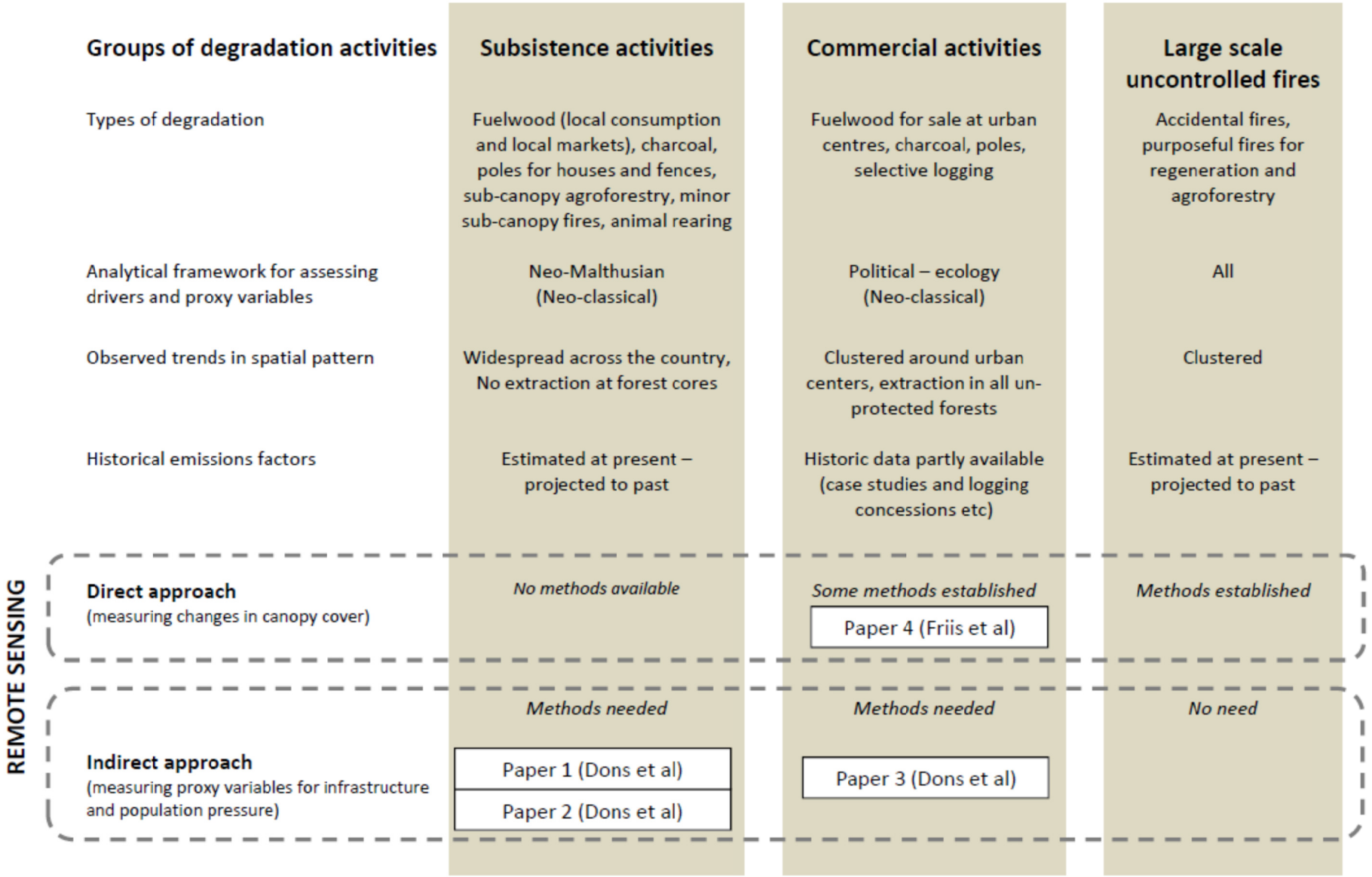
We identified wood extraction both for commercial and subsistence purposes and we found that the spatial patterns of subsistence wood extraction activities were influenced by distance from the forest site to nearest settlement and by the distance to the forest edge. We also found that commercial wood extraction for charcoal was less influenced by distance parameters, but can be detected and to some extent delineated by high resolution optical satellites. Furthermore we discovered a statistical method that may be used for superior prediction of biomass loss and a disturbance index that may be used for relative comparison of forest disturbance across time periods.

Background

Dryland forests contain less carbon per unit area than dense humid forests yet they cover vast areas for example in Tanzania and it is has been suggested that the gradual degradation from these populated forests brings serious contributions to overall carbon emissions. Degradation activities in these areas may be measured with high accuracy but it comes at a cost. The problem

with dryland forests in a climate change mitigation mechanism such as REDD+ is that even a very successful reduction in emissions from these areas provides small amounts of carbon credits per unit of area. Thus developing countries are facing a situation where the cost of measuring and monitoring emissions from dryland forests may exceed the potential benefit. On the other hand doing low accuracy estimations also reduce carbon credits following the principles of conservativeness build in REDD+. Remote sensing seems to be the answer but considering some of the major underlying drivers of degradation in Tanzania, population growth and rural poverty proportions of subsistence wood extraction are high in these areas and subsistence wood extraction is very hard to estimate with direct measurement of changes in canopy cover. In terms of designing monitoring approaches there are three main types of forest degradation activities: (1) commercial wood extraction, (ii) subsistence wood extraction and (iii) large scale uncontrolled forest fires. In this study we focus on wood extraction only. A conceptual framework categorizing the research needs is presented below. Here it is also illustrated that there is a primary need for understanding how wood extraction primarily for subsistence may be estimated through indirect approaches. This is especially needed in order to be able to apply degradation levels back to activity data (forest area change) from historic periods.

Conceptual Framework for options for measurement and monitoring of forest degradation under REDD+ in Tanzania – including contributions from the PhD dissertation



Results:

The present project is mainly explorative and belongs in the group of applied sciences. The overall workflow for the PhD as a whole has been to (i) search for research gaps in MRV for REDD+ where knowledge was needed and investigate the options available in the REDD+ framework, then (ii) carry out qualitative methods for a full understanding of the problems, causal relationships and possible (and impossible) solutions, (iii) investigate possible solutions within established science approaches from other fields and disciplines and finally (iv) assess the applicability and accuracy of a specific method in the chosen case study areas in order to close the specific research gab.

A number of specific low cost instruments that have been proven successful in other circumstances were assessed in the context of measuring and estimating forest degradation in dryland forest areas. Among these the most interesting include:

- The use of Tweedie Compound Poisson-Gamma GLM (CPGLM) for improved prediction accuracy in cases with the combination of continuous data associated with a proportion of true zeroes as in the situation with biomass loss. This study found good fits with the CPGLM and we were able to provide highly significant predictions of biomass loss from subsistence wood harvesting as a function of increasing distance to both nearest forest edge and nearest settlement. Furthermore, the prediction was used to produce actual maps of forest degradation in order to provide full area-based predictions of subsistence biomass loss.

- The use of an inverse power distance decay model on the globally available Landscan population dataset (figure 1a) as well as distances to nearest forest edge (figure 1b) for better understanding of the spatial patterns of forest destruction

- The use of optical satellite data for estimation of charcoal production and hence biomass loss by delineation of Kiln Burn Marks

- the successful application of the Tassel cap based forest Disturbance Index (DI) to account for temporal climatic variability in comparisons of disturbance across different historic periods.

Figure 1a: Number of wood cuts as a function of population pressure and distance to populated pixels

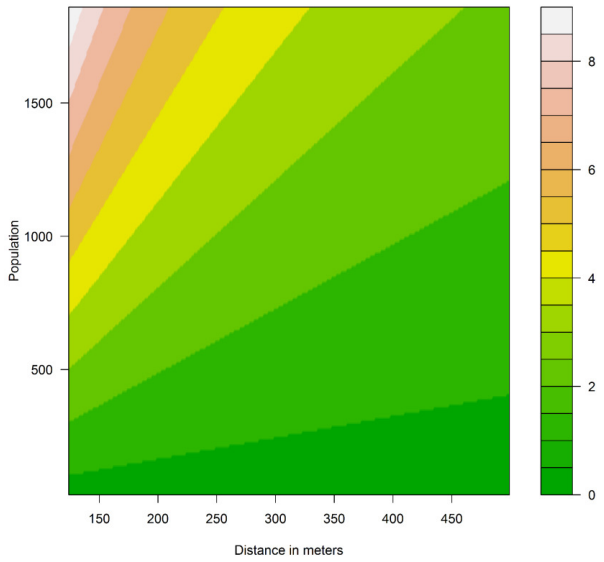
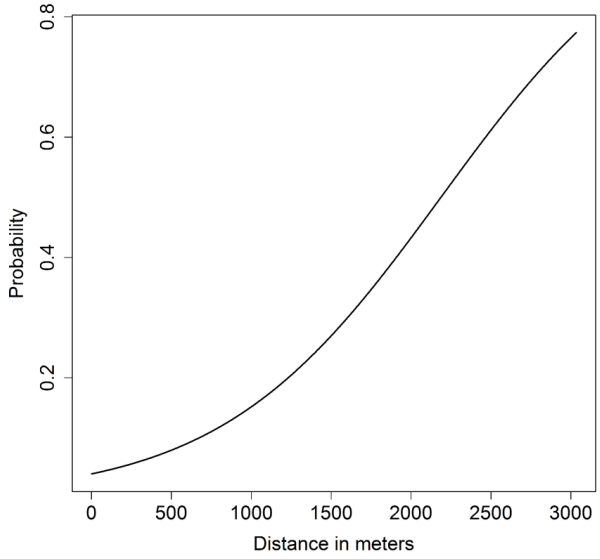


Figure 1b: The probability of finding no wood cuts increases with increasing travel distance into the forest.



Conclusions:

Here is a brief overview of what we have learned from this study:

- We know that nationally and historically available optical remote sensing data may support our understanding of the spatial patterns of commercial and subsistence forest degradation.
- We know that estimations of biomass loss from subsistence forest degradation may be based on the distance to nearest settlement.
- We know that population pressure and distance influence the number of incidents of forest destruction at a given forest location?
- We know that a statistical model new to forestry may be applied for prediction of biomass loss including exact zeroes?
- We know that charcoal production sites can be located and to some extent delineated with remote sensing tools?
- We know that it is possible to perform relative comparison of forest disturbance between two historic time periods while accounting for local climatic variation?

Implications:

The findings in this project contribute to make it feasible and cost-effective to include subsistence wood extraction from dry forests in monitoring approaches for REDD+. Furthermore it is possible to upscale the findings in this project to larger regions because the remote sensing and GIS data used for the study available nationally. Finally, it is now established that the Government of Tanzania may use optical satellites to locate charcoal production sites in Tanzania.

Recommendations:
Call to action, which precise steps should be taken? (both flowing from conclusions, supported by evidence and be feasible and "actionable").

We suggest to establish a regional study that cover larger areas of the Tanzanian dry forest to test the applicability of the modelling approaches in Iringa. The National Forest Resources Monitoring and Assessment project (NAFORMA) in Tanzania has nationwide ground based forest inventory data and may couple this with Landsat based land cover classifications and the Landscan population data-set also used in this study. These 3 sources of data joined using the models from this study could potentially make it possible to include forest degradation in REDD+. Perhaps even in the historic baselines.