

## Consequences of land cover transitions on the sustainability of coral rag forests in Zanzibar, Tanzania

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Forests are complex socio-ecological systems, which are overused especially in the tropical regions. It has been estimated that about 6 million hectares of primary forest is lost globally each year due to agriculture, logging and other human activities [1]. For many decades, governments and global community have tried to tackle the issue of forest deterioration, but the mechanisms leading into forest degradation relate to complex dynamics of physical, social, economic and cultural factors [2]. At local scales, these changes relate closely to values and preferences set on different land use strategies and materialise as various temporary and permanent land use and land cover transitions [3]. At broader scales, land cover transitions are manifestations of the overall land use developments and changes in biophysical and socio-economic factors [4]. We have studied land cover and land use transitions in a tropical island of Zanzibar at local and regional scales using contemporary and historical remote sensing data over the last 50 years. We used spatio-temporal change trajectory analysis [5] on a set of consecutive aerial images (1953-1978-1989-2005) at local scales and post-classification change detection techniques on Landsat TM (2009) and SPOT XS (1996) images at regional scale to detect major land cover and forest transitions. The outcomes of regional level change detection were linked to biophysical factors through regression analyses to explain happened and to predict future changes [4]. Our results show that Zanzibar is deforesting with annual pace of 0.8–1.1%, but within the rural land use regimes significant part of the changes are temporary and forest have capacity to re-establish at local scales. Rates and causes of deforestation seem to differ between the eastern coral rag and the western deep soil areas. At landscape scale, recent deforestation concentrates to the vicinity of the coastline, roads and Zanzibar Town, where also the future risk of deforestation is highest. Deforestation is a direct result of agricultural and urban expansion, but shifting cultivation, fuel wood collection, logging, grazing and extraction of coral cause more subtle forest degradation. Detecting changes at multiple spatial and temporal scales shows the complexity of land cover transitions where forest losses are simultaneously coupled with forest gains and where forests are not simply lost but experience different level of degradation. Since we used two different classification schemes at regional scale, we were able to establish range of deforestation rates rather than one single figure.

### References

- [1] FAO (Food and Agriculture Organization of the United Nations), "Global Forest Resources Assessment 2010, Main Report," FAO Forestry Paper 163, 2010.
- [2] A.B. Brink, and H.D. Eva, "Monitoring 25 years of land cover change dynamics in Africa: A sample based remote sensing approach," *Applied Geography*, vol. 29, pp. 501–512, 2009.
- [3] E.F. Lambin, and P. Meyfroidt, "Land use transitions: Socio-ecological feedback versus socio-economic change," *Land Use Policy*, vol. 27, pp. 108–118, 2010.
- [4] A. Veldkamp, and E. Lambin, "Predicting land use change. Agriculture, Ecosystem and Environment," vol. 85, pp. 1–6, 2001.
- [5] N. Käyhkö, and H. Skånes, "Change trajectories and key biotopes – assessing landscape dynamics and sustainability," *Landscape Urban. Plan.* vol. 75, pp. 300–321.