A participatory modeling framework for assessing biodiversity and ecosystem services future scenarios

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Abstract

In highly diverse and rapidly changing tropical regions, future persistence of biodiversity and ecosystem services (ES) will largely depend on societal willingness to undertake the changes needed to reduce land use and land cover changes (LULCC) and climate change impacts. In particular, through policies that maximize efficiency and opportunities to meet win-win expectations for sustainable development. We developed a framework to build participatory spatially-explicit scenarios of LULCC that captures and harmonise perspectives and knowledge across a diverse range of stakeholders and regions, and can inform decision makers on potential impacts of land and climate policies on biodiversity, ES and livelihood. We applied the framework at different spatial and temporal scales in East Africa.
In the Tanzania mainland we assessed alternative development strategies to the year 2025 - under either a business as usual (BAU) or a green development (GE) scenario. Under a BAU scenario, with no productivity gain and an increasing population, cultivated land expands by ca. 2% per year (up to 88,808 km2), with large impacts on woodlands and wetlands. Despite legal protection, encroachment of natural forest occurs along reserve borders. Additional wood demand leads to degradation (i.e. loss of tree cover and biomass) up to 80,426 km2 of wooded land. This leads to a net carbon stock loss of -290,348,518.4 Mg. The alternative GE scenario envisages decreasing degradation and deforestation with increasing productivity and implementation of REDD+ and Payment for Ecosystem Service schemes. Under this scenario, assuming a 10% increase in crop productivity, cropland expands by 44,132 km2, and additional degradation is limited to 35,778 km2. Carbon stock losses due to deforestation and degradation is reduced by 49% and biomass increase is expected in reserved areas and agro-forestry landscapes.

Under BAU, biodiversity hotspots in montane ecosystems are affected by communities' responses to land scarcity and high demand for fuel wood. Vertebrate total biodiversity is lost by 7% and endemic vertebrate species are heavily impacted (more than 50% habitat loss for

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21 species). WIth variable climatic conditions, if crop suitability increased on the montane slopes compared to lowlands, then further encroachment of montane forest could occur. In the GE scenario, this impact is reversed through legal protection enforcement and reduced pressure on reserved forests supported by PES and improved agricultural systems.
Anticipating future conservation and land use interaction under developing strategies and climate change may contribute to set spatial priorities for intervention sites. Applying a bottom up approach enhances success chance by building local actors ownership and awareness, by incorporating local knowledge and by reducing the gap between local communities and policy makers.

Keywords: REDD+, sustainable development, climate change, conservation