Assessing the potential for sustainable forest management of a dry forest ecosystem in south western Madagascar

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The dry spiny forest in south-western Madagascar harbours a unique flora and fauna with a high level of endemism. It further provides important ecosystem services (ESS) which contribute considerably to the livelihood and cultural identity of the local population. Sustainable forest management (SFM) can be a promising approach to promote the long-term conservation of dry forest ecosystems and their biodiversity and to generate and maintain ESS for present and future generations. However, to develop environmentally, socially and economically SFM schemes, a better understanding of the these ecosystems is essential. The principal objective of our work was therefore to provide sound quantitative measures for the potential utilization of forest resources in dry areas.

Based on data from continuous forest inventory plots in the Tsimanampesotse National Park on the Mahafaly Plateau, we were able to estimate forest structure and growth rates of the dry forest ecosystem. In our results, we differentiated between non-pachycalous and pachycaulous species, i.e. species that are characterized by a thick stem and only few or no branches, such as the characteristic Baobabs, because the latter are not used for fuel or construction wood due to their low wood density.

The density of trees with a diameter at breast height ≥ 5 cm was 630.0 ± 48.9 trees ha^{-1}. Of those, 50.1 trees ha^{-1} belonged to pachycaulous species and 579.9 trees ha^{-1} to other species. The mean basal area of all sample plots was 9.7 ± 1.7 m^2 ha^{-1}, to which pachycaulous species contributed 4.5 m^2 ha^{-1} and non-pachycaulous 5.2 m^2 ha^{-1}. Timber stocks and above-ground biomass amounted to 25.7 ± 5.7 m^3 ha^{-1} and 14.4 ± 3.2 t ha^{-1}, respectively, which is very low compared to other forest ecosystems.

The annual radial tree growth across all species was 0.25 ± 0.06 cm a^{-1}. This value might not seem particularly low in comparison to other forest ecosystems, but tree growth varied strongly between different species groups and species. Pachycaulous species showed a high growth rate of 0.51 ± 0.16 cm a^{-1}, whereas the growth rate for other species was only 0.16 ± 0.06 cm a^{-1}.

The most important principle of SFM is to use only as much forest resources as will be naturally replaced by the forest ecosystem. In that regard, the combination of low timber stocks and low growth rates of non-pachycaulous species results in a very low potential for the sustainable harvest of wood resources and impedes the implementation of SFM plans that both contribute to the long-term conservation of the forest ecosystem and the provision with wood and non-timber forest products for the local population. Promising approaches to improve stocks and growth rates of dry areas through silvicultural activities include community-based forest management and forest restoration and reforestation of abandoned farmlands. Based on our results, we discuss further research needs for the implementation of those approaches on a larger scale in other dry areas.