FORESTS NEWS

Understanding forest change in Tanzania opens door for improved management

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Can Tanzania's tropical forests and miombo woodlands be managed sustainably while still supporting human populations? The findings of a collaborative study on the local drivers of the live matter from trees and shrubs found above ground could be a first step toward making better management decisions about forests that are frequently cut for woodfuel or converted for agriculture.

The study combined Tanzanian national forest inventory (NFI) plots with remote sensing data to shed light on how human activities and environmental factors affect above-ground in both established and recovering forests.

The results could serve as a baseline for localized carbon-sink estimates and landscape management planning of recovering tropical forests and woodlands in Africa, which supply most of the region's cooking fuel.

"This research is part of our efforts to get better, more localized, driver information about forest biomass in African drylands," said Christopher Martius, a senior scientist and a managing director at the Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF). "We will have better figures for countries that have to report their emissions to the UNFCCC (U.N. Framework Convention on Climate Change) compared to some baseline."

African tropical forests and woodlands cover about 636 million hectares and are inhabited by approximately 284 million people, according to the 2020 Global Forests Resources Assessment published by the U.N. Food and Agriculture Organization (FAO). In Tanzania, these forests contribute 92 percent of the country's energy consumption via fuelwood and charcoal combined, reported a 2010 paper. Their supporting role for both human and animal populations means they are always changing and adapting, making them a valuable case study to estimate the potential for carbon storage in forests that are under constant use.

Despite their large land area and population, these landscapes have been infrequently monitored over time, so not much is known about the specific drivers that contribute to forest change at the fine-scale level, according to the new study. To compensate for the lack of historical data, researchers from CIFOR-ICRAF, Wageningen University & Research (WUR), satellite land monitoring firm, TerraPulse and other partners worked closely with the Tanzania Forest Service Agency (TFS) to estimate the time since forest establishment for all forest inventory plots.

They used a satellite time-series of forest cover probability, which enabled the division of forest plots into recovering forests that had been regrowing for less than 25 years and established forests that had been growing for 25 years or more.

The researchers hypothesized that above-ground biomass in recovering forests would increase over time in recovering forest plots, indicating that they act as partial carbon sinks. They further predicted that above-ground biomass would be higher in areas with fertile soils, lots of water, low elevation and low intensity of human use — measured by the distance to the nearest settlements and roads, among other factors.

However, their results were surprising.

While above-ground biomass in recovering forests did increase over time, they found that it unexpectedly decreased in both recovering and established forests when more water was available, suggesting that dry periods are helpful for tree growth and development.

However, these results do not agree with similar studies, and should be proven or disproven by continued research, cautioned Daniela Requena-Suarez, a Ph.D. candidate at Wageningen University and lead author for this study.

“This is just the start,” she said. “What would happen if we tested relationships using re-measured plots? Instead of estimations using chrono sequences, which are derived from plots that have only been measured once, measuring the physical plots more frequently over time will give us more direct results about above-ground biomass and its recovery in Tanzania.”

Further research could also look at different drivers of above-ground biomass that could not be measured at the time of study, suggested Requena-Suarez. These additional drivers could include previous and current land use data, grazing data, how much forest has been converted for agriculture, and fuelwood extraction.

In fact, the selected environmental and human-use predictors contributed less than 24 and 19 percent of the changes observed in above-ground biomass, respectively. This finding highlights the ongoing need for *in situ* research at both the national and sub-national levels in Tanzania, according to Requena-Suarez.

In addition to the physical drivers of above-ground biomass, fine-scale research should be coupled with information about the social dynamics of the region, noted Martius. It is important to understand local norms and land-use regimes already operating in the region. Who is responsible for managing forest land and what are the relationships between local communities and ethnicities, for example?

“We don’t have all this information yet, but it is essential to pair this social information with the physical drivers that we are studying to create a working management plan,” said Martius.

A collaborative approach to forest monitoring

Findings from studies like this one can complement the Tanzanian government’s decades-old efforts to sustainably manage and conserve forests, the authors stated. Already, 36 percent of the nation’s mainland areas are classified as protected, reported a 2020 study from *Forests*.

Tanzanian leaders and policymakers from the TFS can use the improved data sets from studies like this one to make wise land-use decisions, which gives them an advantage over other countries, according to Requena-Suarez.

“Other countries in the tropics usually rely on IPCC (Intergovernmental Panel on Climate Change) estimates of above-ground biomass change, which are very coarse and based on a limited number of plot data,” she said. “Figures like those we are producing with studies like this one can be used by governments to improve their forest carbon estimations and to better predict the rate of recovering forests.”

For example, one key finding from this study found that above-ground biomass in recovering forests increased by 0.4 Mg ha^{-1} yr^{-1} during the first 20 years following establishment. If this number is confirmed with future research, it could be used to estimate the unique carbon-stock potential of recovering forests in Tanzania.

Additionally, these new data sets could impact decisions about which land to convert for agriculture and other economic such as charcoal production, according to Martius.

“You can take the driver information and design activities around it,” he said. “If a forest plot already had lower biomass relative to other plots, it might be more attractive to convert for agriculture while minimizing disturbance in the more forested areas.”

With better planning, he suggested, the forests could potentially continue — providing arable land and woodfuel — while also acting as carbon sinks and biodiversity basins.

And the benefits of this type of research are not limited to Tanzanian forests. Collaborative, mixed-methods studies like these can be replicated around the world to achieve more precise information about the drivers of above-ground biomass and how they affect forest carbon storage, according to Requena-Suarez.

“There are a lot of areas around the world with recovering forests and woodlands. By combining NFI plots with remote sensing and other spatial datasets, similar studies can be made,” she said. “The more these fine-scale variations in above ground biomass can be explored, the more benefits for restoration planning and conservation.”

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