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Bamboo: A resilient strategy for climate change mitigation and adaptation, A case of Tanzania.

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Abstract

In many policy circles, there is a nascent discussion on the role that bamboo could play as an alternative climate change mitigation and adaptation strategy. The major advantage is that it is a fast-growing versatile woody grass, which can prosper on marginal and degraded lands. However, bamboo has been largely neglected in climate policy debates. We assumed that this circumstance is attributable to its taxonomic classification as grass rather than a tree. Moreover, most empirical research on bamboo was conducted in Asia, leaving open questions on the transferability of the results to the African context. In this study, we contribute to the debate by investigating to what extent bamboo can contribute to agroecological systems with the aim of sustaining livelihoods of poor rural societies, especially in degraded ecosystems. Taking Tanzania as a case study, we assessed bamboo's potential for carbon sequestration and storage, assuming that there are dynamics in bamboos' Above-Ground Carbon stock (AGC) across an elevation gradient, between indigenous and exotic species, and between intensive and extensively managed ecosystems. To test our hypotheses, we conducted a 60 plots destructive carbon assessment; we reviewed the literature to determine bamboo's potential for landscape restoration and carried out experts' interviews to determine potential strategies for bamboos' integration into climate policies.

Our results revealed that bamboo's above-ground biomass, carbon stock, and sequestration rates are 52.4t ha^{-1}, 26.2t C ha^{-1}, and 19t C $ha^{-1}yr^{-1}$, respectively. The AGC stock showed a significant variation across an elevation gradient and between species explaining 22% and 11% of the total variations, respectively. However, there was a non-significant AGC stock variation between the intensive and extensively managed bamboo ecosystems explaining only 2% of the total variation. A significantly high amount of AGC was observed in the lower elevation (41.2t C ha^{-1}) than in the higher elevation (21t C ha^{-1}) and the indigenous species (*Oxytenanthera abyssinica,* 34t C ha^{-1}) than in the exotic species (*Bambusa vulgaris*, 18.4t C ha^{-1}). We further observed that variation in bamboo's AGC is influenced by two and three-way factors'/variables' interaction. The interaction between (i) elevation and species and (ii) elevation and silvicultural management options accounted for 12% and 5% of the total variation in AGC, respectively. A three-way factors' interaction between the studied variables accounted for 4% of the total variation. Similarly, findings showed that bamboo's morphological structure provides vast support for a plant to strive in degraded lands. If used for landscape restoration, bamboo could protect soil, regulate water, moderate extreme events, and improve rural livelihoods. However, bamboo's exceptionality among trees was found to be the most significant reason it is neglected under climate change mechanisms and agreements. Other reasons were insufficient climate change mitigation and adaptation knowledge among actors, lack of information concerning bamboo's potential, bamboo's invasiveness, non-permanence of carbon pools, and the country's poor institutional and policy environments. Our results suggest that integrating bamboo into landscape restoration schemes can improve ecosystem benefits at rates comparable to or more than in plantation forestry, including producing a tradable amount of carbon under the climate change mitigation schemes. These results contribute to developing a more nuanced picture of the advantages and disadvantages of incorporating bamboo into climate change strategies. The novel findings presented here may be a first step toward unlocking future climate finance and forest landscape restoration opportunities in Tanzania.

Keywords: Bamboo, alternative, climate change, Carbon sequestration, Tanzania