Abstract

In many policy circles, there is a nascent discussion on the role that bamboo could play as an alternative strategy for climate change mitigation and adaptation. The significant advantage is that it is a fast-growing versatile woody grass, which can prosper on degraded and marginal lands. However, national, and international mechanisms that manage global climate change have been largely neglecting the bamboo alternative. Our assumption is that bamboo's neglect is attributable to its taxonomic classification as grass rather than a tree. So far, most empirical research on bamboo's climate mitigation potential has been conducted in Asia, leaving open questions on the results' transferability to the African context. This study contributes to the debate by investigating how bamboo can substitute trees in climate change mitigation and adaptation strategies to sustain poor rural societies' livelihoods. Taking Tanzania as a case study, we assessed bamboo's potential for carbon sequestration and storage, assuming that bamboo's Above-Ground Carbon stock (AGC) varies 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 bamboo's AGC 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 the average bamboo above-ground biomass carbon stock and sequestration in the studied Tanzania's ecosystem are 52.4t ha^{-1}, 26.2t C ha^{-1}, and 19t C $ha^{-1}yr^{-1,}$ respectively. Results further depicted a significant variation in AGC across an elevation gradient explaining 22% of the total variation, followed by species that accounted for 11% of the total variation and a non-significant variation between silvicultural management options explaining only 2%. The considerable amount of AGC was observed in low elevation (41.2t C ha^{-1}) than in high elevation (21t C ha^{-1}); in indigenous *O. abyssinica* species (34t C ha^{-1}) than in the exotic *B. vulgaris* (18.4t C ha^{-1}); and in Extensive (29.7t C ha^{-1}) than in intensively managed ecosystems (22.7t C ha^{-1}). However, we further observed two and three-way-factors' interaction between elevation and species accounted for 12% of the total variation, and between elevation and silvicultural management options accounted for 5%. Findings showed that bamboo's morphological structure provides vast support for a plant to strive in marginal and degraded land. If used for landscape restoration, bamboo can protect soil, regulate water, moderate extreme events, and improve rural livelihoods. However, bamboo's exceptionality among trees is the most significant reason it is neglected under climate change mechanisms and agreements. Other reasons are 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 low institutional and policy environments. Our results show 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 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.

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