Review Paper

PROMOTING SUSTAINABLE AND INCLUSIVE BAMBOO RESEARCH AND ENTREPRENEURIAL SKILLS DEVELOPMENT IN SAHELIAN AFRICA

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Received: 26 July 2023, Revised: 19 November 2023, Accepted: 21 November 2023

Abstract

Woody bamboos are wonderful replacement for tropical hardwood trees because of their short growth cycles and a high carbon dioxide exchange rate; they are capable of promoting avoided tropical deforestation. This article aims at analysing the usefulness of bamboo-based landscape restoration programmes, agroforestry systems and appropriate technologies towards improving sustainable food security while at the same time contribute to reclaiming degraded soils, boost bamboo product manufacturing, and supplement animal feeds. The outcomes of this paper would further contribute to improving climate resilience and livelihoods at households and community levels in Central and West Africa. Logically, the first expected approach is to highlight relevance of Nnamdi Azikiwe University (UNIZIK)-based bamboo research platform known as the Sahelian Institute for Bamboo Research and Entrepreneurship Development (SIBRED), which is established to build capacities and share knowledge on contemporary bamboo related innovations available within Sahelian Africa Countries and their neighbours. Using the UNIZIK-based SIBRED as an outreach platform, we hope to strengthen relationships with local communities, government agencies, non-governmental organisations and bamboo value chain investors at both domestic and international levels. Thus contributing to achieving some of the 17 United Nations Sustainable Development Goals (SDGs) as well as support the realization of a stronger green industrial growth and entrepreneurship education in Central and West Africa. Therefore, the outcomes from this paper would serve as reference materials that can support the development of policy responses, at regional, national or catchment scale, to existing and emerging environmental related problems using bamboo nature based solution (NBS) through partnership with SIBRED.

Keywords: Entrepreneurship, Sahelian Africa, SDGs, SIBRED, UNIZIK, Woody Bamboo

1. Background

Climate change is negatively impacting agriculture and food security - phenomenon that makes the challenge of ending hunger and malnutrition even more difficult (FAO, 2015); especially, in Sahelian Africa countries of Nigeria, Democratic Republic of Congo and Cameroon. Aside from the persistent high risks of climate change for agricultural production in this region, the rural social-economic aspect which is largely characterized by farming, trading, and transhumance (UNARM) is increasingly being jeopardized by insurgencies. In

recent years, food insecurity in most parts of rural the Sahel has increased significantly as a result of the incessant farmers–herders crisis. If left unabated, millions of people in Nigeria, DRC and Cameroon could become chronically food insecure, and millions more could experience transitory shortages of food during the lean season (Ringler et al., 2020). Regrettably, within the context of widespread and entrenched gender inequality, food insecurity further affects women disproportionately, especially in rural areas. Persistent gender disparities continue to challenge development and have an impact on food and nutritional security (WFP, 2022). Yet agricultural production remains highly underdeveloped in rural parts of the afore-listed Sahelian Countries. Worst-still, smallholder agricultural production is highly destroyed by the impacts of reoccurring flooding on an annual basis, since 2012 (UNARM).

Hence, since the world is regarded as a global village, many of challenges that are experienced in the Sahelian Africa region are global driving factors. For example, the world is currently facing a series of environmental and so-economic challenges that are compounded by the novel coronavirus global pandemic. Currently, 770 million people do not have access to electricity (IEA, 2020). Also, two billion people in the world are said to be lacking safe, nutritious, and sufficient food (FAO *et al.*, 2020). At the same time, the global climate crisis have grown worse, and the current greenhouse gas emissions strategies by national governments across the Globe are nowhere near the targets needed to limit the global average surface temperature rise to below 1.5°C and avert irreversible damage of global warming (UNFCCC, 2021) . Countries are already having to adapt to the impact of a warming planet Earth as extreme weather events become commonplace. The unprecedented rise in tropical deforestation, which is linked to the climate change, has also become direr.

As such, with the increasing impacts of global climate change, the depletion of forest resources and the increased degradation of the world's environment, there is a need for more sustainable development. Sustainable development and growth can be achieved by the improved management of ecosystems and the more strategic use of water, land and other natural resources such as trees which are crucial for curbing loss in forest biodiversity that helps to support environmental ecosystems health and local livelihoods enhancements. Currently, the growing global awareness is that, if we want to deal with the impacts of climate change, improve water quality, enhance livelihoods of people and curb loss of forest biodiversity, taking good care of our tropical forests is of utmost importance. The European Union (EU) is one of the largest importers of commodities linked to deforestation

(WRI, 2022). However, such a scenario could change, because, an EU Draft Regulation would prevent products that cause deforestation or forest degradation from entering the EU market, which could significantly reduce greenhouse gas emissions and protect tropical forest biodiversity (EC, 2020).

Remarkably, bamboos can help solve the world housing and climate crises. This is because, the utilization of bio-based materials in modern building construction is a viable solution to global housing shortages, while at the same time contributing to the mitigation of global warming and achieving carbon neutrality (INBAR, 2023). According to studies, some species of bamboo can absorb more carbon dioxide than most trees and they also produces 35% more oxygen than an equivalent stand of trees (Atanda, 2015; Ramakrishnan *et al.* 2018). Hence, researching on indigenous African bamboos could be a great way to contribute to reducing carbon footprint and help to fighting global warming. More importantly, bamboo is one of the forestry and food safety value chains that is socially acceptable, economically viable and ecologically sound for landscape restorations.

Equally, bamboo is an emerging and an important substitute for wood and fibre within the UN COMMTRADE (UNSD 2020). The distinct advantage that bamboo has over conventional timber is in its fast growth, multiple harvesting pattern, little or no dependence on synthetic fertilizers and plant protection chemicals and a wide adaptability to a range of soil and climates. Thus, while raw material supply from tropical forests is decreasing, woody bamboos can meet demands for raw materials at both domestic and the international forest products marketplace. Irrefutably, bamboo products are competing effectively as a substitute material for a range of resources such as timber, viscose, fiber reinforced plastics (FRP), and construction materials. Globally, domestic trade and subsistence use of bamboo are estimated to be worth US$4.5 billion per year, and export of bamboo generates another US$2.7 billion (INBAR 1999).

2. Research Motivation

Based on the foregoing analogies, since human beings are now at a pivotal moment in time where the world is experiencing a confluence of pressures from climate change, demands for greenhouse gas mitigation, stakeholder pressures on businesses to do more in mitigating the rising negative impacts of climate change, and the demands for more sustainable solutions for manufacturing materials, climate justice demands, sustainable livelihoods enhancements, boosting of food security in communities, environmental sustainability, etc.; conducting a four-year multidisciplinary, multinational, inclusive and multifaceted bamboo translational research at this

defining point in time, should be a vital priority for the selected Sahelian Africa Countries of Nigeria, DRC and Cameroon. The concept of translational research simply refers to the process of harnessing knowledge from basic sciences to impacts beyond the academic environment (Witzell *et al.*, 2021).

Therefore, this paper draws inspiration from the premise made in a newly published article by the University of Oxford in January, 2023 (Smith et al., 2023), expressed as follows: "The science is clear. No matter which IPCC pathway humanity will follow, holding the global average temperature increase below 1.5°C will require removing increasing amounts of CO_2 from the atmosphere". Also, "every year of delaying rapid and sustained emission reductions increases the requirements for CDR deployment in the long term." The reliable availability of sustainable bamboo plantations is required for a healthy environment, social and economic wellbeing of Sahelian Africa Countries. Hence, this paper holds a promise for achieving such the proposition posited by Smith et al., 2023 in the Shel. This thrust accordingly focuses on developing the understanding of global climate change and adaptation options and solutions at national, regional and local scales within Sahelian Africa.

In view of the above analogies, this paper bridges the knowledge gap towards promoting the relevance of bamboo for sustainable green industries and bioenergy, bamboos for boosting small-and-medium scale enterprises and entrepreneurship development in Nigeria, including 'bamboo for livestock fodders' which is expected to reduce incessant herder-farmers crises in the project countries.

3. **Research Aim**

The aim of this paper is unveil the newly established Sahelian Institute of Bamboo and Entrepreneurship Development (SIBRED) at Nnamdi Azikiwe University Awka in South-eastern Nigeria in order to promoting novel bamboo value-chain technologies and education in Africa that can aid stakeholders to improving sustainable food security while at the same time support the reclamation of degraded soils and boosting bamboo products manufacturing. Particularly, the outcomes of this paper would further contribute to attaining sustainable bamboo industry, innovation and infrastructure (SDG-9) through green jobs and manpower creations (SDG-7) that can support sustainable consumption and production patterns (SDG-12) carbon dioxide removal (CDR) (SDG-13), promote avoided tropical deforestation to boost forest biodiversity (SDG-15), bamboo based agroforestry production and bamboo foliage production for agro-pastoralism that can reduce herder-farmers crises (SDG-2), and SDG-6 (bamboo for flood management). Meanwhile,

through the Paris Agreement, Sahelian countries including Nigeria, DRC and Cameroon have together set quantifiable goals to reduce (or "mitigate") climate change. Additionally, the expected outcomes of this proposal could contribute to meeting the nationally determined contributions (NDCs) Targets of the Paris Agreement of the project countries.

4. Methodological description

Desktop study was adopted in this study through which we searched related literature using Google Scholar and open-source Scopus literature domain.

5. Research Findings

In Nigeria for instance, a couple of literature confirm the availability of only two bamboo varieties in Nigeria. These varieties are: *Bambusa vulgaris* (common bamboo) and *Oxystenanthera abyssynica* (African lowland bamboo). The two varieties grow naturally in the forests, especially, below River Nige (FAO, 2010). In Nigeria, bamboo plant has long been recognized as an economically important raw material which is used in the building industry for scaffolding and for yam staking by farmers. The species also assist to stabilize river bank and protect the shore especially in fresh water areas. Bamboo forests and plantations are key components of sustainable and resilient nature-based solutions, providing a wide range of ecosystem goods and services. Bamboos play important roles in the achievement of the 17 United Nations (UN) Sustainable Development Goals, in particular that earlier mentioned under Section (3) above; with all contributing to making safer, resilient, healthier and sustainable environments.

Interestingly, all the afore-mentioned issues regarding the sustainable production and consumption of forest resources have provided opportunities for the development of substitute forest resources such as bamboo. The earlier referenced new EU Regulation holds promise for sustainable development of bamboo raw materials and its value-added products. As such, the Chapters 47 and 48 of the EU Combined Nomenclature (EUCN, 2020) on pulp and paper specifically mentioned bamboo-based and recovered (waste and scrap) products as exceptions to the Regulations.

Specifically to Nigerian bamboo, the Food and Agriculture Organization (FAO) states that, Nigeria has 26.8 million tonnes of growing bamboo stock on 1.59 million hectares, yielding an average of 16.9 tonnes per hectare (FAO, na). However, same FAO report expressed that, 'no methodology notes' were attached to the Nigerian report. Hence, the FAO report recommends that,

the bamboo figures for Nigeria should be considered with caution. Likewise, FAO, (2010) indicated that, there are various species of bamboo in Nigeria but not captured in conventional forest surveys. Again, this paper attempts to emphasise the foregoing identified problems towards bridging the gap on bamboo forest data credibility and validity. In spite of growing public and private investments in bamboo across the global, little is also known about the opportunities, challenges and impacts of commercializing bamboos growing in Nigeria (Okokpujie *et al.*, 2020). Also, despite that bamboo is a crop of immense potential, yet there is limited recognition of its value and cultivation in Nigeria. No single private or government – owned bamboo plantation is available in Nigeria. What is currently available are bamboo growing naturally within the natural forests (Ogunsanwo et al., 2015). Thus, creating another significant knowledge gap.

More-specifically, in Nigeria, the medium-to-long-term impacts of Sahelian indigenous bamboo species have not yet been comprehensively studied. Likewise, there is little evidence-based, academic analyses in the online literature domains on the subject matter. Many projects appear to be carried out with an underlying unproven assumption that bamboo industry development will automatically lead to economic, social, and environmental benefit.

FAO (2010) emphasized the urgent need for strategic research on bamboo in Nigeria along the following listed research lines: (i) Inventory of the species in the country, (ii) Silviculture of the species in the nursery and plantations, (iii) Agroforestry option using bamboo, (iii) Plantations of the species either as pure or mixed, (iv) Identifications of bamboo species/introduction of exotic ones in Nigeria, and (v) Socio economic impacts of the bamboo species on the rural communities. Thirteen years down the line, the fore-listed research needs as postulated by FAO in 2010 have not be significantly unexplored in Nigeria. Worst-still, bamboo species already important contributor to national economies in China, India, Columbia; and not yet in the Sahelian Countries such as Nigeria, Democratic Republic of Congo (DRC) and Cameroon.

Meanwhile in other climes, the annual bamboo trade was estimated at a value of USD 60 billion in 2017, half of which was conducted in China (INBAR, 2019) but not in any Sahelian African countries. Again, despite the long history of bamboo availability in Africa, its contribution to national GDP is at the infant stage (Bahru and Ding, 2021).

Conclusion

Despite that FAO in 2010 emphasized the urgent need for strategic research on bamboo in Nigeria along the following listed research lines: (i)

Inventory of the species in the country, (ii) Silviculture of the species in the nursery and plantations, (iii) Agroforestry option using bamboo, (iii) Plantations of the species either as pure or mixed, (iv) Identifications of bamboo species/introduction of exotic ones in Nigeria, and (v) Socio economic impacts of the bamboo species on the rural communities; thirteen years down the line, the fore-listed research needs as postulated by FAO have not be significantly unexplored in Nigeria. Worst-still, bamboo species already important contributor to national economies in China, India, Columbia; and not yet in the Sahelian Countries such as Nigeria, Democratic Republic of Congo (DRC) and Cameroon.

Meanwhile, bamboo plantations have the potential to become a promising solution to climate change, increase forest biodiversity, and supplement the requirements for timber, paper and bioenergy. Bamboo by virtue of being fast growing and permitting annual harvests, also has the potential to supply high yields of fibre and bamboo shoot for food in a relatively small area. Bamboos provide ecosystem services like carbon sequestration, erosion control, including support rural development and livelihoods enhancement. The market for bamboo value chain looks set to grow as rapidly as the plant itself. By this assertion, any bamboo enterprise could be the primary source of subsistence livelihoods and the source of economic upliftment for both the poor and underprivileged people.

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