



REVIEW ARTICLE

Bamboo in green economy: Social and ecological perspectives from Nigeria and the Democratic Republic of Congo

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Abstract

Poaceae would literally mean that 'all bamboos are grasses, but not all grasses are bamboos'. Thus, *Bambusoideae* (bamboo) – is a subfamily within the large grass family *Poaceae* - possessing a wide range of values and uses. However, global bamboo research is heavily skewed towards Asia (91%), leaving Africa (7%) and South America (1%) under-reported, with literature asserting this imbalance. This paper presents a case study of Nigeria and the Democratic Republic of Congo, examining the social and ecological perspectives on bamboo resource towards the attainment of green economy. The United Nations Environment Programme defines a 'green economy' as one where growth in employment and income is driven by investments that reduce carbon emissions, enhance efficiency, and prevent tropical biodiversity loss. Methodologically, a historical analysis of bamboo resource utilization was undertaken through literature searches in academic and institutional databases (English/French alike). Bibliometric analysis was not applied in this study; however, a qualitative synthesis of the literature was used to present the findings. The findings of this research indicate that bamboo's rapid regrowth and adaptability drive climate change mitigation, ecosystem restoration, and contribute to a green economy with ecological and social benefits. In conclusion, this paper emphasizes bamboo-related technical and vocational education and training (TVET) to build a skilled workforce for the bamboo value chain, driving industrial growth and promoting eco-friendly practices. This article is useful for policymakers, manufacturers, and researchers seeking to harness bamboo's potential in driving green economies in Nigeria and D.R. Congo.

Keywords: Bambusoideae, Climate change mitigation, Democratic Republic of Congo, Ecological infrastructure, green economy, Nigeria, Poaceae, Social bamboo forestry, TVET

1. Introduction

Across the African continent, the urgency to transition toward sustainable economic systems is intensifying in response to escalating environmental degradation, demographic pressures, widespread poverty, and escalating youth unemployment. The compounded nature of these challenges has catalyzed a rethinking of development models that align ecological stewardship with economic and social progress. Nowadays, a green economy paradigm is widely adopted as a viable pathway to achieving sustainable development. This review article therefore, focuses on a case study evaluation of the historical evolution of bamboo resource utilization and institutionalization in Nigeria and the Democratic Republic of Congo towards achieving a sustainable bamboo-driven green economy. The United Nations Environment Programme (UNEP) defines a 'green economy' as one where growth in employment and income is driven by investments that reduce carbon emissions, enhance environmental resource efficiency, and prevent tropical biodiversity loss (UNEP, 2025).

Consequently, *Bambusoideae* (bamboo) – a subfamily within the large grass family *Poaceae* – is gaining recognition as a key driver in the shift to a greener economy (Ahmad *et al.*, 2025). The Asian Development Bank (ADB, 2025) emphasizes the need for developing countries to harness bamboo's financial potential through FinTech. FinTech, a combination of the words “financial” and “technology”, is defined by Michigan Technological University (2025) as a technology that is used to provide a financial product or service to financial markets. The Central Bank of Ireland (2025) further describes FinTech as the use of technology to deliver financial services and products to consumers. This technology can be applied in areas of banking, insurance, investing – anything that relates to financial services. Therefore, both planted and natural bamboo forests can function as a secure, bankable, and tradable asset as part of the FinTech ecosystem.

According to ADB (2025), bamboo forestry has the potential to revolutionise finance, housing, and sustainability in developing countries in five key ways, *viz.*: (i) bamboo can be harnessed as a secure, bankable asset through the use of FinTech, incorporating geocoding, geospatial data, and Artificial Intelligence (AI) for valuation and forecasting; (ii) the rapid growth and carbon capture capabilities of bamboo timber make it an ideal material for affordable, sustainable housing, promoting green building practices and reducing deforestation; (iii) bamboo plays a crucial role in mitigating climate change by capturing and storing carbon dioxide (CO₂), and can serve as a substitute for emissions-intensive materials like steel and concrete; (iv) engaging communities in bamboo cultivation can promote social inclusion, gender equality, and economic growth, with potential for high-value products; lastly, (v) integrating bamboo with technologies like AI and geospatial data can create inclusive financial ecosystems, supporting sustainable development and resilience; particularly in regions like Africa.

A comprehensive literature review by Bahru and Ding (2021) reveals that the African continent is home to 115 bamboo species, distributed across 48 countries out of the 55 countries as defined by the OAU (Organisation of African Unity) in 1976 (CM/Res.464QCXVI) (African Union Commission, 2025). The aforementioned number of bamboo species in Africa represents 7.3% of global bamboo species and covers 82.8% of the African region, stretching from Nigeria in the west to Rwanda in the east, and from the Sahrawi Republic in the north to Zambia in the south. This range also includes the Democratic Republic of Congo that is situated within the Congo Basin rainforest in Central Africa – home to the world's second-largest tropical rainforest after Latin America's Amazon (Ogbodo, 2013).

Specially, *Oxytenanthera abyssinica* is the most widely distributed indigenous bamboo species, found in 38 countries, followed by *Olyra latifolia* in 30 countries, *Oldeania alpina* in 13 countries, and *Oreobambos buchwaldii* in 10 countries (Bahru and Ding, 2021). Among introduced species, *Bambusa vulgaris* is the most widespread, present in 20 countries, followed by *Dendrocalamus giganteus* in 10 countries. The extensive distribution of bamboo species across Africa underscores the continent's significant bamboo resources, warranting further exploration of their potential for sustainable development.

In the case of Nigeria and the Democratic Republic of Congo, a total of six (6) bamboo species (both indigenous and introduced) out of the seven (7) accounted for by Bahru and Ding (2021) are adopted in this present study. According to Bahru and Ding (2021) the D.R. Congo is home to the following indigenous bamboo species: *Oldeania alpina* (K. Schum.), *Olyra latifolia* L., *Oreobambos buchwaldii* (K. Schum.), and *Oxytenanthera abyssinica* (A. Rich) Munro, including the introduced species such as *Bambusa vulgaris* (Schrader ex J.C. Wendl) and *Dendrocalamus asper* (Schult. and Schult.f.) Backer. In the case of Nigeria, Bahru and Ding (2021) listed 14 bamboo species (both indigenous and introduced) for the country. The indigenous bamboo species for Nigeria are: *Guaduella densiflora* Pilg, *O. latifolia*, and *O. abyssinica*, while introduced species comprise *B. vulgaris*, *Brachystachyum stellatus*, *Dendrocalamus giganteus* Munro, *Dendrocalamus sinicus* L.C. Chia and J.L. Sun, *Fargesia robusta* T.P. Yi, *Gelidocalamus stellatus* T.H. Wen, *Phyllostachys edulis* (Carrière) J. Houz, *Pleioblastus fortunei* f. *kiakebono* Muroi and H. Okamura, *Shibataea chinensis* Nakai, and *Yushania baishanzuensis* Z.P. Wang & G.H. Ye.

However, not all species identified by Bahru and Ding (2021) are globally prioritised for their economic importance. In 2022, the International Bamboo and Rattan Organisation (INBAR) published a list of thirteen bamboo species deemed economically significant to Africa, specifically: *Bambusa balcooa*, *Bambusa multiplex*, *Bambusa vulgaris*, *Dendrocalamus asper*, *Dendrocalamus giganteus*, *Dendrocalamus hamiltonii*, *Dendrocalamus membranaceus*, *Dendrocalamus strictus*, *Guadua angustifolia*, *Oldeania alpina*, *Oxytenanthera abyssinica*, *Phyllostachys aurea*, and *Phyllostachys edulis* (INBAR, 2022). Based on the documentation by Bahru and Ding (2021), a comparative analysis reveals that four species (30.8% of INBAR's list), namely *Oldeania alpina*, *Oxytenanthera abyssinica*, *Bambusa vulgaris*, and *Dendrocalamus asper*, are of economic relevance to the D.R. Congo. Similarly, four species (30.8% of INBAR's list), namely *O. abyssinica*, *B. vulgaris*, *Dendrocalamus giganteus*, and *Phyllostachys edulis* are of economic value to Nigeria. Two species, *O. abyssinica* and *B. vulgaris*, are common to both the D.R. Congo and Nigeria.

In Nigeria, FAO (2003) confirms the availability of only two bamboo varieties: *Bambusa vulgaris* and *Oxytenanthera abyssinica*, which grow naturally in the forests, especially along the banks of River Niger, River Benue and their tributaries. Bamboo plants also help to stabilize river banks and protect freshwater river sources. Likewise, bamboos have for long been recognized as an economically important raw material in Nigeria which is used in the building industry for scaffolding and for yam staking by smallholder farmers. Regrettably, however, in 2003, the Food and Agriculture Organization of the United Nations 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, (iv) Plantations of the species either as pure or mixed, (v) Identification of bamboo species/introduction of exotic ones in Nigeria, and (vi) Socio-economic impacts of the bamboo species on the rural communities (FAO, 2003). Twenty-three years (23) down the line (i.e., 2003 to 2026), the aforementioned research needs as prescribed by FAO are yet to be significantly explored.

Bahru and Ding (2021) asserts that, the eastern region of the D.R. Congo, particularly North Kivu, South Kivu, Ituri, and Maniema, are naturally endowed with dense bamboo forests. However, Ndavaro *et al.*, (2023) reports the abundance of highland bamboo (*Oldeania alpina*) in villages such as Luotu, Magheria, and Masereka which are situated within the Lubero cool highlands of the D.R. Congo. Traditionally in the D.R. Congo, local populations do rely on bamboos for household needs such as fencing, housing frames, fish traps, and slope stabilization on farmland (Iragi, 2018). In remote and agrarian communities, the bamboo resource served primarily as a versatile material for domestic and agricultural applications. Its lightweight structure and availability made it ideal for constructing fences, rooftops, fish traps, and simple tools. However, nowadays, the bamboo forest cover faces increasing rate of depletion (Iragi, 2018).

Despite strong evidence supporting bamboo's potential for green economy due to its rapid regrowth and adaptability, existing research is geographically skewed. According to Pan *et al.* (2023), Africa accounts for only

7% of global studies on bamboo's potential in climate change mitigation. Whereas, Asia (particularly China and India) dominates with 91% of studies; and the South America contributes a mere 1%. This disparity is further highlighted by Li *et al.* (2025), whose 25-year review of bamboo ecosystem services publications reveals China's significant lead, with 22 publications, likely driven by Asia's 80% share of global bamboo forests (Lobovikov *et al.*, 2012). China's research output in this area has grown rapidly (Jiang, 2017; Zhang *et al.*, 2024). Crucially, research on applying bamboo's climate mitigation potential in Nigeria and the D.R. Congo is scarce, despite that these two countries have abundant bamboo resource and are also dire need for nature-based solutions to social and environmental problems. The afore-mentioned knowledge gap is further worsened by limited research, lack of political will from government, and absence of both federal and subnational policy supports for the promotion of bamboo commodity as a viable national value chain resource in both Nigeria and the Democratic Republic of Congo.

To this end, this paper situates bamboo at the confluence of environmental restoration, socio-economic inclusion, and sustainable industrialization. The research attempts to contribute actionable knowledge that supports green economies by analyzing the conditions under which bamboo value chain can be institutionalized and scaled up. Therefore, the overall aim of this review article is to examine the social and ecological perspectives of bamboo towards contributing to the attainment of green economy in Nigeria (West Africa) and in the Democratic Republic of Congo (Central Africa).

2. Methodology

The methodology involved analysing social and ecological perspectives on bamboo resource through literature searches in academic databases including MDPI (Multidisciplinary Digital Publishing Institute) via (<https://www.mdpi.com/>), ScienceDirect (<https://www.sciencedirect.com/>), Scopus (<https://www.scopus.com/home.uri>), Springer Nature Link (<https://link.springer.com/>), and Google Scholar (<https://scholar.google.com/>). Additionally, institutional websites such as the United Nations Environment Programme (<https://www.unep.org/publications-data>), Food and Agriculture Organisation (<https://www.fao.org/publications/en>), INBAR – International Bamboo and Rattan Organization (<https://www.inbar.int/>), D.R. Congolese's Ministry of Environment and Sustainable Development (<https://medd.gouv.cd/dgfor/>), and other organisational websites focusing on bamboos in Nigeria were also searched.

Keywords used in the literature search included "bamboo AND Nigeria AND D.R. Congo", bamboo value chain AND sociocultural opportunities AND (Nigeria OR D.R. Congo)". This study was limited to peer reviewed articles published only in English and French languages. Both research articles and grey literature, including conference papers, reviews, editorials, and letters, that were available prior to 30 December 2025 were included in this analysis.

Bibliometric statistical analysis methods (Zhang *et al.*, 2024) were not applied in this review paper as the focus was on qualitatively synthesising existing literature on bamboo resource utilisation and institutionalisation in Nigeria and the Democratic Republic of Congo, rather than quantitatively analysing publication trends or citation patterns. At this juncture, it is important to clarify that Bahru and Ding (2021) listed seven species for the D.R. Congo; however, one species was excluded from this study due to uncertainty regarding its classification as a bamboo species.

3. Research Findings and Discussion

In African countries such as Nigeria and the Democratic Republic of Congo, bamboo has begun to transcend its traditional role as a subsistence material used in fencing, household tools, and rural construction. It is now increasingly recognised as a strategic commodity with commercial, environmental, and development value. Both countries benefit from ecological conditions favourable to bamboo cultivation. To facilitate understanding, this

section is structured around three key themes: social perspectives, ecological perspectives, and bamboo-based technical and vocational education and training (TVET): implications for Nigeria and D.R. Congo.

3.1. Social perspectives

Bamboo is referred to as the *gift of God to mankind* by Choudhary *et al.*, (2025). Across the world, particularly in Asia, bamboo is deeply intertwined with culture and spirituality, revered not only as a vital material resource. However, bamboo is also as a powerful symbol of virtues like resilience, integrity, and harmony with nature (World Bamboo Organisation, 2024). This subsection on '*Social Perspectives*' explores the early practical and spiritual applications and assesses the informal adoption of bamboo in traditional cultural institutions in Nigeria and the D.R. Congo. Details are discussed hereunder (3.1.1. and 3.1.2).

3.1.1. Practical and spiritual applications of bamboos (Case study of Nigeria)

The growing recognition of bamboo's potential has led to increased social acceptance in Nigeria. Among certain Nigerian ethnic groups, bamboo holds deep cultural significance, symbolizing resilience and adaptability. As bamboos grow in the wild in many north central and southern parts of Nigeria, it has become a socially acceptable natural resource, particularly among the Igbo people of southeastern Nigeria. The Igbo people refer to bamboo as '*Achalla*' (Nnolim, 2007; Nkama *et al.*, 2022) or '*Achara*' (Onuorah and Obiadi, 2023), depending on the dialect - '*Achalla*' is used by the Awka people of Anambra state, while '*Achara*' is used by the Ngwa people of Abia state. In other Igbo dialects, bamboo is also known as '*otosi*' (Emusa, 2024).

Accordingly, the cultural relevance of bamboo in Igbo land can never be overemphasized. The first instance is that, before the colonial age, there were no concrete bridges across rivers and streams in Igbo land, except pedestrian bamboo bridges. The bamboo bridges in Nigeria are typically temporary, community-built structures used out of necessity in rural areas where formal infrastructure is lacking, connecting communities cut off by floods or poor roads. A famous example is the community bamboo bridge at *Akadoro*, in *Alubeleke* community of Ezza North Local Government Area of Ebonyi State, South East, Nigeria (**Figure 1**). The *Akadoro* bamboo bridge links six other rural communities, including *Ekeimoha*, *Egu-Ogborega*, *Azu-Nramura* in *Umuezokaoha* up to *Alubeleke*, which shares a boundary with *Orokonu* community where the popular *Afor-Izzo* market is situated.



Figure 1: Example of a Pedestrian Bamboo Bridge in a typical Igbo indigenous community
Photo credit: <https://media-cdn.tripadvisor.com/media/photo-s/05/b5/d2/e5/bamboo-bridge.jpg>

The second example relates to an Igbo native soup known as *Ofe Achara*. In the South East, *Achara* is generally known as a special type of *Ofe* (soup) that incorporates *Achara*, a tender and edible bamboo shoot and/or elephant grass (*Pennisetum purpureum*) shoots (Ounje, n.d.; Business Day Newspaper, 2025). According to Onwubiko *et al.*, (2025), *Pennisetum purpureum* is a tall perennial grass with bamboo-like stems of about 4 – 7 metres and 2 – 5 centimetres in diameter. The aforementioned distinction regarding suitable ingredients from the grass family

for *Ofe Achara* supports the philosophy posited in this paper as thus: *Poaceae* implies that, 'not all grasses are bamboos, but all bamboos are grasses', and that, these grasses hold a wide range of values and uses. In a nutshell, *Ofe Achara* is a traditional Nigerian delicacy originating from the Igbo people of Southeastern Nigeria. It is a delicious soup common in Abia, Ebonyi, and Imo States, now enjoyed across Nigeria, Africa, and globally (Onwubiko *et al.*, 2025).

The third example concerns the Igbo naming tradition – *Achalugo*. *Achalugo* is a traditional Igbo feminine given name from southeastern Nigeria that carries deep spiritual and cultural significance within the Igbo naming tradition. The name is composed of two Igbo elements: 'Achalla' means as tall, and evergreen (reproductive) as bamboo' and 'Ugo' meaning Eagle (Names.org, 2024). Therefore, *Achalugo* is a term of endearment, meaning "the pride/beauty of the eagle," used for a woman of exceptional beauty, tallness, fertile and vibrant, royalty, strength, and grace, symbolizing prestige and signifying a partner held in high esteemed, like a queen.

The fourth example highlights the role of Nigerian native bamboos in Complementary and Alternative Medicine. In Nigerian folklore medicine, bamboo is utilised as an emmenagogue (herbs or oils that stimulate or increase menstrual flow), abortifacient (a herb capable of blocking progesterone production), an appetiser (that can make one to eat well), and for managing respiratory diseases (so that a person can breathe naturally well) and gonorrhea (a sexually transmitted infection causing health issues in the genitals, rectum, and throat). Yakubu and Bukoye (2009) supported this assertion, stating that there is no scientific evidence in the literature to substantiate or refute the claim that Nigerian folklore medicine uses *Bambusa vulgaris* leaves as an abortifacient. Similarly, Yakubu *et al.* (2009), in a study conducted at the Department of Biochemistry, University of Ilorin, Southwest Nigeria, found that although *B. vulgaris* shoots are chewed by humans and animals without reported toxic effects, it is possible that saliva is not swallowed or the amount swallowed is insufficient to accumulate toxicologically significant levels in the human body.

The fifth instance pertains to community naming, which draws upon the natural environment and resources, such as bamboo, with significant cultural and economic implications. Nnolim (2007) in 'The History of *Umuchu*', presents a historical account of how some Igbo communities are named after forest species. Take Achalla community in Anambra State, for example, believed to have been named after the bamboo plant (Achalla in Igbo), significant in the area where original settlers built their encampments. This assertion by Nnolim (2007) is further substantiated by the recent findings of Ifeakor and Ndubisi (2023). According to Ifeakor and Ndubisi (2023), many Igbo settlements were named after plants and trees, such as *achara* (bamboo), *ahiara* (giant leaf grass) and *uga* (*Anacystrophyllum opacum*). *Anacystrophyllum opacum*, currently named as *Laccosperma opacum* (Mann & Wendl.) *Drude*, is a spiny rattan palm (https://plants.jstor.org/stable/10.5555/al.ap.upwta.4_606) that symbolises strength, spiritual power, and ancestral connections in Igbo culture, mirroring the ethnobotanical significance of bamboos in the region. These settlements often originated at the base of large trees or with these plants as the dominant vegetation cover within their surroundings. Also, literature assert that in Igbo tradition, it is a deeply significant cultural practice to bury a newborn's umbilical cord (or placenta) at the foot of an economic tree or plant. Such a cultural ritual symbolizes the child's lifelong connection to their ancestral land and forming a bond between the child and the mother, Earth (Ifeakor and Ndubisi, 2023; Ahamefule, 2018). Such beliefs are amongst the various cultural practices of the Igbo people of eastern Nigeria that were, and continue to be, instrumental in preserving the ecosystem from indiscriminate human activities in traditional society (Nkama *et al.*, 2022).

The sixth example pertains to housing in Nigeria. Traditional architecture in Nigeria reflects cultural identity and historical heritage, exhibiting distinct regional variations between the Northern and Southern regions (Emusa, 2024). Nigerian traditional communities constructed their dwellings to meet social, cultural, and religious needs, utilising building materials such as mud, wood, stone, thatch, grass, and other locally sourced vegetation based

materials (Orumu and Yabefa, 2018). In both southern and northern Nigeria, bamboo (particularly *Bambusa vulgaris*) serves vital ethnobotanical roles in construction, including scaffolding, roofing, and fencing. Bamboo skeleton bases (**Figure 2**) are employed in building native mud houses prior to plastering, and as roof frames for thatched houses in Igede and Tiv communities of Benue State, north central Nigeria.



Figure 2: Bamboo split used as a skeleton wall prior to mud plastering

According to the World Culture Encyclopedia (2008), the Ijaw ethnic group in Nigeria's Niger Delta typically construct houses on stilts over creeks and swamps, utilising bamboo and raffia palm fronds for roofing. Such bamboo structures are designed to be airy, allowing heat and smoke from cooking fires to escape easily. In contrast, Igbo houses tend to comprise a bamboo frame held together with vines and mud (World Culture Encyclopedia, 2008). The growing concern about climate change inspired a Nigerian horticulturist to construct a storey building using raw bamboo culms in Kaduna State, North West Nigeria (African Climate Reporters, 2020). Similarly, the traditional Tiv hut house, also known as a thatch house, is symbolic of Tiv culture and tradition, with a history as old as the Tiv people. The construction involves a superstructure and roof, with locally sourced materials such as mud bricks and sand, and a thatched roof built on a spiral frame using bamboo sticks.

The preceding examples underscore the potential of traditional buildings, such as mud houses constructed with bamboo, to inform sustainable design principles and reduce energy consumption, leveraging local resources and natural ventilation towards achieving comfortable indoor temperatures without relying on electro-mechanical equipment (Okafor *et al.*, 2022). Notably, bamboo can serve as a sustainable, strong, lightweight, and cost-effective alternative to steel or iron in construction, particularly for non-load-bearing or lightweight structures (van Duc *et al.*, 2025). In Nigeria, bamboo has been utilised in constructing market stalls, classroom blocks, and church halls, with faith-based and community-led initiatives combining bamboo with local materials to create environmentally adaptive and culturally resonant buildings (Okokpujie *et al.*, 2020; UNIDO, 2018). Such infrastructure aligns with Africa's evolving green building codes and sustainable urban development frameworks, and bamboo presents a scalable material for climate-resilient projects eligible for climate finance schemes and donor-backed housing programs.

3.1.2. Practical and spiritual applications of bamboos (Case study of D.R. Congo)

Throughout the mid-20th century, bamboo use in the D.R. Congo was rooted in practicality and cultural tradition, with symbolic and spiritual significance evident in its incorporation into church architecture and religious spaces, such as in Kikwit. The blending of ecological awareness and sacred design was reflected in the use of locally available materials in places of worship. Despite this, bamboo remained largely absent from state planning, development policies, and commercial enterprises, existing mainly within informal and subsistence contexts.

The early 21st century marked a period of growing institutional interest in bamboo, with the establishment of the Congolese Bamboo Organization (CBO) in *circa* 2017. The CBO aims to enhance local capacities through nursery creation, public education campaigns, and technical training. The D.R. Congo's decision to join INBAR further formalized its engagement, aligning national ambitions with international green development goals.

Bamboo is increasingly being incorporated into urban and semi-urban architectural innovation, particularly in low-cost housing models, due to its affordability, renewability, and design versatility. Its material properties, including tensile strength, flexibility, and lightness, make it a compelling alternative to conventional construction materials (Abdulsamad and Olufunmilola, 2025). In eastern D.R. Congo, local communities have constructed bamboo-based structures, such as learning centers, youth halls, and cattle cages, reducing reliance on costly imports and generating employment for local artisans and labourers (World Bank Group, 2025). These trends indicate a gradual shift away from bamboo's traditional uses toward its integration into climate-resilient infrastructure and sustainable design.

3.2. Ecological Perspectives

One of the most compelling contributions of bamboo lies in its role in ecosystem restoration and climate mitigation. Bamboo species are known to sequester considerable amounts of carbon, up to 12 tons of CO₂ per hectare annually, depending on the species and local growing conditions (FAO, 2020)—this positions bamboo as a valuable asset in nature-based solutions for climate adaptation and emission reduction initiatives. In October 2025, the Bamboo-based Restoration Initiative, led by the International Bamboo and Rattan Organization (INBAR), was recognized as one of the UN World Restoration Flagships under the United Nations (UN) Decade on Ecosystem Restoration. Its robust root systems stabilize soil, making it effective in halting erosion and restoring degraded landscapes. Reason being that, bamboo-based restoration supports poverty reduction, creating livelihoods, carbon storage, land degradation and biodiversity loss (UN Decade on Restoration, 2025). UNFCCC also states that, bamboo fosters protective habitat cover, stabilises soil, and enriches soil nutrients—beneficial for ecosystem biodiversity, especially in restoration sites. A comprehensive scientific review by Ndavaro, *et al.*, (2022) documented on Bamboos (*Bambusiadeae*) as plant resources with ecological values that support socio-economic and cultural virtues. Within this ecological context, a brief discussion is presented hereunder (3.2.1. and 3.2.2).

3.2.1. Local actions for bamboo conservation and ecological restoration in Nigeria

The numerous efforts made by environmental experts and international organisations to address ecological crises over the past two decades underscore the need for alternative perspectives on environmental issues. Local actions with global goals are encapsulated in Agenda 2030, which calls on countries to promote prosperity and social well-being while protecting the planet. In Nigeria, Reverend Father Professor Ikechukwu Anthony Kanu's chapter, "Sacred Trees/Plants: The Greening of Igbo-African Religion," in the book (Kanu, 2021), highlights the significance of indigenous ecological knowledge systems. Although bamboo is not explicitly mentioned as a sacred plant in Igbo land in Kanu, (2021), Eziabor village in Oko community of Orumba North Local Government, Anambra State utilises bamboo to address ecological issues such as erosion gullies, landslides, and river source conservation. In fact, clearing bamboo stands in ecologically threatened sites is considered a cultural taboo in Oko Community. Similarly, the Iga of Ebenebe, His Royal Majesty Christopher Emeka Nnaebuna, reports that the existing approximately 20-hectare bamboo plantation was established in the 1980s through community effort to mitigate erosion in Ebenebe, Awka North LGA, Anambra State. The traditional ruler stated that logging is strictly prohibited within the bamboo plantation. The Ebenebe bamboo plantation remains protected to date, providing ecological benefits such as oxygen, timber, medicine, and wildlife habitat.

3.2.2. Bamboo for ecological restoration and livelihoods in D.R. Congo

In the D.R. Cong, bamboo has been incorporated into reforestation schemes, erosion control strategies, and post-conflict livelihood initiatives, particularly in communities impacted by displacement and insecurity. The D.R. Congo has launched the "Kivu-Kinshasa Green Corridor" for reforestation, economic development, and stabilization of conflicted regions, offering both ecological restoration and economic reintegration (Nghonda *et al.*, 2025). These interventions are slowly gaining national traction as government institutions begin to integrate bamboo into broader frameworks, such as the National Forest Plan and the National Climate Resilience Strategy (Ndavaro *et al.*, 2022).

In the Lubero cool highlands, D.R. Congo (**Figure 2**), highland bamboo (*Oldeania alpina*) is a vital resource in villages like Luotu, Magheria, and Masereka (Ndavaro *et al.*, 2023). The *O. alpina* bamboo is utilised for various purposes in the Lubero cool highlands, including fuelwood (22.5%), construction (22%), handicrafts (17%), agriculture (14.5%), traditional medicine (14%), worship (8%), and food (2%) (Ndavaro *et al.*, 2023). These ventures include bamboo-based furniture production, biomass energy derived from bamboo charcoal, eco-construction utilizing bamboo panels, and small-scale ventures in paper or textile production (Patel *et al.*, 2025). Such industries do generate employment, particularly for women and youth in rural areas, while reducing dependency on fossil fuels and imported materials UNIDO, 2018; AfDB, 2023).

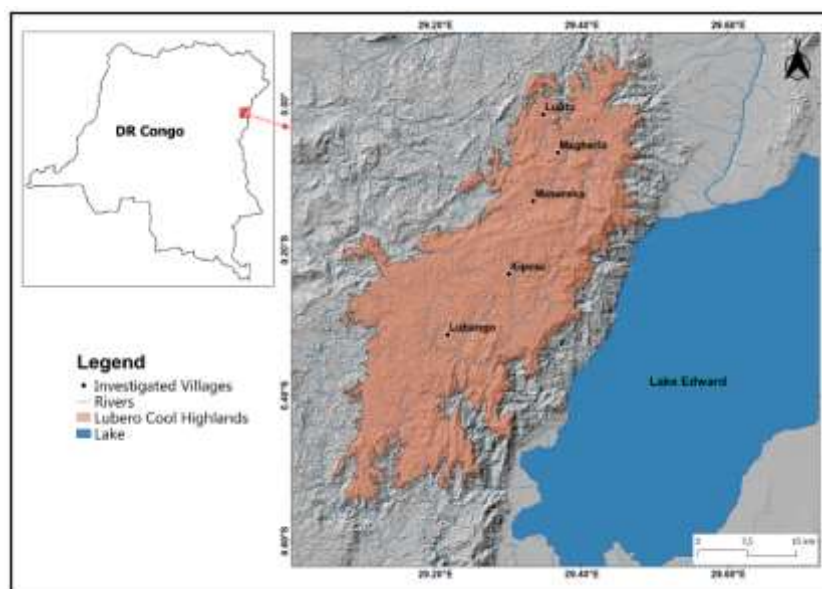


Figure 2. Map of *O. alpina* bamboo in Lubero cool highlands, D.R. Congo (Ndavaro *et al.*, 2023)

In addition, bamboo provides essential goods and services, including food, medicine, and income, while supporting microbial diversity and rainforest ecosystem balance in D.R. Congo (Kamalebo *et al.*, 2021; Doumenge, 1998). In the D.R. Congo, bamboo-based livelihood programs for ex-combatants and displaced populations have shown promise in facilitating social reintegration and economic recovery (Caritas Goma, 2022; Kambale, 2016). Expanding these models through scalable funding could link peace-building with green entrepreneurship. This is particularly relevant in post-conflict and mining-affected areas like Lubero, Walikale, and Ituri, where organizations like Caritas Goma are already using bamboo agroforestry to restore land and support livelihoods (Doumenge, 1998; Caritas Goma, 2022).

The \$300 million Forest and Savanna Restoration Investment Program (FOREST) in the D.R. Congo aims to enhance land-use planning, forested landscape management, and community livelihoods (World Bank, 2025). Building on the success of the Improved Forested Landscape Management Project (IFLMP), which promoted sustainable land management across 375,000 hectares (including 25,000 hectares of new agroforestry plantations),

FOREST can leverage bamboo resources to amplify its impact. This is because, bamboo offers key benefits like erosion control, sustainable construction, and bioenergy. These include bamboo-based furniture production, bio-mass energy derived from bamboo charcoal, eco-construction utilizing bamboo panels, and small-scale ventures in paper or textile production (Patel *et al.*, 2025). Such industries can generate employment, particularly for women and youth in rural areas, while reducing dependency on fossil fuels and imported materials (UNIDO, 2018; AfDB, 2023).

Despite its ecological and socio-economic promise, bamboo has not yet been mainstreamed into the national development apparatus in D.R. Congo. The sharp rise in deforestation in the late 20th century forced both policy actors and local populations to identify alternatives to declining hardwood stocks. As forest cover diminished, bamboo resource emerges as a viable and renewable alternative to timber for household energy and construction. In South Kivu, experimental projects began exploring the production of bamboo charcoal as an eco-friendly alternative to firewood, marking the start of a more intentional utilization model. The emergence of international environmental organizations during this time could play a pivotal role in ecosystem restoration using bamboo varieties in the rainforest zone of Africa.

3.3. Bamboo TVET: Global Insights for Nigeria and D.R. Congo

The United Nations Educational, Scientific and Cultural Organization (UNESCO) defines technical and vocational education and training (TVET) as "education and training that provides knowledge, skills, and competencies for specific occupations or groups of occupations, usually in a practical, hands-on approach (UNESCO, 2025). In line with UNESCO's definition, bamboo-related TVET aims to equip learners with practical skills for employment or entrepreneurship in the bamboo sector, promoting economic growth and sustainable practices. Therefore, in this article, bamboo-related TVET refers to technical and vocational education and training interventions focusing on skills development for bamboo cultivation, processing, and product creation, integrated across primary, secondary, and tertiary educational levels.

Green economy, green technologies, green TVET, green jobs – are ecofriendly related concepts that seem to have an important effects on a variety of political, social and ecological processes (UNESCO, 2013). In China, TVET programs have driven bamboo sector growth by producing skilled workers for bamboo industries, as seen in initiatives like the program integrating career development with socio-emotional learning for rural primary school children (Chen *et al.*, 2025). China's approach focuses on practical skills, enabling rural populations to innovate and contribute to economic growth. For instance, traditional Chinese bamboo weaving craftsmanship is being modernized through sustainable design theory, enhancing product design and market relevance (Jiang, 2025). The Chinese government, through the Ministry of Commerce and the China National Bamboo Research Center (CBRC), has developed the Training Course on Bamboo Technologies for Developing Countries. Staff from the Sahelian Institute for Bamboo Research and Entrepreneurship Development, SIBRED (<https://sibred.unizik.edu.ng/>) at Nnamdi Azikiwe University, Awka, Nigeria, participated in this training in 2024 and 2025, in cities like Hangzhou (<https://www.china-aibo.cn/en/info/1002/1459.htm>) and Beijing. These Chinese cities regularly host China-sponsored training courses, organized by CBRC and supported by the Chinese Ministry of Commerce (MOFCOM). The intensive, multi-week courses cover cultivation, processing (furniture, construction materials, fiber, charcoal, shoots), industry standards, sustainable management, and policy, featuring lectures, expert speakers, and field trips to bamboo plantations and factories. Aiming to boost bamboo's economic role in partner nations, this approach has positioned China as a global leader in TVET on bamboo production and innovation.

Similarly, India's National Bamboo Mission promotes green economy through bamboo cultivation, processing, and marketing through subsidies, training, and infrastructure development (Government of India, 2025).

India's TVET initiatives, like the Bamboo Technology Park (<https://bamboosahihai.com/place/bamboo-technology-park/>) at Chaygaon in Kamrup, provide hands-on training, enhancing skills for sustainable bamboo management (Bhattacharya *et al.*, 2021). India's approach is like a gardener, nurturing bamboo cultivation and marketing. Indian bamboo entrepreneurs are fostering rural entrepreneurship by leveraging bamboo for sustainable development and economic growth in country.

Yet, D.R. Congo and Nigeria are yet to fully harness its bamboo potential, despite having vast bamboo resources, highlighting an opportunity for TVET-driven growth in the sector, similar to approaches seen in China and India. Therefore, the experiences of China and India highlight opportunities for Nigeria and D.R. Congo to harness TVET to drive growth in the bamboo sector. According to Wang *et al.* (2021), bamboo-based TVET in China boosts farmers' incomes and promotes economic development across five key industries: food, manufacturing, eco-tourism, energy, and construction (Figure 3).

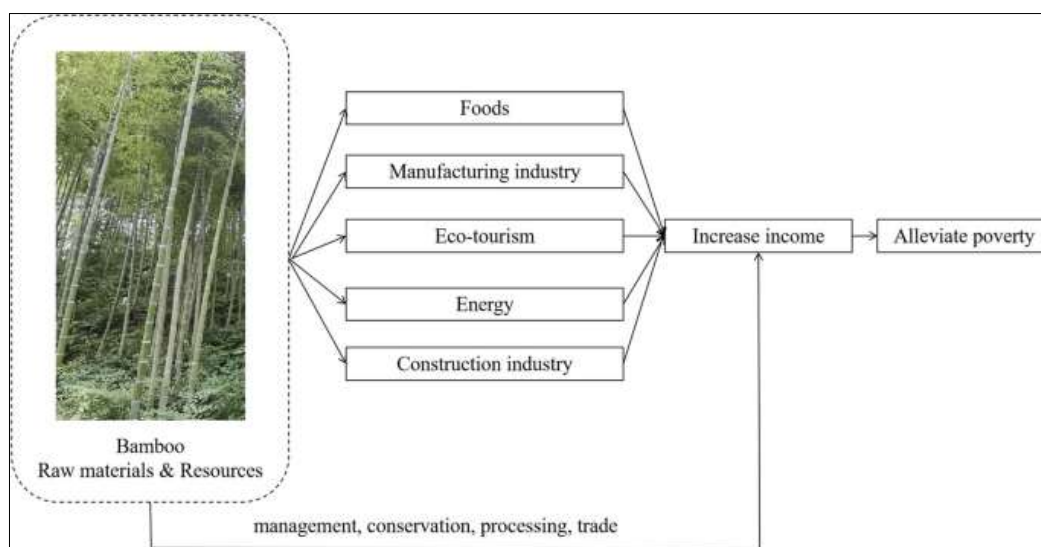


Figure 3. TVET-driven Bamboo Sectors in China (Wang *et al.*, 2021)

4. Conclusion and Recommendations

4.1. Conclusion

This study examined the social and ecological perspectives on bamboo resource in Nigeria and the Democratic Republic of Congo, towards the attainment of green economy. Bamboo presents a compelling pathway towards achieving green economies in Nigeria and the D.R. Congo, with its multifaceted applications in construction, medicine, ecology, and culture. The species' rapid growth, carbon sequestration potential, and versatility make it a valuable resource for environmental restoration, climate mitigation, and sustainable development. The experiences of China and India demonstrate the potential of bamboo-related TVET in driving growth in the sector. By investing in bamboo education and training, Nigeria and the D.R. Congo can unlock new economic opportunities, promote sustainable practices, and improve livelihoods. Overall, leveraging bamboo's potential can contribute to achieving the Sustainable Development Goals, promoting green economies, and improving the well-being of citizens in both countries. In conclusion, bamboo has evolved into a vital component of Africa's green development agenda, which is capable of addressing climate change, reduce poverty, and promote sustainable industry in D.R. Congo and Nigeria. Its ecological resilience, regenerative properties, and broad applicability make it an attractive resource for sustainable livelihoods, environmental recovery, and investment opportunities.

4.2. Recommendations

To catalyze a thriving, equitable, and sustainable bamboo economy in the DRC and Nigeria, the following four (4) salient recommendations are proffered:

Integrate bamboo into national priorities and develop industry-aligned TVET programmes: By drawing lessons from successful models in China and India, the governments of the D.R. Congo and Nigeria can harness bamboo's transformative power to drive sustainable development and green growth by developing bamboo-focused technical and vocational education and training (TVET) programmes that would aligned with industry needs, enhance partnerships with international organisations to support curriculum development and build trainers capacity, promote entrepreneurship and innovation within bamboo value chains, and address gaps in TVET provision towards unlocking the potential of bamboo and foster sustainable development.

Establish bamboo-based economic clusters and innovation zones: Governments should create designated bamboo clusters with infrastructure and support services, setting up Bamboo Innovation Hubs in high-yield regions, in D.R. Congo and Nigeria, offering fiscal incentives for investors, and developing cluster ecosystems to boost productivity and competitiveness.

Scale public-private partnerships for investment and knowledge transfer: Strong public-private partnerships are crucial for mobilizing private capital and expertise, involving collaborations between forestry agencies, research institutions, and private sector actors to co-create bamboo technologies and business models, with governments offering matched grants and hosting investment summits to showcase viable bamboo markets and reduce investor risk.

Integrate bamboo into national climate finance and market architectures: Bamboo should be formally recognised as a climate-resilient asset, featuring in national submissions to climate funds like the Green Climate Fund and Global Environment Facility, with national carbon accounting guidelines and robust monitoring, reporting and verification (MRV) framework in order to earn carbon credits on bamboo forestry ventures. Also, every bamboo venture should prioritise social equity, providing support to community cooperatives, women-led enterprises, and vulnerable groups, while integrating bamboo livelihoods into recovery programs and promoting eco-certification to improve incomes and access global markets.

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