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# Bamboo Policy Integration Analysis

Ghana

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#### **International Bamboo and Rattan Organisation**

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# **List of Abbreviations**

| 1D1F    | One District One Factory                                     |
|---------|--|
| AGOA    | African Growth and Opportunity Act                           |
| BARADEP | Bamboo and Rattan Development Programme                      |
| CPESD   | Coordinated Programme of Economic and Social Development     |
| CSIR    | Council for Scientific and Industrial Research               |
| CSOs    | Civil Society Organizations                                  |
| ECOWAS  | Economic Commission of West African States                   |
| ETLS    | ECOWAS Trade Liberalization Scheme                           |
| EU      | European Union   |
| FC      | Forestry Commission  |
| FORIG   | Forestry Research Institute of Ghana                         |
| FWP     | Forest and Wildlife Policy                                   |
| GDP     | Gross Domestic Product                                       |
| GHC     | Ghana Cedi   |
| IFAD    | International Fund for Agricultural Development              |
| INBAR   | International Network for Bamboo and Rattan                  |
| LNDP    | Long-term National Development Plan                          |
| MEST    | Ministry of Environment, Science and Technology              |
| MLNR    | Ministry of Lands and Natural Resources                      |
| MMDAs   | Metropolitan, Municipal and District Assemblies              |
| MWh     | Megawatts per hour   |
| NBSAP   | National Biodiversity Strategy and Action Plan               |
| NDPC    | National Development Planning Commission                     |
| NTFP    | Non-Timber Forest Product                                    |
| PNDC    | Provisional National Defence Council                         |
| REDD    | Reducing Emissions from Deforestation and Forest Degradation |
| RMSC    | Resource Management Support Centre                           |
| SDGs    | Sustainable Development Goals                                |
| SMEs    | Small and Medium Enterprises                                 |
|         |  |

| IOR I erms of Reference |
|-------------------------|
|-------------------------|

- U.S United States
- U.S.A United States of America
- UNCCD United Nations Convention to Combat Desertification
- UNFCCC United Nations Framework Convention on Climate Change
- USD United States Dollar
- VRA Volta River Authority



### **Executive Summary**

Bamboo as a resource has received little attention from both the private and public sectors of the Ghanaian economy. This neglect is largely due to bamboo's classification as a non-timber forest product (NTFP) and a general lack of knowledge of the full potential of bamboo as a substitute for wood. However, in view of the current depletion rate of Ghana's timber resources and the increasing demand for wood products in Ghana, it has become necessary to develop alternative forest resources to complement the timber industry and thus satisfy demand. Bamboo comes in handy for this purpose; however, a nascent bottleneck that must be overcome in order for bamboo to match timber is to integrate bamboo as a resource into national development of plans, policies and strategies. This study reviewed and analysed relevant complementary policies in different thematic areas that cut across various sectors of the economy. This was done to ensure that bamboo policies and programmes are fully connected to national sustainable development plans. such as those captured in the United Nations Sustainable Development Goals (SDGs) and the Long-term National Development Plan of Ghana 2018–2057 (LNDP 2018–2057). The study also assessed investment and market opportunities, as well as incentives available for encouraging the development of bamboo in Ghana. Again, the study mapped key stakeholders and outlined their roles and responsibilities in developing the bamboo sector. Methods of data collection included desk study, consultations and key informant interviews with experts and key stakeholders.

There are various complementary policies and programmes in different sectors of the Ghanaian economy that influence the development of the bamboo sector. These policies were made without any direct objectives to develop bamboo; however, the means of achieving them could easily be found through developing bamboo as a resource. This review illustrates that different public institutions need to collaborate to incorporate bamboo into their developmental policies in order to stimulate Ghana's economic development and enhance social wellbeing. However, lack of coordination between government institutions and misalignment of policies in different sectors of the economy are barriers to achieving such an all-encompassing national development policy. The private sector has not taken advantage of investment and marketing opportunities in the bamboo sector because the purpose of the resource has not yet been defined. Additionally, a conducive business environment for the bamboo sector has not been provided by the state since

all efforts made to develop forest resources have always been directed towards the timber industry. The government has to incentivise the bamboo sector to make it attractive to the private sector for investment. Existing opportunities in the sector include increased demand for bamboo products both locally and internationally, the availability of raw materials and labour in Ghanaian villages, and an increasing need to find a substitute for timber to combat deforestation.

Though a political will to develop the bamboo sector exists, governments need to take pragmatic steps to achieve success. Some pathways towards integrating bamboo policy into national development include the sensitisation of relevant political authorities to fully appreciate the potential and advantages of using bamboo over timber in Ghana and the effective coordination of relevant public institutions (e.g. ministries) by establishing "bamboo desks" in each institution to take care of affairs related to the development of bamboo in the country.

There are several possible entry points for bamboo in Ghana's national development policies and programmes. The first is government support for youth in bamboo-endowed districts to create bamboo businesses in the micro, small, and medium-sized enterprises (MSMEs) category. This could be done through the Ministry of Business Development, as it aligns with their mandate to initiate, formulate, monitor and evaluate national policies and programmes aimed at improving the entrepreneurial and technical skills of MSMEs, particularly among youth, in accordance with the government's economic and social development agenda. The second entry point is targeting bamboo MSMEs under the One District, One Factory (1D1F) initiative. The third is giving legal backing to forestry sector policies that advocate for the development of NTFPs (e.g. Policy Objective 3 of the 2012 Forest and Wildlife Policy [FWP] and its strategies). This could make it compulsory for such policies to be implemented religiously. The fourth entry point is the government prioritising the purchase of bamboo products to create a market for and awareness of it. The fifth is the promotion of bamboo charcoal production to reduce the exploitation of forests for wood fuels. This could create jobs for people who would raise bamboo plantations to produce and export charcoal for the local market. The sixth is using bamboo in climate change mitigation activities. The establishment of bamboo plantations and the subsequent shift from wood to bamboo would spare more trees in the natural forest, allowing them to continue to lock and sequester carbon. The last entry point for bamboo in Ghana is the creation of awareness of and advocacy for incorporating bamboo in the agriculture sector as a cash and food crop.

### **1. Introduction**

Bamboo is one of the best-yielding renewable natural resources in the world, having over 1,500 documented applications (Syeda and Kumar, 2014; Nath, Silesh and Das, forthcoming). In its lifetime, a single bamboo clump/stand can produce culms of 15 kilometres in length (Syeda and Kumar, 2014). Eight species of bamboo are currently known to grow in Ghana; these are *Bambusa arundinacea, Bambusa bambus, Bambusa multiplex, Bambusa pervariabilis, Bambusa vulgaris, Bambusa varvitata, Dendrocalamus strictus* and *Oxynanteria abbyssinica* (Akoto et al., 2017) Obiri and Oteng-Amoako, 2007). Only *Oxynanteria abbyssinica* and *Bambusa vulgaris* are indigenous to Ghana; the others were introduced into the country from Asia (Akoto et al, 2017) *xynanteria abbyssinica* has small culms and occurs in the savanna belt in northern Ghana, often in relic stands composed of small clumps. The other indigenous species (*Bambusavulgaris*) and the imported ones thrive in southern Ghana (Obiri and Oteng-Amoako, 2007). Bamboo constitutes about 5% of forest vegetation in Ghana and covers an estimated area of 300,000 ha (Tekpetey, 2011; Obiri and Oteng-Amoako, 2007).

Given the geographical distribution and multi-purpose nature of bamboo as a resource, it has the potential to significantly improve Ghana's economy through poverty reduction, job creation and easing the country's housing problem. The availability of bamboo in rural communities (where most of the country's poor live) its products' diversity and ease of use make it a versatile resource for employment creation and, as a result, poverty reduction. The qualities of bamboo qualify it to be integrated into most sectors of the Ghanaian economy, including agriculture, forestry, energy, construction, tourism and housing (Akoto et al, 2017).

Ghana's economy is currently driven by mining, petroleum and services provided by information and communication technology (World Bank, 2018). It appears that the recent growth trajectory of the economy may not facilitate the achievement of the first goal of LNDP2018–2057, which is to "build an industrialized, inclusive and resilient economy" (National Development Planning Commission [NDPC], 2017). This may be because the industrial and services sectors present few employment opportunities for the vast majority of rural Ghanaians who have little or no formal education and employable skills. The industrial sector led the expansion of the economy from 4.3%



in 2016 to 9.3% in 2017, with a significant contribution from mining and petroleum that recorded their highest growth of 16.6% (World Bank, 2018). While this may increase Ghana's gross domestic product and improve the general health of its economy, there seems to be an emergence of the "Dutch disease", in which one sector of the economy grows rapidly to the disadvantage of other sectors as a result of a decline in the export performance of traditional and non-traditional export commodities, occasioned by an appreciated real exchange rate (Barder, 2006).In Ghana, the rise of the extractive industry has appeared to stifle the agriculture sector, of which forestry is a component. The agriculture sector recorded 0.8% growth in 2011, which happened to be its lowest in two decades. Interestingly, this was the same year in which Ghana commenced its commercial oil production (Debrah and Graham, 2015). The agriculture sector has not fully recovered from its pre-2011 growth rates.

The third goal of the LNDP advocates for the building of "well-planned and safe communities while protecting the natural environment" (NDPC, 2017). This goal resonates with Goal 15 of the United Nations' SDGs – to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss". Protecting the natural environment comes with political, economic and financial commitments to efficiently and sustainably manage natural resources. Current management interventions do not appear to match the rapid rate of forest exploitation. This has led to a frightening reduction of Ghana's forest cover from about 7.5 million ha in 1990 to 4.1 million ha in 2015, with an annual depletion rate of 135,395 ha (Oduro et al., 2015; Food and Agriculture Organization of the United Nations [FAO], 2015). Bamboo development can be linked to efforts made towards achieving several of the SDGs in Ghana.

#### Linking bamboo development with SDGs in Ghana

#### • SDG 1. Poverty alleviation

Bamboo can be incorporated into poverty alleviation strategies. Bamboo grows locally in some of the poorest communities in Ghana and can be transformed into value-added products. Enterprises can be formed around the use of bamboo in these localities through current development policies such as1D1F and Planting for Food and Jobs.

#### SDG 7. Clean energy

Bamboo is gradually becoming recognised as a globally important biomass source for energy generation. Bamboo can be cultivated to produce clean and sustainable energy for local use and export through charcoal and briquette-making.

#### • SDG 11. Housing and cities

Bamboo supplies millions of households around the world with building materials and employment. Bamboo's compressive strength is higher than that of wood, brick and concrete, and its tensile strength is comparable to steel. With these qualities, bamboo can be processed into various building materials, including scaffolding, footings, trusses and roofing tiles. If bamboo usage in this direction becomes popularised, the huge housing deficit in cities and towns can be reduced.

#### • SDG 12. Sustainable consumption

Bamboo and rattan can contribute to sustainable development in many sectors of Ghana's economy. Due to its fast growth, bamboo can be a source of sustainable bioenergy, green building materials and a sustainable substitute for wood in manufacturing.

#### • SDGs 13 and 15. Climate change and life on land

Bamboo can become a key resource for climate mitigation in Ghana, as it is a strategic – yet largely untapped – resource for combating climate change. By virtue of its fast growth, bamboo is considered a good species for carbon sequestration. Additionally, it can be grown without the use of agrochemicals. Furthermore, using bamboo as a wood substitute/complement for energy, furniture and building materials could save large areas of forest and thus slow down deforestation, biodiversity loss and carbon emissions.

The bamboo sector in Africa has received little attention as a potential sector for economic growth. In Ghana, for example, forest resources have been degraded, undermining sustainable development principles. Of particular interest is the indiscriminate harvesting of bamboo in the country's High Forest zone. The value placed on bamboo is relegated to subsistence use and



benefit. However, small-scale production and processing of bamboo occurs in major cities without any direct socio-economic benefits or impact on resource-owning communities. There also seems to be limited information regarding the status of the bamboo resource base as well as the policy options for bamboo development in Ghana. Fortunately, environmental policy in Ghana is rapidly changing in a positive direction, as old policies are being updated and new ones are being developed to accelerate economic growth. Several legislations and policies governing forestry, land, energy, small-scale enterprises and the environmental sector have implications for the bamboo sector. However, few policies (e.g. the 2012 FWP) specifically identify or guide the development of bamboo in Ghana. This study therefore presents an opportunity to provide insights into how bamboo development issues can be integrated into sustainable national development policies in various sectors of the Ghanaian economy. This study was commissioned to identify key factors and conditions that facilitate or impede the integration of bamboo policy and programmes into national development plans and strategies, including green growth strategies and climate change plans. It is expected that the study will also identify measures that can be taken to facilitate more effective bamboo policy integration into national sustainable development plans. A policy integration analysis will form the basis for framing roundtable discussions, which will be convened in cooperation with focal ministries.

The study was conducted with an emphasis on the High Forest zone in Ghana, where bamboo thrives and is used for various purposes. The information gathered pertained to policies and programmes in various sectors of the Ghanaian economy that have repercussions on the development of the bamboo industry in the country. This study, among other things, critically analysed policies and programmes of Ghana's forestry, environment, agriculture, energy, trade and employment sectors to establish their links or potential links with the bamboo sector.

# 2. Objectives and Outcomes

#### 2.1 Main objective of the study

The main objective of this study is to analyse relevant complementary policies or programmes on thematic areas, such as landscape restoration, bio-energy, and rural employment, to ensure that newly drafted or existing bamboo policies and programmes are fully linked to national sustainable development planning with the objective of leveraging increased investment in bamboo development.

#### 2.2 Specific objectives of the study

The specific objectives of the study are as follows:

- I. To provide an understanding and analysis of various sectors, including, among others, forestry, energy, biodiversity conservation and climate change, that have implications for bamboo development in Ghana;
- II. To define relevant legislation, complimentary policies and programmes that directly or indirectly support bamboo development in Ghana;
- III. To map key stakeholders (including their roles, responsibilities and interests) in the development of the bamboo sector;
- IV. To assess opportunities and incentives, including the market for and investment in bamboo development in Ghana; and
- V. To define a framework for bamboo policy integration for sustainable development in Ghana, with emphasis on – but not limited to – community participation, research and development, and public and private roles in resource sustainability.

#### 2.3 Structure of the report

This report is made up of seven chapters. Chapter 1 offers an introduction and background for the study, in which a brief profile of bamboo, its distribution in Ghana and its resourcefulness for achieving national and global development goals were presented. The general problem of the study and its scope and purpose were also indicated in the first chapter. Chapter 2 includes the objectives, tasks and expected outcomes of the study. The methods used to achieve the objectives of the study are detailed in Chapter 3. Chapter 4 presents some of the results pertaining



to bamboo development and various sectors of the economy, while Chapter 5 includes an analysis of policy, legislation and programmes related to bamboo development. Chapter presents an analysis of the institutions, stakeholders and factors that shape the bamboo sector in Ghana. Lastly, Chapter 7presents a conclusion and some recommendations and policy options that could help integrate bamboo as a resource into national development policies and programmes.

# 3. Methodology

A mixed-methods approach, which included both descriptive and exploratory methods, was adopted to achieve the objectives of this study.

#### 3.1 Data collection methods

Data were collected using a desk study approach, stakeholder identification and mapping, as well as a brainstorming session through a validation workshop.

#### 3.2 Desk study

The desk study included a review of relevant documents on issues related to bamboo in various sectors of Ghana's economy. Sources of information included reports, journal articles, books, theses and proposals from all sectors relevant to bamboo development. The literature survey was specifically intended to elicit relevant information to form an overview of concepts and ideas for incorporating bamboo issues into national development policies.

#### 3.3 Stakeholder identification and mapping

An identification and mapping of key stakeholders and institutions linked to bamboo development was carried out through a brainstorming session and in consultation with key personnel at the International Bamboo and Rattan Organisation (INBAR). These stakeholders and informants were selected based on their experience and association with the development of the bamboo sector in Ghana. They were individuals with long-term involvement in programmes and policies that have impacted or have the potential to impact bamboo sector development. The perspectives of these stakeholders on the development of the bamboo sector were analysed.

#### 3.4 Key informant interviews

A semi-structured questionnaire was prepared based on the specific tasks outlined in the terms of reference. The target respondents were identified stakeholders and key informants in ministries and agencies. The checklist (Table 1) covered the roles and responsibilities of institutions and



agencies that influence or have the potential to shape the development of the bamboo sector. The challenges confronting various agencies in the execution of their roles and responsibilities were also examined. Furthermore, questions were asked about the roles of the public and private sectors in the development of the bamboo industry in Ghana. The respondents' views were sought on investment, marketing and other opportunities and incentives that are available in the bamboo sector in Ghana, as well as constraints militating against efforts to use these opportunities. Interviews were conducted face-to-face with individual respondents, and an average of 90 minutes was spent with each respondent. Two key personnel were interviewed at the Forestry Commission (FC): a technical advisor and a former coordinator of the Bamboo and Rattan Development Programme(BARADEP). Three persons were interviewed at the Bamboo Rattan Unit (BRU): the project coordinator, the officer in charge of bamboo processing and utilisation, and the officer in charge of marketing, research and communication. The coordinator of BAREDEP was interviewed at the Ministry of Lands and Natural Resources. The director of renewable and alternative energies at the Ministry of Energy and the deputy minister in charge of annual crops at the Ministry of Food and Agriculture were also interviewed.

#### 3.5 Validation workshop

The validation workshop was organised for key findings of the study to be presented to stakeholders in the bamboo sector. This workshop attracted participants from Cameroon, Ethiopia, Madagascar and Ghana, and it included people from academia, business, entrepreneurship, state governments and civil society organisations (CSOs). After the presentation and the question-and-answer session, the participants were placed into two groups (private and public sector actors) to brainstorm how best the bamboo and rattan industry in Ghana could be developed and utilised for national economic development.

# 4. Bamboo Development and Sectors of the Economy

Ghana's mode of adoption of the 2030 Agenda (SDGs) is expected to address three interconnected elements of sustainable development – economic growth, social inclusion and environmental sustainability – with a focus on people, plants and the prosperity of society (Ministry of Finance and Economic Planning, 2018). The bamboo sector can be developed to support this kind of sustainable development if it is integrated into the various sectors of the economy. Many sectors of the economy have different programmes and policies that may use bamboo as a resource for radical change in job creation, poverty alleviation and social upliftment. An analysis of how the bamboo sector could be incorporated into various sectors of the economy is presented below.

#### 4.1 The agriculture sector and bamboo development

The agriculture sector of the economy remains in the lead for the livelihood of and job creation for the rural populace in Ghana, with a very large multiplier effect on employment (World Bank, 2018). For every additional USD one million worth of output from the sector, over 750 jobs are created, according to the World Bank (World Bank, 2018). Increased fiscal appropriation to and proper management of the sector can yield even higher output and more jobs since the resource base is renewable. Although bamboo is not yet known as an agricultural crop in Ghana, it has the potential to become an important food and cash crop. Agroforestry practices that involve bamboo are being piloted in Ghana, and preliminary findings indicate that farmers are familiar with the value of bamboo for fodder and charcoal (Akoto et al., 2018). Production of bamboo shoots for human consumption could also be introduced to farmers and Ghanaians in general, since they can be processed into several edible forms and have high nutritional and health benefits (Satya et al., 2010). Increased budgetary allocation to the agricultural sector for research and project implementation could help integrate bamboo as a crop.

Under the 2003 Maputo Declaration, African heads of state (including Ghana) committed to allocating at least 10% of their national budgets to agriculture (World Bank, 2018). However, several recent studies (Benin, 2016; Kolavalli, 2015) have indicated that Ghana may not be able



to meet this commitment with the current fiscal allocation to the agricultural sector. Ghana is also signatory to the common agriculture policy of the Economic Commission of West African States (ECOWAS). One of the priorities of this policy is sustainable agricultural development at the farm level through: (i) integrated soil fertility management; (ii) better support services for producers; and (iii) dissemination of improved technologies (ECOWAP Commission, 2017; ECOWAS, 2004; African Union-NEPAD, 2003). Bamboo agroforestry and plantation development ties in well with this policy priority, and if these commitments are met, enough finances could become available in the agricultural sector to implement innovative programmes.

#### 4.2 Trade arrangements and bamboo development

Ghana's trade arrangements could favour the bamboo industry if the production and processing of bamboo commodities were scaled up to supply the West African market. The ECOWAS Trade Liberalization Scheme (ETLS) affords member countries the opportunity to enter the markets of other member countries (with goods manufactured or processed in the sub-region) without paying import duties or equivalent taxes (Ministry of Finance and Economic Planning, 2018). Though the ETLS is faced with challenges such as the "operationalization of the ETLS Protocol by member states, inadequate sensitization of businesses on the ETLS, low compliance levels, policy incoherence in member states, high number of physical barriers along corridors, etc.", Ghana has taken advantage of it since its inception in 1990 (Ministry of Finance and Economic Planning, 2018). By the end of the third quarter of 2018, 37 companies with 101 products in Ghana were given approval to access the ECOWAS market under the ETLS. Ghana's geographical location among the active ETLS member-countries (Ghana, Nigeria, Cote d'Ivoire, Senegal, Burkina Faso, Togo, Benin, Mali and Niger) gives it an added advantage, as physical access to these markets is comparatively easy. Again, the kinds of goods approved under ETLS (light manufacturing and agro-processed products) make bamboo products highly gualified. In addition to the West African market, items made from bamboo in Ghana can be exported to American and European markets. Bamboo bikes produced in Ghana are already being exported to the U.S. and Europe. Ghana has taken advantage of preferential market access to the U.S. market through the African Growth and Opportunity Act (AGOA).

Under AGOA, many bamboo products (e.g. furniture, artefacts and handicrafts) can be exported when they are carefully produced to meet set standards. If small-scale saw milling actors are supported to understand the technicalities of wood/bamboo processing and factory management as well as forest and timber trade policies (Tropenbos Ghana, 2018), the quality of bamboo products in Ghana could be improved and become more acceptable to both local and foreign consumers. Again, the fight against illegal chain saw milling could be advanced significantly if the struggling wood sawmill sector is revamped with the capacity to produce bamboo boards for carpentry work. Currently, artisans who use bamboo are concentrated in Ghana's capital city, Accra; however, efforts are also being made to help producers in Kumasi use bamboo. Using an integrated approach to tackle poverty and unemployment in the country, youth could be targeted in districts endowed with bamboo to be trained under the 1D1F policy and the National Entrepreneurship and Innovation Programme. These two programmes were allocated over GHS 1.4 billion in 2018, according to the Ministry of Finance and Economic Planning (Ministry of Finance and Economic Planning, 2018). The inclusion of bamboo processors in these programmes might end the funding drought that has been the bane of the bamboo sector.

#### 4.3 The energy sector and bamboo development

Energy is vital to Ghana's socio-economic transformation agenda. With the current population growth rate and industrial expansion, it is important for the country to explore various energy sources, especially those that can be used for household heating and the needs of small and medium-sized enterprises (SMEs) (MLNR, 2012). Biomass fuel (particularly wood) is a very important source of energy for both households and SMEs in Ghana. Most SMEs, including bread bakeries, local breweries, traditional soap makers, fish smokers and food services use wood fuel for energy. In the domestic arena, over 73% of households in Ghana use wood fuel (firewood or charcoal) for cooking and heating (Ghana Statistical Service, 2014). The average annual per capita wood energy consumption is estimated to be 1.3 m<sup>3</sup>, indicating a total estimated wood removal of more than 30 million m<sup>3</sup> for firewood and charcoal, or about 85% of the total wood removal in Ghana (MLNR, 2012). Almost all wood fuel in Ghana is extracted from the wild, and with the country's increasing population and industrial expansion, continuous reliance on natural forests for wood fuel could exacerbate the problems of deforestation, carbon release and biodiversity loss. Bamboo has the potential to become a major source of charcoal in Ghana (Nje et al., 2019). The use of bamboo instead of trees for charcoal production in Ghana could save 64% of the wood extracted for the same purpose, going by its yield rate of 30% (Nje et al., 2019). An advantage of using bamboo charcoal over wood charcoal is that the former can also be used



to make soap and even bread (Nje et al., 2019). In addition, vinegar and tar, which are by-products of bamboo charcoal processing, are used as a food additive and a coating for wood, respectively (Nje et al., 2019).

INBAR West Africa - with support from the WENZHAO Bamboo Charcoal Company in China has disseminated knowledge and skills in bamboo charcoal-making in several bamboo-endowed communities in Ghana (Kwaku, 2010). Projects carried out by INBAR and its partners have proven that bamboo charcoal is a viable alternative to wood for fuel and charcoal used for cooking and heating (Sanders, 2005). A study conducted on three species of bamboo in Ghana indicated that they have good gross calorific values (17.24-17.84 GJ/kg), a low ash content (0.9-2.90%) and an average moisture content (16.30–11.41%) (Sarfo, 2008). In addition, the characteristic lignin, cellulose, hemicellulose and extractive content of the studied species give them desirable fuel properties that make them potentially suitable species for the reliable production of energy through the combustion process (Sarfo, 2008). Ghana has a strong potential to produce 0.9 million tons of bamboo charcoal on a sustainable basis at a 30% yield rate (Kwaku, 2010). INBAR projects have proven that through capacity-building and training activities, wood charcoal producers can easily shift to produce bamboo charcoal. The environmental benefits of using bamboo biomass for energy instead of wood are enormous (Nie et al., 2019). With their fast growth, bamboo forests have high carbon storage potential (Nath, Silesh and Das, forthcoming), as new shoots can grow rapidly after harvesting to absorb carbon that may have been released by burning the harvested culms. Additionally, bamboo can be propagated and harvested through simple processes that may not involve the use of machinery or, for that matter, carbon emissions (Nath, Silesh and Das, forthcoming).

Its fast growth and ability to thrive on marginal soils make bamboo a suitable plant species for producing charcoal for rural households in Africa, which may not be able to afford alternate sources of energy. With bamboo's high productivity, it has been identified as a plant that can sequester large amounts of carbon and create a sinking effect when plantations are well managed (Lobovikov et al., 2009). A study in Ghana compared the eco-cost (environmental burden) of producing charcoal from bamboo (*Bambusa balcooa*), teak (*Tectona grandis*) and acacia (*Acacia auriculiformis*) and concluded that the total eco-cost (comprised of human health, ecosystem, resource depletion, and global warming eco-costs) of a cradle-to-gate production of 1 MJ of

charcoal from teak and acacia is higher than the eco-cost of producing same quantity of charcoal from bamboo (Partey et al., 2016). This means that charcoal production from *Tectona grandis*, *Bambusa balcooa* and *Acacia auriculiformis* pose different environmental impacts. *Tectona grandis* recorded the greatest impacts on global warming (with eco-costs amounting to EUR 1.99E-06), human health (with EUR 4.92E-07 as eco-costs) and ecosystems (resulting eco-costs: EUR 4.96E-07), while *Bambusa balcooa* showed the greatest impact on natural resource depletion (EUR 1.41E-06). While the results showed that more *Bambusa balcooa* may be required than *Tectona grandis* and *Acacia auriculiformis* to produce 1 MJ of charcoal energy, the overall assessment showed that compared to *Bambusa balcooa*, the total eco-cost (comprising the eco-costs of human health, ecosystems, resource depletion and global warming) of a cradle-to-gate production of 1 MJ of charcoal will be 140% higher with *Tectona grandis* and 113% higher with *Acacia auriculiformis*. The increased environmental impacts associated with *Tectona grandis* and *Acacia auriculiformis* production stage (involving nursery and plantation establishment), which constituted about 85% of their total eco-cost.

In various sectors of the economy, there are numerous policies and programmes (e.g. wood fuel and renewable energy policy, national REDD+, forest investment policy, domestic timber market policy, decentralisation policy and wildfire management policy) to guide the use of environmentally friendly, safe and cheap sources of energy in Ghana (MEST, 2016). However, the implementation of these policies and programmes has often become problematic, leading to policy objectives not being achieved. For example, policy intendment number 4 of the wood fuel and renewable energy policy stipulates that government should support the development and introduction of improved technologies and higher levels of efficiency in the production and consumption of wood fuels. However, implementing organisations have yet to receive resources from the government to develop and implement these technologies. Technologies for bamboo charcoal production are already being introduced to Ghanaians through individuals and non-government in this direction could have made it easier to achieve the objectives of some of the policies mentioned above.

#### 4.4 The environment, climate change and bamboo development

Bamboo offers a wide range of potential solutions to address the problems that arise due to climate change. It can be integrated into land use-based climate change mitigation activities such



as afforestation/reforestation or avoided deforestation, as it is one of the fastest growing plants on Earth (Yiping et al., 2010). Bamboo can reduce soil erosion by up to 75% due to its significantroot strength (Phimmachanh, Ying and Beckline, 2015). For example, the roots of *Phyllostachys bambusoides* can travel up to four metres per year, and the established network is estimated to bind about 6 square metresof soil, which is very helpful in combating soil erosion on riverbanks and hill slopes (Phimmachanh, Ying and Beckline, 2015). While the impact of bamboo growth on soil differs at the species level, the general qualities of bamboo make it suitable for restoration of degraded lands. Bamboo can rapidly colonise disturbed lands by virtue of its ability to conserve nutrients and adapt to different soil conditions (Zhihua et al., 2013). The growth habits of bamboo therefore make it suitable for protecting steep slopes, waterways and even soils contaminated with heavy metals (Yiping et al., 2010; Zhihua et al., 2013).

The potential of bamboo to remove  $CO_2$  from the atmosphere is comparable to that of trees. To investigate the carbon sequestration capacity of bamboo and tree species, Yiping et al. (2010) compared the performance of the Chinafir *(Cunninghamia lanceolata)* and moso bamboo *(Phyllostachys pubescens)*, both in the short term (Figure 1) and the long term (Figure 2).

The China fir is one of the fastest-growing plantation species in subtropical China. It was compared with moso bamboo because the two plant species grow at similar sites in natural forests and require similar climatic conditions (Yiping et al., 2010). The study concluded that bamboo and trees may have different carbon intake patterns, but they are likely to have comparable carbon sequestration capacities if the bamboo forest is managed and the total amount of harvested fibre from both species is turned into durable products (Yiping et al., 2010).







Figure 2. Accumulation of carbon in moso bamboo and the China fir over a 60-year period.



Bamboo can play a significant role in linking climate mitigation with sustainable economic development in the developing world (Yiping et al., 2010). The development of the bamboo sector in a country could lead to the expansion of carbon sinks (Lobovikov et al., 2009) in that country through carbon sequestration by the extra bamboo plants planted and the savings made on tree forests that would otherwise be felled to produce items that bamboo is used to produce. Jobs and corresponding income from the development of bamboo plantations, processing factories and marketing could contribute significantly to poverty alleviation in an inclusive manner since both rural and urban populations find niches in the bamboo value chain (Phimmachanh, Ying and Beckline, 2015).

In Ghana's national climate change policy, the vision is to "ensure a climate resilient and climate compatible economy while achieving sustainable development through equitable low carbon economic growth" (MEST, 2012). Bamboo development is well in line with this vision due to its ability to contribute to a resilient climate via carbon sequestration and sustainable development through the provision of renewable raw materials for various consumer products.

#### 4.5 The forestry sector and bamboo development

Forestry sector policies, such as the 2012 FWP, the Ghana Forest Plantation Strategy and the National Plantation Development Policy, are designed essentially for the production of commercial lumber, the protection of the environment, the maintenance of favourable conditions for agricultural crops, public education and research (MLNR, 2012). It is becoming increasingly important for natural resource management policies to consider livelihoods and community development issues as important as biodiversity conservation. The 1994 FWP morphed into the 2012 FWP as a result of its implementation failure to address issues largely pertaining to the forest-community/society interface (Akapame, 2016). For instance, the 1994 FWP "promised a number of changes such as the equitable sharing of management responsibilities; increased benefit flow to local stakeholders, especially the rural poor; and increased participation, transparency and accountability in the sector's activities" (Akapame, 2016). However, the policy intendments related to improving flow to local communities were not given legal backing to make them enforceable. The development of NTFPs such as bamboo has the potential to solve this problem since local communities are often the main actors and beneficiaries of that stream of forest resources. Policy Strategy 3.1.1e for Objective 3 of the 2012 FWP recommends support

for schemes to train specialised artisans to process bamboo, rubber wood, cane and rattan, as well as lesser-known tree and NTFP species as a means of reducing reliance on chainsaw lumber (MNLR, 2012). As far as bamboo is concerned, government efforts over the years towards achieving this have been seen in collaborations with foreign partners (e.g. China) to transfer technologies to Ghanaians to improve at processing bamboo into various consumer products. In addition, collaborations between public private partnership (PPP) plantations and the FC have been ongoing since the launch of the National Forest Plantation Development Programme in 2001. The Ghana Forest Plantation Strategy has identified bamboo and rattan as the two most important NTFPs in Ghana and projects that 50,000 ha of bamboo and rattan plantations will be required to augment supplies from natural stands by 2041 in order to satisfy national demand (FC, 2016). Some bamboo species (Bambusa spp, Dendrocalamus spp, Guadua spp and Oxytenanthera spp) are part of a list of tree species recommended by the FC for plantation development, especially in degraded forest reserves. As part of the PPP arrangements, two private companies, EcoPlanet Bamboo LLC and Global Bamboo Products Ltd, have planted 923.40 ha and 30.0 ha of bamboo, respectively, on degraded forest reserves assigned by the FC (FC, 2017). Increased and regular budgetary allocation by the government for these PPP plantation development projects could catalyse their establishment. The 2012 FWP advocates for a holistic development of the entire value chain of NTFPs, including bamboo, to reduce pressure on species exploited for lumber. More support from the government in terms of further training of artisans and the establishment of factories and modern market centres could achieve this holistic development.

The recognition of bamboo as a forest resource with the potential to solve both environmental and socio-economic problems in Ghana came to the fore in 2002 when the then-government, through the cabinet, approved the adoption of bamboo and rattan development as a national programme in pursuit of a presidential initiative on forest plantation development. The secretariat of BARADEP was later established under the then-Ministry of Lands, Forestry and Mines to coordinate its activities (FC, 2019). BARADEP is now exclusively in charge of policy at the Ministry of Lands and Natural Resources, while a new unit of the FC, the BRU, was created to take charge of the implementation. "The overall goal of the BRU is to contribute to poverty alleviation, economic development, and to ensure sustainable management of the country's forest resources and the improvement of the environment" (FC, 2019). Specifically, the BRU seeks to promote bamboo and rattan plantation and industry development as a complement to the wood industry



to reduce the pressure on the natural forest for timber and increase income and employment opportunities for the rural poor. The BRU is soliciting support from the Chinese government to set up a Bamboo and Rattan Common Facility and Training Centre at Ayi Mensah, Accra (FC, 2019). The facility is intended to house all bamboo and rattan artisans in Accra and serve as a one-stop market for finished bamboo and rattan products.

In terms of using bamboo to ameliorate environmental problems, the BRU (through the FC) is collaborating with the Volta River Authority (VRA) to plant bamboo along the banks of Volta Lake to stabilise the banks, prevent siltation and provide other ecosystem services. This may also reduce perennial flooding of farms and villages along the river and prevent communities living along the river from farming too close to the banks. The BRU supports rural communities in managing and using bamboo resources efficiently. Though in charge of policy, BARADEP tries to help private enterprises in the bamboo sector produce and market their products both within and outside Ghana. For example, the Bamboo Bike Project, introduced by two Americans in 2007, is now engaging and giving income to several rural individuals and two main enterprises in Kumasi: Booomers Ghana Limited and the Ghana Bamboo Bike Initiative. These companies market their products in Ghana and export to other countries, including Germany, the United States, the Netherlands and Italy. Despite the importance of BARADEP, there are no strategies or policies to guide its operations, and this has been a major challenge of the unit since its inception in 2002.

# 5. Analysis of legislation, policies and programmes

# 5.1 Existing policies and legislation that support bamboo development in Ghana

The need for developing the bamboo industry as a means of reducing poverty and facilitating inclusive human development is backed by Article 36(1) of the 1992 constitution of Ghana, which stipulates that "the State shall take all necessary action to ensure that the national economy is managed in such a manner as to maximise the rate of economic development and to secure the maximum welfare, freedom and happiness of every person in Ghana and to provide adequate means of livelihood and suitable employment and public assistance to the needy." The wide distribution of bamboo over many regions and districts in Ghana and the ease of its use for economic gain makes it a singular resource with the potential to reduce poverty through rural development and youth employment. Maximising the rate of economic development requires a critical needs assessment of the population and the suitable use of available resources to solve economic problems. The utility of bamboo (e.g. raw material for furniture, building, fodder for animals, land restoration, energy, etc.) vis-à-vis the current needs of Ghana's development makes bamboo a low-hanging fruit for economic development.

Policy and legislation for the management of forest resources in Ghana have gone through several changes from colonial rule to the post-independence era (Akapame, 2016). These reforms usually become necessary as a response to international agreements and to combat illegal logging and deforestation. Unfortunately, successful outcomes of the reforms have always eluded Ghana due to growing demand for forest products and a lack of replacement of felled timber and plantation developments. Oduro et al. (2011) pointed out that the 1948 Forest Policy particularly encouraged large-scale deforestation to satisfy the then-growing wood processing industry but was silent on the replacement of trees cut in off-reserve areas.

PNDC Law 116 and the Ghana Investment Code of 1985 provided general incentives and benefits to motivate entrepreneurs and investors in the wood sector to increase their output. These included granting firms and investors full exemption from customs import duties on plants,



machinery, equipment and accessories required for the enterprises. However, no precise responsibility was placed on timber contractors to plant trees as they harvested them. In an attempt to address the rapid deforestation that resulted from this practice, the government, under the Timber Resources Management Act and Regulation in 1999, introduced the Timber Utilization Rights and Social Responsibility Agreement. This was done to ensure that timber utilisation contract holders would respect the existing rights as well as the social and cultural values of landowning communities. However, a major defect of forest policies in Ghana (particularly in the 1980s and 1990s) was that they had little regard for NTFP development in taking care of some of the aspects of wood demand.

In the 2012 FWP, an attempt was made to put the spotlight on NTFPs. The policy particularly mentioned bamboo, recognising the importance of bamboo as a substitute for timber and specifically seeking to ensure the sustainable management of bamboo resources and improve existing stock. One of the strategic directions of the 2012 FWP was to develop systems and structures to support the sustainable establishment of commercial plantations through the help of the private sector. Under Policy Objective 3 of the 2012 FWP - "promoting the development of viable forest and wildlife based industries and livelihoods, particularly in the value-added processing of forest and wildlife resources" -Strategic Direction 3.1.1 (c) advocates for the support of specialised training and craftsmanship schemes for the processing of bamboo, rubber wood, cane and rattan, as well as lesser-known tree and NTFP species to reduce the reliance on chainsaw lumber (MLNR, 2012). The missing link between policies and implemented government programmes, however, remains a barrier to achieving policy objectives in Ghana. For instance, current (2019) government programmes, such as the National Entrepreneurship and Innovation Programme, the National Afforestation Programme, Planting for Food and Jobs and 1D1F initiatives, are all interventions that could have incorporated the bamboo sector for job creation and poverty alleviation; however, this is not happening at the moment.

#### 5.2 Land tenure and bamboo development

A fundamental requirement for the development of the bamboo industry is a well-established land tenure system. Under customary arrangements, the ownership of NTFPs, wildlife and trees on communal or private land is based on contracts governed by the type of tenure system operating in the area (Akapame, 2016). This makes it difficult for one legal framework to regulate the

development of any land-based resource across the entire country. As mentioned above, bamboo charcoal is an important product that can reduce deforestation and thus contribute to carbon sequestration and create jobs. Institutional responsibilities, such as the development of permit regimes for planting, harvesting and the regulation of the production of bamboo charcoal, rest with the FC and, to some extent, the Energy Commission on the part of the charcoal production. Meanwhile, the Timber Resources Management Act 1998 (Act 547) and its implementation regulations did not mention any type of permit for harvesting, collecting or planting trees or any plant for fuel or charcoal (Akapame, 2016). The 2012 FWP promised to develop systems and structures to support the sustainable establishment of commercial wood fuel plantations to ease the pressure on the savannah woodland to produce charcoal and firewood to meet the cooking energy needs of households in Ghana. However, this is yet to receive legal backing to make it enforceable and operational. In Ghana, people are not usually motivated or encouraged to plant trees on lands they do not have full ownership rights over (Otsuka et al., 2003). This is because land users do not want to spend resources and time tendering long-term tree crops only for the rightful owners to confiscate them in the future. A national land tenure and use policy that defines clear ownership and user rights could help solve such problems.

# 5.3 International agreements on climate change mitigation and bamboo development

African states who are parties to the UN Convention to Combat Desertification (UNCCD) are obliged to elaborate national action programmes through participatory and consultative processes. These plans should include measures to conserve natural forests. A plan already exists on the regional level, and it indeed mentions the need for increased availability of new and renewable sources of energy and the long-term substitution of firewood and charcoal by other sources of energy (Akapame, 2016). Though Ghana is a party to the UNCCD, the guidelines provided for the involvement of rural communities through consultative processes to adopt efficient energy sources are not followed. The utilisation of bamboo for energy (charcoal) will be enhanced if sustainable levels of collecting bamboo and other NTFPs are included in forest reserve management plans. The rights of local communities (with domestic user rights) to have continuous access to forest produce (NTFPs) must also be included in management plans to ensure benefit flow to forest-fringe communities.



The United Nations Framework Convention on Climate Change (UNFCCC) entreats parties to promote the sustainable management of biomass and forests to increase carbon sequestration. Ghana, as a party to the UNFCCC, can use bamboo to achieve sustainable forest management since the plant has a shorter turnaround time than many timber trees and can substitute wood for many purposes. Bamboo's development and substitution for wood fits well into the vision of the 2012 National Climate Change Policy of Ghana - to "ensure a climate resilient and climate compatible economy while achieving sustainable development through equitable low carbon economic growth for Ghana" (MEST, 2012). Two of the principles guiding the policy direction of the National Climate Change Policy establish the premise for an all-inclusive climate change adaptation strategy. These are: 1) "the principle of a harmonized and integrated climate change policy with other interrelated policies because adaptation to climate change and mitigation of greenhouse gas emissions will also involve many aspects of other social and economic policies" and 2) the principle of horizontally and vertically integrated approaches at all levels, bringing together sectors, regions, districts, and more (MEST, 2012). The National Climate Change Adaptation Strategy seeks to address climate change adaptation through a broader context of national development policy, employing wide stakeholder consultations to formulate implementation guidelines to ensure national ownership. Adaptation strategies will be based on gender-sensitive approaches to sustainable development and poverty reduction to mitigate longterm impacts of climate change (UNDP, 2012). These principles clearly espouse the smart use of natural resources in a manner that supports economics and social systems and ensures the sustainability of the natural resource base. Integrating the bamboo industry efficiently into various sectors of Ghana's economy will reflect these policy principles and take the path towards achieving the vision of the National Climate Change Policy.

#### 5.4 Biodiversity conservation policies and bamboo development

The Ghana National Biodiversity Strategy and Action Plan (NBSAP)recognises the importance of biodiversity conservation and the need for planning and formulating clear-cut strategies as the country strives to keep its commitments outlined in the Convention on Biological Diversity (MEST, 2016). The plan acknowledges bamboo as an NTFP that has provided economic benefits as well as ecosystem services in Ghana for a long time (MESTI, 2016). Bamboo development could therefore lead to the enhancement of the economic status of actors in the bamboo sector and an improvement in ecosystem services in Ghana. The strategic objectives of the NBSAP include the

need to improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity. This provision allows for the introduction of more species of bamboo that are fast-growing, could serve as suitable alternatives to timber and are compatible with indigenous forest species (MESTI, 2016).

#### 5.5 Energy policies and bamboo development

In 2011, the Renewable Energy Act was enacted to provide a framework for the development, management, utilisation, sustainability and adequate supply of renewable energy to increase the proportion of renewable energy in the national energy supply mix while contributing to the mitigation of climate change. Bamboo is one such material with the possibility of significantly increasing the energy mix if processed thermally or by biochemical conversion to produce energy products such as syngas, biofuels and charcoal (Truongand Le, 2014). While syngas and biofuels can be experimented with to ascertain their feasibility, bamboo charcoal has already proven to be an economically viable alternative to other sources of charcoal. Bamboo biomass has been shown to have the capacity to replace coal in thermal applications (Truong and Le, 2014). Biomass per hectare of bamboo plantation is estimated to contain 608GJ of energy, which could generate 56MWh power at 33% efficiency (Dube, 2008). Dube (2008) indicates that one species, Bambusa balcooa, possesses a very high calorific value (4,468 kcal kg<sup>-1</sup>) and is an excellent source of activated carbon. The Renewable Energy Act suggests that Ghana is ready to provide an environment that will enable private investment in the sector. While it also recognises that a major challenge in the utilisation of known biomass resources may be the uncertainty of uninterrupted biomass supply for large-scale energy generation, this could be surmounted with bamboo plantations.

#### 5.6 Housing policy and bamboo development

Bamboo is a useful raw material that has the potential to reduce the costs of housing construction. However, bamboo housing in Ghana is often considered "poor man's" housing. This poor perception of bamboo has limited the extent of its utilisation, relegating it mainly to rural areas. However, the 2015 Ghana Housing Policy seeks to draw attention to the use of local building materials, including bamboo, stating that at least 60% of raw materials used in building and construction should be derived from indigenous materials. Specifically, the policy seeks to promote the use of local building materials such as compressed earth, laterite and bamboo as



alternative building material sources to reduce construction costs and improve lower-income households' access to suitable housing. Increasing the use of available local raw materials will considerably reduce the import bill on building materials; it will also retain capital and provide employment for youth (Appiah-Kubi et al., 2015).

# 6. Stakeholders and Factors that shape the Bamboo Sector in Ghana

#### 6.1 Mapping of key stakeholders for bamboo development

Interactions with key informants and stakeholders revealed that several institutions and players across different sectors of the economy have roles and responsibilities in facilitating the development of the bamboo sector. Table 1 presents the key institutions whose active participation can shape the development and management of the bamboo sector in Ghana.

| Organisation/Institution            | Mandate   | Roles and responsibilities  |
|-------------------------------------|---|---|
| Forestry Commission (FC)            | To protect, develop<br>and sustainably<br>manage forest<br>resources, including<br>bamboo   | <ul> <li>To manage, conserve and develop the bamboo industry</li> <li>To provide technical advice to private sectors</li> <li>To educate and mobilise youth and encourage them in the craft industry</li> <li>To develop the craft industry</li> <li>To conserve and utilise existing natural resources</li> <li>To develop plantations and inventory the resource</li> </ul> |
| Bamboo & Rattan Unit (BRU) of<br>FC | To ensure the<br>sustainable<br>management and<br>utilisation of Ghana's<br>bamboo and rattan<br>resources to<br>contribute to the<br>country's socio-<br>economic<br>development | <ul> <li>To promote bamboo and rattan resources<br/>and industry development as a<br/>complement to the wood industry to reduce<br/>pressure on the natural forest</li> <li>To increase income and employment<br/>opportunities for the rural poor</li> <li>To contribute to forest biodiversity<br/>conservation and resource sustainability</li> </ul>                      |

Table 1.Institutions and their roles and responsibilities in the bamboo sector in Ghana



| Ministry of Lands and Natural                                     | To develop policy   | • To coordinate programmes and projects  |
|---|---|--|
| Resources – BARADEP   | and legislation for<br>sustainable forest<br>management.<br>Through BAREDEP,<br>to ensure the proper<br>management of the<br>bamboo industry by<br>educating and<br>providing incentives<br>to promote the<br>development of the<br>bamboo industry                                   | <ul> <li>between the public and private sectors</li> <li>To coordinate bilateral and multilateral programmes in the sector involving Ghana and other nations</li> <li>To create awareness and provide incentives for artisans in the form of organising field trips for artisans outside the country</li> <li>To ensure that enough education is given regarding the economic potential of the bamboo industry in Ghana</li> <li>To create an environment that enables private enterprise growth in the bamboo sector</li> </ul> |
| Ministry of Environment,<br>Science, Technology and<br>Innovation | To ensure<br>accelerated socio-<br>economic<br>development of<br>the nation through<br>the formulation of<br>sound policies and<br>a regulatory<br>framework that<br>promotes the use<br>of appropriate,<br>environmentally<br>friendly, scientific<br>and technological<br>practices | <ul> <li>To support partners and stakeholders in using bamboo for the restoration of degraded lands and the protection of water bodies</li> <li>To promote and provide technology for the use of bamboo to prevent soil erosion, especially in hilly areas</li> <li>To promote the creation of greenbelts around towns and cities to improve their protection from the greenhouse effect and reduce global warming</li> </ul>  |
| Ministry of Trade and Industry                                    | To ensure effective<br>trade and industrial<br>development for<br>national<br>development   | <ul> <li>To facilitate enterprise development, including MSMEs</li> <li>To promote and develop the bamboo trade through awareness creation and the discovery of new markets</li> <li>To facilitate technology transfer and ensure the maintenance of quality control</li> </ul>  |

| Ministry of Tourism and Culture                       | To facilitate the<br>interface between<br>government,<br>implementing bodies<br>in tourism, culture<br>and creative<br>industries, as well as<br>international civil | <ul> <li>To empower industry players to access credit facilities to enhance the processing of bamboo and rattan for export and the local market</li> <li>To promote bamboo/gardens (museums, artefacts, etc.) for eco-tourism</li> <li>To facilitate the exposure of bamboo artefacts to tourists</li> <li>To promote the bamboo art industry both internally and externally</li> </ul> |
|---|--|---|
|   | society partners   |   |
| The Energy Commission                                 | To regulate and<br>manage the<br>development and<br>utilisation of energy<br>resources in Ghana.   | <ul> <li>To be a national energy policy adviser</li> <li>To promote bamboo as an alternative energy source for households in areas where the resource is abundant</li> <li>To promote competition in the supply, marketing and sale of renewable energy products and other forms of energy</li> </ul>   |
| Ministry of Local Government<br>and Rural Development | To ensure the good<br>governance and<br>balanced<br>development of<br>Metropolitan,<br>Municipal and<br>District Assemblies<br>in Ghana.                             | To promote bamboo/rattan as part of the<br>District Assembly's poverty alleviation<br>programme for income generation,<br>employment creation and rural<br>industrialisation  |
| Ministry of Food and Agriculture                      | To develop and<br>execute policies and<br>strategies for the<br>agriculture sector<br>within the context of<br>a coordinated<br>national socio-<br>economic growth   | <ul> <li>To promote bamboo in agro-forestry systems using education.</li> <li>To create awareness of the cultivation of bamboo as a food crop, the plant may be:         <ul> <li>Promoted as a cash crop or</li> <li>Grown for its shoots to be used as vegetables.</li> </ul> </li> </ul>   |



|                                 | and development         |  |
|---------------------------------|-------------------------|--|
|                                 | agenda.                 |  |
| Ministry of Business            | To initiate, formulate, | To support agencies in initiating and        |
| Development                     | monitor and evaluate    | formulating policies to improve              |
|                                 | national policies and   | entrepreneurial skills among Ghanaians       |
|                                 | programmes aimed        | To monitor business and entrepreneurial      |
|                                 | at improving the        | policies and programmes                      |
|                                 | entrepreneurial and     | • To create an environment that will foster  |
|                                 | technical skills of     | private sector-led investment                |
|                                 | MSMEs, particularly     |  |
|                                 | among youth in line     |  |
|                                 | with the                |  |
|                                 | government's            |  |
|                                 | economic and social     |  |
|                                 | development agenda      |  |
| Research institutions and       |                         | To conduct more research and develop         |
| institutions of higher learning |                         | technologies for the efficient use of        |
| (CSIR-FORIG, KNUST,             |                         | bamboo                                       |
| University of Cape Coast, etc.) |                         | To introduce training programmes in          |
|                                 |                         | bamboo technology for higher learning        |
| Local communities and           |                         | To help protect natural stands of bamboo     |
| community leaders (chiefs)      |                         | in their native areas                        |
|                                 |                         | • To encourage youth to engage in bamboo     |
|                                 |                         | sector businesses                            |
|                                 |                         | To make land available for plantation        |
|                                 |                         | development when the need arises             |
| The private sector              |                         | To invest in the bamboo sector               |
| (entrepreneurs, investors and   |                         | • To collaborate and help transfer state-of- |
| the business community)         |                         | the-art technology from advanced             |
|                                 |                         | economies to Ghana                           |

# 6.2 Major factors impeding the integration of bamboo policy into national development plans

Bamboo is generally recognised as a resource that can improve livelihoods and help solve environmental problems such as deforestation. However, it remains unclear why bamboo development has not yet been featured prominently in any government policies and thus led to the concerted development of the resource in Ghana. Several stakeholders and key informants identified major factors that impede the integration of bamboo policy and programmes into national development plans and strategies (Table 2). This information was elicited through key informant interviews.

| No | Factor                                  | Remark   |
|----|---|--|
| 1. | Lack of a well-defined role for bamboo  | Ghana lacks a well-defined role for bamboo in its national       |
|    | as a resource for development           | development agenda since bamboo is not considered a major        |
|    |   | forest product.  |
| 2. | Neglect of NTFPs (including bamboo)     | NTFPs are not considered as important as timber products in      |
|    |   | Ghana; thus, policymakers in forest resources often pay little   |
|    |   | attention to them.   |
| 3. | Lack of adequate knowledge of the       | It is believed that even people in decision-making positions     |
|    | potential of bamboo                     | may not have adequate knowledge of the potential of bamboo       |
|    |   | for socio-economic development.                                  |
| 4. | The feeling that Ghana has enough       | According to the respondents, developing the value chains of     |
|    | timber                                  | traditional timber species in Ghana receives more attention      |
|    |   | than developing NTFPs, including bamboo.                         |
| 5. | Low interest of the private sector      | The private sector (in the timber industry) has shown inertia in |
|    |   | switching to the use of bamboo, probably due to risk aversion.   |
| 6. | No inventory data on volumes of         | Perhaps the limited data on bamboo stock is making it difficult  |
|    | bamboo in Ghana                         | for policymakers to make provisions for bamboo in national       |
|    |   | development plans and policies.                                  |
| 7. | Low technology in the processing, arts  | Artisans and processors in Ghana mainly produce with their       |
|    | and crafts industries                   | hands, making bamboo businesses appear like subsistence          |
|    |   | art, which does not require policy.                              |
| 8. | NTFPs are considered rural              | Timber is considered the main commercial forest product in       |
|    | subsistence                             | Ghana, while NTFPs are generally considered means of             |
|    |   | subsistence for rural folks.                                     |
| 9. | Non-prioritisation of rural development | The decentralisation of economic development in Ghana is of      |
|    | in Ghana                                | little concern to politicians who control and disburse the       |
|    |   | country's resources.   |

Table 2. Factors impeding the integration of bamboo policy into national development plans



# 6.3 Stakeholder views on how the bamboo industry could be developed in Ghana

As part of a validation workshop organised by INBAR to share the preliminary findings of this study, the participants were put into two groups (government/public sector and the private/business/CSOs) to deliberate on the best way to fully realize the potential of the bamboo and rattan industry in Ghana. The deliberation and brainstorming session ended with the following suggestions and recommendations from the two groups:

#### Suggestions and recommendations made by the public sector group

- A strategic plan must be drawn to cover all stakeholders of the bamboo industry. All stakeholders should be made active participants in the entire process from beginning to end.
- Extensive land mapping and statistical research should be conducted of all bamboo species in Ghana; through adequate and extensive research, inventory data on all bamboo species should be recorded and documented, as this will help in future decisionmaking in the industry.
- Bamboo should be seen as a resource that requires effective management and maintenance and utilisation research. Bamboo as a resource should be improved through awareness creation and extensive research into revealing the qualities that would help improve its management.
- Training and capacity-building activities should be conducted in bamboo development and utilisation, as this will aid in better usage of the resource.
- A well-equipped monitoring and evaluation team or committee should be set up to monitor the research component of the bamboo industry and ensure that its outputs are implemented to enhance innovation in the industry.
- Ghana's land tenure system should be examined in terms of plantation development with respect to bamboo.
- Incentives must be made available to people who want to go into bamboo product manufacturing (e.g. tax exemptions and incentives to attract private investors to the industry).

#### Suggestions and recommendations from the private sector group

- Getting access to funds to help start up a bamboo business is very difficult. In addition, the interest on loans taken from financial institutions as starting capital is too high. It is therefore necessary for the government to include players in the bamboo industry in government programmes that will enable them access funds to enhance productivity.
- There is a huge gap in the knowledge regarding bamboo species and end products. Thus, it is necessary to develop an information hub where interested investors can easily access information that may influence their decision to invest in the bamboo industry.
- Import limitations on foreign products, tax refunds and exemption to local products: There
  should be limits as to the types and number of products that are imported. This should be
  done strategically to ensure that we import just enough to complement locally produced
  goods. There should also be some form of a tax refund on some local goods or, better still,
  tax exemptions for local goods, as this would motivate local producers to grow their
  budding businesses to maturity.
- The government needs to set up bamboo training programmes in vocational schools across the country to build the capacities of students in that regard.
- The government of Ghana should continue to promote foreign partnerships to ensure the transfer of knowledge and skills from professionals in countries where the bamboo industry is already developed (e.g. China).
- Marketing of bamboo products should be promoted by the government and local communities. Awareness of the potential of bamboo and the need to patronise made-in-Ghana goods should be raised all over the country. This will help change the perceptions of local people towards the resource.
- The government should help the private sector in purchasing bamboo processing machinery and tools and should be willing to reduce or completely remove the duties on these machines.
- Standards for the bamboo industry in Ghana need to become fully developed, as this will help maintain consistency in the products as well as improve quality.
- Just as the wood industry is using Ghana's wood tracking system to track wood from the forest to the finished products, the need exists for bamboo species to be tracked to control illegal and unsustainable harvesting.



• The education sector should be integrated with the bamboo industry to offer internship opportunities to students. This will help improve the skills of the workforce in the industry.

#### 6.4 Market and investment opportunities for bamboo development

The world export of bamboo and rattan products in 2014 was estimated to be USD 1.830 billion (INBAR, 2016). The international trade of bamboo and rattan products has been reported to be fairly stable since 2007, except for a drop in 2008, which was largely attributed to the global financial crisis, as this was also observed in the trading of many other global commodities (INBAR, 2016). Figure 2 shows the global trend of the bamboo and rattan trade from 2007 to 2014. While Ghana has yet to make a mark in the international trade of bamboo and rattan products, some African countries are becoming major exporters of such goods. For instance, in 2014, South Africa exported bamboo shoots, woven rattan, bamboo flooring and bamboo/rattan seats; Kenya, Nigeria, Egypt and Namibia exported bamboo charcoal; and Cote d'Ivoire exported bamboo plywood. The composite value of all exported products from these countries totalled USD 21,385,000.



USD, in thousands

The potential exists for Ghana to produce several products (e.g. woven bamboo and rattan; bamboo and rattan furniture/seats; bamboo shoots; bamboo and rattan raw materials; and

engineered bamboo products) beyond current products in the market; however, the low technical expertise and capacity of Ghanaian producers limit Ghana's capacity to take advantage of the sector's international trade opportunities. A huge investment potential in bamboo in Ghana exists. It appears that a number of products made of wood in Ghana can also be made with bamboo (e.g. furniture, ceiling panels, trusses and scaffolding), and all parts of the plant, from the root to the growing tip, can be used for medicine, food and artefact-manufacturing purposes. Bamboo can be found in almost all the agro-ecological zones in Ghana, but it particularly thrives and is most abundant in the High Forest area. Raw material availability across a wide area in Ghana may therefore be a major advantage when investing in the bamboo industry in Ghana.

The stakeholders revealed that management of the natural stocks of bamboo in the country is not apt, as basic assessments of quantities available in the natural stands have not been done due to the limited financial capacity of responsible institutions, such as the BRU. However, private sector institutions (INBAR, in partnership with Resource Management Support Centre [RMSC]) are making efforts to assess natural bamboo stocks in Ghana. Bamboo resources are always available in sufficient quantities for the market. Traditional authorities are willing to make land available for bamboo-processing enterprises and plantations, with the hope of creating jobs for youth near their residences. For example, the BRU visited Kyebi for bamboo processing training, and, in the end, the chiefs voluntarily offered a 14km<sup>2</sup>mined portion of land for the establishment of bamboo plantations. Successive governments since the establishment of BARADEP in 2002 have shown goodwill towards the development of the bamboo sector. External collaborations, especially for the training of artisans in the sector, have always been facilitated by the government to ensure that artisans are exposed to state-of-the-art technical expertise in bamboo processing. China has been a major partner in this regard and has, since 2002, provided skills to hundreds of artisans in the bamboo sector in Ghana.

In addition to the opportunities in the international market, there seems to exist a thriving local bamboo market in Ghana that can be elevated if bamboo processors and enterprises are empowered to produce sufficient quantities and quality products to meet the demand. The real estate market in Ghana can become a huge consumer of bamboo products when Ghana's capacity is fully developed to produce bamboo plywood, flooring and furniture. Up to 69% of all urban households in Ghana depend on charcoal for cooking, bringing the annual per capita



consumption to around 180 kg (Energy Commission, 2012). Through sustainable management and harvesting of bamboo, bamboo charcoal can be produced to supplement and subsequently replace wood charcoal.

# 6.5 Pathways towards the integration of bamboo into national development plans and strategies

It is important to engage both the private and public sectors to find ways of integrating bamboo into national development plans and strategies. The government, as part of its role to provide a conducive environment for private sector development, needs to provide incentives in the bamboo sector to attract investors. A good starting point could be sensitising and educating players in the timber industry to improve their awareness of the opportunities and advantages of using bamboo over timber. This will help shift the focus on timber to bamboo for the manufacture of wood products. Free training programmes on bamboo utilisation and the provision of basic tools and equipment could motivate a shift from timber usage to bamboo. Entry points for bamboo in various sectors of the economy are outlined below.

*Employment and job creation:* In line with policies that target rural development and job creation (e.g. 1D1F), the government needs to do more to facilitate the establishment of bamboo factories in districts that are endowed with natural bamboo stands. Notably, a bamboo factory is currently being established in the Ashanti region by a private investor with the support of the government under the 1D1F programme. More government support in this direction would be an important pathway for the continued development of the bamboo industry. For example, farmers within bamboo-endowed districts could be supported in cultivating bamboo as a cash crop while efforts are made to sensitise Ghanaians on the use of bamboo shoots for food. This could boost bamboo utilisation in the country and help achieve the policy goals of rural development and employment creation.

*The forestry sector:* The forestry sector naturally becomes the main entry point of bamboo into the national economy. The effective implementation of sector policies (e.g. the 2012 FWP) could be an easy way to start developing the bamboo industry. The 2012 FWP recommends support for schemes to train specialised craftsmen in processing bamboo and rattan as a means of reducing reliance on chainsaw lumber. The policy also advocates for the holistic development of

the entire value chain of NTFPs, including bamboo, to reduce pressure on species exploited for lumber. Simply implementing this and related policies and strategies could serve as a game changer in the development of the bamboo industry. As part of the policy implementation, regulations on legal timber exploitation should be enforced to encourage the substitution of bamboo for wood. Regulations governing log processing/manufacturing, as captured in the 2012 FWP, the FC Act of 1999 (Act 571), L.I. 1649 (the Timber Resources Management Regulations of 1998), the Forest Protection Decree of 1974 (NRCD, 243) and the Forest Protection (Amendment) Act of 2002 (Act 624), must be enforced strictly to ensure that illegal access to timber logs is restricted. The expectation is that this might lead to demand for bamboo as a substitute for wood. In this light, timber taxes, fees and charges can also be revised to divert demand towards bamboo. Imported machinery and equipment for bamboo processing could be allowed to enjoy free import duties and tax holidays. Budding bamboo businesses could also be given some tax holidays to encourage investors, particularly in the wood industry, to shift towards using bamboo as a raw material for production.

Trade and market opportunities: In terms of trade and market opportunities for bamboo products, the government can play a pivotal role by encouraging and directing state institutions and agencies to patronise furniture made from bamboo for offices. This would have to be done gradually, as the current rate of production of bamboo furniture may not meet the furniture demand for all government offices. "Quality bamboo handicraft products, toothpicks, bamboo furniture, scaffold and industrial ply-bamboo are already making a niche in the local market" (Oteng-Amoako et al., 2008), and government support for producers could scale up production to meet domestic demand and likely leave a surplus for export. Although there is a growing market for bamboo products globally, access to it locally and internationally is an important consideration for government industry players. In the local market, major obstacles in the demand for bamboo products include poor finishing, improper treatment of raw material before usage and the inability of producers to supply large quantities in good time. These challenges can be overcome through the mechanisation of the production process and the establishment of bamboo factories. The government must target existing processors (artisans) and put them into groups that could then be trained to sharpen their skills and given financial assistance to acquire machinery for increased productivity. Standards for bamboo products should be developed and a taskforce put in place to ensure that those products meet the standards for both the local and international markets. The



private sector, as an engine of growth for the economy, must be attracted to the prospects and opportunities in the bamboo sector. One way for this to occur would be for the BRU, in collaboration with the Ministry of Business Development, to organise business fora on the prospects of the bamboo sector across the country to whet the appetite of investors. Public education on the economic and environmental benefits of using bamboo over wood products should be initiated so that the general public can fully appreciate the reasons for the need to substitute wood products with bamboo products.

The energy sector: An entry point for bamboo into the energy sector in Ghana could be through charcoal production for both the domestic market and export. A major focus of government policy on wood fuels, as outlined in the 2010 National Energy Policy, is to ensure that utilisation of the forest for wood fuels is done sustainably and efficiently to avoid deforestation (Energy Commission, 2012). Bamboo could be used to achieve this, given its high calorific value and fast growth. It is estimated in the Ghana Forest Plantation Strategy (2016–2040) that 50,000 hectares of bamboo would have to be established over a period of 25 years to sufficiently augment supplies from natural stands (FC, 2016). Effective implementation of these policies should make bamboo a readily available resource to boost the energy sector as well as other sectors of the economy. Regarding environmental protection and climate change mitigation, two government institutions - the VRA and the Environmental Protection Agency (EPA) - are currently collaborating to establish bamboo plantations to protect Volta Lake. A 270-hectare bamboo plantation is to be raised on the deforested, VRA-acquired, 280-ft contour around the lake to prevent siltation, excessive evaporation and human encroachment. The government could initiate similar projects to plant bamboo along major water bodies in the country (especially the Volta system) to protect them. Some research is also ongoing on agroforestry initiatives using bamboo, and this needs to be supported to find solutions for deteriorating soil fertility and general environmental degradation. Bamboo has been identified as useful in rejuvenating poor soils and protecting water bodies (Zhou et al., 2005). The Yangtze River in China, the Lofa River in Liberia and the Mahaweli River in Sri Lanka are all protected by bamboo plantations (Zhou et al., 2005; Bokpe, 2019).

INBAR is also very keen on the use of bamboo for diverse purposes in Ghana. It has established five key ways that bamboo can help countries mitigate and adapt to the impacts of climate change:

- **Carbon sequestration:** Bamboo's fast-growing and renewable stands sequester carbon in their biomass at rates comparable, or even superior to, a number of tree species.
- **Replacing fossil fuels and reducing deforestation:** Bamboo helps avoid fossil fuel use and reduces deforestation by offering an alternative, highly renewable source of biomass energy.
- Adaptation: Bamboo's rapid establishment and growth allow for frequent harvesting. This allows farmers to flexibly adapt their management and harvesting practices to new growing conditions as they emerge under climate change.
- **Restoration of degraded lands:** Bamboo is integral to many natural and agricultural ecosystems in and near the tropics. It is useful for restoring degraded lands.
- Livelihood development: Bamboo is a versatile and rapidly renewable resource with a wide range of livelihood applications.

The full potential of bamboo for national development can be tapped with the effective coordination of relevant intuitions. Governmental institutions such as ministries and other agencies must be strengthened with logistics and human resources to offer the necessary policies and business environment for the development of the bamboo sector. Existing entities such as BRU and BARADEP must be strengthened by vehicles and adequate personnel with requisite expertise to guide policy and carry out awareness creation through training programmes. It would be useful to revive the comatose National Steering Committee on Bamboo and Rattan Development Programme so they could play the coordinating role of synergising the efforts of all relevant institutions. Bamboo desks should be created in all relevant ministries and agencies (lands and natural resources; trade and industry; business development; local government; the Energy Commission; food and agriculture; the EPA; and science, technology and innovation) to facilitate coordination. This would promote inter-sectorial policy design and programmers to fasttrack the development of the bamboo sector. The MLNR through BARADEP, in consultation with the BRU, could provide policy and strategic direction for bamboo development in Ghana. The strategy must define actions that consider the unique opportunities for bamboo identified in the different sectors of the economy. It must also be guided by best practices and lessons from other countries (e.g. China) that have leveraged bamboo to increase their economic and social development. The strategy also needs to consider the development needs of the country, such as housing, biofuel for homes, rural development, job creation, poverty alleviation and environmental protection.



## 7. Conclusion

This section presents a summary and synthesis of the findings of this study in relation to bamboo policy integration into Ghana's national development processes. The versatility of bamboo in terms of its growth and utility makes it a very important natural resource to leverage in Ghana's national development agenda. Bamboo is already a resource and potential resource in many sectors of the economy and can therefore be used to accelerate inclusive development. If the economic potential of bamboo is sufficiently harnessed in Ghana, would aid in the achievement of SDGs 1 (poverty alleviation), 7 (clean energy), 11 (housing and cities), 12 (sustainable consumption), 13 (climate change) and 15(life on land). However, due to the lack of coordination of policies in various sectors of the economy, very little of bamboo's potential has been realised. Ghana has a long-term national development plan (LNDP 2018-2057) that aims to" build an industrialized, inclusive and resilient economy"; however, the resources that should be used and how this goal can be achieved are not clearly stated in LNDP 2018-2057 or any other development policy. Well-aligned, relevant policies and coordinated institutions can aid in Ghana's economic growth by using bamboo as a resource in building and construction, energy, environmental protection, job creation and rural development. Timber resources in Ghana are guickly being depleted, making it imperative to develop substitutes for timber to save the country's forests. Saving the forests in Ghana is imperative to meeting SDG15 and implementing international agreements such as REDD+ and the Kyoto Protocol. Since bamboo can be used to produce many of the same products as wood, it can be developed as a good substitute for timber.

The need to develop the bamboo industry as a means of alleviating poverty and rural development can be traced to Article 36(1) of the 1992 Constitution, which enjoins the state to stimulate inclusive economic development and thus improve the livelihoods and engender the welfare and happiness of all citizens. The versatile nature of bamboo in terms of its uses and its geographical distribution in Ghana qualifies it as a resource for equitable development in Ghana. Many policies and legislative frameworks for the forestry sector in Ghana were designed to facilitate the exploitation of timber resources, with little regard for NTFP development. However, the importance of bamboo has been recognised in the 2012 FWP. This policy particularly mentions bamboo, recognises the importance of it as a substitute for timber and specifically seeks to ensure the sustainable management of bamboo resources and improve existing stocks. There is,

therefore, a missing link between policy and implemented projects since bamboo has not been a part of any government interventions since 2012. Bamboo can be used as a resource to achieve the objectives of many environment-related policies in Ghana, such as the 2012 National Climate Change Policy, Ghana NBSAP (2016), the 2011 Renewable Energy Act and the 2015 Ghana Housing Policy.

The government will play a major role in the development of the bamboo sector in Ghana. Various public institutions in different sectors of the economy need to coordinate to formulate actionable policies for this sector. Relevant public institutions need to be strengthened with a high calibre of human resources and logistics to roll out programmes that can have a significant impact on society and the economy in Ghana. The FC could become the coordinating agency to work with an inter-ministerial committee and chart a policy path to attract the attention of both the public and private sectors. To help achieve this, bamboo desks should be created in all relevant public institutions to ensure effective coordination and consultation on issues related to bamboo, even among the elite and stakeholders in other public institutions whose decisions affect the development of the resource. It was revealed in this study that the majority of people who make decisions on bamboo development actually have little knowledge of its potential and advantages as a substitute for timber.

While the private sector holds the key to the economic development of bamboo, the government needs to create a conducive business environment for the sector by providing incentives to attract investments. However, stakeholders in the bamboo industry believe that the government should engage all actors in the sector in the decision-making and support research in developing the resource. Stakeholders also recognise the important role of the private sector through investing and helping to train students through internships. A good starting point would be to sensitise the business community (including SMEs) by pitching the potential and advantages of bamboo enterprises. In addition, tax exemptions and holidays for bamboo business start-ups would attract more investors into the sector.

Bamboo products have an emerging global market, but they are also doing well in the Ghanaian market. While low capacity and low-tech finishing militate against the full exploitation of local and



international markets, the availability of raw materials and labour remains a huge investment potential in the sector. The continued training of processors and access to state-of-the-art machinery and tools could boost the prospects of bamboo businesses in Ghana and make their products more readily acceptable in local and international markets. Enhanced skills and machinery will also make bamboo enterprises capable of meeting market demand in terms of both time and quantity.

Possible entry points for bamboo in national development policies and programmes include: 1) government support for youth in bamboo-endowed districts to create bamboo businesses in the MSME category. This could be done through the Ministry of Business Development, in line with its mandate to initiate, formulate, monitor and evaluate national policies and programmes aimed at improving the entrepreneurial and technical skills of MSMEs, particularly among youth in line with the government's economic and social development agenda. 2) Targeting bamboo MSMEs under 1D1F. 3) Giving legal backing to forestry sector policies that advocate for the development of NTFPs (e.g. Policy Objective 3 of the 2012 FWP and its strategies). This can make it compulsory for such policies to be implemented religiously. 4) The government prioritising the purchase of bamboo products to create a market for and awareness of bamboo products. 5) The promotion of bamboo charcoal production to reduce the exploitation of forests for wood fuels. This could create jobs for people who would raise bamboo plantations to produce charcoal for local market and export. 6) Using bamboo in climate change mitigation activities. The establishment of bamboo plantations and the subsequent shift from wood to bamboo would spare more trees in the natural forest to lock and sequester more carbon. 7) Awareness creation and advocacy for the incorporation of bamboo into the agricultural sector as a cash and food crop.

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