

## **Bamboo for housing in Ghana: challenges and prospects for the future**

**E. Appiah-Kubi \***, F. W. Owusu, S. L. Tekpetey and C. Essien

CSIR-Forestry Research Institute of Ghana, P.O. Box UP 63, KNUST-Kumasi, Ghana.

**Abstract:** Bamboo can be used for housing and is widely regarded as an excellent substitute for wood in the form of laminated bamboo boards. The extent of bamboo housing in Ghana is relatively low and is mainly traditional and rudimentary. It is perceived as a “poor man's house”. A stakeholder meeting was organized to identify the key challenges to the efficient use of bamboo in housing and propose recommendations for extensive utilization. The paper reports on the challenges identified, the opportunities and prospects available and major recommendations made to enhance bamboo utilization for housing. Lack of adequate expertise in bamboo processing and construction as well as appropriate technology for processing local bamboo species was identified as major challenge to bamboo usage. Furthermore, lack of commitment on bamboo usage by various stakeholders (industry, government, professionals, Non Governmental Organizations, private enterprises, individuals) was also identified as inhibiting bamboo development in the country. Opportunities available for enhanced bamboo utilization include the availability of the raw material and relevant institutions with capacity to support the industry. It was agreed by stakeholders that stronger institutional collaboration, capacity building and exhibitions are needed to promote bamboo for housing. To ensure a sustainable resource base, it is important to consider bamboo species as part of the priority species selected for the national plantation programme and should be managed appropriately.

*Key words:* Bamboo, challenges, future, housing, stakeholders.

### **INTRODUCTION**

Housing is recognized as one of the most important infrastructural developments necessary for the economic growth of a nation. Affordable shelter is a principal requirement for improving the quality of life of people in developing countries. Again, housing has been reported by Espiloy (1987) as one of the basic needs of man. However, the rising cost of housing is a problem that has bewildered many nations especially those in the developing world. Ghana is no exception to the rising cost of housing, which is due to the persistent increase in cost of building materials that are mostly imported. Ghana faces an acute housing deficit of one million, seven hundred thousand (1,700,000) units (Andoh, 2014), which represents an average of 13% increase for the year 2011. Currently cement is produced from clinker and gypsum at an annual cost of about \$80 million and that during the past decade the cost of cement per 50 kg bag has increased from GHC3.20 to GHC35.00 (1 Ghana Cedi (GHC) is equivalent to 0.26 US\$).

\* To whom correspondence should be addresses: [appiahkemma@yahoo.com](mailto:appiahkemma@yahoo.com)/[appiahkemma@gmail.com](mailto:appiahkemma@gmail.com)

The abundant nature of diverse raw materials, which can be used in the construction industry in the country, cannot be over emphasized. The increased use of the available local raw materials will considerably reduce the import bill on building materials as well as retain capital, provide affordable housing, generate revenue to the state, provide employment for the youth and hasten infrastructural development in the districts.

The government was seeking to ensure that by the year 2015 at least 60% of the raw materials used in the building and construction industry will be indigenous raw materials. One of such local raw materials is bamboo. It is renewable and grows abundantly in both the tropical and sub-tropical countries (Hsiung, 1991; Belcher, 1996; Fu and Banik, 1996) and has rapid growth capabilities thereby enabling it to reach maturity within three to five years (Zhou, 1995). The strength, lightness, straightness, flexibility, extra-ordinary hardness, range in size of bamboo, its abundance and ease of propagation make it suitable for a variety of purposes and hundreds of different uses (Jayanetti, 2001). According to Jayanetti (2001) bamboo is one of the strongest plant-based building materials, and there are bamboo structures that have been in existence for hundreds of years. The properties of the bamboo plant are advantageous especially in tensile and bending strength where they supersede man-made materials (Dunkelberg, 1985; Schaur, 1985; Hidalgo, 1996).

Bamboo can be used for housing and is widely regarded as an excellent substitute for wood in the form of laminated bamboo boards. According to Janssen (1987) four major factors have been reported for using bamboo as a building material in comparison with concrete, steel and wood. These include the energy needed for production of structures, safety of material in construction, of which bamboo is next to steel, strength and stiffness per unit area of material and simplicity of production of the material.

A bamboo house is a structure that integrates the use of bamboo, either partially or fully and functions as a habitat for humans. According to Tekpetey *et al.* (2013), there are three major types of bamboo structures namely

- Type 1: structure built with raw/round bamboo culms.
- Type 2: structure built with laminated/processed bamboo.
- Type 3: structure built with round culms, processed/ laminated bamboo in composite with other building materials.

The extent of bamboo utilization for housing in Ghana is relatively low. The use of bamboo as housing material in Ghana is as Type 1 structures i.e. structures built with raw or round bamboo culms with limited processing since they still follow the traditional and rudimental patterns of housing. This has led to the poor promotion of bamboo as a housing material in Ghana in spite of its excellent qualities and aesthetic value in housing showcased in other parts of the world especially in China, India and other south eastern Asian countries. Though the country is endowed with bamboo resources which are mainly grown in the wild, still it is not being made use to its full

extent. This made it necessary for the stakeholders in bamboo usage to gather and discuss the challenges faced in the usage of bamboo and propose solutions to enhance the efficient utilization of this resource especially for housing. The paper outlines these challenges and recommendations discussed during the bamboo stakeholders' meeting.

## MATERIALS AND METHODS

A nationwide survey was conducted to identify the key stakeholders involved in the use of bamboo for housing. The stakeholders include the Bamboo and Rattan Development Programme (BARADEP) of the Forestry Commission of Ghana under the Ministry of Lands and Natural Resources. A list of all organizations (governmental, non-governmental and inter-governmental), communities and local industries involved in bamboo cultivation, processing and utilization across the country were collected. Contacts were made to all the organizations and visits were also made to their premises, factories, and plantations by the team. Structured questionnaires were designed and pre-tested in Kumasi. These were administered to the communities and artisans involved in bamboo processing through interviews. Six out of the ten regions of Ghana were visited during the survey. The regions include Western, Eastern, Central, Ashanti, Volta, and Greater Accra. These regions either had a large amount of bamboo resource or higher consumption of bamboo products. Stakeholders' workshop was organized at the Forestry Research Institute of Ghana to validate the findings from the survey, identify any additional challenges faced by the bamboo industry and bring out the recommendations for enhanced utilization and promotion of bamboo.



**Figure 1:** Stakeholders group at the Bamboo stakeholders' meeting

## RESULTS AND DISCUSSION

Figure 1 shows some relevant bamboo stakeholders that were identified and interviewed during the survey as well as the sites of bamboo processing/utilization in the six regions of Ghana visited. These stakeholders included NGOs, research institutes, associations, communities, hotels/beaches, processing/manufacturing companies and government metropolitan (Figure 1).

### Opportunities and prospects for bamboo use in housing

*Bamboo resources are available in most parts of Ghana*

Bamboo resources are widely distributed and grow mostly in the wild in the southern part of Ghana. With the increasing interest and state of knowledge in bamboo cultivation, bamboo plantations can be established easily in Ghana. There is the possibility of producing hybrid varieties possessing superior properties. It is known that the predominant species, *Bambusa vulgaris*, available in Ghana might not be suitable for housing and construction because most of the stands are not well managed. However, hybrid species which are stronger and possess desired qualities for construction can be introduced and managed in plantations.

*Indigenous knowledge on bamboo housing*

Ghanaians use bamboo for different purposes in rural areas. Bamboo is used in building houses, kitchens, barns, huts, fences, etc in the villages. A number of restaurants and summer huts at amusement parks and beaches across the country have been built with bamboo by local artisans (Figure 2). Evidence from existing bamboo structures show that, some knowledge on the use of the material exists. Few artisans encountered in the survey have built 1-storey structures made of bamboo for clients in the Central and Western regions of Ghana. From the existing designs and structures, bamboo houses can be easily integrated with other building materials.



**Figure 2:** Use of bamboo in 'summer hut' construction at Cape Coast, Ghana

*Available Institutions / Organizations / NGOs*

Ghana has a number of universities offering programmes in Forestry, Wood Science and Technology with one of the study areas being development of Non-timber Forest products (Bamboo and Rattan resources). Students are therefore exposed to bamboo as a natural resource and a substitute for wood. The Forestry Research Institute of Ghana under the Council for Scientific and Industrial Research (CSIR-FORIG) is a centre of excellence in forest and forest products (including bamboo) research. The institute has scientists with expertise in bamboo research and development. Scientists have published articles in journals and reports on the various development stages of bamboo in Ghana. The Wood Industry Training Centre (WITC) of the Forestry Commission of Ghana is a centre set up to train personnel for the wood industry for which training in bamboo processing and utilization can easily be integrated.

In 2002, Ghana government set up the Bamboo and Rattan Development Programme (BARADEP) under the Ministry of Lands and Natural Resources to develop the bamboo and rattan industry and promote bamboo as an alternative to wood. The programme has facilitated the dissemination of information on bamboo harvesting, propagation and utilization and has both technical and administrative personnel to achieve its objectives.

The International Network for Bamboo and Rattan (INBAR) has an office in Ghana (Kumasi) which also doubles up as the West Africa regional office. INBAR is an intergovernmental organization dedicated to improve the livelihoods of the poor producers and users of bamboo and rattan, within the context of a sustainable natural environment. INBAR promotes sustainable development with bamboo and rattan by consolidating, coordinating and supporting strategic and adaptive research and development. INBAR organizes and supports many training programmes in bamboo utilization and sustainable use of bamboo for housing in many countries. Immense support can be sourced from INBAR in developing the bamboo and rattan industry especially for housing in Ghana.

Other non-governmental organizations and individuals are developing the industry through establishment of plantations, training of local artisans and the youth, product development and marketing of bamboo products across the country. A local company, Ghana Bamboo Bikes Limited, located in Kumasi has been established and producing bicycles from bamboo for both export and domestic market. A bamboo processing facility, has also been set up at Assin-Fosu in the Central Region.

*Job Opportunities*

A number of the Wood processing industries are folding up due to the depletion of the raw material base. Most of the companies are operating under capacity because of the reduced log volumes. These companies can be converted into bamboo processing facilities to supplement the wood industries. Various products can be developed for both local and export markets. Bamboo boards and beams can be produced by these

companies for the housing industry. Housing elements built in wood can be substituted with bamboo. Bamboo craftsmanship can therefore be a new area of employment for many young people. Local people can be employed by these bamboo factories or be self-employed as bamboo artisans, thereby reducing the unemployment rate in Ghana.

### **Challenges and gaps for Bamboo utilization in housing**

#### *Lack of expertise in bamboo processing and construction among stakeholders*

Ghana, like other African countries, lacks expertise in the field of bamboo processing, design and construction. Professionals in the building industry are used to designing and building with other conventional materials such as concrete, steel, and to some extent wood. There is no formal training specifically for bamboo utilization unlike the other conventional building materials. Experiences gained by several stakeholders have been on their personal use of the material over time without adequate technical information about the material's properties and behaviour. Technical data on the bamboo species available for use have not been made available to architects and engineers for consideration in design and construction of houses.

#### *Stigmatization associated with bamboo houses or products*

In Ghana, like other African countries, the use of bamboo in housing is mostly found in the rural communities. The extent of usage include building barns, huts, drying platforms, kitchens, fences, and as reinforcements in mud houses (Wattle and daub). These houses are usually built by poor farmers who collect the material from their farms and the wild. This has led to bamboo being considered as a 'poor man's building material in the rural communities and therefore inferior to other building materials. Bamboo houses are seen as temporary houses to solve immediate housing problems in the rural communities or on farmlands. Bamboo is readily available and less expensive unlike cement, sand, steel etc which are very expensive to acquire for building. Hence it is seen as inferior building material.

#### *Lack of promotion of bamboo houses*

Bamboo houses have not been promoted due to many factors including poor finishing of existing bamboo houses in the country. The houses are usually built by villagers or poor farmers who lack the resources and technical know-how in building with bamboo or laminated boards. The bamboo is used raw without value addition and appropriate chemical treatment to make them durable. Lack of design and aesthetic considerations make the houses despicable. The available houses are poorly finished and do not promote the use of bamboo.

#### *Non availability of Processing equipment and tools*

Equipment and tools for processing bamboo are not available. Ghana is advanced in processing wood with a number of wood processing companies spread across the nation especially in the forest regions of the country. Large scale wood processing

companies have invested in equipment and tools for wood processing and heavily export wood and wood products. However, bamboo processing machines are lacking in the industry. The same machines used in processing wood are currently being used in processing bamboo. This makes processing of bamboo difficult, ergonomically hazardous and laborious, hence lack of value addition to bamboo. This also contributes to the poor finishing of bamboo products as compared to bamboo products from other parts of the world (China, India). The only company, Pioneer Bamboo Limited, known to have some machines for bamboo processing faces some processing challenges and suffer from frequent breakdown of machines.

#### *Commitment of stakeholder institutions/Government*

There is lack of synergy and collaboration among stakeholder institutions in promoting and enhancing the use of bamboo in the country. There is no direct link between research institutions and industry or NGOs working with bamboo. The commitment of the government in funding bamboo research and development has been low. The government agency responsible for coordinating and supporting the development of bamboo, BARADEP, has not achieved much in its efforts due to lack of funds and logistics. There is no specific policy on bamboo as a raw material and its utilization especially in housing. Support to state institutions to set up bamboo processing and resource centres are not available. Furthermore, there is general lack of commitment by various stakeholders (industry, government, professionals, NGOs, private enterprises, individuals) on bamboo usage despite the suitable properties bamboo possesses for housing.

## **RECOMMENDATIONS**

### **Bamboo Resource development**

The Forestry Commission (FC) of Ghana should release some of the degraded forest lands for bamboo plantation development. NGOs and individuals who are ready to establish bamboo plantations should be encouraged. Bamboo can be used to reclaim mined sites where it is difficult for indigenous tree species to thrive. It is therefore recommended that bamboo be planted on mined sites to increase the resource base. To ensure sustainable management of the resource base, it is important to include bamboo species as part of the priority species selected for the national plantation programme. In this case introduction of new bamboo species from China and India for different end uses is recommended.

### **Capacity building**

The capacity of scientists and professionals in bamboo research and development, utilization and promotion should be built through further training. Scientists, professionals and artisans in the industry should be trained in specific areas relevant for bamboo utilization especially in housing. Training should be organized in China or India where bamboo utilization is well advanced. These selected people will then act as trainers on their return and transfer knowledge, experiences and researched

technologies to relevant industry players to enhance the use of bamboo in our industry. Training workshops needs to be organized for all levels of artisans and builders in bamboo cultivation, processing, treatment and construction. Educational institutions, especially those offering courses in the built environment disciplines, should introduce bamboo design and construction as part of their courses to help sustain knowledge transfer in the industry. Bamboo housing design competition can be instituted at the university and other tertiary institutions for students in Architecture and Civil Engineering to boost interest in bamboo as a material.

### **Promotion of Bamboo Houses**

Bamboo houses should be promoted through exhibitions and at housing fairs. Prototype and miniature bamboo houses should be constructed and showcased during such fairs and special exhibitions. Competitions can be organized at such fairs and awards for best designs should be instituted for professionals who design and build with bamboo and other local materials as a form of honor and recognition. This will encourage others and the general public to develop interest in bamboo as a building material. Influential people in communities should be encouraged to begin building their houses with bamboo and other local materials to serve as an example and models for others in society to copy. People easily copy and tend to fancy what influential and rich people in their communities do. If the rich are involved, adequate value can be added to the bamboo during the processing and construction and hence increase the beauty or aesthetics of such houses.

### **Inter-institutional / interdisciplinary collaboration**

Inter-institutional or interdisciplinary collaboration must be encouraged to help promote bamboo and other local materials for design and construction. Researchers from the research institutions and universities must work together and liaise with the industry to share knowledge and transfer technology. Different research units and institutions are working on different aspects of bamboo and its utilization. It is necessary that all these units come together to share ideas and use synergy in solving problems thereby developing technologies for enhanced utilization of bamboo. Various agencies and government institutions linked to local raw materials usage, housing, environment, technology, trade and industry should collaborate to develop policies to promote the industry. For example, BARADEP can liaise with the Ministry of Environment, Science, Technology and Innovation (MESTI) on its project of promoting the use of local materials for housing to help achieve their objective of promoting bamboo development within the same funding scheme instead of sourcing for different funds for their activities. MESTI (Ministry of Environment, Science, Technology and Innovation) and MWRH (Ministry of Works, Water Resources and Housing) can liaise with the Ministry of Education (MOE) to incorporate bamboo in the construction of classrooms for schools under trees. Bamboo can also be incorporated in the construction of the affordable housing scheme by the government. This will also help to create market and jobs for those willing to invest in the bamboo construction industry.

## CONCLUSION

Bamboo is a renewable natural resource and has many of the properties of hardwoods that have been used in building and construction over the years. It can be used for housing just like any other building material. It has been used globally to build houses, especially in Asia, where they are in abundance. Bamboo is also found in large quantities in Ghana. In spite of its unique qualities as a building material and abundance, bamboo use has been limited to building huts, barns, kitchen and reinforcement in mud houses. Its usage is low in Ghana. This has been due to a number of challenges and gaps in its management, processing, utilization and promotion. However, the use of bamboo has a lot of prospects in Ghana as an alternative to wood. Opportunities exist for bamboo usage in housing for maximum benefit to the country. The recommendation made should be tackled to enhance the use of bamboo in housing to reduce the housing deficit and improve the livelihood of the people.

## ACKNOWLEDGEMENTS

The authors are grateful to the various stakeholders who participated actively in National stakeholders meeting. Special thanks to Ministry of Environment Science Technology and Innovation for the funding the Phase One of the project on bamboo for housing that led to this achievement.

## REFERENCES

- Andoh, D. 2014. Ghana has 1.7-million housing unit deficit. Daily Graphic. 1<sup>st</sup> March 2014. <http://graphic.com.gh/news/general-news/18541>
- Belcher, B. 1996. The role of bamboo in development. *In*: Belcher, B., Karki, M. and Williams, T. (Eds.) *Bamboo, people and environment: Proceedings of the 4<sup>th</sup> International Bamboo congress, Bali, Indonesia, June 1995, vol 4: 1-9.* New Delhi: The International Network for Bamboo and Rattan (INBAR).
- Dunkelner, K. 1985. Bamboo as a building material. *Bambus – Bamboo IL 31.* Stuttgart: In Institute for lightweight structures, University of Stuttgart. No. 38
- Espiloy, Z.B. 1987 Physico-mechanical properties and anatomical relationships of some Philippines bamboo. *In*: Rao, A.N., Dhanarajan, G. and Sastry, C.B. (Eds.) *Recent Research on Bamboos: Proceedings of the international bamboo workshop organized jointly by MOF - China, IDRC – Canada and IUFRO and held in Hangzhou, China on October 6 – 14, 1985. 257-264.*
- Fu, M. and Banik, R. 1996. Bamboo production systems and their management. *In*: Ramanuja Rao, I.V. and Widjaja, E. (Eds.) *Bamboo, People and Environment: Proceedings of the 4<sup>th</sup> International Bamboo Congress, Bali, Indonesia, June 1995, Vol 1: 1-5.* New Delhi: The International Network for Bamboo and Rattan (INBAR).
- Hidalgo, O. 1996. Study of mechanical properties of bamboo and its uses as concrete reinforcement: Problems and solutions. *In*: Ganapathy, P.M., Janssen, J.A. and

- Sastry, C.B. (Eds.) Proceedings of the 4<sup>th</sup> International Bamboo Congress, Bali, Indonesia, June 1995, Vol 3: 76 - 91. New Delhi: The International Network for Bamboo and Rattan (INBAR).
- Hsiung, W. 1991. Prospects of bamboo development in the world. Bamboo Society of America, No 1-2: 168 – 178. Republished in Bamboo Research, 1993, (Sum no. 47. No. 1. Nanjing: Nanjing Forestry University.
- Janssen, J.J.A, 1987. The mechanical properties of bamboo. *In*: Rao, A.N., Dhanarajan, G. and Sastry, C.B. (Eds.) Recent Research on Bamboos: workshop organized jointly by MOF - China, IDRC – Canada and IUFRO and held in Hangzhou, China on October 6 – 14, 1985. 250-256.
- Jayanetti, L. 2001. Bamboo housing: TRADA's work in India. *In* Proceedings of the 3<sup>rd</sup> International seminar on Bamboo cultivation, processing and utilization. Held in Yibin city, Sichuan, China from 20<sup>th</sup> – 22<sup>nd</sup> October 2001 and sponsored by International Network for Bamboo and Rattan (INBAR), Provincial Forestry Administration of Sichuan and Yibin Municipal Peoples' Government. 125-137.
- Schaur, E. 1985. Bamboo a material of the future. Bambus – Bamboo IL31, Stuttgart: Institute for lightweight structures, University of Stuttgart No. 418.
- Tekpetey, S.L., Owusu, F.W. and Appiah-Kubi, E. 2013. The extent of bamboo housing in Ghana. A presentation at the Stakeholders Meeting on Bamboo for housing in Ghana. 30<sup>th</sup> September 2013. Forestry Research Institute of Ghana, Fumesua, Ghana.
- Zhou, F. 1995. The production and utilization of bamboo in China. Bamboo Research. 1995, No.1, Sum No. 52, 1995, Nanjing: Nanjing Forestry University.