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Research Article

Bamboo use for the housing industry in Ghana: Urban Stakeholders' Perception

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Abstract
The study was undertaken to determine stakeholders' perception on bamboo housing; finding the benefits and identifying perceived challenges in the use of bamboo for housing in urban centres. Personal interviews, questionnaire administration and field observations were used to gather information from 114 purposively and conveniently selected respondents in Abokobi, Dwobor and Fumesua, as well as key informants from International Network for Bamboo and Rattan. Two main types of bamboo housing were found in the study areas; the traditional bahareque and modern prefabricated bamboo houses. The results also showed that affordability (35.9%), generation of employment (23.7%), easy maintenance (15.2%), good air circulation (10.7%), durability (7.8%), control of deforestation (4.1%) and purification of the environment (2.6%) were some of the benefits stakeholders associated with the use of bamboo for housing. Lack of technical know-how (34.67%), people's misconception about bamboo housing (33.33%), lack of funds (24.00%) and inadequate assistance from the government (8.00%) were perceived challenges encountered by people involved in bamboo housing. Most respondents hold the view that bamboo housing is for the poor (44.00%), not durable (29.33%), lack of appropriate technology (16.00%) and unsuitable bamboo species (10.67%). Awareness creation in the use of bamboo for housing should involve intensive education on the use, treatment and qualities of bamboo for housing in the various communities is paramount.

Keywords
bamboo–fabricated-houses–traditional bahareque-bamboo- houses–stakeholders–awareness creation

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1. Introduction

The existing stock of housing in Ghana cannot cope with the rapid population growth resulting from natural increase and tides of industrialization and immigration [1]. The idea of increasing the stock may be hindered by other difficulties and damping factors such as lack of resources, shortage of building materials and lack of skilled labour. Although, factually, human needs for shelter and natural resources can hardly ever be imagined to fall, it is imperative to consider alternative, sustainable materials for the housing industry especially as each year about 13 million hectares of the world's forests are lost due to deforestation [2]. One natural material which has great appeal in terms of availability and ease of use in the rural and farming communities in the developing world is bamboo. Bamboo is a fast growing, renewable, widespread, low cost, environment enhancing resource with great potential to improve poverty alleviation and environment conservation [3]. Bamboos are giant, woody grasses which put out several full length, full diameter, naturally prefinished, ready-to-use culms ("stems") each year. Bamboo is the most diverse group of plants in the grass family, and the most primitive sub-family. It is distinguished by a woody culm, complex branching, a generally robust rhizome system and infrequent flowering. There are about seven (7) species of bamboo in Ghana. These are; *Bambusa arundinacea*, *Bambusa bambus*, *Bambusa multiplex*, *Bambusa pervariabilis*, *Bambusa vulgaris*, *Bambusa varvitata*, and *Dendrocalamus strictus*. Only Bambusa vulgaris is indigenous to Ghana while the others were introduced into the country from Asia. Because of its strength, flexibility and versatility, bamboo culms have been used

mainly in housing and for other construction purposes (e.g. bridges, scaffoldings) for centuries, particularly in rural areas. Bamboo provides pillars, walls, window frames, rafters, room separators, ceilings and roofs for houses. Other uses of bamboo are many and varied. It is used in the making of furniture, handicrafts, musical instruments, basket ware, matting, rayon and paper, and is used as food (bamboo shoots), fodder and fuel wood. Bamboos are tied together to make grid reinforcement and placed in soft clay to solve deformation problems in embankments [4]. Apart from traditional uses, bamboo has many new applications as a substitute for fast depleting wood and as an alternative to more expensive materials. Examples of this are the modern paper industry and new products such as bamboo parquet and veneer. The advantages of using bamboo for construction do not end with technical advantages only. It is very economical because it is a local product and therefore amongst the cheapest building materials. Prices have been increasing lately though due to over extraction from forests and lack of plantations that are well managed. Cultivating bamboo can have very high yields if managed properly. Moreover, bamboo can be used as a substitute for timber in many applications, and compared to the trees used for that timber, bamboo grows substantially faster. It can contribute to a solution for the deforestation that is at the present causing concerns for the environment. Bamboo which is a viable alternative to wood has not gained the needed recognition and attention. Much awareness of its viability has not been created and information on the stakeholders' perception is also lacking. Such information is imperative in an attempt to promote bamboo use as an innovative technology for society's adoption so as to reduce over-reliance on natural wood as raw material for housing in Ghana. Bamboo is one of the world's best natural engineering materials. Due to its high tensile strength, it is an essential structural material in earthquake architecture and is one of the strongest building materials. Its qualities of strength, light weight and flexibility make it a viable alternative to tropical timber that is used in the furniture and building materials industries. It is relatively cheap, easy to work with and readily available in Ghana. This study is intended to solicit various stakeholder views on the use of bamboo as a suitable alternative to wood for housing in order to promote its use to reduce the ever increasing pressure on the already extinction threatened traditional tree species for the housing industry in Ghana. Subsequently the study sought to (1) identify bamboo houses at the study area; (2) find out the benefits of using bamboo for housing; (3) assess the people's perception on bamboo housing and (4) identify key challenges encountered in the use of bamboo for housing in the study area.

2. Materials and Method

2.1 Description of Study Area

This study was conducted in five forest-dependent communities around Krokosua Hills Forest Reserve (KHFR) in the Western Region of Ghana (Figure 1). The reserve, which lies between 6^o 15' and 6^o 40' North latitudes and 2^o 40' and 3^o 00' West longitudes, covers an area of 481.61 Km^2 divided into two major blocks: production block (70%) for timber production and a globally significant biodiversity area (GSBA) (30%) for conservation. The adjoining off-reserve areas are mainly farmlands with a few scattered trees.

The study areas were Abokobi, Fumesua and Dworbor in the Ga East Municipal Assembly in the Greater Accra Region, Ejisu- Juaben municipality in the Ashanti Region and Cape Coast in the Central Region respectively. Ejisu-Juaben Municipality is one of the 26 administrative and political Districts in the Ashanti Region of Ghana. The municipal stretches over an area of 637.2 km2 constituting about 10% of the entire Ashanti Region. The municipal is located in the central part of the Asanti Region and lies within latitude 10^o 15' N and 1^o 45' N and longitude 6^o 15' W and 7^o 00W'. Fumesua is 15 kilometres away from the centre of Kumasi. It serves mainly as a residential area for workers in various companies in Kumasi. Dworbor lies on coordinates 5^o 11'N 1^o 19'W and it is bounded on the south by the Gulf of Guinea, west by the Edina Municipal, east by the Abura district and north by Twifu district.

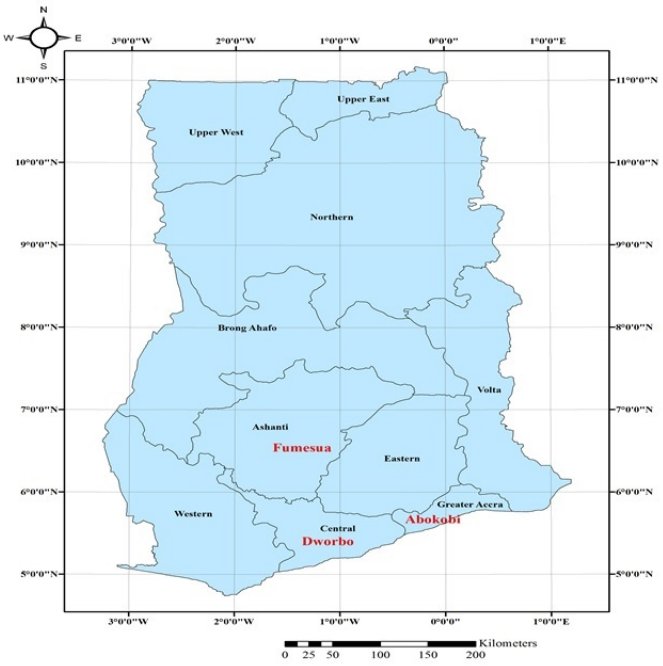

Figure 1. Map of Ghana showing study areas (in red colour)

2.2 Sampling Design

Purposive sampling method was used to select three communities (Abokobi, Fumesua and Dworbor) for the study. This was due to the availability of bamboo utilization for diverse purposes.

2.3 Method of Selecting Respondents

The study involved 114 respondents from selected communities, Non-Governmental Organizations and International Network for Bamboo and Rattan. The target respondents for the study were grouped into;

- Non-Governmental Organizations: Housing the Masses and Sabre Charitable Trust were purposively sampled. Ten (10) respondents each from the selected NGOs were solicited for their views in the study.
- Key informants' interviews were conducted with 4 employees of International Network for Bamboo and Rattan (INBAR).
- Community Members: convenient sampling method was used to select 30 households from each community.

2.4 Instruments for data collection

Data were obtained from both primary and secondary sources. Primary data was gathered from selected respondents through personal interviews, questionnaire administration and field observations. Secondary data were obtained from the library of the Faculty of Forest Resources Technology and Bamboo and Rattan Development Programme (BARADEP).

2.5 Data Analysis

The data collected were analysed in descriptive statistics (frequencies and percentages), and cross-tabulations at 5% level of probability using Statistical Package for Social Sciences (SPSS – IBM version 20). Results were presented in tables and figures.

3. Results and Discussion

3.1 Identification of bamboo houses in the study area

The study revealed two kinds of bamboo houses namely; traditional bahareque bamboo in which a bamboo frame is plastered with cement or clay and modern prefabricated houses made of bamboo laminated boards, veneers and panels (Table 1). A total of five (5) traditional bahareque bamboo houses were identified in Abokobi (4) and Fumesua (1) whereas eight (8) modern prefabricated houses were also spotted in Dworbor (5) and Abokobi (3).

The traditional bahareque bamboo houses were mostly found at Abokobi and Fumesua. The bamboo houses at Abokobi were built by Housing the Masses in an attempt to provide Low-Income Housing and Slum Upgrading in the area. Again, they seek to meaningfully contribute to

Table 1. Occupational Health and Safety Requirement among LPG Refilling Plants

Types of bamboo house	Description	Location	Quantity	Remarks
Traditional bahareque bamboo houses	Bamboo frame is plastered with cement or clay	Abokobi	4	These bamboo houses were built by Housing the Masses in an attempt to provide Low-Income Housing and Slum Upgrading in the area
		Fumesua	1	A bamboo classroom built by INBAR at Fumesua as means of creating awareness on the use of bamboo for housing
Modern prefabricated houses	Made of bamboo laminated boards, veneers and panels	Abokobi	3	These bamboo houses were built by Housing the masses in an attempt to provide Low-Income Housing and Slum Upgrading in the area
		Dworbor	5	The Sabre Trust has designed and built a new type of kindergarten schools which delivers an optimal learning environment for the pupils

Source: Field data (2014)

addressing the challenges of the rapid rate of urbanization in Ghana, while making significant use of its opportunities in a comprehensive and sustainable manner. A bamboo classroom was also built by INBAR at Fumesua as means of creating awareness on the use of bamboo for housing in the area. The Modern prefabricated houses were found at Dworbor and Abokobi. Through close collaboration with the community, the Sabre Trust has designed and built a new type of kindergarten schools at Dworbor. This schools provides a light, airy, spacious and comfortable learning environment - a stark contrast to the make-shift schools found in most villages. The school is also very environmentally friendly, using local materials such as bamboo, soil and coconut husk, and includes a roof designed to capture rain water for washing and drinking. With this innovative school design, the use of cement and metal is minimised and local, renewable resources are given preference. The modern prefabricated houses built at Abokobi by Housing the Masses, used bamboo for the foundation and as its roofing.

3.2 Benefits of using bamboo for housing

Responses on the benefits of using bamboo for housing varied among stakeholders as shown in Table 2. Majority (35.9%) of the respondents indicated that bamboo housing was affordable, followed by employment generation (23.7%), easy maintenance (15.2%), good air circulation (10.7%), durable (7.8%), control of deforestation (4.1%) and purification of the environment (2.6%) . The NGOs and key informants had a more elaborate view on the benefits of bamboo houses. Majority (35.9%) of the respondents were of the view that bamboo housing is of low cost compared to wood and masonry. Bamboo has an enormous potential for alleviating many ofthe social and environmental problems of the developing world today [5]. As a raw material, bamboo is one of the cheapest construction materials. According to the NGOs, 1 bamboo culm (6–8 m) is GH ¢ 3.00; hence, for 35 pieces cost GH ¢ 105.00, whereas the market price of 1 m3 of Odum (Milicia excelsa) wood is almost GH ¢ 780.00 – 820.00. According to calculations done by [6], the price of 35 pieces of bamboo culm (80 mm outer diameter, thickness 6 mm and length 8 m) is comparable with price of 1 m3 of wood. From this, one can easily compare the cost of bamboo and wood.

The manufacturing of low-cost bamboo houses provides employment to a large number of people, including generation of extra employment in its forward and backward linkages such as cultivation, harvesting, primary processing, transport and marketing of bamboo. The NGOs indicated that proper treatment of bamboo provides a service life of up to 30 years. Durability can be prolonged with careful choice of bamboo species, preservation, and use of complementary construction materials and regular replacement of outdated or deteriorated parts [7]. Again, it was realized that bamboo houses provide

Table 2. Respondents' view on the benefits of using bamboo for housing

Responses on the benefits of using bamboo for housing	Community Members		NGOs	Key informants		Total		
	No.	%	No.	%	No.	%	No.	%
Affordable	73	50.7	20	19.4	4	17.4	97	35.9
Employment Generation	40	27.8	20	19.4	4	17.4	64	23.7
Easy maintenance	21	14.6	17	16.5	3	13	41	15.2
Good air circulation	10	6.9	15	14.6	4	17.4	29	10.7
Durable	0	0	17	16.5	4	17.4	21	7.8
Control of deforestation	0	0	9	8.7	2	8.7	11	4.1
Purification of the environment	0	0	5	4.9	2	8.7	7	2.6

Source: Field data (2014)

good air circulation in the room. This is as results of the fact that full bamboo culms are cylindrical with holes in them and as such when used for walls, the holes trap heat flow from external environment to the interior space for about 12 hours, releasing it gradually [8]. This maintains a cool interior temperature. The holes also serve as sound barrier when the culms are embedded in the concrete. According to Janssen [9], only 70 ha of bamboo plantation are sufficient to build 1000 bamboo houses per year. If these houses were built with timber, 600 ha of natural forest would be destroyed each year. Additionally, bamboo can regenerate within 2–3 years, while for timber it could take more than 25 years. It is the fastest growing plant of the world and replacement is easier and faster. Rural housing in Ghana to a greater extent still depends on the availability of products, i.e. wood, thatch grasses, etc. [10]. The depletion of forest resources and checks imposed on their harvesting has led to a severe shortage of wood raw material. Bamboo could make a viable substitute to control indiscriminate cutting of trees and to protect environment [10]. One of the important advantages of bamboo housing is that it can be maintained regularly by replacing deteriorated parts.

3.3 Perception on Bamboo Housing

Community members' view on the use of bamboo for housing revealed that bamboo housing is for the poor as indicated by majority (44.00%) of the respondents. Unsuitable bamboo species accounted for 10.67% of the total respondents engaged in the survey. About 29% and 16% of community members also claimed that bamboo species are not durable and lack of technology for processing respectively (Fig 2).

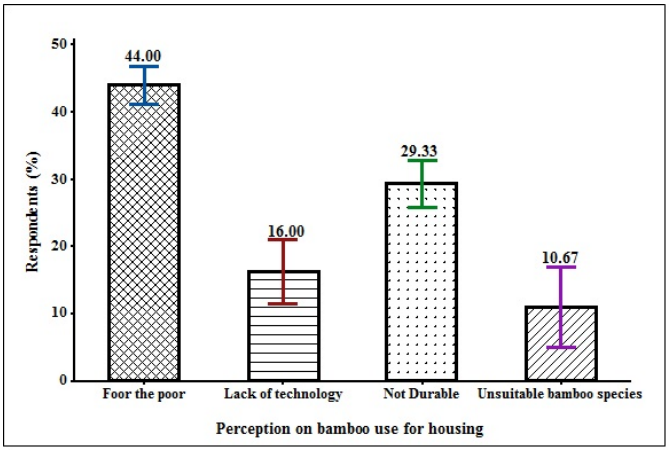

Figure 2. Community members' perception on bamboo housing

The survey revealed that generally, people within the districts have some knowledge about the use of bamboo for housing; however that in depth knowledge needed for change was lacking. Interest in bamboo housing seems to be low within the districts. The community members were of the view that people living within bamboo houses are poor. Despite engineering recognition as a strong building material, prejudices of so-called 'poor man's timber' have abated its real value as a construction material and living in a bamboo house is seen by community members as a shame on the family. People tend to plaster their houses to make them look like concrete houses. As they think it is an indicator of poverty. Again, respondents were of the view that bamboo is not durability. Most of the traditional bamboo users, from where the knowledge emerged, are not aware of treatment of bamboo, which could prolong the life of bamboo. Various methods of bamboo preservations have been developed. One has to make a careful choice of methods and preservatives, considering economic and environmental factors [11]. Most of the respondents were of the view that the durability of bamboo is low. This is in line with [12] assertion that in general, the natural durability of bamboo is low and varies from 1–7 years, depending upon its use and exposure. Generally, as majority of the people lack knowledge on life-prolonging treatments of bamboo, the general perception among the local people is that the bamboo housing is a temporary solution, as it does not last long. There were instances whereby some of the respondents living within a bamboo house did not know they were living in a bamboo house. When explanation was sought about it, the estate NGOs disclosed that they normally don't want people to know that because of the misconceptions people have about bamboo housing [13]. It appears there is a general misperception regarding bamboo's wider applicability for building purpose. It is for this reason that there is a need for a country wide education on the use of bamboo for housing so as to promote change in the people. This is in agreement with [14] assertion that, change is always necessary but changing is different from wanting to change when the necessary impetus for change is absent.

3.4 Challenges in the use of bamboo for housing

Majority (34.67%) of the respondents outlined lack of technical know-how as their biggest challenge followed by people's misconception about bamboo housing (33. 33%), lack of funding (24.00%) and inadequate assistance from the government (8.00%) as illustrated in figure 3. Most of the respondents were of the view that there is limited number of trained artisans in the use of bamboo. Very few people are trained on building with bamboo and as such are unable to use the right techniques and standards for bamboo. For instance, it is not recommended to use nails for joining bamboo but since they don't know, the use nails causing the destruction of the bamboo. Additionally, bamboo building projects often involve a North–South transfer of knowledge, since much of the building research works take place in industrialized nations [15]. There seems to be a feeling of a technological gap among the

people to use bamboo in improved engineering designs. It was realized that most of the respondents were not interested in living in a bamboo due to their perceived idea that living within a bamboo house shows that your poor therefore, it's becoming increasing difficult to convince people to adopt the use of bamboo for housing [16]. It was also realized that there is difficulty in getting funds for bamboo housing projects. The ministry of agriculture is not putting bamboo as a major resource and as such most of the state funds are used for projects other than bamboo related activity. Again, the information obtained from the key informants indicated that there is weak leadership at the bamboo sector since most of the workers employed by the government to help promote bamboo is not working as full time workers and as such are not fully committed to the promotion of the use of bamboo.

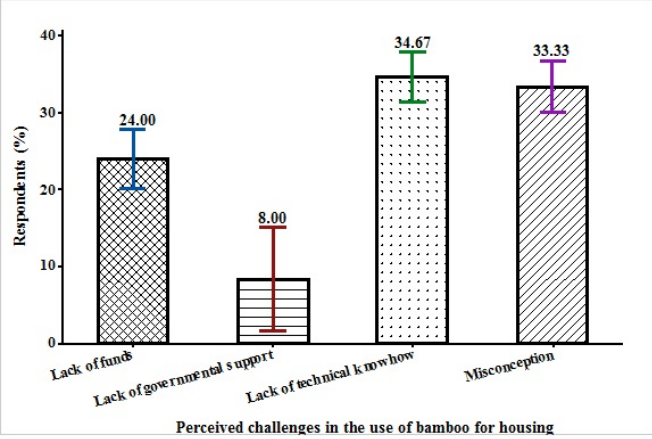

Figure 3. Respondents' perceived challenges in using bamboo for housing

4. Conclusion

The research has revealed farmers' observation of climate variability which is in line with many research findings that the temperature has been increasing and precipitation has been decreasing. The rising temperature has resulted in higher evaporation from irrigation dams, soil surfaces and transpiration of agricultural crops. The declining rainfall has also affected soil moisture content, dam levels and underground water recharge. The erratic nature of the rainfall coupled with rising temperature will have serious implications on sustainable food production and security, and subsequently affects farmers' livelihood. The anthropogenic activities and the complete lack of maintenance of the dams are challenges that need urgent attention even without climate change. It is therefore important that measures are taken to curb the indiscriminate burning and deforestation coupled with regular maintenance of the dams. Strategic water harvesting and storage in addition to planting of trees around the dams are all important steps towards the fight against climate change. Moreover, the following are proposed to help farmers cope with the changing climate: farmers should practice sustainable agriculture through the efficient use of irrigation dams and adopt new and improved seed varieties that are climate resistance, high yielding, drought resistance, low water consuming and early maturity crops. Farmers should also employ agro-forestry practices, planting under mulching with support from extension officers; adjust planting dates, adopt improved land and water management practices in addition to erosion control and soil protection principles. With their current knowledge of climate variability, farmers should be prepared to adapt favourably to climate variability to improve their livelihood. However, such effort will require an integrated approach which should involve all the players in the water, agricultural, and the environmental sectors.

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