



ASSESSING AREAS AND TRENDS OF BAMBOO USAGE IN BUILDING CONSTRUCTION IN GHANA.

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Abstract

Ghana's forest timber production area is declining in an increasing manner in both size and productivity due to unecological logging practices and over utilization of the traditional timber species. The alleviation of the problem of insufficient and extinction of the timber species allowable to the market, especially to the construction industry, has called on exploitation of other forest resources like bamboo, comparable to timber. This study sought to identify the areas and trends of bamboo usage in building construction in Ghana and its prospect of being an alternative material to timber. The study employed structured questionnaire survey of 100 medium and small scale building contractors who responded to 14 areas of bamboo usage identified through a comprehensive literature review. Data was analysed by means of relative importance index to identify the possible areas in the construction industry where bamboo is mostly used. The findings showed that props and landscaping are the two most significant areas where bamboo is used. The findings also showed that bamboo has received little attention in its usage in the areas of ladders, scaffolds, workers shed, roofing, ceiling, wall partitioning and flooring. Generally, the respondents agreed to the increase in the usage of bamboo as a construction material in the Ghanaian building industry. However, the increment is significant in the areas of props and landscaping. This study should create the required awareness of bamboo as an alternative material to timber which is dwindling in its supply to the Ghanaian building industry.

Keywords: Bamboo usage, areas, trends, building construction, Ghana

INTRODUCTION

The increase in population and human activities in Ghana has rapidly pulled up a high demand of buildings to house individuals and activities (i.e. the provision of residential, commercial, industrial or the combination of any of the building categories). However, the demand for building has beckoned the activeness of the building construction industry (BCI) to support in whinging the wheels of development, especially in developing countries (Ofori, 2012; Lopes, 2012).



The BCI is characterised by three main resources; human, plant and equipment, and material resources. Notwithstanding the importance of the mentioned resources, the impact of the material resource in building construction (BC) should not be undermined (Fapohunda and Stephenson, 2010). Deshwal (2011) asserts that building materials account for nearly 60% to 65% of the total cost of building construction. The demand for materials either locally obtained or imported has pulled an array of different industries to play roles in the construction industry and the list of these industries is not complete without mentioning the timber industry. To confirm the rapid demand for timber and timber products, a study by Food and Agriculture Organisation, FAO, (1997) affirmed that there is an outburst demand for building construction and this is coupled with the increased demand for timber in the industry. In a study to project into the stability of the supply of timber into the market for various uses, it was anticipated by the FAO that the demand of order for wood and wood products would increase by thirty percent (30%) by 2013 (FAO, 1997). A related study in Ghana outlined that, Ghana's forest timber production area is declining in an increasing manner in both size and productivity due to unecological logging practices and over utilization of the traditional timber species (Solomon-Ayeh, 2004; Ayarkwa, 1998). The extreme exploitation of the forest has beckoned on authorities to put strict regulation which has eventually reduced the quantity of timber supplied to the furniture and construction industries (Solomon-Ayeh, 2004; Ayarkwa, 1998).

The alleviation of the problem of insufficient and extinction of the timber species allowable to the market, especially to the construction industry, has called on exploitation of other forest resources comparable to timber. Bamboo is identified as a constructional material with properties comparable to that of timber (Amanda et al., 1997). Bamboo has been identified and tested by many countries and proven to have the qualities which make it a very good material for the building and construction industry. According to Gutiérrez (2000), there has been an ancient exploration of bamboo for construction and this is due to the fact that it appears to be a tailor-made material for use as a building component. Bamboo appears round, straight, smooth, strong and beautiful (Gutiérrez, 2000).

Bamboo possesses constructional properties like high tensile strength, high strength to weight ratio and high specific load bearing capacity and this confirms its potential as a material for building construction (Tada et al., 2010; Ghavami, 2005; Van der Lugt et al., 2005; Paudel, 2003; Yao and Li, 2003; Iyer, 2002; Amada and Untao, 2001). Bamboo has the ability to grow almost everywhere in various seasons and has short rotation (Power, 2004). Like wood, bamboo also possesses high residual strength to absorb shocks and impacts making it a highly suitable material for construction of houses to resist seismic and high wind forces (Shyamasundar et al., 2008).



Areas of bamboo usage in Building Construction

The uses of bamboo for building construction havemetamorphosed from simple pole construction to more sophisticated construction (Tekpetey, 2006). Bamboo can serve as a material for the whole or part of a construction of a building (Tekpetey, 2006). Ithas greatly been given consideration by several countries in Asia and Latin America as an important building material not only for the construction of rural houses but also for urban private houses and public buildings(Shyamasundar and Vengala, 2008). According to Malin and Boehland (2006),the use of bamboo in building construction can be classified into temporary (Props, Scaffolding, Workers shed, Ladder, Formwork and Hoarding) and permanent uses (Bamboo Reinforcement, Trusses, Ceiling, Doors and windows, Roofing, Bamboo floor, Partition walls and Landscape).

To confirm the growing utilization of bamboo in building construction, literature outlines that bamboo tremendously has multiple uses in building construction (Table 1). Jansen (2000) asserts that the trend of bamboo usage in building construction is increasingly gaining attention and utilisation. Contractors and architects are patronising the potential of bamboo by increasing its usage and specifying it respectively.

Table 1. Summary of the areas of bamboo usage in building construction

No.	AREAS	Reference
1	Props	Jiang, (2008);Tekpetey (2006)
2	Scaffolding	Chung et al. (2003); Janssen (2000); Jayaneti and Follet (1998); Fu (1993)
3	Workers shed	Recht et al. (2001)
4	Ladder	Chung et al. (2003)
5	Formwork	Recht et al. (2001)
6	Hoarding	Jiang (2008);Tekpetey (2006)
7	Bamboo Reinforcement	Iyer (2002)
8	Trusses	Paudel and Solomon-Ayeh (2004)
9	Ceiling	Bandara(1990)
10	Doors and windows	Gangopadhyay (2003)
11	Roofing	Shyamasundar (2005)
12	Bamboo floor	Xiao et al. (2009); Haregewoin, (2007)
13	Partition walls	Punhani and Pruthi (1992)
14	Landscape	Tekpetey (2006)



To confirm the areas of bamboo usage in building construction in Ghana, Tekperterey (2006) noted that the most popular areas are props and hoarding, though his statement was not with any empirical evidence but by observation. Although the above mentioned areas (Table 1) expose extensive use of bamboo in building construction in some Asian and Latin American countries, little research has been done to popularise the potential of bamboo to make it attractive to architects and building contractors to specify and use it in Ghana. This study therefore focuses on identifying other areas and trends of bamboo usage in building construction in Ghana.

RESEASRCH METHODOLOGY

The study deployed a comprehensive review of related published works to identify the various areas of bamboo usage in building construction. The identified information was modified to suit the situation in the Ghanaian building construction industry to help outdoor the pertaining situation of bamboo usage in Ghana. A closed-ended questionnaire survey was employed to reduce biases in the opinions of the respondents (Roberts, 2007). However, respondents were also asked to add to the areas of bamboo usage and suggest other values that will improve the use of bamboo in building construction in Ghana. A convenience purposive sampling approach was used to select 100 small and medium scale building contractors in the Kumasi and Accra metropolis. A face-to-face approach of questioning was used to administer the questionnaires to maximize the response rate.

The questionnaire was divided into three sections. The first section focused on background information of the respondents and how often bamboo is used in building construction. The second section sought information on the possible areas and trends of bamboo usage. On the possible areas of bamboo usage respondents were asked to rank on the Likert scale of 1 to 5, which areas bamboo is highly used, where 1= Highly unused 2= Unused, 3= Neither used nor unused, 4= Used and 5=highly used. The final section focused on the trend of bamboo usage with regards to volume and this was also evaluated on the Likert scale 1 to 5.

Out of the total of 100 questionnaires administered 85, representing a response rate of 85% were retrieved and used in the analysis. This response rate was considered sufficient for such a study (Oladapo, 2005; Newman and Idrus, 2002; Ellhag and Boussabaine, 1999).

The Relative Importance Index (RII) method of analysis was employed to help identify the significance of the factors which influence bamboo in building construction. According to Adnan et al. (2007), to analyse data on an ordinal scale (e.g. Likert scale 1-5) as used in this research, the application of Importance Index (II) is suitable and this helped in coming out with various rankings in the research.



RESULTS AND DISCUSSION

Respondents' Profile

The average years of experience of the firms surveyed in the construction market are between 15 and 25 years, implying that they all have significant experiences in the building industry. Fifty percent (50%) of the Contractor respondents had Bachelor of Science Degrees, 40% had Master of Science and 10% had Doctorates Degrees. The results further showed that the respondents from the Building Construction firms provided services to both the public and private sectors.

Uses of bamboo in building construction

Respondent were asked to evaluate how often they use bamboo in building construction. Figure 1 shows that 44% of building contractors reiterated that they do not often use bamboo. However, thirty six percent(36%) responded that they use bamboo often. The remaining 20% were not very sure of the use of bamboo within certain areas of their projects and so remained neutral in their decisions. The results further show that the building contractors do not often encourage the use of bamboo in construction and this issue needs urgent attention following the dwindling nature of Ghana's timber species.

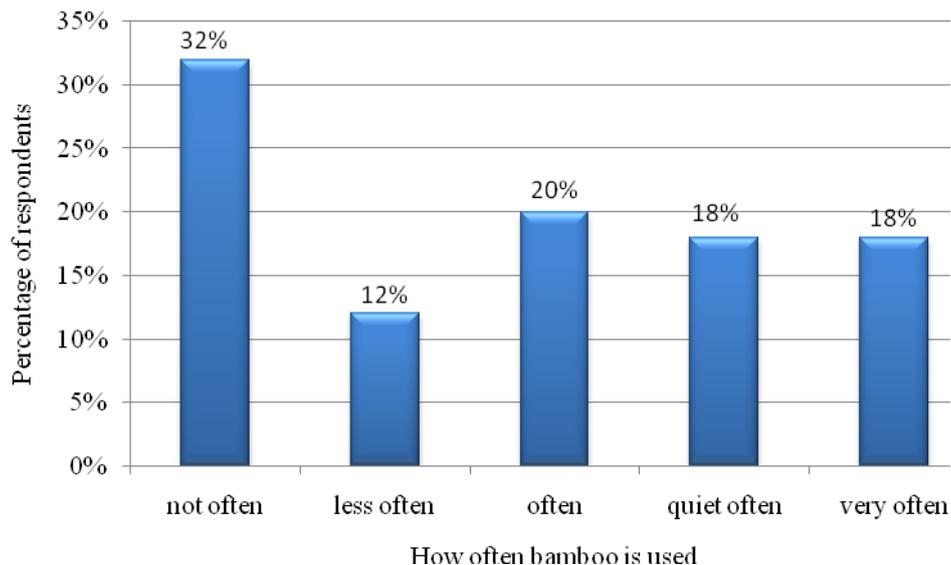


Figure 1: Response on how often bamboo is used in BC



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Views of building contractors on areas of bamboo usage in building construction

Table 2 presents the views of building contractors on areas in construction where bamboo is often used. For this study, any factor with a relative importance index of 0.5 or more was considered significant. The results show that in the opinion of the respondents, the two most important areas of bamboo usage are for props (RII = 0.8343) and landscaping (RII = 0.5257). Other areas of usage included partitioning of walls, hoarding and scaffolding, among others. Though bamboo was used in the aforementioned areas, they are not given much attention as in the case of props and landscaping. This result implies that in the opinion of the building contractors, the use of bamboo in building construction in Ghana has not been fully exploited.

Table 2: Views of building contractors on areas of bamboo usage

AREA OF USAGE	BUILDING CONTRACTORS	
	RII = $\frac{\sum W}{(S * N)}$	Rank
Props	0.8582	1st
Workers shed	0.4182	2nd
Scaffolding	0.3891	3rd
Ladder	0.3856	4th
Hoarding	0.3782	5th
Formwork	0.3236	6th
Landscape	0.3055	7th
Doors and Windows	0.2946	8th
Bamboo Reinforcement	0.2836	9th
Trusses	0.2800	10th
Bamboo floor	0.2691	11th
Ceiling	0.2582	12th
Partition Walls	0.2546	13th
Roofing	0.2400	14th



Quantity of bamboo culms per building project

Following the usage of bamboo for props as indicated by the respondents (Table 2), a further survey was conducted to identify the average bamboo culms used by contractors per building project. Figure 2 shows that 38% of building contractors use 100-200 bamboo culms per project, 25% use more than 200 culms of bamboo per project and 37% use below 100culms of bamboo per project. In spite of the fact that most of the bamboo culms are used regularly on building sites for temporary activities, there was no contractor who had used more than 500 culms per project regardless of the size of the project. According to Tekperthey (2006), bamboo culms below 100 pieces are mainly used for activities which do not require a lot of time to complete. In relation to building construction, the use of bamboo culms below 100 are for small building projects which require a very short time to execute.

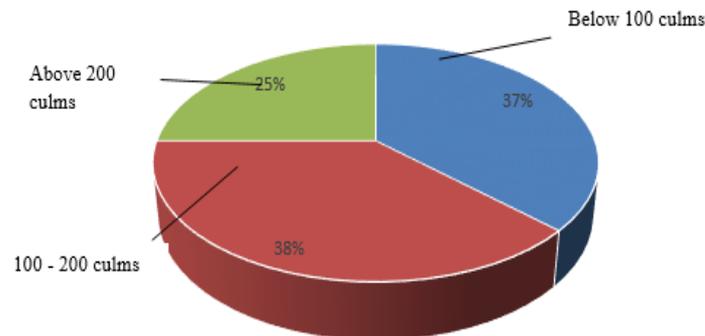


Figure 2: Contractors response on the average quantity of bamboo culms used per project



Table 3. Contractors' response to the trend of volume of bamboo usage

AREA OF USAGE	Building Contractors	
	RII = $\frac{\sum W}{(S * N)}$	Rank
1. Props	0.8909	1st
2. Scaffolding	0.5636	6th
3. Workers shed	0.5600	7th
4. Ladder	0.5673	5th
5. Formwork	0.5309	14th
6. Hoarding	0.5891	4th
7. Bamboo Reinforcement	0.4564	9th
8. Trusses	0.5927	3rd
9. Ceiling	0.5527	11th
10. Doors and Windows	0.5527	11th
11. Roofing	0.5455	13th
12. Bamboo floor	0.5600	7th
13. Partition Walls	0.5564	9th
14. Landscape	0.6146	2nd

The results as shown in Tables 3 above show that the use of bamboo in the area of props in building construction has seen significant increase (it was ranked first by the building contractors) and this relate to the finding of Tekpertey (2006) which acknowledge the fact that bamboo is largely used in the area of props in building construction in Ghana. The use of bamboo in the area of landscape has also seen an appreciable increase as it is ranked second. Clients of building projects are appreciating the beauty of bamboo as a material, hence increasing demand of its usage (Gutiérrez, 2000). Averagely, respondents were indifferent (neutral) about the use of bamboo in areas such as scaffolding, workers shed, ladder, formwork, hoarding, trusses, ceiling, doors and windows, roofing, bamboo floor and partition walls. According to the building contractors, bamboo usage in the area of reinforcement has seen no significant increase and this decrease is as a result of the shift to urban modernity since bamboo as a reinforced material was normally used for traditional



construction in the rural areas of Ghana. Therefore there is the need to put the use of bamboo in an innovative way to make it acceptable in the peri-urban and urban areas of Ghana, which will eventually affect its use in the rural areas.

CONCLUSION

Bamboo as a material is gaining much usage in several countries in the world. This study sought to identify areas and trends of bamboo usage in building construction in Ghana and its prospect of being an alternative material to timber. From the views of the respondents interviewed bamboo is used in several areas of building construction. The results showed that bamboo is mostly used for temporary works than permanent works in building construction in Ghana, the most popular area of usage being props. The results further showed that bamboo has not gained popularity in its permanent usage in building construction, except in the area of landscaping. Also, the results showed that on the whole, different areas of bamboo usage in building construction have not been fully exploited. However, there appeared to be an increase in the use of bamboo in the areas of props for temporary uses and landscape for permanent uses. This research further outlined that, bamboo has a potential to thrive in the building construction industry in Ghana but the various areas of usage have not been fully exploited. Further exploitation of the uses of bamboo is needed to be able to meet modern trends of construction. Promotion of bamboo usage in less used areas in building construction should be given the needed attention to create the awareness of its potential as a building material. Research into bamboo in construction should be encouraged in building construction institutions to enhance basic promotion of the potential of bamboo.

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