POTENTIAL FOR GREEN BUILDING ADOPTION: EVIDENCE FROM KENYA

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ABSTRACT

The construction industry plays an important role in economic, environmental, and social development and sustainability. Several studies have demonstrated that green building evolution is key to promoting sustainability in the built environment. This paper is based on a recent research study that employed a mixed methods approach to explore the potential for adoption of green building in Kenya. The study unveiled a set of select green attributes that would provide best potential for adoption. Kenya stands out as a suitable case study because of its latitude as a leading economic hub in a region that is endowed with an abundance of natural resources, some of which could constitute renewable energy sources. Essentially, this study was timely in providing a preliminary platform for developing green building guidelines and best practices that would be meaningful to the Kenyan construction industry.

JEL: Q00, Y8, R00

KEYWORDS: Kenya, Green Building, Construction Industry, Adoption, Potential

INTRODUCTION

This paper is based on a recent study which sought to determine what green building attributes provide the best potential for adoption in Kenya. As the green building concept continues to permeate the construction industry globally, preliminary findings of the study revealed that there were no green building guidelines in Kenya as of that time. However, there was an apparent interest in green building practices among stakeholders in Kenyan construction industry. This combination of findings underscores the need for the study.

The study utilized focus groups and personal interviews to identify and validate 26 green building rating attributes that could be adopted as a platform for developing a meaningful green building rating system for the context of Kenya without necessarily reinventing the wheel of other green building rating systems. Further, the study employed descriptive statistics to rank order the attributes in order of importance, as perceived by construction professionals in Kenya. Ideally, the 26 green building attributes are the 'low-hanging fruits' that would provide the best potential for adoption in Kenya.

Beyond Kenya's boundaries, this study provided a template that could be used to create green building standards and best practices in countries where economic, environmental and social geographies are similar to those in Kenya. Additionally, the tenets of this study would provide guidance for future research efforts dedicated to inquiry on similar subjects. In arguing that the construction industry has not done enough to reduce its environmental footprint, Horvath (1999) asserts that concerted national and international research and educational efforts are therefore needed to change the situation.

The next section of this paper provides a summary of some of the literature that was used to develop the background research. This is followed by an outline of the research methodology employed for data collection. Next are results and discussions. The paper closes with conclusions and directions for future research.

LITERATURE REVIEW AND RESEARCH DEVELOPMENT

Extensive review of literature was conducted to provide a foundational understanding of what would be required to develop green building practices and a green building standard that is meaningful to Kenyan construction industry. Some of the literature review areas that were relevant to the theme of this research were: 1) definition of green building in regard to three pillars of sustainability: economic, environmental, and social; 2) an overview of the construction industry in Kenya, including its characteristics and the roles of key stakeholders; and 3) an examination of characteristics of select green building standards and their adoption in other countries.

The increasing adoption of green building practices is primarily driven by global efforts to build resilience to the negative impacts of the built environment on economic, environmental and social systems. Liu (2011) proclaims that the built environment has huge impact on the natural and social environment, resource consumption, indoor environmental quality, human health associated with it, and land use. Kozlowski (2003) defines a green building as one “that uses a careful integrated design strategy that minimizes energy use, maximizes daylight, has a high degree of indoor air quality and thermal comfort, conserves water, reuses materials and uses materials with recycled content, minimizes site disruptions, and generally provides a high degree of occupant comfort.”

Since the detrimental effects of the construction practices on the natural environment were highlighted, the performance of the buildings has become a major concern for occupants and built environment professionals (Cooper, 1999; Crawley & Aho, 1999; Kohler, 1999; Ding, 2008). The overarching implication is that the construction industry needs to pay heed to the triple bottom concept of sustainability – economic, environmental, and social. For example, the quest for green building can be seen as a contributing factor to the significant research that has recently been conducted to determine the financial benefit of adopting green building technologies (Fuerst, 2009; Miller, Spivey, & Florence, 2008; Wiley, Benefield , & Johnson, 2010). A study conducted by Kats (2003) found that the financial benefits of green buildings are ten times their initial cost premium.

In response to growing trend toward embracing green building, various green building rating tools, or systems/standards, have been introduced into the marketplace to provide a systematic approach, or guidelines, to achieving sustainability in the built environment (Bebbington, & Gray, 2001; Hemphill, McGreal, & Berry, 2002; Wyatt, Sobotka, & Rogalska, 2000). These tools provide a way of showing that a building has been successful in meeting an expected level of performance in various declared criteria (Cole, 2005). A typical rating system contains a variety of green attribute categories such as sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovative design. Each of these categories is assigned a specific number of points, and a building that achieves a specific number of points in each category is awarded a certificate level based on the requirements of the rating system. Such a building is then regarded as “green.” In particular, the green rating attributes of the U.S. Leadership in Energy and Environmental Design (LEED) system were adopted as a key model for developing this research since the standard has been adopted as a template for framing green building standards in other countries, such as Canada, China, and India.

<u>Economic Perspective</u>

Industrialized nations, particularly in Europe incur enormous replacement costs of existing energy grids and related production infrastructure; developing nations like Kenya can learn and avoid a similar experience in the future as they build their economies today. The costs of replacing or updating obsolete and inefficient energies can be burdensome, especially for developing nations. Besides, sustainable energy production has an important role in achieving the Millennium Development Goals targeted by Kyoto. From an industrial perspective, better access to sustainable energy is necessary at macro and micro levels, to foster economic growth and stimulate income-generating activities respectively (KAS, 2007).

Kenya's 2030 vision projects a long-term development blue-print to create a globally competitive and prosperous nation on economy as one of its pillars. A part of the action plans for the vision involve major infrastructure projects such as the *Dongo Kundu Freeport*. It is possible that as the envisioned substantial growth unfolds, so can growth in energy inefficiencies and even pollution. It is a known fact that the rapid pace of industrialization in developing nations has also seen increases in the usage of unsustainable energy forms.

Further details from a previously cited 2003 report to California's Sustainable Building Task Force by Greg Kats estimates that minimal increases in upfront costs of about 2% to support green design would, on average result in life cycle savings of up to 20% of total construction costs, which is more than ten times the initial investment. Cost implications are further amplified with the incorporation of externalities. Anthony Owen (2006) argues that incorporating associated externalities would likely serve to hasten the transition process to green alternatives. Generally, it is accepted that green design adoptions are bound to have financial and externality impact, with implications to resource allocation patterns in industry.

METHODOLOGY

In an attempt to encompass as much of Kenyan construction industry as possible, all survey participants for this study were drawn from the Board of Registration of Architects and Quantity Surveyors of Kenya (BORAQS) database. This is Kenya's nationally accredited body for construction professionals, and consists of industry stakeholders that are deemed likely to play a major role toward embracing green building concept in the country. As a way of conforming to appropriate research ethics, prior consent was obtained from the Registrar of BORAQS before inviting the study participants.

The study consisted of two phases of survey, with the first phase serving as a pilot to the second. Both surveys were completed between August 31 and December 31, 2012. The pilot survey was guided by the research question, "What green building attributes are applicable to the construction industry in Kenya?" In an attempt to answer this question, a combination of focus groups and personal interviews was utilized to generate and validate a list of green building attributes that would make sense to industry context in Kenya. The sample of participants in the pilot survey consisted of 12 building professionals who had international experience and were actively involved in managing construction projects within Kenya.

The pilot findings revealed 26 green building attributes that were identified as having the potential for adoption in Kenyan construction industry. These attributes belong to 5 broad categories of green building: sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality (Table 1).

The preliminary list of green building attributes was then used to develop a comprehensive questionnaire research instrument for the second, or main, survey. The main survey targeted all construction professionals in the BORAQS database. Convenience sampling was utilized to narrow down the selection to only 608 potential participants. These were individuals that had an active email on their registration profiles. In order to avoid bias in responses, participants of the pilot survey were not allowed to take the main survey.

Out of the 608 questionnaires that were distributed, only 347 responses were received and analyzed for the purpose of the study. This represented a response rate of 57.1%. In an effort to ensure unbiased geographic representation across Kenya, all data for this phase of the study was collected electronically. This strategy would also contribute to environmental friendliness of the survey.

The main survey was guided by the question, "What is the likelihood of adopting certain green building rating attributes and what is their level of importance, as perceived by Kenyan building professionals?" In pursuance of this question, the respondents were asked to rank each attribute based on perceived level of importance. A five point Likert scale ranging from 1 to 5 was employed; 1 being lowest and 5 being the highest score respectively.

Table 1: Green Building Rating Attributes That Are Applicable to Kenyan Building Industry

Category	Green Building Rating Attribute
Sustainable Sites	Prevent construction activity from causing site and air pollution. Protect or restore the natural state of the building site in terms of ecosystem, agriculture, plants and animal habitat. Build/construct on a previously developed site. Preferably locate the project site in a location with higher population density. Build/construct on a contaminated site such as brownfield. Preferably build/construct near to existing transport and utilities infrastructure. Provide secure bicycle storage space for building occupants/users. Encourage building occupants to use vehicles that are fuel-efficient and emit lesser pollutants. Minimize the number of car parking spaces on the building premises/site. Maximize open space on the building/site. Control the quantity of storm water runoff from the building/site. Control the quality of storm water runoff from the building/site. Preferably use roof and non-roof materials with higher heat reflection.
Water Efficiency	Implement strategies to minimize the amount of water used in the building. Treat and re-use waste water in the building. Collect rainwater for use in the building.
Energy and Atmosphere	Implement strategies to minimize the amount of energy used in the building. Preferably use renewable energy that is generated on the building site (e.g., solar and wind). Implement strategies to measure and verify energy use in the building.
Materials and Resources	Preferably re-use an existing building structure instead of constructing a new one. Preferably use recycled or salvaged building materials. Preferably use materials that are available close to the building/site. Preferably use building materials that are rapidly-renewable or replenishable.
Indoor Environmental Quality	Prohibit smoking indoors. Provide walk-off mats, grills, or grates at building entries. Implement strategies to achieve maximum daylight entering the building.

This table shows the list of 26 green building attributes that were identified and validated during the pilot survey as demonstrating potential for adoption in Kenya. The attributes are displayed according to the corresponding categories of sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality.

Responses garnered from the main survey were computed for results by using descriptive statistical tools for mean ratings of each attribute according to its level of importance, as perceived by industry stakeholders in Kenya. The mean scores were then ranked according to their weighted importance, followed by a comparative analysis of the results, as displayed in Table 2. Each green building rating attribute corresponding to the survey items was identified with one of the following categories: 'sustainable sites,' 'water efficiency,' 'energy and atmosphere,' 'materials and resources,' and 'indoor environmental quality.' The following formula was then used to calculate and rank the importance of each attribute and corresponding category:

Mean rating = $(\sum_{i-1}^{5} W * Fi)/n$

where,

W = weight assigned or scale value of respondent's response for the specified survey item (variable): W=1, 2, 3, 4 and 5;

F_i = frequency of the i^{th} response;

n = total number of respondents to the survey item (variable); and i = response scale value = 1,2,3,4 and 5 for no opinion/do not know, disagree, somewhat agree, agree, and strongly agree, respectively.

For the purpose of this analysis, responses with variable means below 2.5 were considered low/not important; those between 2.5 and 3.0 were considered moderate; those between 3.0 and 4.0 were considered moderately high; while those above 4.0 were considered high. The results of data analysis for each green building ratting attribute and its corresponding category is are tabulated in Table 2. For ease of data interpretation, each green building attribute was assigned a unique code (e.g. Q**). Also, there were variations in response counts due to skipping of some questions by respondents.

Table 2: Comparative Ranking for Green Building Attributes in Order of Importance

Survey Code	Green Building Attribute	Category	Mean Rating	Rank
Q17	Minimize the amount of energy used in the building	EA	4.88	1
Q24	Use strategies to achieve maximum daylight entering the building	IQ	4.68	2
Q14	Collect rainwater for use in the building	WE	4.66	3
Q18	Use renewable energy that is generated on the building site	EA	4.63	4
Q15	Treat and re-use waste water in the building	WE	4.55	5
Q16	Minimize the amount of water used in the building	WE	4.40	6
Q19	Measure and verify energy use in the building	EA	4.39	7
Q1	Protect or restore the natural state of the building site in terms of ecosystem, agriculture, plants and animal habitat	SS	4.37	8
Q2	Control the quality of storm water runoff from the building/site	SS	4.25	9
Q3	Control the quantity of storm water runoff from the building/site	SS	4.22	10
Q4	Prevent construction activity from causing site and air pollution	SS	4.20	11
Q20	Use materials that are closely available to the building/site	MR	4.13	12
Q5	Maximize open space at the building/site	SS	3.98	13
Q25	Build/construct using recycled or salvaged building materials	MR	3.85	14
Q6	Use roof and non-roof materials with higher heat reflection	SS	3.85	14
Q22	Use building materials that can be renewed or replenished rapidly	MR	3.85	14
Q7	Build/construct near to existing transport and utilities infrastructure	SS	3.76	17
Q25	Prohibit smoking inside the building	IQ	3.71	18
Q8	Encourage building occupants to use vehicles that are fuel-efficient and emit lesser pollutants	SS	3.68	19
Q9	Provide secure bicycle storage space for building occupants	SS	3.61	20
Q10	Build/construct on a contaminated site (e.g., industrial site or brownfield)	SS	3.34	21
Q26	Provide walk-off mats, grills, or grates at building entries	IQ	3.20	22
Q25	Re-use an existing building structure instead of constructing a new one	MR	3.15	23
Q11	Build/construct on a previously developed site	SS	3.03	24
Q12	Minimize the number of car parking spaces at the building premises/site	SS	2.85	25
Q13	Build/construct in a densely populated neighborhood	SS	2.74	26

*This table shows the rank-order list of 26 green building attributes that demonstrate potential for adoption in Kenya. The ranking is based on computed mean rating that indicates each attribute's perceived importance, as perceived by Kenyan construction professionals. The mean value is directly proportional to the level of perceived importance. Each attribute was assigned a unique code (Q**) in the survey questionnaire. Also, each attribute is identified with its corresponding green building category, thus Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), and Indoor Environmental Quality (IQ).*

RESULTS AND DISCUSSIONS

According to the results in Table 2, all the 26 green building rating attributes identified and tested in this study were perceived to be important. This is based on the scale of importance that was employed in this study, which shows that all the mean scores ranged from moderate, to moderately high, to high. Essentially, this affirms that the green building rating attributes and corresponding categories identified in this research provide potential for adoption in Kenyan building industry. Results further show that all the three green building attributes in the category of 'energy and atmosphere' were ranked as having top-most importance. Q17 *(minimize the amount of energy used in the building)* was ranked the most important overall with a mean rating of 4.88; Q18 *(use renewable energy that is generated on the building site)* had a mean rating of 4.63 was ranked 4th overall; while Q19 *(measure and verify energy use in the building)* was ranked 7th overall.

Besides the 'energy and atmosphere' category, the 'water efficiency' green building attributes were also rated as highly important. Q14 *(collect rainwater for use in the building)* took 3rd place overall with a mean rating of 4.66; Q15 *(treat and re-use waste water in the building)* was 5th overall with a mean rating of 4.55;

while Q16 *(minimize the amount of water used in the building)* was ranked 6th overall with a mean rating of 4.40.

Out of the three 'indoor environmental quality' green building attributes, only one was rated as being highly important. This was Q24 *(use strategies to achieve maximum daylight entering the building)*, and had a mean rating of 4.68. Second in this category was Q25 *(prohibit smoking inside the building)* which was rated moderately high in importance with a mean value of 3.71. Q26 *(provide walk-off mats, grills, or grates at building entries)* was rated as being moderately important and had a mean rating of 3.20.

Among 'materials and resources' green building attributes, only Q20 *(use materials that are closely available to the building/site)* was rated as highly important, and had a mean value of 4.13. Both Q25 *(build/construct using recycled o salvaged building materials)* and Q22 *(use building materials that can be renewed or replenished rapidly)* were rated as being of moderately high importance with a mean value of 3.85. However, Q25 *(re-use an existing building structure instead of constructing a new one)* was rated as having moderate importance and received a mean rating of 3.15.

Out of the thirteen green building attributes in the category of 'sustainable sites,' four were rated as being highly important. These were: Q1 *(protect or restore the natural state of the building site in terms of ecosystem, agriculture, plants and animal habitat)* which had a mean rating of 4.37 and was ranked 8th overall; Q2 *(control the quality of storm water runoff from the building/site)* which had a mean rating of 4.25 and was ranked 9th overall; Q3 *(control the quantity of storm water runoff from the building/site)* which had a mean rating of 4.22 and was ranked 10th overall; and Q4 *(prevent construction activity from causing site and air pollution)* which had a mean rating of 4.13 and was ranked 11th overall.

Seven of the green building attributes in the category of 'sustainable sites' were rated as having moderately high importance. These were: Q5 *(maximize open space at the building/site)* which had a mean rating of 3.98 and was ranked 13th overall; Q6 *(use roof and non-roof materials with higher heat reflection)* which had a mean rating of 3.85 and was ranked 14th overall; Q7 *(build/construct near to existing transport and utilities infrastructure)* which had a mean rating of 3.76 and was ranked 17th overall; Q8 *(encourage building occupants to use vehicles that are fuel-efficient and emit lesser pollutants)* which had a mean rating of 3.68 and was ranked 19th overall; and Q9 *(provide secure bicycle storage space for building occupants)* which had a mean rating of 3.61 and was ranked 20th overall; Q10 *(build/construct on a contaminated site (e.g., industrial site or brownfield))* which had a mean rating of 3.34 and was ranked 21st overall; and Q11 *(build/construct on a previously developed site)* which had a mean rating of 3.03 and was ranked 24th overall.

Out of the entire list of twenty six green building attributes investigated, only two were determined to be of moderate importance to the context of building practices in Kenya. Both belonged to the category of 'sustainable sites.' They were: Q12 *(minimize the number of car parking spaces at the building premises/site)* which had a mean rating of 2.85 and was ranked 25th overall; and Q13 *(build/construct in a densely populated neighborhood)* which had a mean rating of 2.74 and was ranked 26th overall.

CONCLUSION AND RECOMMENDATIONS

This paper is based on a recent study which sought to determine what green building attributes provide the best potential for adoption in Kenya. In pursuit of this goal, the study 1) utilized qualitative research methods of focus groups and personal interviews to identify and validate 26 green building rating attributes that would address the research gap; 2) utilized descriptive statistics to rank the attributes in order of importance, as perceived by construction professionals in Kenya. The survey participants were sampled from the BORAQS database – a key source of nationally recognized construction professionals in Kenya.

Data for the main survey was collected by means of an electronic questionnaire instrument which was developed upon findings that were garnered from the pilot survey.

By unveiling green building rating attributes that have highest potential for adoption in Kenya, this study is imperative to fostering creation of a green building standard that is contextual to the country's construction industry. Also, it is evident from the study that 'energy and atmosphere' attributes are generally rated highest in regard to likelihood, or potential, for adoption in Kenya. This implies that, among other green building attributes, Kenyan building professionals perceive 'energy and atmosphere' green building attributes to be of topmost importance. 'Water efficiency' attributes were ranked second while 'indoor environmental quality' were ranked third overall. In fourth place were 'materials and resources' while 'sustainable sites' attributes were ranked fifth. This rank order of potential green building attributes in order of their perceived importance serves as an additional platform toward creating a meaningful green building template for Kenya.

It would not be an overstatement to articulate that this research is one of the pioneer studies that attempts to create a platform for adoption and uptake of green building practices and green building rating system in Kenya. However, the scope of the study was limited to a sample of 608 construction professionals who were listed as members of BORAQS as of August 31, 2012, and had an email address on their registration profiles. It was further limited to only 347 survey responses that were received by the data collection deadline of December 31, 2012. This might impact the generalization of the present results.

As a way of expounding on the theme of this study, it is recommended that future research looks at unveiling barriers to green building adoption in Kenya. A combined understanding of both the potential and barriers would equip the Kenyan construction stakeholders with a more robust roadmap to developing green building practices in the country. Secondly as mentioned elsewhere in this paper, LEED was adopted as a key model for developing this study. It would therefore be interesting for alternative research to pursue a similar theme but use different green building standard/s as their model. Lastly, it is recommended for future research to adopt the tenets of this study to explore a similar theme but employ alternative research instruments such as the Delphi method or panel technique.

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