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Social Economic Benefits of Green Buildings in Tertiary Institutions in Kenya

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Abstract

Sustainable development is a global concern given that the natural resources are getting depleted. Conventional buildings consume a lot of electricity and water and release carbon dioxide gases into the atmosphere, contributing to global warming and air pollution. The green building concept is the practice of creating structures that are environmentally friendly and resource-efficient throughout a building's life-cycle. Research revealed that a minimum increase in cost of two percent to support a green design results in a life cycle savings of twenty percent of the total construction costs. Cost Benefit Analysis carried out using life cycle costing shows that green buildings are cost effective investments. Green buildings address the challenges of high cost of electricity, perennial water shortages, waste disposal, and occupants' health issues accompanied by declining abilities to learn or perform tasks. The Kenya building industry is slowly embracing the green building concept. Kenya currently uses two rating systems for green buildings; Leadership in Energy and Environmental Design (LEED) and Green Star certifications based on specified features and points are earned. Out of the nine green buildings certified in Kenya, two are for education institutions; Strathmore University and Catholic University of Eastern Africa. Education institutions are considered ideal for green buildings because a large population spends more days in school. Despite the enormous benefits of green building concept, out of 141 universities and government Technical and Vocational Education and Training (TVET) colleges in Kenya, only two have attained certification which account for 1.4 percent. This brings to question whether the concept is understood by the Kenyan population and in particular, whether the tertiary institutions are aware of the benefits of constructing green buildings. This paper therefore, puts into perspective the immense contribution that tertiary institutions stand to benefit by adopting the green building concept.

Key words: ***Green buildings, resources, certification, benefits***

Introduction

The green buildings movement started in the 1970's when glass high rise buildings became popular in America. In 1992 President Bill Clinton agreed on a greening program for the White House as a model for energy efficiency and environmental performance. This was carried out by identifying opportunities to reduce waste, lower energy use, and make an appropriate use of renewable resources, as well as improving the indoor air quality and building comfort. In the first two years of the greening project, more than $150,000 per year in energy and water costs,

landscaping expenses, and expenditures associated with solid waste were saved (Greening White House Report, 1999).

The real estate industry is one of the key contributors which accounts for 8.8 percent of Kenya's Gross Domestic Product (Economic Survey Report 2016). The common modern glass structured skyscrapers building designs do not necessarily meet green buildings rating threshold. Green building concept is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle; from siting to design, construction, operation, maintenance, renovation, and demolition (US EPA 2016). A climate change agreement signed in Paris Climate Conference (COP21), in 2015 aimed at limiting the increase in global average temperature to 1.5oC in order to reduce the impact of climate change, has caused developers to incorporate the use of environmentally friendly methods in construction. According to Green Building Information Gateway (GBIG, 2018), Kenya Activity rating is for 26 organizations which are either certified, received Awards or registered for certification. Out of these organizations only two universities have certified green building out of a total of 141 universities and TVET colleges

Literature Review

Sustainable development is a global concern given that the natural resources are continuously getting depleted. The world is experiencing a change from fueling by oil, coal, and natural gas, and moving to the use of wind, solar, and geo-thermal energy. Conventional buildings consume a lot of electricity and water and release carbon dioxide gases into the atmosphere, contributing to global warming and air pollution. In 2014, Nairobi Business Park Phase II and Garden City Mall were awarded the Leadership in Energy and Environmental Design (LEED) Gold pre-certification (Wairimu, 2014). The Kenya Green Building Society (KGBS), registered under the World Green Building Council (WGBC), has adopted and customized the Green Star rating system of South Africa for use in Kenya. Developed countries have moved to green buildings, with nations like the US offering grants, credits for buildings rated as green (USGBC, 2014). The aim is to reduce emission of pollutants which cause respiratory illnesses, acid rain and greenhouse gasses. Green buildings have numerous benefits to the owners, tenants, occupants, counties, the country and the world at large. The paper discusses the social economic benefits that may accrue to the tertiary institution, benefits of which have been reaped mostly in the commercial building sector worldwide. Therefore, embracing the green building concept in tertiary institutions could be the first move towards cost savings and innovations.

Green Building Features

According to Musau (2014), the features appropriate for the East African green building setup include; buildings orientation with the long axis along the East-West axis and window openings on the North and South facing walls to receive less solar

radiation; designs of narrow buildings to achieve maximum natural lighting penetration into the buildings or use of courtyards; sun-shading all glazed areas by use of vertical and horizontal sun-shading elements; the use of natural ventilation to provide cooling throughout the building using operable windows and thermal chimneys and construction using high thermal mass on walls. Building services like lifts, lobbies, toilets, located on the east and west facing facades to act as heat buffers from strong solar radiation and minimal window openings. He states that glass covering buildings must be fully sun-shaded against direct sun shine throughout the day and the use of external finishes that are smooth and light coloured to reduce solar heat absorption. The building should use locally available materials, with low embodied energy, minimal maintenance, sustainably harvested, non-toxic, with minimal internal pollution and damage to health and those which are easy to re-cycle or to re-use.

Musau (2014) states that the building should be capable of generating enough green energy to meet all its energy demands during the day and at night such as the use of solar power, wind energy to generate electricity and use of biogas produced from the biodegradable waste generated within the building and the use of motion sensing bulbs. Rainwater should be harvested from the building roofs and its water used for cleaning, flushing toilets and watering plants. The use of environmentally friendly toilets and sewerage system such as, bio-digesters or oxidation ponds is beneficial. Toilet waste from the building can be used to produce biogas. Waste water from bathrooms and sinks can be treated and reused as grey water in flushing of toilets or watering grass. The solid waste generated within the building should be sorted out and the biodegradable waste used to produce biogas whereas the non-biodegradable waste is recycled. The proposed development should be landscaped with well-chosen native trees and shrubs that require minimal irrigation. On-site storm water captured for use or groundwater recharge and recycled or reclaimed water use. Reduction of the number of indoor air contaminants by selecting paints, carpets, and composite woods that emit low Volatile Organic Compounds.

Green Building Certifications

Leadership in Energy and Environmental Design (LEED) is a certification programme developed by the United States Green Building Council. It is aimed at encouraging environmental responsibility and the efficient use of resources in buildings. The LEED rating system is based on points earned across 9 areas; Integrative process, Location and transport, Sustainable sites, Energy and Atmosphere, Materials and resources, Indoor Environmental Quality and lastly Innovation and design. Four levels of LEED certification are possible; Certified, Silver, Gold and Platinum (LEED USGBC 2017). According to Green Building Information Gateway (GBIG 2018), Kenya Activity rating is for 26 organizations; 3 LEED Certified, 1 Energy Star Challenge for Industry, 1 LEED Award for Excellence and 21 Registrations for certification. The Kenya Green Building Society (KGBS) is registered with the World Green Building Council and is

mandated to certify the buildings in Kenya using the Green Star SA rating tools hence promoting healthy and sustainable environment for the nation.

Greening Kenya

The reality of the current Kenyan buildings, is that most owners and tenants are accustomed to inefficient lighting, power interruptions, perennial water shortages, sewer bursts, poor ventilation, poor waste disposals, all which contribute to the degradation of our environment. This has necessitated innovation of environmentally conscious commercial and residential buildings. The Nairobi Business Park Phase II is an office block along Nairobi's Ngong road and has leisure facilities, cafes, restaurants, banking halls, convenience shopping units and a fitness centre. Garden City Mall is a 32-acre mixed-use development along Thika road. The design has incorporated water recycling and rainwater harvesting, solar collectors, the planting of indigenous trees and landscaping that will form the central park.

In 2014, the green building category was added to the Energy Management Awards, only nine buildings met the criteria; Learning Resource Centre at Catholic University of Eastern Africa; Coca Cola East and Central Africa Business Unit, Nairobi; Oleleshwa Primary School, Ewaso Ng'iro, where the school incorporated climatic features with natural lighting and ventilation, rainwater harvesting, wastewater recycling and use of local and recyclable materials; UNEP UN-Habitat headquarters as part of the UN Greening the Blue Initiative; Strathmore University, where the building's major window facades in the North and South facing walls prevents excess glare to the users and sun shading on all windows. Natural lighting and ventilation, high thermal mass walls and a natural cooling tower, rain water harvesting, waste water recycling technologies, a permeable landscape, light colour on the exterior reflects solar radiation and reduces heat gain to the building. Red Pepper House, Lamu; Uaso Nyiro Primary School in Segera, Laikipia, was voted as green by the US Green School Building Council for its water harvesting techniques in a semi-arid area. Each year, the school collects 350,000 litres of water which is filtered using a clay-based system and is stored through an underground storage tank. Its design has natural ventilation and lighting systems and a permeable landscaping and green areas throughout the building. Others are Manda Airport, Lamu and Leven House, Mombasa (Muiruri, 2014).

Kimeu (2013) reported on Catholic University's Learning Resource Centre (LRC) completed in 2012, which consists of a 3,000 seater ultra-modern library, 1,200 seater conference facilities and a cafeteria capacity of 500 people. The construction used locally sourced materials such as Njiru blue stone, Mazeras paving, Rongai Grey stone and Mvule timber. The building orientation is such that the long axis is on aN East-West direction with most windows on the North and South facade, hence adequate sunlight throughout the day. On natural ventilation, cool air is from side windows and the warm air is exhausted through the roof enhanced by exhaust chimneys. The conference hall makes use of the unique rock bed cooling system and has high thermal mass 250mm thick Njiru stone for external walls. Rainwater harvesting is done and the water is collected in an underground tank and used for

watering the lawns and fruit trees. Sewer treatment consists of several oxidation ponds. The conference hall has acoustic design; hence a public address system may not be necessary. Access ramps are in place throughout the building and a water fountain and internal garden area in the library to soothe students' minds.

A research by Kanyaura and Obino (2015) concluded that the level of green building technology adoption has been low due to inadequate expert knowledge about the technology, lack of an appropriate legislative framework and awareness of green concept. Khaemba and Mutsune (2014) in their study of green buildings adoption in Kenya concluded that green buildings have the highest potential for adoption in Kenya.

Conventional buildings are found to bring about the Sick Building Syndrome (US EPA, 2013) and occupants constantly suffer from respiratory sicknesses, headaches, nausea, dizziness and fatigue, which are caused by poor Indoor Environmental Quality (IEQ) (Yousef et al 2016). People spend 90% of their time indoors, and the concentration of pollutants indoors is typically higher than outdoors, sometimes by as much as 10 or even 100 times. A research on the Sick Building Syndrome (SBS) costs to California office and classroom workers revealed an estimated decrease of 2% in productivity caused by SBS symptoms. Published data indicate that 23% of office workers and teachers reported two more frequent symptoms that improve when they leave their workplace (Alevantis, 2002).

Green Buildings Benefits to Tertiary Institutions

The features in the green building design fulfill a given benefit to the building users or owners. To the owners, it reduces the life cycle cost. Research revealed that a minimum increased cost of two percent to support a green design, results in a life cycle savings of twenty percent of the total construction costs. Strathmore University reported a 20% saving of its projected budget for green building. In Kenya, the construction cost would reduce more due to the use of local materials. Green Building Save Report (2017) by Urban Green Consultants, Nairobi shows that green buildings save; 30 -50% of energy, 35% of carbon emission, 40% of water and 70% of solid waste. They also state that in green buildings; workers are 18% more productive, students achieve 5 -14% higher test scores, hospital stays 8.5% shorter, and retail sales of building 15 – 40% higher than conventional buildings Green building certification or award improves public image of an institution, as it brings an innovative fame which may influence the surrounding community.

Social economic issues relate to the student's health and well-being. Green buildings offer better day lighting, and indoor air quality resulting in reduced student illness, and reduced absenteeism. Green building features such as outdoor views of green vegetation, increase learning rates and concentration. The use of moisture control, pollution prevention, and ventilation innovations makes green building healthier for students. Good Indoor Environmental Quality (IEQ) brings about improved productivity of an instructor and the performance of a student in a school set up. A report by Heerwagen (2000), identified human benefits of green building design include improved health outcomes, psychological well-being,

reduced stress, improved cognitive performance, and improved work and life satisfaction. William Pape, the cofounder of VeriFone, reports that eighteen months after VeriFone employees began working in a building designed to cut indoor pollutants and improve indoor environmental quality, absenteeism rates went down by 40% and productivity was up by more than 5% (Pape, 1998). Gary Jay Saulson, the Director of Corporate Real Estate for PNC Realty Services, described the benefits of the LEED Silver PNC Firstside Center building in Pittsburgh, stating that people wanted to work there, and sought employment just to work in the building. Absenteeism decreased, productivity increased, recruitment was better and turnover less (Browning, 1997, 2003). Improved performance on logical thinking tasks was reported in a review of interior environmental quality (Wyon, 1996). Wyon cited studies done in Sweden showing a 2.7 per cent increase in logical thinking associated with personal control over temperatures.

A research done by Fisk and Rosenfeld (1997) on Potential Productivity Gains from Improvements in Indoor Environment showed that improvements in IEQ resulted in reduced respiratory illness in form of common cold or influenza, reduced allergies and asthma from 8 to 25per cent, reduced Sick Building Syndrome symptoms from 20 to 50 per cent, and improved worker performance from changes in thermal environment and lighting. A study by the Heschong Mahone Group evaluated the test score performance of over 21,000 students in three school districts in San Juan Capistrano, Seattle, and Fort Collins. The study found that in classrooms with the most day lighting, students' learning progressed 20 per cent faster in math and 26 per cent faster in reading than similar students in classrooms with the least day lighting. The overall findings show that increased day lighting and generally improving quality of lighting significantly improves student test performance even with repeated analysis. The kind of work done by most state employees is very similar to the work students do. The tasks include; reading, comprehension, synthesis of information, calculations, typing and communications. Studies correlating day lighting with student performance on standard tests therefore provide insight about the impact of increased day lighting on state employees (Heschong, 1999, 2002).

Conclusion

Out of 71 universities and 70 TVET institutions, only Strathmore University and Catholic University of East Africa (CUEA) have received certification. Green buildings typically have lower energy and water usage, reducing both the operating costs to the institutions as well as overall demand for these utilities from the municipal council. The institutions which invest in day light controlled lighting or occupancy sensors will save much on electricity expenses. This is beneficial where students leave rooms without switching of lights. Proper landscaping of an institution's grounds dramatically reduces erosion and storm water runoff problems. Storm water in parking area can be collected and used to water the flower gardens or the grass. Sewer waste can be treated for use as biogas. An institution's kitchen sink water can be filtered and used to keep the grass and native trees green.

This will avoid semi-desert looking patches of grass in hot weather. A natural environment soothes students and can bring innovative ideas. Green building development in a location may encourage other building owners to do the same. The hiring charges for an institutions green building will be higher than a conventional building in the same location.

Recommendations

Therefore, all tertiary institutions should consider going green in their next constructions or adding green features to the existing buildings. The institutions should find ways of reducing their huge operational costs and also fully utilize renewable energy. Sustainable development should be included as a learning unit in the curriculum in order to instill a culture of environmental sustainability to the learners.

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