



Campus Sustainability Assessment: The Case of University of Cape Coast, Ghana

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Authors' contributions

This work was carried out in collaboration between both authors. Author SD designed the study, managed literature searches, collected data and wrote the first draft and final version of the manuscript. Author HE collected data, performed the statistical analysis and managed the analyses of the study. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: To assess buildings and their subsequent impact on land and energy use to validate campus sustainability.

Study Design: A survey.

Place of Study: Department of Vocational & Technical Education, University of Cape Coast.

Methodology: A questionnaire was administered to conveniently select senior members and senior staff of the university. Questions covered issues on land/energy use versus building types. The Land surveyor, Quantity surveyor, Architect, Estate officer, grounds and maintenance representative and 5 other high ranking officials of the university were purposively interviewed to obtain information on indices that dictated siting of buildings on campus. A total of 60 questionnaires were retrieved and 10 in-depth interviews conducted.

Results: Findings showed a 25% land encroachment rate. About 33 buildings have been raised on campus since the year 2000 of which 72% are low rise 1-3 storey and 28% 3-4 storey. Building type was determined by financial factors followed by original university laid down designs and nature of land, and its availability. Horizontal land use was attributed to building especially along the periphery

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to curb encroachment. Respondents (72%) suggested the construction of more residence halls, libraries and laboratories to meet the needs of increased student populations on campus. Others suggested demolishing some existing structures to make room for high rise buildings. Finally, the officials interviewed stressed the need for government support to help the university erect more appropriate buildings and adopt ways of making activities on campus more sustainable.

Conclusion: Horizontal rather than vertical land use practices and the type of buildings being put up on campus may not be sustainable in the long term. The university needs to take practical steps towards a more sustainable land use policy and planning hopefully with help from government and other stakeholders. Community engagement is highly recommended.

Keywords: Campus; sustainability; higher; education; assessment.

1. INTRODUCTION

Education has been the foundation of development in most countries with Ghana being no exception. Education in Ghana occupies a highly important place especially in the socio-economic development of the country thus policies such as the Free and Compulsory Universal Basic Education and the School Feeding Program have been instituted by governments within the last decade. These policies have resulted in high enrollment and completion rates in the basic schools which in turn are having rippling effects on the secondary and tertiary institutions including the universities. Although majority of basic schools in Ghana are day schools and thus require fewer structures and resources to operate, the same cannot be said of secondary and tertiary institutions. On the contrary, majority of secondary and tertiary institutions in Ghana are boarding in nature and require more structures and resources for operating. As a result, there seems to be inadequate provision made in these sectors to absorb the large population of pupils from the basic schools.

The University of Cape Coast (UCC) is located along the Cape Coast –Takoradi highway and is surrounded by highly-dense encroached residential and business areas. In such municipal setting, decisions guiding land use are intricate and highly imperative. Both the academic and functional needs of the campus must be balanced with limited space and the need to maintain a sustainable campus. Thus, proper management of this space is of crucial importance. UCC was established in October, 1962 to train graduate teachers in Arts and Science for Secondary schools, College of Education, Polytechnics and Technical Institutions in Ghana. At the onset, the University operated in two departments namely: the Arts and the Science department with an initial

student enrollment of 155. Currently, the University has adopted the collegiate system with five main colleges, the College of Health and Allied Sciences; College of Agriculture and Natural Sciences; College of Humanities and Legal Studies; College of Distance Education and College of Education Studies and a School of Graduate Studies.

The total student population has risen from 155 in 1963 to 18498 (12393 males and 6105 females) in 2014/2015 for regular students and 36, 313 in 2013/2014 for distance education students. It is evident that the university has grown in the number of programs and population of students since its inception. After speaking to the development unit of the University of Cape Coast, we learned that up to 33 new buildings had been put up on campus by the university since the year 2000. Majority of these buildings are low rise in nature (1-3 storey) and the remaining are 3-4 storey buildings. This growth in infrastructure involves more horizontal land use rather than vertical and thus has vast implications on the use of natural resources including land. Considering the fact that the university's original lands acquired have some encroachment issues, the horizontal consumption of land area may be inappropriate. The consistent increase in the enactment of low rise buildings on campus coupled with the alarming rate of encroachment on the university land makes it imperative for immediate action to be taken towards protecting the land in a sustainable manner so as to ensure that the future generation may still have access to it.

The concept of sustainability in recent times has been discussed extensively amidst numerous environmental catastrophes attributed to human activities that require immediate attention [1]. The concept of sustainability originated from the advent of the 1987 Brundtland Commission Report and World Conservation Strategy with

focus on ecology, socio-economic and sustainability highlights [1]. The definition in the Brundtland Report of the World Commission on Environment and Development (WCED 1987, p. 43) is as follows:

"... development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

"... In essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations" (ibid., p. 46).

A more operational concept of sustainability in this study would be sustainable development which is people centered and based on the ability to provide resources and life support services to improve the quality of human life on campus. In this age, sustainability has become the icon of nations, organizations, institutions and industries with proof given in the United Nations Climate Change Conferences in Mexico (2010) and South Africa (2011) stressing that it is a must to reach a low carbon sustainable society in order to deal with climate change. Sustainability is an ongoing conversation everywhere which basically aims at meeting the needs of the present generation without compromising that of the future generation [2]. Land is one of the basic resources that is always in high demand. [3] defines sustainable land management as "the adoption of Land use systems that enable maximization of the economic and social benefits of land use through appropriate management practices while maintaining its ecological support functions. If well practiced, sustainability can help optimize one's resource utilization and will offer our future generation a cleaner, safer environment. The concept of eco campus has been implemented worldwide in such situations and has contributed a lot to sustainability in universities involved in mass consumption of resources and creation of wastes [4].

FAO [5] reported the need for Africa to maintain its land and other natural resources to support its growing population in future. They further added that Sustainable Land Management (SLM) is crucial to minimizing land degradation, rehabilitating degraded areas and ensuring the optimal use of land resources for the benefit of present and future generations. Campus

sustainability has been studied widely in developed countries like the United States of America, but its paucity in some parts of South America specifically Brazil and yet very few studies in African countries, calls for such studies in Ghana.

There is need for universities to make necessary adjustments to reduce the negative impact of campus operations on the environment and include sustainability into their structures. There is practically no documented study conducted on the sustainable use of land and other resources in any of the universities in Ghana including the University of Cape Coast and thus imperative to undertake this study. The objectives of the study were to examine the present state of UCC campus land and energy use, identify factors that influence development projects on campus, and determine the knowledge/perception of UCC staff on University campus land use and to drive the University to embrace sustainable practices to make it a good example amongst other Ghanaian universities. To achieve this goal, further research into land and energy audit will help generate more preliminary baseline data.

2. MATERIALS AND METHODS

2.1 Study Population and Sampling for Survey and Interviews

The study population was made up of senior members and senior staff of the university. Out of these, some senior members and senior staff were conveniently sampled from the university administration, College of Education Studies, Faculty of Arts, Faculty of Social Sciences, the School of Physical Sciences and the School of Business and administered questionnaires. Purposive sampling was then used to select the land surveyor; quantity surveyor and architect from the Directorate of Physical Development, the estate officer, an employee of the grounds maintenance unit of the university and 5 other high ranking officials from other units and departments of the university and interviewed. A total sample size of 60 respondents provided information through questionnaire responses and interviews.

2.2 Data Collection

Primary documents including records on campus land development, campus plans and assessments were obtained from the Directorate of Physical Development and Estate

Management, University of Cape Coast and the contents analyzed extensively. Data for this study was collected using a qualitative approach that involves three main instruments. These were a survey using a self developed questionnaire, an interview guide and observation. The questionnaire was used to obtain data on University of Cape Coast staff knowledge/perceptions of how university campus lands are developed. Items on the questionnaire included: Types of buildings erected on campus, types of windows found on these buildings, availability of good ventilation and light, reasons for choice of site and building and the original nature of land prior to being developed among others. With the interview guide, semi-structured interviews were conducted with relevant individuals at the University of Cape Coast. These included the land surveyor, quantity surveyor and architect from the Directorate of Physical Development, estate officer and grounds maintenance employee and 5 other officials of high rank at the university. These professionals were purposively sampled and interviewed separately but on the same day. They were first briefed on the purpose of the study then interviewed. Data obtained from the interviews included the present state of University of Cape Coast campus land and factors that influenced development projects. Observations were carried out to validate data obtained from participants on the present state of University of Cape Coast campus lands.

Two research assistants from the Vocational and Technical Education Department of the University of Cape Coast helped the researchers to collect data by administering and retrieving completed questionnaires. Prior to collecting the data, the research assistants were schooled briefly mainly on the content of the questionnaire since they both had prior experience in questionnaire administration and collection procedures. Participants were assured of confidentiality of their responses and anonymity. Prior to participating, verbal consents were obtained from participants after a statement of consent was read to them and they responded and agreed to participate. Items on the questionnaire were explained to participants before the questionnaires were handed over to them. Respondents were allowed at least 30minutes to respond to the questions after which questionnaires were collected or retrieved. The interviews and observations were carried out by the main researchers and analyzed within August and September 2014.

2.3 Data Analysis

Retrieved completed questionnaires were serially numbered according to the departments within each college, school or faculty. Items were scored according to the order in which they appeared. Data obtained was input into SPSS version 21 and analyzed. Results were presented as frequency and percent tables. Some relevant transcripts of the interviews conducted were also presented.

3. RESULTS AND DISCUSSION

With the current advocacy for campus sustainability worldwide, it is becoming essential that all universities become cautious of land use. Prior to this study, an interview with personnel from the Directorate of Physical Development and Estate Management, University of Cape Coast revealed that approximately 33 buildings have been put up by the university on its campus since the year 2000. Majority (72%) of these buildings are low-rise (1–3 storey) buildings while the remaining 28% are 3–4 storey buildings (Table 1). This implies horizontal consumption of land area as against vertical utility of space is the existing practice on the UCC campus, an approach that is deemed inappropriate for land use especially one with an encroachment percentage of 25. The consistency with which low rise buildings are being put up on UCC campus, coupled with the alarming rate of encroachment on UCC campus land makes it imperative for immediate action to be taken towards protecting the land and sustaining it for future use.

Participants understanding of the sustainability of land and other natural resources were similar. Majority (76.7%) of the participants reported sustainability to be the efficient use of land and other natural resources in order to conserve, and preserve them for future generations (Table 1). These responses were consistent with several others provided in sustainability studies [2,6]. Consequently, one could make an argument for more practical and official incorporation of student engagement in campus sustainability into university sustainability initiatives.

The factors that influenced University authorities to decide on the type of buildings to put up was topped by financial, followed by design originally laid down by the University and the nature of the land as shown in (Table 2). Financial factors (46%) followed by UCC designs (39%) greatly

Table 1. Understanding of sustainability of land and natural resources

	Responses (Frequency)
Land	
Efficient use of natural resources presently to conserve some for future generation	46
Meeting present needs for land with high chance	6
Minimum use of existing land for future benefits	7
Efficient use of existing lands for present needs	1
Total	60
Natural resources	
Efficient use of land presently to conserve some for future generations	43
Meeting present needs for land without compromising future generations ability to meet their needs	9
Minimum use of existing land for future benefits	8
Efficient use of existing lands for present needs	5
Total	60

influenced decisions made by management regarding the type of buildings erected by the University.

Table 2. Factors that influence decisions made regarding type of buildings erected by the university

Factors	Frequency	Percentage
Financial	25	46.3
In accordance with UCC design	21	38.9
Nature of land	8	14.8
Not known/Not provided	6	10.0
Total	60	100.0

Considering the reasons provided by participants for choosing building sites on campus, environmental issues though were considered prior to siting buildings, were just above average and still did not cover all choices. Rather laid down UCC Site Plan and land available greatly influenced the choice of buildings on campus. From (Table 4), findings show that all the infrastructures listed will be under pressure in the next 10 years but may not necessarily be to the extreme. From the responses of the participants, it is evident that all infrastructures will not be adequate for students in the near future and steps need to be taken to nullify that.

In terms of finding solutions to inadequate infrastructure that the University may be facing in the next ten years following the ever increasing population of students on such campuses, majority of the participants (72%) suggested the construction of more halls of residence, libraries, and laboratories among others. These suggestions are to curb the expected pressure on infrastructure in the next 10 years. This will

mean the idea of horizontal use of land as persists on the campus currently may not support building of more facilities as stated in years to come. There is the need for better use of land and probably to engage in more vertical utilization of land to still have some for future developments. Looking at the next suggestion provided “demolishing of existing buildings and replacing them with high rise ones,” one would ask why high rise buildings should not rather be put up now and prevent the waste of demolishing buildings in the near future.

It was interesting to learn from (Table 6) that majority of the participants felt the need for nature on campus and wanted to have a sense of nature amidst all the developments. For participants to desire nature, it is not surprising that only three (3) of them suggested putting up more buildings to the detriment of plant and animal existence as shown in (Table 5). About 50% and 43% of the participants reported that they preferred buildings that had both vegetation inside and outside of them, and buildings with vegetation outside them respectively (Table 6). With an approximate total of 93% of the participants preferring some form of vegetation associated with the buildings, one may confidently say that the participants love nature. To achieve this, the university needs to adopt strategies that can help utilize land efficiently by building more efficient structures and sustainably leaving land for plant growth.

“Spending time in nature through stewardship and other outdoor activities can foster both human well-being and pro-environmental behaviors, incorporating such activities into the practice and study of sustainability in higher education is important” [7].

Table 3. Reasons for choice of building sites on campus

	Most influential	Influential	Less influential	Not influential
In accordance with UCC's site plan	28	8	7	8
Accessibility by majority of users	5	17	11	14
Available land	18	19	6	3
Environmental consideration	8	16	11	9

Table 4. Infrastructure that is likely to be under pressure in the next ten years

Infrastructure	Ranking										Mean
	1	2	3	4	5	6	7	8	9	10	
Main library	4	7	4	4	7	1	5	2	3	12	5.8163
Departmental library	4	7	4	4	7	1	5	2	3	6	5.7021
Science labs	3	2	6	8	2	2	5	8	4	5	5.8667
Computer labs	1	2	5	12	5	1	3	4	2	9	5.9091
Halls of residence	10	2	1	1	1	3	1	6	4	19	6.7708
Staff residence	4	9	3	1	3	2	7	7	5	6	5.7872
Lecture theatres	2	6	2	3	2	2	4	3	10	12	6.8696
Offices	3	3	2	4	7	9	4	7	2	3	5.7273
Parking space	5	2	5	1	2	5	3	3	5	14	6.6222
Hospital	3	0	4	2	8	4	4	3	2	15	6.8222

Table 5. Suggested solutions to infrastructure likely to be under pressure in the next 10 years

Infrastructure	Frequency
Build more halls of residence, libraries, labs etc	46
Demolish existing buildings and replace with high rise ones	15
Construct access roads and parking spaces	8
Erect more buildings to the detriment of plants and animals' existence	3

Table 6. Preferred environment/nature of buildings on campus

Choice	Frequency
Building with vegetation within	2
Building with vegetation outside	26
Building with vegetation within and outside	30
None of the above	2
Total	60

Looking at the type of buildings being put up on campus, usually 3-5 storey, land is being used horizontally rather than vertically which implies that more land is used for less. In this case land is not being efficiently used. This probably could be argued out that the energy capacity in the country especially electricity may not be able or cannot support high rise buildings where people will require elevators to move from one level to the other. This is coupled with the constant intermittent power interruptions that are seen

more frequently in the country in recent times. If such facilities were put in place, the university may have to depend on generators to power elevators so the facilities can be put to full use. The associated fuel for such operations may equally not be sustainable. With these outlined observations, it is not surprising that majority of the participants suggested for implementation in UCC's environmental development plan buildings that were well lighted naturally and would require less of electricity at least during the day time (Table 8).

Table 7. Reasons for choice of nature of buildings/building environment

Reason	Response		Total
	Yes	No	
Reduce stress	11	46	57
Promote peace and tranquility	11	46	57
Enhance self-esteem	6	51	57
Gives sense of mastery of the environment	11	46	57
Gives sense of touch with nature	40	17	57

From observation, most of the new buildings constructed on campus in recent times have sliding aluminum glass windows with very little openings which allow very little air and light into the rooms. As a result, the rooms are often hot and humid demanding the continuous use of lights, fans and sometimes air conditioners to provide air and comfort every time the rooms are

used. Probably, if ordinary glass louvers were used and more windows were created, the rooms would be well ventilated and lighted up naturally. This would have saved the situation where electricity must be used to provide both light and good ventilation anytime these rooms are used. Also, if these buildings were sited in the right direction, lighting and ventilation would have been less of a problem and more sustainable. These sliding aluminum glass windows which are often used in the more developed cold regions serve the purpose of retaining warmth during winter which helps to reduce heating cost of the rooms. Apart from the aesthetic value that it presents, it may not be the most ideal windows to use in this part of the world.

A few years ago, universities were not required to pay for the use of water and electricity but that is no longer the case. There has been constant on pass between university authorities and government concerning the payment of such utility bills. Both electricity and water companies have started installing pre-paid meters for electricity and ordinary meters for water at the various departments and offices in the university and is expected to extend to the individual halls of residence. Implications are that without purchasing power the individual departments and offices may not have electricity to work with. It is time for university authorities to conduct proper audit of resource use to help them manage it well and sustainably.

Community engagement in sustainability has become success stories in some universities across the world. Examples are Monash University in Australia and Cornell University in New York, USA. Monash University was rated Australia's greenest university in 2011 [8]. The Monash footprints is a major behavioral change sustainability project which encourages a more sustainable lifestyle among its staff and students. That project which promotes recycling rates among staff by helping them dispose of waste more appropriately, the annual campaign where the community members pledge to mitigate their environmental impact on energy, waste, food, water and transport. The last project is the Transport fiesta which encourages staff and students to travel by sustainable means of transport such as public transport, bicycles, walking and carpools or 2 weeks [9]. Cornell forms green teams who incorporate sustainability into their daily activities in every department, students engaged in the lights off Cornell volunteering where they go round switching off lights in buildings after office hours. Finally,

students engage in Take Back the Tap which aims at reducing supply and demand for bottled water and reinvest in public water infrastructure and the Public Transport Service where students and staff are provided with free transport services, bus shuttles etc. [9].

Looking at (Table 8), it can be said that participants still value nature and are sensitive to it. Majority (41) recommend gardens, relatively half of those who recommend buildings that will be well lighted naturally. Recommending that the university creates water bodies and game reserves still go to strengthen the value participants place on nature.

A sustainable university model has been proposed as a way to approach a sustainable campus [10]. The model entails forming a sustainable vision with an attached concept of a sustainability mission. They further recommended a university wide committee which will put in place and ratify sustainability policies that are targets and goals that go with the sustainability mission. It will be worth learning from the approaches in sustainability's of other universities to help build upon achieving a sustainable campus. These approaches ought to cover education, research, outreach and partnership, and campus operations.

Table 8. Recommendations for implementation in UCC's environmental development plan

	Frequency
Gardening	41
Lighting	22
Create artificial water bodies	11
Create game reserves	13
Erect or establish more buildings on campus	16

If participants do appreciate the effects of these developments on the environment, then they are environmentally sensitive and could contribute to a more sustainable campus. [11] reported that universities often rely on operational measures as a traditional way of improving their sustainability, yet community engagement and outreach play equally vital roles in sustaining changes in the direction of greater sustainable practices. Further, [11] stated that "communities are the heart and hands" of all sustainability movements, regardless of its context. As a result, there are "critical relationships" within the three parts or components [11]. [12] reported that community participation in sustainability programs is both "dynamic and intergenerational"

thus creates difficulty in successfully assessing it always.

The main concern of increase in deforestation would be addressed if land was better utilized so less forest is destroyed to make way for buildings. This also goes for retaining land for agricultural purposes and avoiding destruction of natural forest which serves as home for the animals that are extinct. Sustainability has often been focused on the environment and economy leaving out other aspects like institutional sustainability [13-16]. [4] had suggested the adoption of the concept of Eco campus by universities to help them operate with self consciousness in the utility of resources inside the campus. The higher education sector research in sustainability proposes management or leadership as a key driver in employing the university community in sustainability [17,18]. Similarly, [19] specified that top-level commitment which includes sustainability as a highest priority of universities can generate motivation for innovation in sustainability across university campuses. Others have disputed that peer pressure from contending institutions as well as available funds could strengthen the growth of sustainability in universities [20,21].

Table 9. Likely effect of increase in infrastructure on environment

Effects	Frequency
Increase in deforestation	31
Reduction in available land for agriculture use	18
Extinction of animal life from campus	13
Change in climate	16

Sustainable campus landscapes have been reported to improve learning and add to mental and physical health through the promotion of outdoor leisure activities and cut down on respiratory and stress-related diseases [22]. The AASHE's *How-to-Guide: Promoting Sustainable Campus Landscapes* explains "sustainability" as applied to the campus landscape as including the effectiveness and difficulty of nature into the landscape, bringing back damaged ecologies, raising biodiversity, promoting human health, and making available well established livelihoods whereas managing potentials of the "campus aesthetic. Well planned campus buildings and landscape need to be ecologically, economically and socially sustainable [22].

Even though this study was based on a small number of participants, many of them were

selected to participate because of their special position on campus thus making their responses important. Possibly, the most important contribution of this study is its implications for the way in which we think about campus sustainability.

4. CONCLUSION

Findings showed that the University of Cape Coast's current land use practices which is more horizontal than vertical and the type of buildings constructed for use as lecture halls and offices may not be sustainable in the long term thus reducing the availability of land for use by future generations. Based on this study, exploring the possibility of developing a campus wide sustainability policy may be ideal and timely.

The University authorities and stakeholders need to take practical steps toward investing in more appropriate buildings which will take up less land area and demand or require less energy to put them into required or proper use. There is also the need to develop a more sustainable land use policy and plan hopefully with help from government and other stakeholders. Community engagement in achieving sustainability in all activities on campus is highly recommended. The knowledge and perceptions of the staff on campus showed that they still value nature and look forward to seeing better provisions made for students in terms of lecture halls, libraries, halls of residence among others and concurrently conserving nature on the campus.

CONSENT

Participant's consents were sought orally prior to being administered the questionnaire or being interviewed.

ETHICAL APPROVAL

Institutional Review Board (IRB) clearance was not required for the study because it did not have sensitive human subjects or animals issues.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

A summary of some of the transcripts from the interview is provided below.

The university plans to put its buildings along the periphery of its land because of the massive encroachment on the land by neighbouring villages.

There has been a lot of encroachment on the land and if serious measures are not taken to curb these unlawful acts, the university will lose greater part of its land to these encroachers. This probably is causing the horizontal utilization of land rather than vertical. If the University had more financial support from the government, it could put up reasonably high rise building which will help in sustainable land management.

In the past, the University pulled down some buildings that belonged to individuals who had encroached on the University lands but this drastic measure received such negative rage from those affected that it was short lived. The problem is that some of the University employees were equally involved.

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