

## Comparative Analysis Of Land Space And Structural Facilities In Relation To Academic Output

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### ABSTRACT

The goal for attainment of sustainable infrastructure for cities and communities of the world was set to be attained latest by year 2030. Goal 11 of the Sustainable Development Goals (SDGs) specifically is about making cities and human settlements inclusive, safe, resilient and sustainable. This paper in consideration of this laudable goal considers vertical developments incorporating mixed use as an option to lateral development in educational institutions communities in Nigeria. Data were collected from selected educational institutions in Nigeria and were compared with similarly selected educational institutions outside Nigeria using internationally accepted ranking criteria as basis to see if possessing excessive land mass as observed in Nigerian Universities will lead to better academic performance and better world ranking as witnessed in foreign Universities. The result shows that total land mass available to educational institutions outside Nigeria is minimal, more productively used and effectively maintained in a sustainable manner than land available to higher institutions in Nigeria where land is awkwardly used and wasted. Higher Institutions should center more on research and academic excellence rather than possessing massive lands that are not effectively maintained. This work therefore recommends that Authorities in Nigeria should reduce land mass requirement for establishment of higher institutions and mandate investors to develop vertically by applying the mixed use concept.

**KEYWORDS:** SDGs, Vertical Development, Mixed Usage, Educational Institutions.

### INTRODUCTION

#### Sustainable Development Goals (SDGs)

Sustainable development is a development that meets the needs of the present generation without compromising the ability of the future generations to meet their own needs (World Commission on Environment and Development, 1987). Since the later part of the twentieth century, the negative impact of development in the environment with its damaging consequences has continued to bring fear into the minds of Environmentalists. Earlier studies tried to lay a foundation calling for sustainable development of land resources. Malthus (1798) attempted to address the issue of the Earth Carrying Capacity through his theory of exponential population and arithmetic food supply growth. Bartors(1995) addressed the issue of gradual change in temperature that could lead to ultimate death. Schumachar (1982) addressed the economic ideas that had sadly been forgotten such as the need for economic use of land resources and Holmberd (1991) wrote a masterpiece on the need for the present to defend the future. The Land Use Act (1978) in Nigeria was promulgated mainly to address the issue of Land Use and sustainability by putting the length and breadth of all the Lands in a State under one Caretaker – The Governor of the State. This is believed would lead to judicial distribution since ownership can be regulated to mean one man one plot.

Due to all the natural calamities faced by the world and for the fact of the relationship between man and his environment where man must derive sustenance from the land he occupies, pitifully, man has been making attacks on his own environment by plundering it thereby threatening his own survival; Ijagbemi (2010). The enormous problem posed by human activities therefore has called for more sustainable management of resources Adegoke (2005).

Sustainable development concept therefore addresses issues of environmental friendliness in all ramifications of human development. The goals as spelt out at the UN Stockholm Conference on human environment in 1972, the Earth Summit in Rio De Janeiro, Brazil in June 1992 and the culminating declaration at the general assembly are all blue prints to achieve a better and more sustainable future for all; these are global goals to protect the planet earth and make it a better place for the present and generations yet unborn to live in.

### **Vertical Development**

Property Development is faced with lots of risks right from inception to completion. In the sense of this work however, flexibility in use is being proposed as an option to counter some of these risks. Flexibility in use allows the Developer/Investor to mitigate some of the risks faced. Development takes place on land and for proper maintenance and effective use, vertical development then is seen as an option over lateral development for higher institutions.

Vertical Development in the settings of higher institution community is any development that rises above 4 floors. It is necessary to say that developments here can rise as high as available technology permits. Scientists and developers even as far back as early ages came into the understanding of the advantages of vertical development in the case of the Tower of Babel in the Bible. Since this time, such high rises have been employed, not for environmental beauty purposes only but more to make use of space and conserve land available.

Higher Institutions in countries all over the world have also keyed in into this phenomenon. The case in Nigeria Institutions should not be different then because of the advantages of economy in the use of land, this being a major reason for this option which makes it very attractive and the reason of sustainability, Pearson (2008). This advantage is being exploited maximally by the Government of China demonstrating this in all recent Government planned cities which favours High Density Developments. Nigerian Government on the other hand seems not to realize that though land is a free gift of nature it is not created by man hence its supply is fixed. Vertical Development is for the sustainability of this resource knowing full well that the built environment constitute one of the major consumption units of land. The Institutions requires a lot of land mass for physical development and other uses.

Vertical Development using the concept of mix-use is a feasible alternative therefore to the present lateral and sprawling concept. Dalal& Bass (2012) opined that sustainable vertical development is perceived as a mixed use development (MUD) and is in the form of clusters of interconnected high rise buildings that facilitate quality environment to its inhabitants and visitors. Vertical cities (Vertical developments) is seen as a vision of a complete eco-system in the sky – a place you will never have to leave if you don't want to; Schiller, (2014).

### **Mixed Use Development**

This is a type of development in urban centres that blends more than one use such as residential, commercial, cultural, institutional or entertainment. These functions are physically and functionally integrated thereby providing pedestrian connections. This kind of development can take the form of a simple building, a city block, or entire neighborhood's construction. This term may also be used more specifically to refer to a Mixed – Use Real Estate

Development Project – a building, complex of buildings or district of a town or city that is developed for mixed – use by a private developer (quasi) Governmental agency, or a combination thereof. Modern settlements all over the world are now adopting mixed use pattern. Nigerian Institutions should subscribe to this idea rather than continue to allow their environment to be defaced with a large expanse of land rarely covered due to high level of availability. Instead of mapping out the area of land for the tangible development that will lead to aesthetically and sustainable development through the idea of vertical development that inculcate a lot of uses, land that ought to be conserved for the coming generations are wasted. Management or Government believes in scattered settlements which in turn cause the gross lack of proper management of the land and other landed properties, deforestation which leads to degradation. However, with industrialization as well as modern technology, the use of and the exploration of vertical space and its development should replace lateral development.

### **Benefits Of Mixed – Use Development**

Better space allocation, guaranteed variety and density.

Reduction in distance covered by the Institutions community

More compact development, land – use synergy

Stronger neighbourhood character, sense of place

Reduced transportation cost as a result of walkable, bike – able neighbourhoods enjoying increased accessibility via transit points.

Properties can boast of luxurious shared facilities

Ease of facility maintenance

Reduction in cost of security as sections can be monitored by powerful CCTVs

Roads, Drainages, Electricity, Water Spraying points and other facilities can be provided with ease

### **Types Of Contemporary Mixed – Use Zoning In Education Institution**

Mainstream classrooms mixed with offices on different floors within a single block.

General convenience block

Retail and service uses to service the offices

Centralised Parking with adequate security watch ( CCTV and human)

### **Higher Educational Institutions**

These are institutions where people of different ages learn. Higher Institutions in the context of this study are the Universities and the Polytechnics. They provide a large variety of learning environments and learning spaces thereby forming unique communities.

## **METHODOLOGY**

Data used in this write-up were sourced directly from the internet as they are ready available. Information on Ranking Criteria from Times Higher Education (THE), from Academic Ranking of World Universities (ARWU) and from Quacquarelli Symonds (QS) World University Ranking was obtained at the sites of these bodies. Information on current Ranking of Nigeria Universities was also obtained through the same means.

Due to the volume of information available at these sites, only the top 20 Universities were picked as these were considered enough for the analysis. Information on land mass by each institution was obtained from their sites. The ranking done by these bodies were then adopted for easy comparison.

## DISCUSSION

As at today, Nigeria has about 160 Universities made up of 50 Federal Universities, 45 State Universities and 65 Private Universities approved by the Nigeria University Commission (NUC 2019). The minimum land requirement to set up a University is 250acres (100hectres). Other requirements are proximity to source of water supply – probably building a dam, private accommodation to complement available hostel, setting of Agricultural farms etc. All these will take extra hectres of land.

In the context of this work, land is viewed from the physical angle (terra firma) which makes its supply to be inelastic. As a result of this peculiarity which differentiates land from other resources, the total area for mans use cannot be appreciably increased. Its usage, sharing and allocation methods for present uses must be in recognition of generations yet unborn that must equally have land available for their use. Allocation to higher institutions now must be economical and sustainable.

### Criteria For Ranking

This is based on some general indicators which serve as basis for ranking. Generally, the following are considered:

- Alumni of the Institution winning Nobel prizes and field medals
- Staff of an Institution winning Nobel Prize and field medals.
- Highly cited researchers in 21 broad Subject categories
- Papers published in Nature and Science (publication output)
- Papers indexed in Science citation index (citation impact)
- Per capital academic performance of an Institution

**Table 1: Times Higher Education (THE) Ranking**

CRITERIA	WEIGHT
Teaching – the learning environment	30%
Research – volume, income and reputation	30%
Citations – research influence	30%
Industry Income – innovation	2.5%
International Outlook–staffs, students and research	7.5%
TOTAL	100%

**Source: Field Research 2019**

**Table 2: Top 20 Universities Ranking Under (THE)**

S/N	NAME	COUNTRY	RANK	LAND MASS(ACRES)
1	University of Oxford	UK	1	12.5
2	University of Cambridge	UK	2	288
3	Stanford University	US	3	8,180
4	Massach. Institute of Technology	US	4	166
5	California Institute of Technology	US	5	124
6	Harvard University	US	6	210
7	Princeton University	US	7	500
8	Yale University	US	8	1,015
9	Imperial College London	UK	9	
10	University of Chicago	US	10	217
11	ETH Zurich	SWITZERLAND	11	
12	John Hopkins University	US	12	
13	University of Pennsylvania	US	13	694
14	UCL	UK	14	
15	University of California, Berkeley	US	15	6,679
16	Columbia University	US	16	299
17	University of California, Los Angeles	US	17	419
18	Duke University	US	18	
19	Cornell University	US	19	4,800
20	University of Michigan Amador	US	20	

Source: Field Research 2019

**Table 3: Academic Ranking Of World University (ARWU) Ranking**

CRITERIA	WEIGHT
Quality of Education	10%
Quality of Faculty (staff )	20%
Quality of Faculty (subject category)	20%
Research Output (publication)	20%
Research Output (social science)	20%
Per capital Performance	10%
TOTAL	100%

Source: Field Research 2019

**Table 4: Top 20 Universities Ranking Under ARWU**

S/N	NAME	COUNTRY	RANK	LAND MASS(ACRES)
1	Harvard University	US	1	210
2	Stanford University	US	2	8,180
3	University of Cambridge	UK	3	710
4	Massachusetts Institute of Tech.	US	4	166
5	University of California, Berkley	US	5	6,679
6	Princeton University	US	6	500
7	University of Oxford	US	7	12.5
8	Columbia University	US	8	299
9	California Institute of Technology	US	9	124
10	University of Chicago	US	10	217
11	Univ. of California, Los Angeles	US	11	419
12	Yale University	US	12	1,015
13	Connell University	US	13	4,800
14	University of Washington	US	14	703
15	University of California, San Diego	US	15	2,141
16	University of Pennsylvania	US	16	694
17	University College, London	UK	17	299
18	John Hopkins University	US	18	
19	Swiss Fed. Inst. of Tech. Zurich	SWITZERLAND	19	
20	Washington University, St. Louis	US	20	2,313

Source: Field Research 2019

**Table 5: Quacquarelli Symonds (QS) Ranking**

CRITERIA	WEIGHT
Academic reputation from Global survey	40%
Employer reputation from global survey	10%
Citation per faculty form Scopus	20%
Faculty Student Ratio	20%
Proportion of International students	5%
Proportion of International faculty	5%
TOTAL	100%

Source: Field Research 2019

**Table 6: Top 20 Universities Ranking Under QS**

S/N	NAME	COUNTRY	RANK	LAND MASS(ACRES)
1	Massachusetts Institute of Technology (MIT)	US	1	166
2	Stanford University	US	2	8,180
3	Harvard University	US	3	210
4	University of Oxford	US	4	12.5
5	California Institute of Technology	US	5	124
6	ETH Zurich-Swiss Fed Inst. of Tech	US	6	710
7	University of Cambridge	UK	7	
8	UCL (University College London)	UK	8	299
9	Imperial College London	UK	9	
10	University of Chicago	US	10	217
11	National University of Singapore	SINGAPORE	11	
12	Nanyang Technological University	SINGAPORE	12	494
13	Princeton University	US	13	500
14	Connell University	US	14	
15	University of Pennsylvania	US	15	694
16	Tsinghua University	CHINA	16	
17	Yale University	US	17	1,015
18	Columbia University	US	18	299
19	EPFL Ecole Poly. Fed. de Lausanne	SWITZERLAND	19	299
20	EPFL Ecole Poly. Fed. de Lausanne	UK	20	

**Source: Field Research 2019**

Table 1, 3 & 5 above shows the criteria under which Universities are ranked. Weights are attached to show relative importance of each criterion.

Table 2, 4 & 6 shows the top 20 World Universities rankings along with the landmass of each university (urban setting). Out of about 30 universities rated, only about 4 has landmass marginally above 1000 acres. This represents about 13.3%.

### **Framework For Rankings In Nigeria**

Nigerian Universities (along with other higher institutions) have specific bodies charged to rate them. These bodies are known as Regulators and they are as follows:

- National Universities Commission (NUC) - Universities
- National Board of Technical Education (NBTE) - Polytechniques & Monotechnics
- National Commission for Colleges of Education (NCCE) - Colleges of Education

### **Criteria For Ranking Nigerian Universities (UNIRANK)**

- Being chartered, licensed/accredited by appropriate Nigeria higher education-related organisation.
- Offering at least 4-year undergraduate degree or postgraduate degrees
- Delivering courses predominantly in a traditional face to face, non distance education

**Table 7: Top 20 Universities Ranking Under NUC (UNIRANK)**

S/N	NAME	CITY	RANK	LAND MASS(ACRES)
1	University of Lagos	LAGOS	1	1,100
2	University of Ilorin	ILORIN	2	37,500
3	Ahmadu Bello University	ZARIA	3	17,500
4	Obafemi Awolowo University	IFE	4	12,500
5	University of Nigeria	ENUGU	5	2,500
6	University of Ibadan	IBADAN	6	6,375
7	Covenant University	OTA	7	560
8	Fed. University of Tech. Minna	MINNA	8	26,625
9	Landmark University	OMU-ARAN	9	1,400
10	River State University of Science & Tech	PORTHARCOUT	10	11,655
11	Fed. University of Technology	AKURE	11	21,104
12	University of Benin	BENIN	12	16,540
13	Federal University	OYE	13	5,680
14	Adekunle Ajasin University	AKUNGBA	14	11,040
15	Babcock University	ILISHAN, REMO	15	925
16	University of Jos	JOS	16	16,054
17	Ladoke Akintola Univ. of Tech	Ogbomosho	17	8,550
18	Lagos State University	OJO	18	1,600
19	American University of Nigeria	YOLA	19	24,000
20	University of PortHarcout	PORTHARCOUT	20	12,225

**Source: Field Research 2019**

Table 7 above shows the top 20 Universities in Nigeria by NUC ranking alongside their landmasses. Only one has a landmass that is significantly below 1,000acres. This represents just 5% of the whole.



**Table 8: World Ranking For Nigerian Universities**

S/N	NAME	CITY	LAND MASS	WORLD SCORE	NU RANKING	WORLD RANKING
1	University of Ibadan	IBADAN	6,375	1145	6	1
2	University of Nigeria	ENUGU	2,500	2125	5	2
3	OAU	IFE	12,500	2244	4	3
4	Covenant University	OTA	560	2291	7	4
5	Ahmadu Bello University	ZARIA	17,500	2341	3	5
6	University of Lagos	LAGOS	1,100	2583	1	6
7	Fed. University of Tech. Minna	MINNA	26,625	2784	8	7
8	University of Ilorin	ILORIN	37,500	2786	2	8
9	University of PortHarcourt	PORTHARCOUT	12,225	2999	20	9
10	Federal University of Technology	AKURE	21,104	3117	11	10
11	Adekunle Ajasin	AKUNGBA	11,040	3479	14	11
12	Federal University of Technology	OWERRI	10,120	3703	36	12
13	University of Benin	BENIN	10,000	3721	12	13
14	Federal University of Agric	ABEOKUTA	25,000	3737	21	14
15	Lagos State University	OJO	1,600	3768	18	15
16	University of Uyo	UYO	14,604	3805	25	16
17	University of Jos	JOS	16,054	3812	16	17
18	Ladoge Akintola University of M	OGBOMOSHO	8,550	3823	17	18
19	Bayero University	KANO	16,420	3829	24	19
20	University of Calabar	CALABAR	13,508	3928	56	20

**Source: Field Research 2019**

This table observes the landmass of the top 20 Universities in Nigeria along with their world score. University of Ibadan is the most highly ranked University in Nigeria with a world score of 1145 score and urban landmass of 6375. University of Ilorin that has a world score of 2786 has a landmass of 37500.

**Table 9: Aggregate World Ranking**

This ranking is based on the ranking of the 3 International bodies above. A point of 20 is awarded to the top most in each ranking while 1 is awarded to the least. The points scored on the 3 is added and then used to prepare a table which forms the aggregate world ranking using THE ranking table.

S/N	NAME	AGGREGATE POINT (A+B+C)	RANK	LAND MASS(ACRES)
1	Stanford University	56	1	8,180
2	Massach. Institute of Technology	54	2	166
3	Harvard University	53	3	210
4	University of Cambridge	52	4	288
5	University of Oxford	51	5	12.5
6	California Institute of Technology	44	6	124
7	ETH Zurich	38	7	N.A
8	Princeton University	37	8	500
9	Imperial College London	36	9	N.A
10	University of Chicago	33	10	217
11	Columbia University	31	11	299
12	University of California, Berkeley	30	12	6,679
13	Yale University	26	13	1,015
14	University College London	24	14	N.A
15	Univ. of California, Los Angeles	22	15	419
16	University of Pennsylvania	19	16	694
17	Cornell University	17	17	4,800
18	John Hopkins University	16	18	N.A
19	Duke University	8	19	N.A
20	University of Michigan Amador	3	20	N.A

**Source: Field Research 2019**

The table shows the world rankings for the top Universities of the world. No Nigerian University made the list. Despite many of these Universities having landmass of less than 1000acres, they still made the top 20 best Universities of the world.

**Table 10: Top 20 Universities Ranking By Land**

RANK	WORLD UNIVERSITIES	LAND (ACRES)	NIG. UNIVERSITIES	LAND(ACRES)
1	Stanford University	8,180	University of Ibadan	6,375
2	Massach. Institute of Tech.	166	University of Nigeria	2,500
3	Harvard University	210	Obafemi Awolowo University	12,500
4	University of Cambridge	288	Covenant University	560
5	University of Oxford	12.5	Ahmadu Bello University	17,500
6	California Institute of Tech.	124	University of Lagos	1,100
7	ETH Zurich	N.A	Fed. University of Tech. Minna	26,625
8	Princeton University	500	University of Ilorin	37,500
9	Imperial College London	N.A	University of PortHarcourt	12,225
10	University of Chicago	217	Federal University of Tech. Akure	21,104
11	Columbia University	299	Adekunle Ajasin	11,040
12	Univ. of California, Berkeley	6,679	Federal University of Technology	10,120
13	Yale University	1,015	University of Benin	10,000
14	University College London	N.A	Federal University of Agric	25,000
15	Univ. of California, Los Angeles	419	Lagos State University	1,600
16	University of Pennsylvania	694	University of Uyo	14,604
17	Cornell University	4,800	University of Jos	16,054
18	John Hopkins University	N.A	Ladoke Akintola University of Tech.	8,550
19	Duke University	8,691	Bayero University	16,420
20	University of Michigan Amador	3,177	University of Calabar	13,508

**Source: Field Research 2019**

Though the landmass of some of the top 20 Universities are not available for comparison, generally it is observed that the landmass of most of the top 20 Universities are less than 2000acres which is believed to be sufficient. On the other hand, the landmass of most Nigerian Universities that are poorly rated are above 6000acres which is assumed should be the upper limit else not sustainable.

**Table 11: Ranking By Academic Excellence**

S/N	WORLD UNIVERSITIES	WORLD RANK	NIG. UNIVERSITIES	WORLD RANK
1	Stanford University	1	University of Ibadan	1145
2	Massach. Institute of Tech.	2	University of Nigeria	2125
3	Harvard University	3	Obafemi Awolowo University	2244
4	University of Cambridge	4	Covenant University	2291
5	University of Oxford	5	Ahmadu Bello University	2341
6	California Institute of Tech.	6	University of Lagos	2583
7	ETH Zurich	7	Fed. University of Tech. Minna	2784
8	Princeton University	8	University of Ilorin	2786
9	Imperial College London	9	University of PortHarcourt	2999
10	University of Chicago	10	Federal University of Tech. Akure	3117
11	Columbia University	11	Adekunle Ajasin, Akungba	3479
12	Univ. of California, Berkeley	12	Federal University of Technology	3703
13	Yale University	13	University of Benin	3721
14	University College London	14	Federal Univ. of Agric, Abeokuta	3737
15	Univ. of California, Los Angeles	15	Lagos State University, Ojo	3768
16	University of Pennsylvania	16	University of Uyo	3805
17	Cornell University	17	University of Jos	3812
18	John Hopkins University	18	Ladoke Akintola Univ. of Tech.	3823
19	Duke University	19	Bayero University, Kano	3829
20	Univ. of Michigan Ann Arbor	20	University of Calabar, Calabar	3928

**Source: Field Research 2019**

The above shows the world ranking of the top 20 Universities in the world alongside the top 20 Nigerian Universities. The world scores shows the level of performance and academic excellence of Nigerian Universities.

### RESULT

It was observed that most Nigerian Universities have allocated land above 6000 acres which could not be managed properly hence left in the hands of land grabbers and speculators. A lot of encroachment occurs on these lands. This greatly hinders the process of sustainability of land use in Nigerian Higher Institution communities as empty land are allowed to waste away with no definite time of when development will reach various phases of the land.

However, land use in developed nations are judiciously used, well maintained and properly managed for the sake of sustainability. Oxford University with an intake of over 24,000 students occupies only 12.5 acres of land with 12 faculties. This shows the level of compatibility and sustainability involved in the use and management of land. This institution was established as far back as 1096 when sustainability was still in the dreams.

Higher institutions are rated based on stability of academic calendar, staff strength, student's intake, number of faculties and departments, quality of research output, quality of lectures and facilities but never on the land mass of such institutions particularly those left to waste.

**Table 12: Selected Higher Institutions outside Nigeria**

INSTITUTION	YEAR ESTABLISHED	LAND AREA(ACRES)	STUDENT POPULATION	STAFF STRENGTH	FACULTIES
Columbia Univ. N.Y	1754	299	27,492	3,999	18
Univ.of Hong Kong	1911	132	28,744	3901	10
Oxford University	1096	12.5	24,650	13600	12
Korea University	1905	202.9	28,431	5,225	17
Univ. of Campinas	1966	860	35,676	10,322	11

Source: Field Research 2019

### CONCLUSION AND RECOMMENDATION

The Institutions from developed nations were able to make use of vertical development and employed the idea of mixed uses in their choice of physical development. This helped them to conserve their valuable land resources available to them for the use of unborn generations. The use of vertical development makes the institutions arena to be more compact thence, effectively maintained in a sustainable manner. They were able to manage their huge number of staffs and students, incorporating a number of aesthetic facilities within the mapped out area.

The achievement of sustainable communities and cities all over the world as desired in the SDGS is a feasible goal In Nigeria if Government can actually guide against illegal structures and other undue developments on the campuses that leads to wasteful land. Government should drastically reduce the minimum land required by the required bodies before such institutions can be set up. Developers and Investors in this sector should be encouraged to make use of vertical development rather than lateral development. The minimum floors for the academic blocks and offices should be stated in the approved document setting up the institution.

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