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Measuring Sustainability: Appraisal Of Resource Consumption Pattern On The Ecological Footprint Of Bida, Nigeria

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Abstract: ***This research appraises the impact of resource consumption on the ecological footprint (EF) of Bida. In achieving this, the resource consumption was used to derive the Ecological Footprint. Descriptive and inferential analyses were carried out on the field survey data used to calculate the EF. In calculating the EF of Bida, household component method was used, this best suit the study because the EF of Bida is categorised under a local EF (Scotti and Bodini, 2009) who classified Municipal EF as local since EF was initially designed to be calculated on national scale. The sampling technique adopted was random sampling with a sample size of 396. The research reveals that people have the tendency to be sustainable in their living and consumption patterns, but did not translate their knowledge to action as the study only shows that they are aware of the impact of unsustainable consumption but their behaviour remains unsustainable. Bida's EF when calculated was 0.669gha per capita and the Bio capacity calculated to be 0.19gha per capita for 2016. The difference in the bio capacity value and EF of Bida gives the sustainability level. The result of sustainability index of Bida shows deficit, which is an implication that Bida is not sustainable. This index is a reflection that Bida will need a 0.669hectares of earth resources or land to sustain an individual and whereas Bida has only 0.19hectares per capita. Its implies that Bida needs $3^{1}/_{2}$ of its present size to make a sustainable town. Food footprint has the largest share of the EF of Bida with 57.25% of the whole EF, Transportation has a share of 15.99%, and Energy has 14.05%. Water footprint has the lowest share of the EF distribution, this is due to the fact that most households in Bida depends on alternative source to public source, and this alternative source user have the energy required for processing the water already summed up under their energy footprint. Since Bida remains unsustainable because of the deficit from the index of Biocapacity that reflects that Bida has a higher footprint index than the EF index., the study recommends that the bio capacity of Bida should be optimised by having a sustainable regional land use planning.***

Keywords: Consumption, Ecological footprint, Sustainability, Bida

I. INTRODUCTION

Culture counts as a way of life. It counts more than ever before, for cities the powerhouses of the contemporary society (Borg and Russo, 2005), and as well local setting. Culture remains important in the way its influences approaches to sustainable living in both the economic giants (cities) and rural environment. Culture is a key issue of concern in consumption rate and habit, the significance of its impact is not limited to natural environment, but also involves the interconnected expenditure of environmental transactions (Alonso, 2015).

Although, culture can be referred to as the trait of a particular population, in other words, approaches imbibed in carrying out activities, yet, global traits do not exist (Triandis and Suh, 2002). The differences in traits established the variation in consumption habits of different geographical location, be it micro or macro to vary significantly. Hence, Borg and Russo (2005) reported the defined the culture by UNESCO during the global conference held in 1982 as the peculiar historical development of a community which involves all the specific features, spiritual, material,

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intellectual or affective, that characterise a society or human group.

In recent times, rate of consumption globally has been said to be unsustainable and thus pulls the ecosystem beyond its capacity. According to WBCSD (2008), which reported that the last five (5) decades has seen 60% of services rendered by Earth's Ecosystem to have been degraded, hence further, puts the demand for consumption of material resources needed for industrial growth to have been on the increasing side, thus inflicting Biocapacity of the earth resources. This is expected to rise to 170% of the Earth's Biocapacity by 2040. This trend of human consumption has been identified to be measured best with Ecological Footprint (EF).

Ecological footprint as an approach to sustainable development puts a check and balance between bio productive spheres and the rate of consumption (Wiedmann & Barett, 2010; Global Footprint Network, 2008). Its early application spans through measuring the environmental impact of activities within a national scale but in recent times, ecological footprint have been structured to measure the performance of a micro environment which had the ability to tell the sustainable level of a small conglomeration or even a product on local scale (Klingsky et. al 2009).

Therefore Ecological Footprint as a concept of sustainability has been defined as: *"the biological productive land an individual, population requires to produce all the resources it consumes and to absorb the wastes it generates using prevailing technology and resources management practice"* (Global Footprint Network, 2009).

Since consumption pattern varies both at local and regional settings, thus sustainability demands particularity in its approach. There seems to be some level of individualism to man's co-existence with life which involves it relationship with his ecosystem and thus demands a special and distinctive approach to managing a habitat in its small form or an environment in the larger state. Ecologies shape cultures; cultures impudence the development of personalities to all human endeavour which includes consumption and approach to sustainable knowledge. Hence the need to appraise the ecological footprint of Bida became necessary.

The specific objectives of this study are therefore to determine the level of sustainability from the resource consumption angle. To achieve this, the research investigate individual ecological footprints (in food consumption pattern, frequency of travel, energy consumption, strength of home installations and and amount of water usage)

II. STUDY AREA

MAJOR FOOD CONSUMPTION IN BIDA

Bida is on latitude 9006'N and longitude 6001'E which almost places Bida at a centre point of Nigeria. The town formally starts at 19kms North of River Kaduna but development has cut up beyond this point. The location is now at 14km along Mokwa - Bida road. Bida is 86 kms South East of Minna, the Niger State Capital. Bida is sited in a location below every other location outside the town (NPC, 2011).

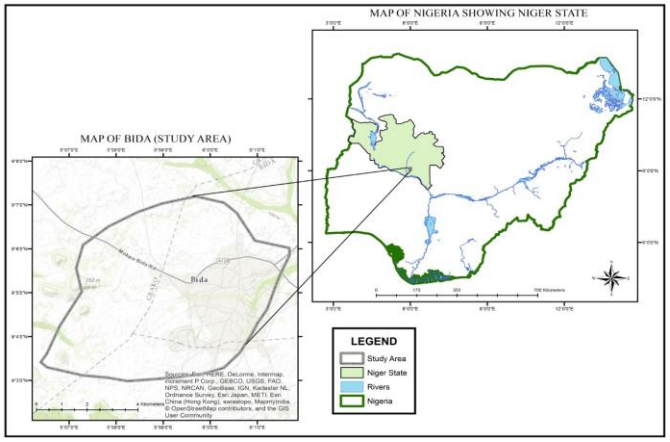

Figure 1: Author produced from ESRI Data, 2017

The present day Bida has its boundaries extending beyond the spartial settings of Bida Local Government, it has spread beyond the walls and developments have taken over the farmlands. It has a high population density because of the densely populated core where housing units are closely built together in a compound housing form. Hence this has extended the development of Bida into Gbako Local Government, Lavun Local Government and Katcha Local Government of the state. Major prominent institutions are found located in these local governments. As at 1980's, the size of the town was around 51km2 but now the development has extended to 200.50km2 which is approximately four times its size in 1980's (Maxlock, 1980). Staple food in Bida which are predominantly grains and tubers, which are of secondary importance. The consumption of majorly rice and sugarcane in Bida is as a result of large proportion of expanse of seasonally flooded land in adjourning settlements to Bida. Settlements like Badegi and its rural communities in Lavun local governemtn that adjourns Bida are known majorly for rice production. Settlemnet on all axis of the town are known majorly to cultivate rice and sugarcane. These also has influenced the consumption of rice and made it the most common staples in major household as it is readily available locally and the presence of milling outlets made it easy processed to a finishing state hence made it the commonest staple.

ECOLOGICAL FOOTPRINT AND THE CONCEPT OF SUSTAINABLE DEVELOPMENT

The implications which these two concepts have for future development vary with respect to the concept of wealth and the role of economic activities (Berker *et al*, 2012). However, their subservience to human and environmental needs is seen to be inseparable. Sustainability is conceived to enhance a future with better harmony between human activities and the life-supporting systems of the biosphere (Rochstrom *et al* 2009). Reviews of the range of schools of thought that have been documented over time offered diverging perspectives on the sustainability debate, some contesting and others complementing each other.

Despite the broad interpretability of sustainability, it constitutes a relative consensus between global actors. On the issue of possible resource constraints, the concept of "efficiency" (both inflow and outflow), attempts to build an

economic case for reduced resource-use from the relationship with nature's carrying capacity (Rochstrom et al, 2009). Hence, necessitated the need to build indicators of natural capita overuse by economic activities and not as environmental policy advice in terms of measurement of inflow.

Richard (2002) posits and advanced that using sustainable indicators for the assessment of sustainable development has been discovered to only consider the inflow, He advocates that every activities of man should be sustainably carried out which may involve the simplest activities like process of fish harvesting, log falling, and growing foods should all be done in a sustainable manner which was believed will all end in sustainable development. Natural resources account for majorly agricultural concern that involves the forest activities, fisheries, soils and general agriculture.

Ecological Footprint Assessment (EFA), although examines the supply side of sustainability, also covers assessment to consumers by assessing the impact of consumption pattern on the natural resources. Views of EF gives everyone a share of the impact felt by the ecosystem since every activities has it resource sourced from the environment and every activity carried out is on the earth surface. (Wieldman and Barette, 2010)

Therefore, while sustainable development gives attention to supply side of the sustainable equation with respect to no other source, EF pays more attention to both the supply and the demand sides of the equation and places the responsibility for sustainable development equally on the consumer. Thus, it examines resource sustainable development component in both ways. To express sustainability in quantitative terms, ecological footprint as a tool is more statistically effective in the computation and measurement of resource generation and use. (Wieldman and Barette, 2010)

III. REVIEW OF RELEVANT LITERATURE

Wieldman et al (2008) in their research on the EF of Victoria did a comparism between the total footprint of Melbourne resident and the total area of Melbourne and Victoria, the findings revealed that the Melbourne has a total footprint of 6.9gha which stands at 12% larger than the physical land area of the whole state. The differences that could be noted between the consumption pattern in rural area to that of urban area is due to the lifestyle of urban areas that significantly differ from that of the rural area. The need of transportation is said to differ greatly and also in urban centres the complexity of resource usage is very complex which reflect the differences that could be thought of in the EF of the urban centres and rural centres.

Ojedokun and Elugoke (2016) in their research to appraise the level of influence of Human development Index and Ecological footprint indices to achieving sustainability. They further reported that indices as a key to defining standards that are provided by agencies that promote matters of sustainability such as the United Nations Environment Programme – UNEP, United Nations Development Programme – UNDP and Global Footprints Network – GFN. The results of their findings in the determination of the relationship between the HDI and EF of Ile – Ife citizen, A South-Western city in Nigeria revealed that there is a variation in spatial pattern of both human development index and personal ecological footprint across the sampled residential areas in Ile-Ife.

Lin et al (2010) in the need to check the difference from the global figure to the continental figure and lastly the China's ecological footprint index carried out a detail research on Chinas ecological footprint, biocapacity and development, reported that Asia's has an average EF of 1.78gha per capita. This value is of the same with the world's average biocapacity. Asia was reported to have an EF that sums up to 60% of the whole world's footprint. The advantage gained was largely to the population of this which is more than half the world population and it is said to have a little less than 1/3rd of the global biocapacity. Asia's was reported to have EF that is 2.2 times its biocapacity and thus supplement its biocapacity by adopting regional integration. The ability to have a sustainable regional integration resolved the basis for meeting up with the demand for a higher biocapacity. Before the late 18th century, China has more than the biocapacity needed to cater for their resource demand. This trend has since changed as transportation mode has thus skyrocket and contributed mainly to the footprint of China. The research reports that as at 2007, the EF of China has been greatly influenced by the carbon footprint by 57%, and thus attributed the the larger percentage of wealthier citizen in China.

Using data from 69 LCAs, Kissinger et al (2013) worked on accounting for the EF of materials in consumer goods by aiding the development of ecological footprint values for each material that further reflect production data from several countries.

The study reveals climate change as a critical issue for cities to tackle through GHG emissions reduction policy and action, increasing global resource depletion and related ecosystem impacts pose equally imminent and dramatic risks. EFA reveals that the global human population is using earth's resources more quickly than they can be replenished.

Roy and Caird (2011) reported on the household Ecological Footprint in United Kingdom (UK). The outcome of reveals that major energy consumption in the UK is by households, the study also reveals that the indirect energy equals 60% of the direct energy usage. Their findings revealed the role age bracket and household size as factors that determine the man's impact on the environment. The findings revealed that the household size declined in the 1960's from 3 to 2.5 in 1991. They also found out that the present situation in 2011 is that larger population of household are single man household which has increase the demand for houses.

Monika (2009) in the research titled "is their consumption sustainable: An inquiry into the consumption habits of citizens and university students of Szeged. The study revealed the relationship between the EF and Population Distribution of the students, Consumption per capita and Technological efficiency. There research discloses the level of awareness of student in different faculties of the university to consumption. It further tells that Medical student tends to have lower EF, which was attributed to little time they have for social activities. The management students were seen to have a larger EF than any other faculty students.

IV. METHODOLOGY

Both primary and secondary data were used in the analysis of this research. Political ward demarcation was used in the questionnaire administration. Questionnaire was proportioned to the population distribution as gotten from the NPC figure of 2006 was distributed randomly. Structured questionnaire was used to collect household resource consumption. Other secondary data were collected from Global Footprint Network, Food and Agricultural Organisation, like yield and equivalent factor of Nigeria, National Bureau of Statistics, Niger State Environmental Agency and other organisations. The use of Ecological Footprint spreadsheet for calculation was formulated and made available by redefine organization was used (Household Ecological Footprint 2.0 by redefine.org). This sheet estimates the Ecological Footprint of households within a local setting. The sheets calculates the EF components (Food, Water, Waste, Transport, Energy and Housing).

The Ecological Footprint of each estate was calculated using the physical and consumption variables so as to determine the estimate of household and the per capita Ecological Footprint. The physical parameters used are the land for development of each household housing unit. The consumption focuses on food, transport, and utilities (energy and water consumptions), waste and housing. A total of 396 households were sampled using systematic random sampling.

The sample size was arrived at from sample calculator estimate. The data on food consumption was obtained from household expenditure on food. Transport energy, water and electricity usage was also obtained. Data for the total waste collected was collected from Niger State Environmental Protection Agency, Bida branch office. The number of trucks of waste collected was gotten and the volume of the waste collected was arrived at by measuring the length, breadth and height of the container at the back of the trucks to derive the volume in a year.

Specific information gathered includes the number of cars owned by each household and alternative usage to public electricity supply and alternative water supply. Information on total number of employed people per household, total households working, The amount of water used, the electricity and fuel for generators were also estimated on yearly basis as obtained from the household consumption. This is to enable the researcher calculate the EF since the EF is calculated on annula basis.

V. RESULTS AND DISCUSSION

FOOD FOOTPRINT

The approach adopted in calculating the food footprint of Bida involves several steps. The procedure involves calculating the mean daily consumption of food in Bida as well the mean annual food consumption with the different categories of food. The process of categorising the food was adopted from NBS, (2010).

The process of calculating food footprint involves calculating firstly the land needed to produce the food, and secondly embodied energy of food consumption. The embodied energy of the food categories leads to calculating the CO_2 conversion and the energy required to transform each parts of the food. The study reveals that food demands in Bida is in the proportion of 76% to 24% for Processed and Unprocessed food respectively.

Categories of food	Per Capita Annual (kg)	EF
Unprocessed Non-Animal Food items	124.11	**0.184**
Processed Non- Animal food items	39.19	**0.058**
Animal based food items	62.06	**0.141**

Source: Author's fieldwork, 2017

Table 1: Annual Food Consumption and Food Ecological Footprint of Bida

HOUSING FOOTPRINT

The research adopted the Chamber *et al* (2004) procedure for calculating EF of housing or built land. The assumption was that, built land or housing has to be taken as not disaggregated. It was assumed built land includes all areas that have being built on, contaminated and degraded that could be termed unproductive in a housing unit. Simpson *et al* (1997) as reported by Abd'Razack (2014), the built land includes the garages, veranda and courtyard. The mean housing area in Bida is 203.27m^2, to calculate the housing footprint, Chamber *et al* (2004) puts forward that the crop yield factor will be multiplied with the equivalent factor alongside the household size. The Food and Agrcultural Organisation (FAO) is the global organisation vested with the responsibility of deriving and Publishing the equivalent and yield factor for land and the latest released equivilant and yield factor for Nigeria has been adopted for this research since there is no calculation for such factors at a local scale.

Mean housing size		Crop yield factor		Equivalent factor		Ecological (gha/hectare)
203.27	x	1.24	x	2.51	=	**0.063**

Source: Author's fieldwork, 2017

Table 2: Derivation of Housing Footprint

WATER FOOTPRINT

The analysis reveals the per capita annual water footprint average household in Bida have EF of 0.0016gha. EF of water is conventionally calculated by estimating individual household Ecological Footprint; this is done by calculating the required energy for processing of potable water from its treatment to supply to the households. In order to calculate the footprint of water from public sources, the research adopted the volume of water gotten from the household survey and the findings revealed that the total annual water usage per capita is 10.41$m^{3.}$ Public water supply in Bida is regarded as the bore hole sunk for community or water supply delivered to household by tankers. Household with public borehole dependence is seen majorly in the core of the city and households with dependence on water delivery are seen majorly within the federal polytechnic staff quarters. The

consideration for calculating public water footprint is to be able to account for the energy used in processing the water to these households since the other alternative source involves the use of the energy already accounted for or does not involve the use of energy at all.

Niger State Water Board (NSWB) reported that a total of 370 kWh of energy is required process and transport 1 mega-litre of water in Niger State (NSWB, 2009). Adopting this value in determining the EF of water usage for public water dependant and applying the EF conversion (0.0037), produces 0.061 gha. This implies that the water is supplied with energy of $6.2x10^{-8}$gha/L

To derive the EF of water, the water EF of Bida is then derived by multiplying the per capital footprint of water by the crop land equivalent factor for Nigeria land as reported by Food and Agricultural Organisation to be 2.51 with the annual per capita EF of the public water supply.

Water Conversion Factor	Unit	Value
Average Bida water consumption in Household per capita	L/day	216
Estimated Bida water consumption (Annual/Capita) Public	L/year	$10.41m^3$
Estimated Bida water consumption (Annual/Capita) Alternative	L/year	$13.43m^3$
Ecological Footprint of one (1) litre of water supply	gha/L	6.1×10^{-8}
Annual Ecological Footprint for supply of water per capita (Public) (X)	Gha	0.0006
Annual Ecological Footprint for supply of water per capita Alternative	Gha	0.0008
Bida EF of water (X x 2.51)	**Gha**	**0.0016**

Source: Author's fieldwork, 2017

Table 3: Water consumption and derivation of water footprint of Bida

The water from household with alternative source is not taken into consideration to avoid the duplication of footprint since the alternative source that requires energy must have been accounted for in the energy footprint calculation.

VI. ENERGY FOOTPRINT

Quantity used Annually	tCO_2/Yr.(C)	EF Calculation	EF (gha)
Electricity	0.239	[0.2393/3.66 *x* 0.69/0.95] *x* 1.26	0.05984
Gas	0.035	[0.035/3.66 *x* 0.69/0.95] *x* 1.26	0.00875
Kerosene	0.045	[0.0450/3.66 *x* 0.69/0.95] *x* 1.26	0.01125
Charcoal	0.047	[0.0470/3.66 *x* 0.69/0.95] *x* 1.26	0.01175
Firewood	0.0077	[.0077/3.66 *x* 0.69/0.95] *x* 1.26	0.00193
	Total		**0.09352**

Source: Author's fieldwork, 2017

Table 4: Energy Footprint and derivation process

Table 4 reveals the footprint share of each energy source, Electricity has the largest energy footprint in Bida with 64% usage, Charcoal energy source has next to electricity with 13% usage, Kerosene has 12% of the whole energy distribution, Firewood has the lowest percentile with 2% of the whole distribution.

The outcome of the EF of energy puts Bida at a more fair consumer of energy since the value gotten is 0.09gha per capita which is 10% of the energy footprint of Scotland in 2001(Chamber *et al*, 2004), 55.94% of energy footprint of Minna, Nigeria in 2013 (Abd'Razack, 2014).

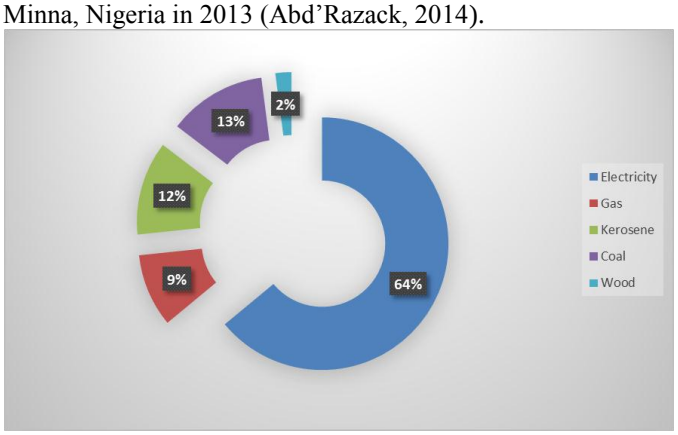

Figure 2: Percentage distribution of Energy footprint by mode of energy usage

WASTE FOOTPRINT

In calculating EF of waste, two factors are very important, the embodied energy of waste products (EF_1) emitted CH_4 from dumpsite (EF_2). Embodied energy can be defined as the energy land required to sequester Carbon di Oxide of the energy release by the decaying waste.

Embodied energy of the products consumed accounts for 28% of waste footprint Indeed, indirect energy and material flows (i.e. embodied energy and embodied materials, meaning the up-stream material inputs used to manufacture consumable products) account for 60% of the embodied energy of EF of waste The degradation of these materials, especially the organic waste produces methane.

Chamber (2004) observed that, quantifying liquid and aqueous waste has remain a difficult task, therefore in calculating the EF of Scotland, the liquid waste only was considered. This is similar in Bida as well.

Bida as an entity has a complex waste management method, the method adopted in waste disposal has made it a difficult task to determine the amount of waste generated in Bida. Bida town centre have fourteen (14) identifiable illegal but traditionally legal dunghills within the neighbourhoods that serves the immediate household. These dunghills with an average radius of 25m. Most of these dunghills serve many purposes to the neighbourhoods, some neighbourhoods where there are absence of public toilet takes advantage of the dunghills for their facae waste.

In the need to exert effort on ensuring effective waste management system, Niger State Government through Niger State Environmental Protection Agency (NISEPA) has shouldered the responsibility of collecting waste within the town; the neighbourhood are encouraged to dump waste along

the road at strategic location agreed upon by each neighbourhood. These waste are being collected twice in a week by NISEPA and being deposited in the only legal Landfill along Bida – Minna road.

In deriving the components that makes up the EF of landfill, data was collected from NISEPA on the annual amount of waste collected from the street of Bida and the collection point that are spread round the town. The annual volume of waste transported to dump site in 2016 from Bida was estimated to be 3311.28.09tonnes (NISEPA, 2017).

The recent technological advancement that has led to establishment of many iron ore and plastic recycling methods has resulted in the activities of scavengers salvaging waste for economic purpose. This serves as a means of livelihood for many as they find it easy to collect recyclable materials like metals and plastic, these they later sell and make a livelihood from. The economist (2014) puts the amount of scavenged waste from dump site to be amount to 13%, therefore annually; a total of 430.46 tonnes of waste is being salvaged from the two identified dump sites in Bida.

According to Chamber (2004), the of waste deposited in landfill requires three factors, the factors were outlined as:

- ✓ Embodied emission of waste to landfill (EF_1),
- ✓ Methane emissions (EF_2) and
- ✓ Recycled waste (EF_3)

Component of Domestic waste	Tonnes of waste	% of waste composition	Embodied energy (Mj/kg)	EF (gha/tonne)	Embodied in Kw/h	tco2
Organic matter	0.0051	46.71	10	0.0021	8.886	0.009
Paper	0.0027	24.77	32	0.0036	15.079	0.015
Textile	0.0016	14.19	95	0.0061	25.644	0.026
Glass	0.0005	4.77	21	0.0005	1.906	0.002
Ferrous	0.0005	4.77	40	0.0009	3.630	0.004
Non-Ferrous	0.0005	4.77	50	0.0011	4.537	0.005
Total	**0.0110**			**0.0142**		

Author's fieldwork, 2017

Table 5: EF of dumpsite waste

Composition	Embodied of Methane in Kw/h	EF of Methane
Organic matter	5.331	0.0008
Paper	4.047	0.0013
Textile	15.387	0.0023
Glass	1.143	0.0002
Ferrous	2.178	0.0003
Non-Ferrous	2.722	0.0004
Total		**0.0053**

Author's fieldwork, 2017

Table 6: EF of dumpsite waste methane emitted

$EF_{waste} = EF_1 + EF_2$

$EF_{waste} = 0.0142 + 0.0053$

EF_{waste} = 0.0195 gha

EF OF TRANSPORT

Table 7 reports the transport footprint of Bida. The two modes of transportation have a sum up total of 0.107gha per capita. Figure 4.5 reveals the percentage distribution of the different mode of transportation. The assumption for transport footprint states that in circumstances where the inflow and outflow of transport mode could not be accounted for, the transport should footprint should be limited to the flow within the geographical boundaries of the considered location alone. In Bida, cars and motorcycle are major mode of transportation and the, although Bida has a Helipad, data gathered from the Helipad revealed that there was no landing and taking off from the Helipad. Also, there is no railway line within the town and none of the respondent submit to commuting by bicycles. The mode of transport submitted by respondents are cars and motorcycle. Car has a total of 59% of the footprint while motorcycle has a percentage of 41% of the footprint distribution. The sum of the Direct and Indirect Energy involved in any transportation mode forms the EF of the modes. Therefore, the major modes of transportation that could be accounted for gives a total of 0.107gha

Modes	Direct Energy	+ Indirect Energy	= EF of transport
Car	0.0599	0.0031	**0.063**
Motorcycle	0.0045	0.0395	**0.044**
Total			**0.107**

Source: Author's fieldwork, 2017

Table 7: Derivation of transport footprint

ECOLOGICAL FOOTPRINT OF BIDA

Ecological footprint has been reported to be the best tool for measuring sustainability at any level. This has made the tool a good and efficient one. The ecological footprint of Bida presents the different resource consumption across the components of the footprint measurement.

The footprint analysis shows the ranking of the components of the footprint according to their gravity. Food footprint has a 57.25% of the whole footprint of Bida. This is an indication that resource flow for food items is high. It reveals the believe in food as a means of survival in Bida before any other thing. The high importance placed on food consumption has influenced the high percentage of the footprint towards food.

Transportation and Energy are next on the list with 15.99% and 14.05% respectively, this thus tells of the level of resource consumption with different categories in Bida. The influencing factor remains that location with high efficiency gain and technological advancement than in the less advanced region. In calculating the transportaional footprint, two major means of transportation that has energy exchange and flow within Bida was accounted forwhich was found to have major influence on the transportation footprint, since transportation has been identified to have a major contribution to the EF of any urban settings (Barette, et al 2005).

Water footprint has the lowest share of the EF of Bida with 0.30%. This is an indication that there is no much energy to be accounted for in providing water to household. The footprint calculated was only for people with public source of water supply, this is because the public source of water have water pumped already and does not involve the energy of such households in the pump, therefore the need to account for the energy that would have been used to pump the water used by each households. Then waste has a percentage of 2.99 of the total EF of Bida.

Conclusively, the analysis revealed needed land to cater for per capita consumption in Bida, the research indicates that

the per capita demand for a sustainable living in Bida is 0.669ha of land.

The outcome of this research reveals the need to have ecological footprint of each location done. The judgment of the regional EF within a spatial setting may not be the best to judge what a local EF will be. Nigeria in 2013 has a per capita EF of 1.1gha and per capita biodiversity of 0.6gha (GFN, 2017), this shows that a Nigerian needs 1.lha of land for a sustainable living in 2013.

Rank	Material Component	EF/capita (gha)	EF Percentage
1	Food	0.383	57.25
2	Transportation	0.107	15.99
3	Energy	0.094	14.05
4	Housing	0.063	9.42
5	Waste	0.020	2.99
6	Water	0.002	0.30
Total		**0.669**	**100.00**

Table 8: Ecological Footprint of Bida
Source: Authors fieldwork, 2017

VII. CONCLUSION AND RECOMMENDATION

CONCLUSION

The EF of Bida is very important; this will aid check and balance on the town's resource consumption habit against the earth share available per capita.

Bida's EF was estimated to be 0.669gha, this is a close figure to the Nigeria EF which was reported to be 0.6gha (GFN, 2017). The major difference between the Nigeria national footprint and Bida's local footprint is linked with the amount of bio capacity available for them. Nigeria has a bio capacity of 1.1gha per capita while Bida have a bio capacity of 0.19gha per capita which is far less than the one available at the national setting. The derived figure for both the EF and Biocapacity reveals that Bida is unsustainable in its resource consumption when it is compared with the available Biocapacity available. This trend, if not looked into will keep Bida at a large deficit that will keep nothing for posterity. Hence, this calls for a more suitable approach to resource consumption in Bida.

RECOMMENDATION

The implication that Bida has a bio capacity of 0.19ha is a big disadvantage, since the national bio capacity is put to be 1.01gha per capita (GFN, 2017). It shows that the resident of Bida has a $1/5^{th}$ of the national footprint share for 2016. The EF of Bida would have been a good determinant for her level of sustainability since it is quite lower than the global footprint and lower than the national footprint, but averagely, the EF per capita of Bida residents is 0.669gha which is far beyond the Biocapacity of Bida.

Generally, the approach to ensure a sustainable Bida can only be achieved through optimisation of regional planning as proposed by Guo J *et al* (2017) this is because the EF of Bida is lower than the national and global footprint figure, but the bio capacity remains low which is an indication of the low yield and earth resources available per capita in Bida. Thus, it is recommended that an optimisation of the bio capacity should be enhanced to increase the yield of the various land classification in the local setting. Yet the need to be cautious in the resource consumption attitude towards each of the components of the footprints is needful.

Food footprint has a largest percentage of the share of EF of Bida, it is be recommended that the residents of Bida imbibe a more sustainable consumption approach. Development should not be in isolation, decision makers should look inward and encourage inter regional developments that will at long run keep Bida on a more sustainable path.

REFERENCES

[1] Abdul'Razack N. & Ludin A. (2014), 'Ecological Footprint and Food Consumption in Minna, Nigeria, A Proceedings of 8th International Symposium on Digital Earth. 2014 IOP Conf. Ser.: Earth Environ. Sci. 18 012179 (http://iopscience.iop.org/1755-1315/18/1/012179)

[2] Alonso E.B. (2015) The Impact of Culture, Religion and traditional knowledge on food and nutrition security in developing nation, Food Secure, www.foodsecure.com

[3] Barrett, J., Birch, R., Charrett, N. and Wiedmann, T. (2005). Exploring the Application of the Ecological Footprint to Sustainable Consumption Policy. Journal of Environmental Policy and Planning. 7, 303-316.

[4] Berker M, Martins T., de Campo F., and Mitchell J. (2012) The Ecological Footprint of Campo Grand and its footprint family, WWF-Brazil, ISBN 798-85-86440-44-1, 132p,

[5] Borg J.V and Russo A.P.(2005) The impact of culture on the economic development of a city. European Institute for Comparative Urban Research (EURICUR) Erasmus University Rotterdam.

[6] Chambers, N., Griffths, P., Lewis, K. and Jenkin, N. (2004). Scotland's Footprint. Oxford, UK: Bestfootforward.

[7] Global Footprint Network (GFN), (2008). The Ecological Power of Nations, available at www.footprintnetwork.org (accessed September 2016).

[8] Global Footprint Network (GFN), (2009). The Ecological Wealth of Nations, available at: www.footprintnetwork.org (accessed September 2016)

[9] Global Footprint Network (2011), 'Living Well In a World of 7 Billion'. Global Footprint Network. Available at http.www.globalfootprintnetwork (Accessed November 26, 2016).

[10] GFN (2017) Nations Ecological Footprint. available at: www.footprintnetwork.org (accessed September 2017)

[11] Klinsky, S., Sieber, R. & Meredith, T. (2009). Creating local ecological footprints in a North American context. Local Environment: The International Journal of Justice and Sustainability, 14, 495 - 513.

[12] Kissinger M., Sussman C., Moore J. and Rees W. (2013) Accounting for Ecological footprint of materials in

consumer goods of urban scale. Sustainability ISSN: 2017-1050, doi:10.3390/su5051960
[13] Lin L, Gaodi X, Shuyan C, ZhiLiia L, Humphrey S, Shengku C, Liquang G, Huying L. & Ewing B. (2010) China Ecological report, Biocapacity, cities and development.
[14] Maxlock (1980) MasterPlan of Bida Nigeria.
[15] Monika T (2009) Is their consumption sustainable? An enquiry into the consumption habits of citizens and university students of Szeged.
[16] NISEPA (2017) Annual generated waste in tonnage for the year 2016.
[17] NSWB (2009). The State of Water Supply in Niger State. Niger State Water Board. Publication of the Governors Office, Minna.
[18] Ojedokun O.E. and Elugoke N.O. (2016), Assessment of human development status and personal ecological footprints of residents of ile – ife, Nigeria. European Journal of Sustainable Development ISSN:2239-5938 Doi 10.14207/ejsd.2016.v5n3p513
[19] Richard, G. (2002), 'Human Carrying Capacity of the Earth'. Institute of Life Cycle Environmental Assessment. Available at www.ilea.org/leaf/richard2002.html. (assesed October 1. 2009)
[20] Rochstrom J, et al (2009), 'Planetary Boundaries: Exploring The Safe Operating Space For Humanity'. Ecol. Stoc., 14 (2009); 32. Available at http://www.ecologyandsociety.org/vol4/iss2/art32/(accessed May 7, 2012).
[21] Roy and Caird (2011), Household Ecological Footprint – Moving towards sustainability? Town and Country Planning 70(10)pp 277 -279
[22] Scotti M. and Bodini A. (2009) Ecological Footprint as a tool for local sustainability: The municipality of Piacenza (Italy) as a case study. ScienceDirect: Environmental Impact Assessment Review, https://doi.org/10.1016/j.eiar.2008.07.001
[23] Triandis H. and Suh E. (2002). Cultural influence on personality. Annual Review Physiological DOI 53:133–60 www.AnnualReviews.org
[24] UNDP(2008) World Population to exceed 9 billion by 2050 Press release
[25] Wieldmann & Barrett (2010) A review of the Ecological Footprint Indicator – Perceptions and Methods Sustainability ISSN 2071-1050 www.mdpi.com/journal/sustainability.
[26] Wieldman T, Wood R, Barrett J, Lenzen M, & Clay R. (2008) The ecological footprint of vichinz Stockholm environment institute at the university of York and centre for integrated sustainability analysis at university of Sydney. www.epa.vic.an
[27] World Business Council for Sustainability Development, (2008). Sustainable Consumption facts and trends. From a business perspective.