Ecological footprint and food consumption in Minna, Nigeria

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Ecological footprint and food consumption in Minna, Nigeria

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Abstract. Cities all over the world are growing and will continue to grow as development is tilted toward development at the expense of the rural area. As a result of this there is need for development of housing that constructed at the urban fringes. There are many tools to measure sustainability of a city and one of them is Ecological Footprint. This paper looked at the Ecological Footprint and food consumption Minna, Nigeria. The paper evaluates the effectiveness of Ecological Footprint in the context of urban development. The survey revealed that food contributed 38.77% of the Ecological Footprint of Minna. This is as a result of the lifestyle of the people. It was concluded that the Ecological Footprint of Minna (1.096gha) is lower than the national bio-capacity (1.24gha), which therefore make city sustainable. Therefore, the people of Minna have to develop a lifestyle that will be sustainable better than the present practice.

1. Introduction

As development all over the world continue to grow in the urban centres, it is pertinent to understand that this has effect on the ecological balance of the environment, thereby causing problems such as climate change, imbalance in ecosystem and poverty. The sprawl nature of our cities had led to loss of agricultural land and ecosystem. This depletes the bio-productivity and biodiversity of the land. The growth of population therefore increases the demand for utilisation of resources to meet the human need. The majority of the development of Minna today is characterised by low density detached housing and car dependency. This has led to high car usage, increase in house size, continual sprawl etc. For any sustainability to be desired and achieved in Minna, the role been played by the city have to be changed to meet the reality of compact cities.

Though interaction between man and environment is dynamic, it can change over time. It is this and many other factors that can lead to biodiversity loss and reduction of the earth's carrying capacity to support human life. The continual growth of our towns and cities has consequential effect on our environment. The ecological impact of our development has been a subject of discussion in the field of sustainability. The growth of population implies higher demand on resources and other ecological services. [1] opined that urban form is a function of energy consumption for transportation; most of the household consumption is centered on its size. Also, for sustainability to be achieved, there is need to consider the form and function of the city, this will reduce the ecological impact the city have on the environment.

Ecological Footprint has emerged as one of the leading measures of human's demand on nature. This is done by measuring how much land and water area a human population required to produce the resources he consumed and to absorb its waste using prevailing technology [2]. Ecological Footprint measure humanity demand on the biosphere by accounting for the area of biologically productive land and sea require to provide the resources used and to absorb the waste. This area of land include the

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cropland, grazing land, forest land, fishing ground (all land require to produce food, fibre and timber consumed by humanity), built up land (for provision of houses and infrastructure) and energy land use for transportation and the embodied conversion land for the absorption of waste and store humanity CO_2 emission which comes from burning fossil fuel and natural gas [2-13].

Cities such as Minna poses more challenging problem for sustainable development because of its highly modified ecosystem, this is caused by population density (it is put at 80person/ha [14], depletion of resources (mainly land, water, and food) and environmental degradation, conflict between the people and the environment. This will change the use of resources and generation of waste, emission and pollutants, technology and institutional factors to the benefit of present population and future generation [15].

Several research carried out by scholars on Ecological Footprint indicated that it was done at different level which reflects their understanding of sustainability. Some of the works carried out are thus [16-17] and Foley [18] who calculated the Ecological Footprint in Canada, Norway and 79 settlements in Ireland with a compound method and major data at national level. Other researchers such as [19,20] and [9] uses component method to calculate EF at regional level of York, Scotland and Ireland respectively, while [21] and [22] calculate the EF of Helsinki, Doon and Freshford at local level using component method. The EF of a city is well defined using the material resources flow to explain the consumption of resources due to lifestyle and habit of the inhabitant of a city to determine whether it is sustainable or not. This is illustrated in the figure 1. Thus:

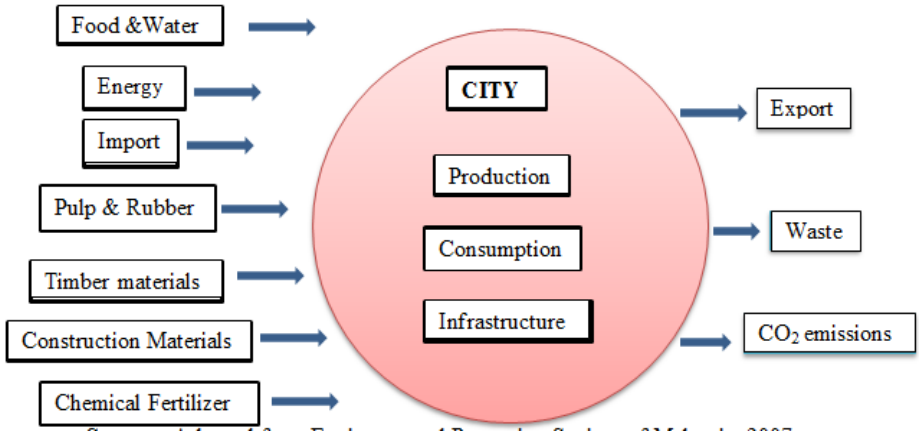

Figure 1. Different level of ecological footprint study.
(Source: Adapted from Environmental Protection Society of Malaysia, 2007)

2. Material and Methods

The empirical survey was divided into stages, questionnaire administration, analysis and policy recommendations. The questionnaire obtained necessary information about consumption in the study area. The survey collected necessary information on mechanism that influences the resident habit to consumption of resources. The survey was conducted between October 8th and 12th 2012.

A model of Household Footprint Calculator was developed using the Redefine organization which is Redefining Progress, version 2.0 model to the analyse the Ecological Footprint of the households which then was measure based on per capita head. This linked the consumption and sustainable development together. The focal point of this survey was households and the type of food consumption. The characteristics of households were also verified.

A total of 400 households were sampled using systematic random sampling. The sample size was arrived to from [23] estimate. The data on food consumption was obtained from household expenditure on food. Transport energy, water and electricity usage was also obtained. These include the number of cars owned by each household and alternative usage to public electricity supply and alternative water supply. The fuel used was determined using average of 11 Km per litre [24]. The amount of water used, the electricity and fuel for generators were also estimated on yearly basis as obtained from the household consumption.

The data collected are then subjected to analysis to be able to understand the underlying factors that causes Ecological Footprint of the estate to be verified. The data was analysed using the statistical package for Social Scientist (SPSS) version 17. The data were analysed using both descriptive and inferential statistics such as frequency table, percentage, ANOVA etc. Analysis was also presented using the pictorial variable such as histogram pie-chart and graphs.

3. Result and Discussion

It is very important to understand that the process of calculating EF requires researcher to know how to quantify the rate of consumption of natural resources and energy in a particular nation or locality and the impact of this consumption on the environment [19]. EF has always been calculated at global, national regional and local levels. The national and regional level is thus using a top-down approach or aggregated data at national or regional level, while at the local level, it is calculated using bottom-up analysis or disaggregate data at the household source of consumption of the resources [25].

This study focus on component method since it is a calculation at local level, therefore needs the data of household consumption at the local level [25]. The equation of calculating EF is therefore expressed thus:

$$\text{EF} = \sum_{i=0}^{n=5} \frac{consumption\ (tonnes)}{National\ Yield\ Factor\ \frac{(gha)}{Ha}}\ x\ Equivalent\ Factor\ \frac{(gha)}{Ha}\ x\ Embodied\ Energy\ \frac{MJ}{Kg}$$

a. EF and Food consumption in Minna

The consumption of food by household is categorised into both animal and non-animal based food. The calculation of both the animal and non-animal EF are shown in figure 1 There is about 30 non-animal food items and about 20 animal based food item identified in the study area 9which are categorised into seven different types). The calculation is done based on the average daily calories intake recommended by the Nutrition Society of Nigeria. The amount of food purchased and consumed by households through survey. There is calculation of one item in both items and the aggregates shown in figure1

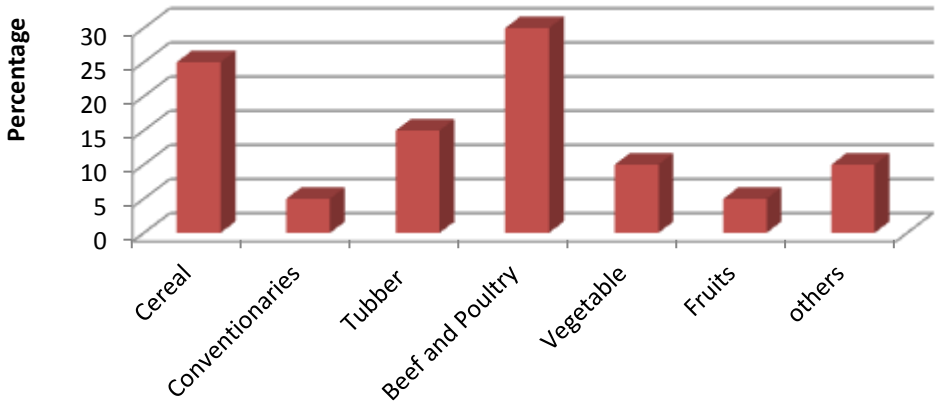

Figure 1. Percentage of daily food consumption in Minna.

The analysis indicated that the average EF of residents of the Minna is about 0.284 + 0.141 = 0.425 gha. The analysis indicated that on an average level about 549g of non-animal food id consume by individual and about 120g of animal based food items are also consumed. This total to about 669g of food on daily basis, which translates to about 262.48kg of food items annually. This indicated that with population of about 5,000 people, the total annual food consumption is about 24.34kg on daily basis and about 1,312.4 tonnes of food annually.

The analysis of the Ecological Food print of Minna residents indicated that more of the non-animal food items are consumed than the animal based food items; this might be due to income and affordability level. The more the lifestyle tends to non-animal based diet the more there is going to be in the Ecological Footprint of the city. The present 70:30% ratio of non-animal and animal food items respectively will therefore reduce the Ecological Footprint to as much as 20%. Therefore the lifestyle

has to be adjusted so that the effect of climate changes can be reduced in the study area. The analysis of comparison of the consumption habit if changed is presented in table 1 thus:

Table 1. Change in lifestyle EF.

Diet and Food Consumption in Household/Capita		
Non-Animal based Diet	**Animal based Diet**	**gha**
100	0	0.048
90	10	0.105
80	20	0.177
70	30	0.234
60	40	0.285
50	50	0.333
40	60	0.380
30	70	0.428
20	80	0.475
10	90	0.522
0	100	0.570

(Source: Author's Field Survey, 2013)

Analysis from this survey of food consumption implies that the change in lifestyle from carnivorous to herbivorous lifestyle has tendencies to reduce EF and increase the EF as lifestyle tends to carnivorous habit.

The other contributors to EF of Minna include transportation (0.236 gha), Housing (0.186 gha), Energy (0.170 gha) and water (0.065 gha) and waste (0.014 gha). This together form the main EF of Minna which is only sustainable if compared to Bio-productive land in Minna put at 1.24 gha. Generally any calculation more than 1 implies unsustainable usage of the resources. It the entire world lives the people of Minna, then it will takes us 14 months to consume what I produced annually. It implies that Minna consumes 91% of their bio-capacity annually. The contribution of all other sources are shown in Figure 2, thus:

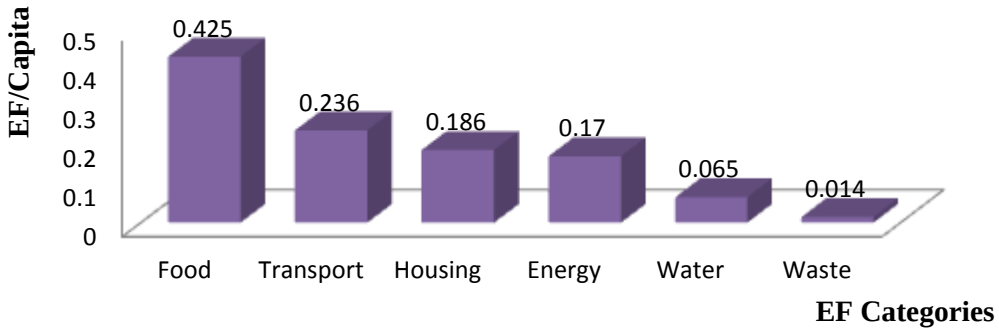

Figure 2. Contribution of all other sources.

4. Food Ecological Footprint in Minna

The process of changing lifestyle to produce low carbon in a society is a daunting task. The protein intake required on daily basis from both animal and non-animal base sources need to be safeguard to promote human health [26]. The production of arable food needs little fossil fuel energy nonetheless this advantage can be balanced by condensed pasture and crop yield [27], and procedures of food preparation and conveyance [26]. It has been said that locally made food items are healthier than treated food items from foreign land that have potentials of execrating the carbon footprint [28]

On the average food consumption in Minna produces 38.77% of the total EF of Minna. This implies that reduction in the food intake will definitely reduce the EF of Minna. This calculation corroborates Foley's calculation in Ireland of 79 different communities [18]. The calculation of the EF

of Minna also indicated that the food items are mixed in the ratio of 30:70% animal and non-animal food items. There is identification of 27 non-animal food items and 8 animal based food items (figure). The national food consumption in Nigeria shows that it is in the mix of 40: 60% to animal and non-animal base food items. This is a divergent from the Minna mix. The difference between Minna and the national food mix implies that there is great variation in the mix of food items across different location in the country. The food EF of Minna is 0.425 while the national food EF of Nigeria is 0.72 gha [29]. This implies that food consumption contribute 50% of the national EF whereas it is about 39% in Minna, then food consumption in Minna has shown to be lower than the national average. This is a sign of different lifestyle in different parts of the country. The implication of this is that local methods and specific solution have to be made to reduce food footprint in Minna. This could be such as variation in the mix in favour of non-animal based food item as seen in table 3

There is other method that could be adopted to reduce the EF of food consumption in Minna such as reduction in the food wastage by the households. Though there is no exact measure for wastage food in Nigeria or Minna. [30] estimated that 33.3% (one third) of the food purchased are been wasted globally. If this estimate is correct, then by minimizing wastage of food we can reduce the EF as much as 25% of the food EF in Minna. Another issue is that of dinning outside which needed more energy than homemade food. The research by [30] implies that energy required to eat food away from home is ten times higher than dinning at home.

5. Conclusion

The analysis above revealed that the present EF of Minna is sustainable (the EF of Minna is 1.096 gha, Nigeria is 1.44 gha and the global EF is 2.70 gha). This implies that the global EF is as high as three times multiples of Minna. The EF of Minna at present is sustainable because of the higher bio-capacity of the city, but that does not mean we should be complacent. The present EF of Minna implies that if the world population living like people of Minna; it will take 14 months to consume what is produce in a year, thereby removing the overshoot in the consumption of resources.

The analysis also shows that various components that make up the EF of Minna has different EF with food having the highest (0.425 gha) and the lowest been waste at 0.014 gha. The food EF shows that the people of Minna combine their food at ratio of 30:070% for animal and non-animal base food items.

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