POPULATION PRESSURE, AGRICULTURAL LAND USE AND ENVIRONMENTAL SUSTAINABILITY IN NIGERIA

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ABSTRACT

The aim of the study is to determine the influence of population and agricultural land use on environmental sustainability in Nigeria. This is necessitated by the fact that decisions on the linkages between population, agriculture and environmental sustainability in the country have often been made without empirical underpinnings and thus without sufficient analytic rigor. To achieve the aim, Environmental Sustainability Index (ESI) was calculated for each state of the country and multiplicative and mediating variables of agricultural land use were combined with demographic variables using linear regression and STIPART models to determine the coefficients of the variables and the impacts respectively. Thereafter, a cluster analysis was used to group the states on the basis of similarity of the impacts and 3.20a GIS Software used to map the spatial impacts. The results show that the southern states of the country have higher ESI scores, than the northern states, implying that the south will be more likely to be able to preserve valuable environmental resources effectively for the future generations. The results also show that the regression model accounts for 66.7 % of the variation in environmental sustainability in the country while the STIPART model indicates that the south eastern states are experiencing the severest environmental impacts resulting from combined effects agricultural land use and population pressure. The pressure has however been responsible for a number of favourable responses that have enabled the south to reap the economic advantage of rising concentrations of production, and social benefits that result from convergence in consumption. This explains the higher environmental sustainability in south Nigeria. The findings underscore the need for policy commitment and support for population and settlement reorganization and changes in landholdings in order to ensure sustainable development and environment in the country. Appropriate recommendations were made in this regard.

KEY WORDS: **Agricultural intensification, agricultural land use, population pressure, Nigeria and spatial impacts.**

INTRODUCTION

The idea that population growth, affects environmental resources and human welfare is as old as civilization. However, intellectual debate about the relationships between human population dynamics and natural resources goes back at least 200 years (National Research Council, 2005). Although, the most intense focus was on human demands on land because of the simple Malthusian argument that population growth would eventually outstrip the productive capacity of lands, it has been shown that the effects do elicit widely different responses from people (Madu, 2009).For instance Boserup (1965), viewed population pressure as a force that stimulates adoption of new techniques that enables more frequent cultivation, hence, greater output.

On the other hand, some believe, it is among the causes of the most urgent problems facing humankind today, while others argue, that the contemporary poverty and illiteracy in poor countries are the causes rather than the consequences of rapid population growth (Dasgupta, 2000).Accordingly, Marcoux (1999), argues that population dynamics, poverty and environmental change are linked in many ways and through multiple social and economic mechanisms at various geographic levels. Specifically, Madulu (2005), states that population growth and the resultant human activities generate pressures to the natural resource base and as a result various resource use conflicts have emerged.

Part of the difficulty in reaching definitive conclusions about the relationship between population growth and natural resource conditions is due to the fact that there are many complex and interdependent ways in which population growth may affect agricultural and natural resource management decisions by households, communities and societies (Pender, 1999). As a result, the impact of population growth on agriculture and natural resource management has been debated at least from the time of Malthus. Although the dismal predictions of Malthus regarding the inability of agricultural production to keep pace with population growth have not come to pass in the industrialized nations, agricultural production per capita has fallen and poverty has increased in many developing countries in recent decades (Pender, 1999). Consequently, the interaction between population growth, the environment, and agricultural intensification raises the most compelling and most controversial issues currently facing developing countries. This is because countries in the developing world, have not extricated themselves from the density problem, like countries in the developed world that have done so as a result of socio-economic development (Uma and Steven 1989; Nwafor and Madu, 2002)

The fact therefore, remains that, as the world population continues to grow, great pressure is being placed on arable land, water, energy, and biological resources to provide an adequate supply of food while maintaining the integrity of the world ecosystem (Pimentel, Huang, Cordova, and Pimentel, 1994). As a result, there is an apparent relationship between land resource availability and population density (Okafor1991). Consequently, scientists of the Royal Society and the U.S. National Academy of Sciences have issued a joint statement reinforcing the concern about the growing imbalance between the world's population and the resources that support human lives (RS and NAS, 1992). This warning should be taken serious because more than 99 per cent of the world's food supply comes from the land. As a result, the continued production of an adequate food supply is directly dependent on ample fertile land, fresh water, energy, plus the maintenance of biodiversity. The implication is that as the human population grows, the requirements for these resources also grow (Pimentel et al., 1996).

Moreover, given the relatively inelastic supply of land on which agriculture and rural development projects are carried out, an unchecked population brings about immense pressure on the available land (Onokerhoraye, 1985). In addition, there are serious and growing concerns about the impacts of rapid population growth on environment and natural resources, including forests, land, water, biodiversity, and other resources (World Commission on Environment and Development 1987; Ehrlich and Ehrlich 1990). In Nigeria, for instance, it has been shown that population concentration in south eastern Nigeria is responsible for agricultural land use change which includes fragmentation of land holdings and intensification of agricultural activities (Okafor, 1991).

In view of the importance of land on food supply, the effect of population changes on agricultural development has attracted much attention recently. However, the impacts of population pressure may be different in different contexts, depending on the nature of local markets, institutions, and other factors. Thus, careful and comparative empirical work is needed in different contexts before general conclusions can be drawn. Unfortunately, there is still a lack of such empirical evidence (Pender, 1999).

In Nigeria specifically, few regional studies have shown that human factors that affect land use particularly population and pattern of rural settlement have been marginally treated (Madu,2005a).Yet, it is recognized that the changing population – land relationship and the associated agricultural change have obvious implications not only for the socio-economic conditions of the people but also for the environmental sustainability (Madu,2005b) .This creates the need for a national level analysis to determine the magnitude of the influence of demographic and socio-economic factor on environmental sustainability in Nigeria. This will help in shaping the policies that will integrate population and agricultural land use in a manner that will bring about sustainable environment and development in the country.

METHODS

The data for the research were obtained from three sources. Specifically, the population data were obtained from Federal Republic of Nigeria Official Gazette 2007, while the socioeconomic data were obtained from Annual Abstract of Statistics and Core Welfare Indicators Questionnaire Survey, both published by National Bureau of Statistics in 2009 and 2006 respectively. The data were aggregated only at the state levels and as a result, states were used in this research rather than communities or Local Government Areas (LGAs), which may have provided finer details of analysis

Two sets of data were used for the research. First, were the Environmental Sustainability variables, which though not exhaustive were selected on the basis of availability. Second, were demographic and agricultural land use and socio-economic variables which, were used in determining the linkages between environmental sustainability, population and agricultural land use. Thus, the variables selected comprise both the multiplicative and mediating variables in accordance, with the perspective of the population-environment nexus, which, states that population interacts in multiplicative ways with other factors, such as levels of consumption and technology, to have an impact on the environment (Commoner, 1992; Codjoe, Ehlers, Vlek, 2005). Tables 1 and 2 show the variables used in the analyses.

.Table 1: Variables used in the Computation of Environmental Sustainability Index

Component	**Indicator**	**Type**	**Variable**	**Unit**
Environment quality	Air quality		Petrol product consumption (Proxy for CO_2 emission)*	000' litres
			Use of fuel wood (Proxy for CO_2 emission)*	percent
	Climate change		Temperature range*	Unit
			Rainfall variability*	Unit
	Exposure to environmental hazards		Drought*	Unit
			Seasonal flood*	Unit
	Land		Arable land	
	Vegetation		Area of forest reserves and plantation	Km^2
Human well-being	Environmental Health and Security		Nutritional status – (weight-for-age)% below – 25D*	Percent
			Children less than one year of age not immunized*	Percent
				Percent
			Access to health care facilities	Percent
				Percent
			Crude death rate*	Percent
			Unemployment rate*	Percent
			Armed robbery cases*	Percent
			Maternal mortality*	
	Education		Primary school enrolment	Unit
			Secondary school enrolment	Unit
			Literate adults	Unit
	Housing quality		Houses with cement or concrete wall	Percent

			Houses with thatched/palm leaves/raffia* Houses with corrugated metal/zinc roof Availability of electricity	Percent Percent Percent
	Sanitation		Access to improved water source Toilet facility (flush to sewage and flush to septic tank) Waste disposal -public approved dump site Refuse disposal facility	Percent Percent Percent Percent
	Income		Household income Poverty head count*	Naira Percent
	Household stress		Age dependency* Household size*	Unit
Social and institutional capacity	Natural resource management		Area of land under irrigation Fertilizer application Pesticide application	Ha Percent Percent
	Local autonomy		Local government administration (No of LGAs) Women empowerment	Unit Percent
	Science and technology		Ownership and access to mobile phone Ownership and access to radio Ownership and access to personal computer Ownership and access to internet	Percent Percent Percent Percent

Table 2: Variables used in the Regression Analysis

Age dependency ratio
Poverty
Population growth
Population density
Practice of family planning
Petroleum products consumption
Percentage area under irrigation
Percentage household using fertilizer
Percentage of agricultural land area
Industrial establishments
Urbanization (measured by percentage of urban population)
Household income
Influence of Local Government Administration(measured by number of Local Government Areas)
Literacy rate

The indicator method of quantifying Environmental Sustainability was used and this was done by systematically combining the selected indicators to determine the levels of Environmental Sustainability. To be able to combine the variables denominated in different units, it was necessary to convert them to unit less measures. This was done by standardizing the values by converting them to natural logarithms. There are however, other reasons why Log transformation was done. First, among these, is that, it has been established that by applying log transformation, the ratio of variables is expressed as a different of two variables and this makes the assumptions required by regression analysis much more realistic (Keene, 1995). Second, it is a highly recommended transformation method if the variables act multiplicatively (Draper and Smith, 1981). Again, it has been shown that the log transformation is the only member of the Box-Cox family of transformations for which the transformation of a positive-valued variable can be truly normal. This, according Keene (1995), is because the log transformed variable is defined over the whole range from $-\infty$ to ∞.

Furthermore, before the calculation of the Environmental Sustainability Index (ESI), different weights were assigned to the variables to avoid the uncertainty of equal weighting given the diversity of indicators used. The Principal Component Analysis (PCA) was used to determine the weights. The PCA is frequently used in research that is based on constructing indices for which, there are no well-defined weights (Deressa, Hassan and Ringler, 2008). Intuitively, the first principal component of a set of variables is the linear index of all the variables that captures the largest amount of information common to all the variables. As a result, factor scores from the first principal component were employed to construct indices for each state of the country.

To calculate the Environmental Sustainability Index, variables were multiplied by their weights and aggregated by subtracting the total of the variables that their increase is disadvantageous to environmental sustainability from the total of those that are beneficial to sustainability. Based on the aggregation, an ESI was interpreted according to Sherbinin (2003), as a measure of the relative likelihood that a locality will be able to achieve and sustain favourable environmental conditions for several generations into the future .Put another way, it evaluates a place's potential to avoid major environmental deterioration (Esty, Levy, Srebotnjak, and Sherbinin, 2005). Therefore, the implication here is that a state with a high score will have more lasting environmental quality than a state with low score.

The analysis of the impacts of population and agricultural land use on environmental sustainability on the other hand, was done by employing an IPAT model .This was done in accordance with Gans and Jost's (2005), argument, that the starting point of all decomposition studies relating to population and environment is an identity, which dates back to Ehrlich and Holdren's (1972) equation as follows:

$$I = PAT - - - - - - - (1)$$

Where *I* denote the index of environmental impact, *P* represents the population size, *A* stands for affluence and *T for* the level of technology.

The IPAT therefore, is a useful framework for identifying the drivers of environmental impacts and for estimating potential changes in impacts due to changes in any of the drivers. However, it assumes a *priori* that the effects of the drivers (P, A, and T) on impacts are strictly proportional and as an accounting equation, does not lend itself to straight forward hypothesis testing (Dietz and Rosa

1994;;Dietz, York and Rosa, 2001).To address the limitations of IPAT, a stochastic form of the model referred to as STIRPAT was reformulated, and this stands for Stochastic estimation of Impacts by Regression on Population, Affluence and Technology (Dietz and Rosa,1997; Rosa and Dietz, 1998) . This version is an improvement, because it links the analytically vulnerable but limited IPAT model to contemporary Social Science theory and methods (Rosa, York and Dietz, 2004; Gans and Jost, 2005).

In line with the Stochastic form of STIRPAT, the impacts of population, and the multiplicative and mediating variables were calculated in this work as indices of their net effects or pressure on Environmental Sustainability as follows:

$$In(I) = a + b(In(P)) + c(In(A)) + d(In(U)).... + e \text{ - - - - - - - } (2)$$

Where *I* is an index of impact on environmental sustainability, P is population, *A* is affluence, *U* is urbanization and *e* is the error term. The constant “a ’’ scales the model, while *b, c* and *d* are the coefficients of the independent variables and were all obtained from linear regression (Rosa, York and Dietz, 2004; Gans and Jost, 2005 ; and Madu,2009). It is important to note here, that the coefficients from the regression model are measures of the proportionate changes in environmental sustainability due to changes in the driving forces (demographic, mediating and multiplicative variables), hence, their use for the computation of the component elasticity for each variable in the STIRPAT model.

Also in this work, the error term (e*),* which, comprises the physical infrastructure, social and economic organization, culture and all factors not captured by the variables used above was calculated as the antilog of the residual from the regression. Furthermore, many variables were included in equation 2 in this study as earlier outlined in table 2 because York, Rosa and Dietz (2003) have justified that within the framework; variables can be added or dropped depending on the purpose and availability of data.

RESULTS AND INTERPRETATION

The result of the Principal Component Analysis shows 11 components with Eigen value of 1 or greater accounting for 82.98 % of the total variance. The first component has an Eigen value of 9.08 and accounts for 22.68% followed by the second component with an Eigen value of 5.26 and percentage explanation of 13.16 .The analysis also produced the component scores and as earlier stated, only the component scores of the first component were used in weighting the variables for the construction of the environmental sustainability indices.

The results of the ESI computation (table 3), shows that the average score is 1.094 and that only 17 states and FCT have values above the average. Out of this number, only two states namely; Kogi and Kwara and the FCT are in the northern Nigeria with scores of 1.44, 1.32 and 1.82 respectively. The remaining 15 states on the other hand, are in the south. Incidentally, the two northern states share boundaries with the southern states implying that as one move southward, the more likelihood that the ESI will increase. However, the relatively high level of environmental sustainability in the FCT is as a result of heavy federal government presence and investment in infrastructure development within the area.

Within the south however, the southeastern region now divided into south east and south-south geo-political zones, enjoys more environmental sustainability than the southwestern region. Although, Lagos state in the south west ranks first, only the state and Ekiti fall within the first eight, the rest being in the southeastern region. Specifically, Lagos state ranks first followed by Akwa Ibom, Enugu, Rivers, Imo, Ekiti and Abia.

The analysis therefore, shows that generally, the states in the north have very low environmental sustainability. However, the worst states are Kebbi, Katsina, Bauchi, Jigawa, Sokoto and Yobe with very low indices of -0.48,-0.27,-0.25,-0.15,-0.14 and -0.07 respectively. They are all located in the extreme north of the country and are prone to extreme weather events and associated environmental hazards including drought and desertification.

Table 3: Environmental Sustainability Indices by States and the FCT in Nigeria

S/NO	State	Geo –political zone	ESI
1	Lagos	South west	2.23
2	Akwa Ibom	South- south	2.21
3	Enugu	South east	2.20
4	Anambra	South east	2.16
5	Rivers	South- south	2.02
6	Imo	South east	1.95
7	Ekiti	South west	1.91
8	Abia	South east	1.90
9	FCT	North central	1.83
10	Cross River	South- south	1.81
11	Bayelsa	South- south	1.79
12	Edo	South- south	1.78
13	Ogun	South west	1.78
14	Delta	South- south	1.75
15	Osun	South west	1.66
16	Ebonyi	South east	1.49
17	Kogi	North central	1.44
18	Oyo	South west	1.43
19	Ondo	South west	1.42
20	Kwara	North central	1.32
21	Adamawa	North east	0.89
22	Benue	North central	0.88
23	Niger	North central	0.78
24	Nassarawa	North central	0.70
25	Taraba	North east	0.68
26	Gombe	North east	0.61
27	Plateau	North central	0.46
28	Zamfara	North west	0.31
29	Kaduna	North west	0.29
30	Kano	North west	0.13
31	Borno	North east	0.04
32	Yobe	North west	-0.07
33	Sokoto	North west	-0.14
34	Jigawa	North east	-0.15
35	Bauchi	North east	-0.25
36	Katsina	North west	-0.27
37	Kebbi	North west	-0.48

The next step of our analysis was the determination of the magnitude or the extent of pressure on environmental sustainability in the country by the combined effects of Population, agricultural land use and other socio-economic variables. As earlier noted, the coefficients that were used to determine the extent of the pressure or spatial impact were derived from regression. In this regard, a positive coefficient represents an increase in pressure or impact while a negative coefficient results in a reduction in pressure. The regression model yielded a coefficient of determination of 0.667, an F-value of 3. 974 and a p-value of 0.002 (table 4). The table shows that the model did not have a substantial problem of multi-collinearity, because the highest VIF was only 3.257, a value well below 10, which, is the acceptable standard (Frees, 1996).

The regression analysis indicates that age dependency ratio, population density, poverty, irrigation, fertilizer application and household income are statistically significant at 95% confidence level. The significance of population density and age dependency ratio is indicative of the strong influence of population pressure on the environment and household resources. As expected, the regression statistics show that a higher population density results in an increase in the pressure on the environment. Here, the indication is that a percentage change in population density results in 0.57 % increase in environmental impact and therefore, more threat to its sustainability. This simply means that 0.57% is the degree of the responsiveness of environmental sustainability to a change in population density.

Similarly, age dependency is an important factor that put pressure on the environment in the country. . The variable has a t-statistic of 2.718 and a standardized coefficient of 0 .469. The interpretation is that a unit increase in age dependency brings about an increase in the impact or pressure on environmental sustainability by approximately 0.50%. Also, poverty as expected poses a threat to environmental sustainability in the country. Accordingly, the results show that an increase in poverty brings about 0.56% increased pressure on the environment. On the other hand, household income, irrigation and fertilizer application, bring about less pressure on the environment in the country. As table 5 shows, an increase in household income, farm irrigation and fertilizer application, results in decrease in the environmental impact by 0.33%, 0.44% and 0.44% respectively.

Having examined the contributions of the variables, the coefficients of the significant variables were employed in the STIRPAT model to calculate the impacts. The calculations as shown in table 5 indicate that again, states in the south eastern region namely, Anambra, Akwa Ibom, Ebonyi, Bayelsa, Abia, Imo and Enugu are experiencing the severest impact on the sustainability of the environment. The states with low impacts on the other hand are Sokoto, Borno and Jigawa, Kaduna, Plateau and Kano.

Table 4: Regression estimates for the STIRPAT model

Model 1	Un-standardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-28.915	8.405		-3.440	.002		
Age dependency	3.769	1.387	.469	2.718	.012	.469	2.133
Poverty	4.443	1.474	.555	3.015	.006	.412	2.425
Pop density	.536	.200	.572	2.683	.013	.307	3.257
Petroleum consumption	-.141	.122	-.187	-1.158	.258	.536	1.867
Irrigation	-.313	.131	-.438	-2.391	.025	.415	2.409
Fertilizer	-.398	.174	-.443	-2.286	.031	.372	2.688
Agric. land use	.058	.192	.063	.302	.765	.323	3.094
Industry	-.231	.162	-.236	-1.425	.167	.510	1.960
Urbanization	-.282	.315	-.179	-.894	.380	.346	2.887
Income	-.606	.269	-.328	-2.249	.034	.658	1.520
LGA	.832	.415	.374	2.004	.057	.399	2.504
literacy	.166	.566	.054	.293	.772	.408	2.449

The grouping of the states on the basis of the magnitudes of the impacts of the variables on environmental sustainability, using hierarchical cluster analysis, indicates that there are five basic clusters as shown in table 6. The first group is made up of states experiencing very high impacts and comprises seven (7) out of the 9 former south eastern region ,namely, Abia, Anambra, Akwa Ibom ,Ebonyi, Bayelsa , Imo and Enugu states. The average impact or magnitude of pressure of the variables in this group is 6.28. The high impact on this region confirms earlier findings by Okafor (1991), that a prima facie evidence of population pressure has been established and that the region stands out prominently on maps of Sub-Saharan Africa showing population distribution and crude densities. Similarly, Madu (2005b) has shown that population pressure is the most important problem of agricultural development in the region.

The second group is the high impact area and comprises all the 6 states in the south west geopolitical zone, FCT and four states in the south-south geopolitical zone. The average impact here is 5.51. Like the first group, this category is characterized by high population density and this coupled with high degree of urbanization has been responsible for the high pressure on the environmental resources and their sustainability.

The remaining groups are experiencing low to very low impacts and are all located in the northern geopolitical zones. Accordingly, the third group comprising

Plateau, Kaduna, Jigawa and Borno states is characterized by low impacts with an average index of 4.55. The fourth group contains 14 out of the 19 northern states of the country and is described here as very low impact. Its average index is 3.59. Finally, is the fifth group described as extremely very low impact with Sokoto state as the only state in the category. It has an index of only 2.16. The common characteristics of the low impact states are that they have large land areas and low population densities. Most of the sates are also characterized by low levels of socio-economic development. The grouping is more vividly appreciated by examining figure 1 which is a spatial representation of the impacts. The pattern clearly shows that the impacts are more in the south than in the north. It also shows that apart from Rivers and Cross River states, all the former southeastern states are experiencing very high impact. The relatively lower impact on Rivers state may be explained by technological and infrastructure development in the state as it is the headquarters of oil production in Nigeria. The lower impact on Cross River on the other is due to its large land mass and lower population density.

One important implication of the findings is that the states that have relatively higher environmental impacts are at the same the ones that are more sustainable. The explanation here is that the responses to the pressure have resulted in the development of the states. For instance, it can be said that the high population density in the southern geo-political zones is advantageous because it permits intensification of economic activities, greater division of labour and new methods of farming. These responses obviously lead to greater income and higher living standards in the southern zones. This is in line with the findings of National Research Council (1999) and World Bank (2000; 2009) respectively, that there is considerable evidence to show that only at higher population densities do one find more intensive and efficient land use and that there is a strong relationship between economic growth and urbanization. Similarly, the findings are in line with Boserup (1965, 1980), who argue that population growth was itself a main cause of technological innovation. Moreover, the perceived or anticipated scarcity resulting from population pressure is presumed to drive technological progress and with it, the search for substitutes and increased efficiency (Dietz and Rosa 1994).

Table 5: The degree of pressure (impacts) on environmental sustainability by states and FCT in Nigeria

S/NO	STATE	Geo –political zone	Impacts
1	Anambra	South east	6.64
2	Akwa Ibom	South- south	6.57
3	Ebonyi	South east	6.42
4	Bayelsa	South- south	6.33
5	Abia	South east	6.13
6	Imo	South east	5.99
7	Enugu	South east	5.90
8	FCT	North central	5.80
9	Delta	South- south	5.74
10	Rivers	South- south	5.65
11	Edo	South- south	5.60
12	Ekiti	South west	5.51
13	Oyo	South west	5.58
14	Ondo	South west	5.44
15	Lagos	South west	5.42
16	Cross River	South -south	5.40
17	Osun	South west	5.28
18	Ogun	South west	5.20
19	Kogi	North central	4.90
20	Nassarawa	North central	4.86
21	Zamfara	North west	4.80
22	Adamawa	North east	4.71
23	Kwara	North central	4.69
24	Benue	North central	4.66
25	Katsina	North west	4.64
26	Niger	North central	4.59
27	Gombe	North east	4.41
28	Bauchi	North east	4.37
29	Kebbi	North west	4.36
30	Yobe	North east	4.28
31	Taraba	North east	4.26
32	Kano	North west	4.18
33	Plateau	North central	3.93
34	Kaduna	North west	3.76
35	Jigawa	North east	3.52
36	Borno	North east	3.16
37	Sokoto	North west	2.16

Table 6: Summary of the Cluster Analysis using Degree of Pressure (Impact) on Environmental Sustainability as a variable

Very high impact (Mean index = 6.28)	High impact (Mean index=5.51)	Low impact (Mean index =4.55)	Very low impact (Mean index =3.59)	Extremely very impact(Mean index =2.16)
Abia	Ondo	Plateau	Bauchi	Sokoto
Anambra	Cross River	Kaduna	Kebbi	
Akwa Ibom	Ekiti	Jigawa	Gombe	
Ebonyi	Lagos	Borno	Taraba	
Bayelsa	Delta		Yobe	
Imo	Edo		Kogi	
Enugu	Oyo		Nassarawa	
	FCT		Adamawa	
	Rivers		Kwara	
	Osun		Benue	
	Ogun		Katsina	
			Niger	
			Kano	
			Zamfara	

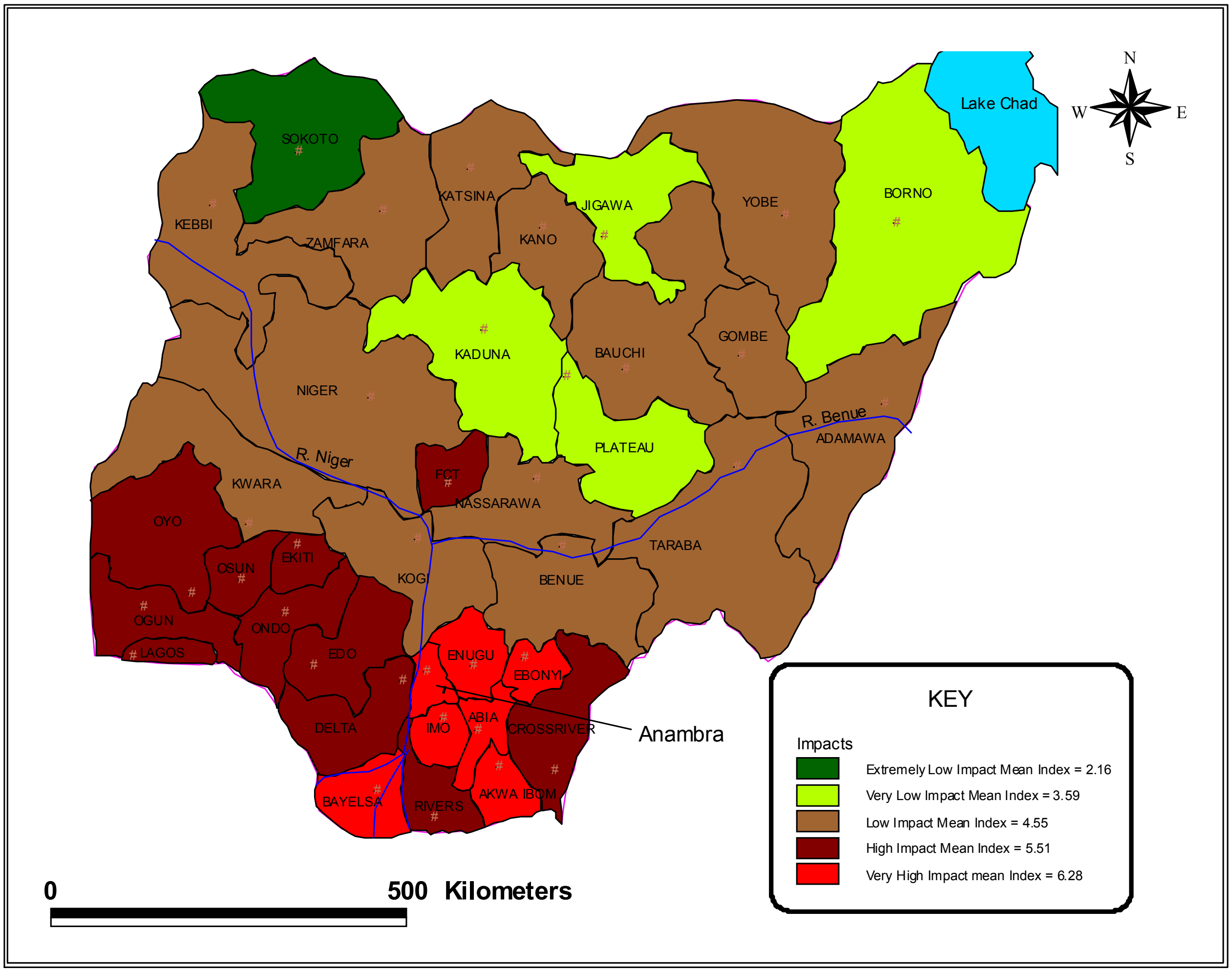

Fig.1: Spatial impacts (pressure) of population and agricultural land use on environmental sustainability in Nigeria

CONCLUSION

The paper has shown that the spatial patterns of the impact of the demographic and multiplicative variables on environmental sustainability in Nigeria, indicate that although, the southern regions have more environmental sustainability indices than the north, they at the same time are experiencing greater pressure on the environment than the northern regions. The explanation is that the consequences of the pressure have not been all negative as the responses to population pressure have brought about out migration, diversification and concentration of economic activities, which in turn have been responsible for higher technological development and household income. This makes the south reap the economic advantage of rising concentrations of production, and social benefits that result from convergence in consumption. Thus, the concentration of economic activities in the south is responsible for its greater development and sustainable environment.

There is therefore, no doubt that population agglomeration is desirable for economic efficiency. In the same way, increased wealth is necessary for a higher standard of living. After all, the two major distinguishing characteristics of developed and developing economies are that where as the former is wealthy and highly urbanized, the latter is poor and the majority of the population is found in low density rural areas. As a result, both concentration of population and wealth creation should be encouraged and sustained in Nigeria. However, they should be mitigated by appropriate choice of policies, technologies and institutions in order to achieve sustainable environment and development in the country. Such policies should include; mainstreaming environmental concerns into population policy, integrating regional development strategy and environmental management and Protection, enforcement of environmental impact assessment, monitoring and auditing on development projects, and the development of infrastructure especially in the rural areas and the ‘‘disadvantaged geo-political zones”.

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