SPATIAL CONCENTRATION OF POVERTY AND ITS DETERMINANTS IN NIGERIA

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DEDICATION

This thesis is dedicated to the memories of my late mother, father and brother:

Mrs Mulikat Adunni Sowunmi **Mr. Iskilu Olaide Sowunmi**

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ABSTRACT

Poverty reduction programmes in Nigeria have not had significant intended effects. This can be attributed to the non-consideration of the heterogeneous nature of poverty and spatial contiguity of geographical units in their designs. There is scarce information on spatial decomposition and spillover of poverty across the Senatorial Districts (SD) in Nigeria. Therefore, the spatial concentration of poverty and its determinants were investigated.

The study employed secondary data from Nigeria Living Standard Survey (NLSS) and Core Welfare Indicators Questionnaire (CWIQ) survey conducted by National Bureau of Statistics (NBS), Independent National Electoral Commission (INEC) and Food and Agriculture Organization (FAO). The NLSS and CWIQ were conducted in 2004 and 2006 respectively. The national sample sizes for NLSS and CWIQ were 22,200 and 77,400 household units respectively. Following the elimination of households with missing values, samples considered for the study were 18,760 and 54,536 households for NLSS and CWIQ respectively. The Poverty Rate (PR) per SD was obtained from household consumption expenditure data sourced from NLSS. Data on Household Size (HS), Household Membership of Association (HMA), Households' Access to Health Facilities (AHF), People Employed in Agriculture (PEA), Access to Credit Facilities (ACF) and Literate Adult (LA) were obtained from CWIQ. Data on Number of Years Spent in the National Assembly by Senators (NYSNAS) (1999 – 2004) and soil fertility classification of Nigeria were sourced from INEC and FAO respectively. These variables and spatial dimension were hypothesized to influence PR. Data were analysed using descriptive statistics, Foster Greer and Thorbeck model, spatial regression, local indicator of spatial association and spatial probit at $p = 0.05$.

Mean annual household per capita consumption expenditure was ₦28475.01 ± ₦11967.5. Percentage of PEA in the SD was 44.2 ± 18.4% while mean HS was 6.5 ± 1.5. Mean values of NYSNAS, ACF and AHF were 4.3 ± 0.5years, 10.5 ± 7.4% and 51.6 ± 18.2% respectively. Fifty-six percent of the SD had fertile soils. Average national PR of the SD was 56.03 ± 24.1%. Fifty three of the SD had PR below the national average. The Moran's I value (3.4) indicated that spillover of poverty existed among SD. Ten percent increase in PR in one SD resulted in 3.1% increase in PR in the neighbouring SD ($\rho = 0.3$). Fifty-two percent of the SD with significant spatial association had low PR neighboured by low PR SD, 41.03% of the SD with high PR were neighboured by high PR SD. The PR in high-high SD was significantly reduced by HMA (-0.9), AHF (-0.3), ACF (-0.9), LA (-1.1), fertile soil (-5.2) and NYSNAS (-6.6). Poverty rate was significantly increased by PEA (0.4)

and HS (5.5). Mean PR in high-high and low-low SD was 82.6% and 31.8% respectively. Household's probability of being poor was higher in high-high SD (0.8) compared to low-low (0.08). Poverty incidence in a senatorial district influenced the neighbouring senatorial district. Reduction in poverty incidence would be achieved through households' membership of associations, improved access to health and credit facilities**.**

Keywords: Spatial concentration, Poverty rate, Spatial probit, Senatorial district

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CERTIFICATION

I certify that the research culminating in this thesis was carried out by Fatai Abiola Sowunmi under my supervision in the Department of Agricultural Economics, University of Ibadan, Nigeria.

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MEANING OF ABBREVIATIONS AND ACRONYMS

AD	Alliance for Democracy
AEC	Agroecological and Environmental characteristics
AHhS	Average Household Size
AIC	Akaike Information Criterion
ANPP	All Nigerian Peoples Party
AsCr	Average Access to Credit Facilities
CBSD	Coastal Bordered Senatorial District
CEEDS	Community Economic Empowerment and Development Strategy
CWIQ	Core Welfare Indicator Questionnaire Survey
DEC	Demographic Characteristics
DFRRI	Directorate of Foods, Roads and Rural Infrastructure
EA	Enumeration Area
FAO	Food and Agricultural Organization
FCT	Federal Capital Territory
FeH	Female Headed Household
FSP	Family Support Programme
GPZ	Geopolitical Zone
GUAPA	Guatemala Poverty Assessment
HDI	Human Development Index
HU	Housing Unit
IDRC	International Development Research Centre
ILBSD	International Land Bordered Senatorial District
ILRI	International Livestock Research Institute
IMF	International Monetary Fund
INC	Infrastructural Characteristics
INEC	Independent National Electoral Commission
LEEDS	Local government Economic Empowerment and Development Strategy
GIS	Geographic Information System
LA	Literate Adult
LISA	Local Indicators of Spatial Association
MaH	Male Headed Household
MDG	Millennium Development Goals

NAPEP	National Poverty Eradication Programme
NBS	National Bureau of Statistics
NC	North-central
NDE	National Directorate of Employment
NE	North-east
NEEDS	National Economic Empowerment and Development Strategy
NEPAD	New Partnership for Africa Development
NIMET	Nigerian Institute of Meteorological Services
NLSS	National Living Standard Survey
NPC	National Population Commission
NW	North-west
PCoM	Political Competition
PDP	Peoples Democratic Paty
PiC	Party in control of Senatorial District
PNE	Primary School Net Enrollment
PRSP	Poverty Reduction Strategy Programme
PSU	Primary Sampling
SaS	Access to Safe Sanitation
SC	Schwarz Criterion
SD	Senatorial District
SE	South-east
SMls	Small and Medium Scale Industries
SNE	Secondary School Net Enrollment
SPC	Sociopolitical and Economic Characteristics
SS	South-south
SUDE	Senatorial District Susceptible to Desertification
SUER	Senatorial District Susceptible to Water Erosion
SW	South-west
SwS	Safe Water Sources
UBOS	Ugandan Bureau of Statistics
UN	United Nations
UNDP	United Nations Development Programme
USU	Ultimate Sampling Unit

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

The poverty phenomenon in Nigeria and other developing nations has attracted significant global attention since the 1990s. The first, was the annual publication of the Human Development Report by the United Nations Development Programme (UNDP) which contains estimates of the Human Development Indices used to rank all the 177 countries that make up the United Nations. The Human Development Index (HDI) is derived from social and economic indicators that are closely correlated with poverty. Human Development Index is a simple summary measure of three dimensions of human development concept: living a long and healthy life, being educated and having a decent standard of living. Thus it combines measures of life expectancy, school enrolment, literacy and income (UNDP Report, 2003). Since 2003, African countries including Nigeria have ranked amongst the countries with the lowest HDI. In fact in 2005, all the 27 countries of the world with the lowest HDI were African countries, Nigeria inclusive. These countries each has HDIs of less than 0.5 and, when compared with figures of 0.968 for Iceland and Norway (the countries with the highest HDI), one will realize the enormity of the poverty problem in Nigeria and other lowly developed African countries. Though the issues of poverty and low human development indices may not be peculiar to Africa, they are, however, more pronounced in the continent and the Nigeria situation is particularly worrisome because of the country's available natural resources and clement weather. Despite the conflicting statistical data on the incidence of poverty between government agencies and international organisations, it is an incontrovertible fact that the poverty situation in Nigeria is serious and deserves greater attention. Specifically, the National Bureau of Statistics (2005) put the poverty rate of Nigeria at 54.4% while the UNDP (2005) and the IMF (2005) reported 70.2% and 70% respectively. The United Nations Habitat (2009) put the present poverty rate at 76%.

The poor state of life in Nigeria and other lowly developed countries resulted in the Millennium Declaration in the year 2000 by world leaders under the auspices of the United Nations. The organisation then set 2015 as the target date to achieve a number of Millennium Development Goals (MDGs) of which 50% reduction in the level of poverty is one of the goals. To meet this goal, the lowly developed countries are to design Poverty Reduction Strategy Programmes (PRSPs).

Over the years a number of PRSPs were initiated in Nigeria. These include National Economic Empowerment and Development Strategies (NEEDS) and concomitant strategies at the state (SEEDS), local government (LEEDS) and community (CEEDS) levels. In addition to the foregoing, a special federal government institution to alleviate poverty in the country, the National Poverty Eradication Programmes (NAPEP), was created. These previously initiated PRSPs in the country and particularly the ones identified in Table 1 along with many others initiated by the state governments appear only to have addressed the various manifestations of poverty, such as unemployment, lack of access to credit and functional rural and urban infrastructures, and gender inequality among others.

While the above mentioned Poverty Reduction Strategy Programmes (PRSPs) were well intentioned, none had any significant lasting, or sustainable positive effects on the people they were planned for (IMF 2005 Country Report; Akinyosoye, 2005). The reason for the insignificant success is not far-fetched: the poverty interventions did not consider variation in poverty from one geographical unit to the other and the need for the use of poverty mappings based on spatial targeting. Generally, poverty rate varies from one part of the country to the other as well as from one administrative area to the other. Significant geographical variations in incidences of poverty may be due to differences in resource endowments, education, health services and a host of other factors (Akinyosoye, 2005). For instance, a high spatial concentration of poverty in a senatorial district (SD) in the northern part of the country may be attributed to desert encroachment, low level of education and salinisation as a result of over-irrigation. Conversely, another SD in the south-south may attribute the incidence of poverty to water and land pollution through crude and refined oil spillage, lack of social amenities and poor accessibility of communities, among others. This research sets out to address varied issues about poverty and factor them into alleviation strategies defined to enhance peoples lives as well as address some methodological problems associated with researches on poverty. These include the influence of neighbouring poverty on the poverty incidence of geographical unit and how to quantify and measure the effect of political factors on poverty incidence.

Table 1: Various Poverty Reduction Programmes (PRPs) in Nigeria

Programme	Year Established	Target Group	Nature of Intervention
National Accelerated Food Production Programme and the Nigerian Agricultural and Co-operative Bank	1972	Rural and urban areas	Encourage agricultural production through provision of agricultural credit
Green Revolution Programme	1979	Rural Areas	Encourage agricultural production through mechanized farming
Go Back to Land Programme	1983	Unemployed youth	Encourage youth to take to farming
Directorate of Foods, Roads and Rural Infrastructure (DFRRI)	1986	Rural Areas	Feeder roads, rural water supply and rural electrification
National Directorate of Employment (NDE)	1986	Unemployed youth	Training, finance and guidance.
Better Life Programme	1987	Rural women	Self – help and rural development programmes, skill acquisition and health care.
People's Bank of Nigeria (PBN)	1989	Underprivileged in rural and urban areas	Encouraging savings and credit facilities
Community Banks (CB)	1990	Rural residents, micro enterprises in urban areas	Banking facilities
Family Support Programme (FSP)	1994	Families in rural areas	Health care delivery, child welfare, youth development, etc.
Family Economic Advancement Programme (FEAP)	1997	Rural areas	Credit facilities to support the establishment of cottage industries.
National Poverty Eradication Programme (NAPEP)	2001	Rural and urban areas	Employment generation
National Economic Empowerment and Development Strategies (NEEDS)	2004	Rural and urban areas	Training, finance, skill acquisition and Credit facilities to support the establishment of cottage industries
Seven Point Agenda	2007	Rural and urban areas	Overall development of Nigeria.
Sure-P (Subsidy, Reinvestment and Empowerment Programme)	2011	Rural and urban areas	Employment generation for youth..

Sources: Oladeji and Abiola (1998), Elumilade and Asaolu (2006), Sure-P website and Nigeriafirst.org

1.2 Poverty mapping

Poverty mapping, which anchors this research,h is defined as a spatial analysis of poverty in visual and econometric terms. Maps are, therefore, powerful tools for representing complex information in visual format that is easy to understand. Poverty maps are important tools that provide information on spatial distribution of poverty within a geographical unit (examples are a country, state, local government or constituency). It is used to reveal the location of the poor people and location–related aspects of the identified determinants of poverty.

Spatial determinants are important for understanding the distribution of assets that are fundamental for poverty alleviation strategies; including human capital (such as health and education), social capital, environmental and political characteristics. Spatial analysis of poverty has been utilized in a number of policy and research applications, ranging from anti–poverty programmes and targeting emergency food aid to assessments of the determinants of poverty and food insecurity. This is in addition to providing visual representations of spatial relationships between variables. The use of spatial analysis in examining poverty rests on the application of geography and statistics in a technology known as Geographical Information System (GIS).

1.3 Role of Geographic Information System (GIS) in poverty mapping

Most types of poverty mapping increasingly depend on data generated through geographic information systems, where values are fixed to specific locations on a grid. Jordan and Shrestha (2000) defined GIS as a tool for enabling mapping and spatial analysis to be performed from a variety of applications. The technology allows spatial relationship to be established for social, economic, political and natural resources variables that were previously difficult to combine and examine in conventional socio-economic research.

Geographic Information Systems are computer software programs designed to handle geographically referenced data. They are essentially database management systems that utilize geographic locations as a reference for each database record. These systems are used to integrate information from very different sources in a single platform, where each observation is matched with the identification of the area it covers. Geographic Information Systems also permit the analysis of spatial association between different dimensions. In particular, they permit the simultaneous analysis of variables, which are observed at different levels and times.

1.4 Problem statement

Poverty arises from a complex mix of socio-economic, agro-geographical, political and cultural factors. In conventional analysis, only a small number of these factors can be brought a into model (Voss *et al.,* 2006) and these factors vary from one geographical location to another. According to Holt (2007), the landscape of poverty is a result of many forces acting independently and in interaction with other social and structural forces to produce a set of opportunities and constraints. These are manifested in the economic realities of wealth and poverty. In Nigeria as in many countries, poverty is a highly heterogeneous phenomenon showing a wide spatial variability. A large difference in the standard of living of the populations in different geographical locations is common as in other countries. Spatial heterogeneity between areas can be introduced in a model for a variety of reasons, including differences in agroclimatic conditions, geographic conditions (particularly access to main urban centres and markets), the presence of natural resources (particularly water for irrigation), other non-physical conditions (especially, historical and ethnic) and facets of public policy (Jalan and Ravallion, 1998).

According to Aigbokhan (2000) and NBS (2005), the incidence of poverty in Nigeria is not uniform within the geo-political zones. In the south for example, poverty is relatively higher in Akwa Ibom, Delta and Edo states; and in the north it is high in Bauchi, Jigawa, Yobe and Kebbi states. Environmental degradation caused by oil spillage and lack of basic infrastructures can be assumed to be the major determinants of poverty and its attendant multiplier effects in the oil-producing states of Niger Delta. The lower economic condition in the northern zones may not be unconnected with long–standing lags in provision of health, education and other social services which resulted in proportionately more poor people in the north (Thomas and Canagarajah, 2002). The southern zones are more industrialized with fairly developed infrastructure (schools, roads, health facilities, drinkable water and electricity) while the northern zones are largely rural and agricultural with a fragile agro–climatic environment and a different socioeconomic history.

Governments over the years have tried to reduce the poverty situation by inplementing various poverty alleviation programmes. Such programmes included Better Life for Rural Women; Directorate of Food, Roads and Rural Infrastructure (DFRRI); Family Support Programme (FSP); and recently 'Keke' NAPEP and NEEDs. The achievements of these programmes appear to be insignificant.

In the social sciences, spatial contiguity in social and economic variables is a consequence of the instincts of individuals and of the patterns of behaviour and economic

constraints that, taken together, help to bind social space into recognizable structures. In a village or urban community, many of the households may have similar sources of income, and all households are affected by the same agro-climatic and geographic conditions. They also have other circumstances in common including road conditions, availability of public facilities for services such as health, water supply and education. Hence, it is reasonable to suppose that households living in the same area tend to act in similar ways and to influence one another (Petrucci *et al.*, 2003). The poverty level of a community is not only determined by factors highlighted above but also by conditions in the neighbouring communities. If the poverty level of a specific geograghical entity is low, the neighbouring communities will be affected by the spillover effects of low poverty. The same is also true if an area is prosperous, the spillover effect of the prosperity will lead to a reduction in poverty in the neighbouring areas.

From the foregoing, this research intends to provide answers to the following research questions, using senatorial district as the reference geographical location:

i. Is the poverty incidence of a senatorial district significantly influenced by poverty incidence of neighbouring senatorial district(s)?
ii. Are there senatorial districts with similar patterns of poverty incidence in Nigeria?
iii. Are there senatorial districts with dissimilar patterns of poverty incidence in Nigeria?
iv. What are the factors influencing poverty levels in senatorial districts with similar spatial patterns of poverty?
v. Do the political factors in the senatorial districts affect the level of poverty?
vi. Do the agro-climatic factors in the senatorial districts affect the level of poverty?
viii. What is the probability that a household will be poor in each of the senatorial districts?

1.5 Objectives of the study

The broad objective of this study is to examine the spatial concentration of poverty in Nigeria and its determinants. The specific objectives are to:

(i) analyze the nature of spatial clustering of poverty in Nigeria;
(ii) determine the locations of senatorial districts with similar patterns of poverty incidence;
(iii) determine the factors determining poverty in Nigeria's senatorial districts; and
(iv) determine the probability that a household will be poor in each senatorial district.

See appendix 25 for an analysis of the objectives.

1.6 Research hypotheses

(i) H_0: Incidence of poverty in each SD is not significantly influenced by a spillover of poverty.

H_1: Incidence of poverty in each SD is significantly influenced by a spillover of poverty.

(ii) H_0: Poverty incidence of SDs is not significantly influenced by geographic location.

H_1: Poverty incidence of SDs is significantly influenced by geographic location.

1.7 Justification of the study

Governance is the responsibility of elected officers who are political heads of their constituencies; from the president of the nation to state governors, senators, members of the House of Representatives, members of states' houses of assembly, chairmen of local government councils, and councillors whose constituencies are the political wards. All these political office holders need to know the levels of poverty in their constituencies to enable them to understand the societal problems associated with the phenomenon. This study will make it possible to identify the causes of poverty in each constituency and how to alleviate poverty, monitor poverty reduction policy interventions and lastly, monitor and evaluate the policy reduction measures initiated by government generally and by the political heads of the various constituencies.

The foregoing explains why the study of this nature that targets the senatorial districts (SD) of Nigeria is very significant. The choice of senatorial district is significant for a number of reasons. Many past studies on poverty (Ogunmike and Odubogun, 1989; Adeyeye, 1999 and 2000a; Olayemi *et al.*, 1999; Okojie *et al.*, 2001; Bankole *et al.*, 2003; Greer and Thorbecke 1986a; Aigbonkan, 2000; Osinubi, 2003; Soludo, 2003; Olubanjo *et al.*, 2007) have focused on the nation, states and geopolitical zones as study areas. Each state has three senatorial districts, which implies that a thorough knowledge of the poverty situation and incidences at the senatorial levels will provide sufficient information to state governors to know how to intervene effectively. Furthermore, each

senatorial district, on average is made up of 7 local government councils (see appendix 1) which also implies that the knowledge of poverty situation in the senatorial district can guide local government chairmen and councillors on how to tackle poverty in their domains.

This study is, therefore, justified as a sub–national analysis of poverty in Nigeria. It will provide information on social, economic, political, agro-ecological characteristics and poverty incidence at the senatorial district, state and geopolitical zone levels that can serve as a guide for initiating developmental project. Moreover, the approach in this study is an indirect way of involving elected representatives, such as the senators and others at the national and sub–national levels of governance in poverty alleviation programmes. Existing poverty studies treat geographical units, such as local governments, states, geopolitical zones and the country as independent and isolated entities rather than entities surrounded by other geographical units which interact. The approach of this study is, therefore, more robust than other similar ones.

The previous studies (Olubanjo *et al.*, 2007; Osinubi, 2003; Oluwatayo, 2007; Oladeji and Abiola, 1998; Omonona, 2000; Farmer *et al.*, 1989; Nwaobi, 2005 and Oyekale *et al.*, 2006) utilized traditional econometric techniques (Probit, Tobit, Logit and Multiple Regression) that do not take the effect of neighbouring geographical unit's poverty into consideration; whether it has a significant impact or not. However, this study utilized spatial econometric technique instead of the conventional econometric methods. The spatial econometrics technique has the advantage of addressing the problem of spillover effect or spatial autocorrelation if present in the data set. Unlike the conventional regression analysis, this analysis is intended to correct the problem of spatial dependence if it is significantly present in poverty incidence in the neighbouring senatorial districts. The consequence of spatial autocorrelation (where it is significantly present) is the violation of the assumption in Ordinary Least Squares Regression Method (OLS), and the estimates derived are likely to be inefficient (Anselin, 1988; Cliff and Ord, 1973; Griffith, 2003; Gao *et al.*, 2006; Ord, 1975; Birungi *et al.*, 2005 and Surianiti, 2006). According to Rupasingha and Goetz (2007), studies that ignore spatial autocorrelation (dependence) can produce biased results (coefficient estimates) and lead to ineffective and possibly counterproductive–recommendations for policies targeted at poverty alleviation.

Voss *et al.*(2006) revisited a journal article by Friedman and Lichter (1998) on the determinants of geographic variability in county-level child poverty rates in which weighted logistic regression model was used. They stated that an explicit acknowledgment of spatial effects in the explanatory variables of regression model improved considerably the earlier

published regression results, which did not take account of spatial autocorrelation. According to them, these improvements include: (1) the shifting of ‘‘wrong sign’’ parameters in the direction originally hypothesized by the authors, (2) a reduction of residual squared error, and (3) the elimination of any substantive residual spatial autocorrelation.

The findings of this study are expected to:

- assist government in localizing poverty alleviation strategy in senatorial districts that exhibit similar spatial patterns of poverty rather than generalizing poverty interventions for all senatorial districts
- justify the need for variation in funding of poverty alleviation strategies, bearing in mind the heterogeneous nature of poverty.
- reveal the factors that are peculiar to senatorial districts that exhibit similar spatial pattern of poverty, which can then be used to plan intervention programmes.

Moreover, the findings of the study is expected to make it possible to measure the effects of agro-climatic and political factors (at senatorial district level) that have previously been excluded from the studies of poverty, or included only anecdotally, and to quantify the complete set of forces determining poverty in within small geographical units of governance.

1.8 Plan of study

The thesis is divided into five chapters. Chapter Two features the theoretical framework and literature review of the study. In Chapter Three, the methodology of the study was discussed. Specifically, the chapter discussed the study area, type and sources of data used, and the analytical tools and models. The results of various analyses carried out were discussed in Chapter Four. These include agro-climatic, environmental, sociopolitical, and economic, and demographic characteristics of the households and the study area. The correlates of poverty incidence and the non-binary variables were also explained. The chapter also discussed the nature of the spillover of poverty, spatial pattern of poverty and the determinats of identified patterns of poverty. In Chapter Five the study was summarized and conclusions were drawn; thereafter recommendations were made.

CHAPTER TWO

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

This chapter discusses the basic theories, concepts and assumptions of spatial analysis that measured geographic variables often exhibit properties of spatial dependency (the tendency of the same variables measured in locations in close proximity to be related). While traditional statistical techniques have treated this feature as a nuisance, spatial statistics considers them explicitly. This chapter also covers a detailed review of literature on the application of spatial analysis to poverty study as well as the conventional methodological approach to poverty study.

2.1 Theory of spatial concentration

The focus on location and spatial interaction has recently gained a more central place not only in applied but also in theoretical econometrics. In the past, models that explicitly incorporated "space" (or geography) and, therefore, applications of spatial econometrics were primarily found in specialized fields such as regional science, urban and real estate economics and economic geography [examples are reviews in Anselin (1992a), Anselin and Florax (1995a), Anselin and Rey (1997), and Pace *et al.* (1998)]. However, more recently, spatial econometric methods have increasingly been applied in a wide range of empirical investigations in more traditional fields of economics as well, including, among others, studies in agricultural and environmental economics [Benirschka and Binkley, 1994); Murdoch *et al.* (1997), Nelson and Hellerstein (1997) and Bell and Bockstael (2000)].

This attention to specifying, estimating and testing for the presence of spatial interaction in the mainstream of applied and theoretical econometrics can be attributed to growing interest within theoretical economics in models that move away from the atomistic agent as a decision maker acting in isolation to an explicit accounting for the interaction of that agent (its preferences and utility, among others) with other heterogeneous agents in the system. These new theoretical frameworks specify and study "direct" interaction between agents, in the form of social norms, neighbourhood effects, copy-catting and other peer group effects, and raise interesting questions about how the individual interactions can lead to emergent collective behaviour and aggregate patterns. Examples of such models are found in the new macroeconomics of Aoki (1994, 1996), in theoretical models of social interaction (Brock and Durlauf, 1995; Akerlof, 1997), interdependent preferences (Alessie and Kapteyn, 1991), models of evolving trading structures (Ioannides, 1990, 1997),

neighbourhood spillover effects (Durlauf, 1994; Borjas, 1995 and Glaeser *et al.*, 1996), and yardstick competition (Besley and Case, 1995; Bivand and Szymanski, 1997).

These frameworks also form some of the underpinnings for empirical models that encompass strategic interaction between agents [Examples are Case *et al.* (1993); Murdoch *et al.* (1997) and Brueckner (1998)]. Much of this literature is inspired by principles developed in statistical mechanics, such as the study of interacting particle systems and random field models (for a review, see Durlauf, 1997), which, interestingly, also forms a basis for some of the spatial Markov field models developed in spatial statistics (example is Cressie,1993). Related to this strand in the literature is the revived emphasis on the spatial aspects of Marshallian externalities, agglomeration economies and other spillovers that are central to the new economic geography reflected in the work of Arthur (1989), Krugman (1991a, 1991b, 1998), Glaeser *et al*. (1992) and others.

The possibility that the behaviour and characteristics of one's neighbours have an effect on one's behaviour has long been a topic of interest among sociologists, and has recently received growing attention among economists as well (Ludwig *et al.*, 2000). The latter's interest stems from the need to obtain accurate estimates of the impacts of particular variables of interest on certain economic outcomes. *Spatial effects* is a catch-all term referring to both spatial dependence and spatial heterogeneity. Spatial dependence (or autocorrelation) and heterogeneity are usually not easily discernable in an empirical sense (Anselin, 2001b). They compete as meaningful but mutually exclusive interpretations of the spatial distribution of realworld phenomena. In the spatial statistical and econometric literature, however, substantially more attention has been paid to testing for spatial autocorrelation as compared to spatial heterogeneity because the extent of heterogeneity can be assessed, using standard statistical tools (Cliff and Ord, 1981).

2.1.1 Spatial dependence

Spatial dependence in a collection of sample data means that observations at location *i* depend on other observations at locations $j \neq i$. According to LaSage (1999), this may be expressed as:

$$y_i = f(y_j), \; i = 1, \ldots\ldots, n \quad j \neq i$$

Note that we allow the dependence to be among several observations, as the index *i* can take on any value from $i = 1, \ldots, n$. He opined that there are two reasons sample data observed at

one point in space is dependent on values observed at other locations. First, data collection of observations associated with spatial units such as zip-codes, senatorial districts, states, census tracts and so on, might reflect measurement error. This would occur if the administrative boundaries for collecting information do not accurately reflect the nature of the underlying process generating the sample data. As an example, labourers move from one place to another in order to better their economic well-being. Therefore, labourer's well being measured on the basis of where people live could exhibit spatial dependence. A second and perhaps more important reason we would expect spatial dependence is that the spatial dimension of socio-demographic, economic or regional activity may truly be an important aspect of a modelling problem. Regional science is based on the premise that location and distance are important forces at work in human geography and market activity. All of these notions have been formalized in regional science theory that relies on notions of spatial interaction and diffusion effects, hierarchies of place and spatial spillovers.

2.1.2 Quantifying location in models

LaSage (1999) reasoned that the task that must be carried out before questions can be asked about spatial dependence and heterogeneity is quantification of the locational aspects of sample data. Given that a set of spatial data observations can be mapped, there are two sources of information on which to draw. The location in Cartesian space represented by latitude and longitude is one source of information. This information makes it possible to calculate distance from any point in space, or the distance of observations located at distinct points in space to observations at other locations. Spatial dependence should conform to the fundamental theorem of regional science — distance matters. Observations that are near should reflect a greater degree of spatial dependence than those more distant from each other. This suggests that the strength of spatial dependence between observations should decline with the distance between observations. Distance might also be important for models involving spatially heterogeneous relationships. If the relationship being modelled varies over space, observations that are near should exhibit similar relationships and those that are more distant may exhibit dissimilar relationships. In other words, the relationship may vary smoothly over space. The second source of locational information is contiguity, reflecting the relative position in space of one regional unit of observation to other such units. Measures of contiguity rely on knowledge of the size and shape of the observational units depicted on a map. From this, it is possible to determine which units are neighbours (have borders that touch) or represent observational units in reasonable proximity to each other. Regarding

spatial dependence, neighbouring units should exhibit a higher degree of spatial dependence than units located far apart. For spatial heterogeneity, relationships may be similar for neighboring units. Generally, the study is based on Tobler (1970) First Law of Geography which states that:"everything is related to everything else, but near things are more related than distant things."

It should be noted that these two types of information are not necessarily different. Given the latitude-longitude coordinates of an observation, a contiguity structure can be constructed by defining a "neighboring observation" as one that lies within a certain distance. Consider also, given the boundary points associated with map regions, the centroid coordinates of the regions can be computed. These coordinates could then be used to calculate distances between the regions or observations.

2.1.3 Spatial Concentration of Locations of Poverty

The term "spatial" in the context of the phrase "spatial concentration" refers to a geographical dependence structure for observations, (Griffith, 1984). 'Spatial concentration of poverty' is defined rather differently from the conventional poverty. The latter refers to an individual or a family that cannot afford the basic necessities of life, or the one that spends more than a certain proportion of its income on such necessities; the former looks at the poverty of neighbourhood. Spatial concentration examines the poverty level of a geographical unit in relation to its neighbouring geographical units. For example, a senatorial district with a high concentration of poverty may share contiguity with senatorial districts having similarly high concentration of poverty (Kazemipur and Halli, 2000).

Spatial clustering shows the similarity or dissimilarity of poverty in neighbouring units and spatial autocorrelation measures the strength of the spatial clustering (Cliff and Ord, 1973; Getis and Ord, 1992; Anselin, 1995). Global spatial autocorrelation (Moran's I) analysis yields only one statistic to summarize the pattern of poverty in the whole study area. That is, Global Moran's I assumes homogeneity of the study area (that poverty pattern is the same in all the senatorial districts). This is the limitation of global Moran's I. To localize the presence and magnitude of spatial autocorrelation, a measure such as Anselin's Local Indicators of Spatial Association (LISA) is necessary. This approach is most useful when, in addition to global trends in the entire sample of observations, there exist also pockets of localities exhibiting heterogeneous values that do not follow the global trend. This leads to identification of so-called hot spots - regions where the considered phenomenon is extremely pronounced across localities as well as of spatial outliers (Oliveau and Guilmoto,

2003). Another way of showing spatial clustering is called 'Moran scatter plot'. It involves ploting a variable of interest against spatial weighted component of that variable. This measure permits a more disaggregated view of the type of spatial autocorrelation that exists in some data. Local Indicators of Spatial Association (Anselin, 1995) and Moran scatter plot (Anselin, 1996) are valuable for gaining a ''local'' understanding of the extent and nature of spatial clustering in a geographical unit. LISA indicates significant spatial clustering for each location.

Moran scatter plot utilizes graph only to identify observations (extent of poverty) that are similar as well as different (outliers: neighbouring senatorial districts that have contrasting poverty rates) from their neighbours while formula is used in Local Moran's I to identify similarity or dissimilarity of poverty rates in neighbouring units. For each location (senatorial district), LISA values allow for the computation of its similarity with its neighbours and also to test its significance. Spatial association can be decomposed into four components, viz:

- Senatorial districts with high concentration of poverty with similar neighbours: *high-high*, also known as "hot spots".
- Senatorial districts with low concentration of poverty with similar neighbours: *low-low*, also known as "cold spots".
- Senatorial districts with high concentration of poverty with low concentration of poverty neighbours: *high-low*, potential "spatial outliers".
- Senatorial districts with low concentration of poverty with high concentration of poverty neighbours: *low-high*, potential "spatial outliers".
- Senatorial districts with no significant local autocorrelation.

All these are expected to emerge from the results of the analyses.

Anselin (1996) demonstrated that the slope of the regression line through the points in Moran scatter plot expresses the global Moran's I value. A strong positive statistic indicates positive spatial autocorrelation (clustering of like values). This means that most senatorial districts would be found in the high-high or low-low (first and third quadrants) areas of the country. A strong negative statistics indicates negative spatial autocorrelation. This suggests that most senatorial districts with high (low) poverty concentration would be found in the vicinity of low (high) poverty senatorial districts (outliers).

2.2 Analytical framework

This section explains the procedure as well as the models required at different stages in spatial econometrics analysis.

2.2.1 Concept of spatial econometrics

Generally, spatial analysis can be carried out in any data set that is location-specific regardless of whether spatial autocorrelation is significantly present or not. When dealing with spatial data, it is important that special attention is given to the possibility that the errors or the variables in the model show spatial dependence. Naturally, spatial autocorrelation/spillover effect is present in any data set that is location specific. Where spatial autocorrelation presence is insignificant, local indicator of spatial association of the data set as well as other spatial analysis can be obtained. Also, if there is the need to establish causal relationship in the data set; a conventional method (Ordinary Least Squares, Probit, and Tobit, among others) is appropriate for analysis. However, where the spillover effect is significant; spatial econometrics is required not only to identify the type of spatial autocorrelation but also for effective solution to the problem that may crop-up as a result of significant presence of spatial autocorrelation,

In spatial econometrics, there are procedures to follow in order to achieve the desired objectives of any research. These procedures are:

2.2.2 Spatial autocorrelation test

Spatial autocorrelation, or more generally, spatial dependence, is the situation where the dependent variable or error term at each location is correlated with observations on the dependent variable or values for the error term at other locations. The general case is formally, or for neighbouring locations, i and j. This specification is too general to allow for the estimation of potentially N times (N-1) interactions from N observations. Therefore, the form of the spatial dependence is given structure by means of a spatial weights matrix (W), which reduces the number of unknown parameters to one, that is, the coefficient of spatial association in a spatial autoregressive or spatial moving average process (Anselin,1992).

The presence of spatial autocorrelation (spatial dependence) is a violation of linear regression analysis which assumes independence among observations. According to Voss *et al.* (2006), when conducting regression analysis with data aggregated to geographic areas such as senatorial district (referred to in the spatial analysis literature as an irregular lattice), it is common to find spatial dependence, that is, correlated with themselves in the

independent variables or in the error (residual) components. There are two ways in which spatial autocorrelation can manifest; these are spatial-lag dependence and spatial-error dependence. Therefore, ignoring the spatial component of the regression analysis may lead to wrong inference. Hence, appropriate model that incorporates the effects of spatial dependence will be required to correct this anomaly.

2.2.3 Lagrange multiplier test or Rao Score

This test is intended to determine the actual cause of spatial dependence (spatial-lag or spatial-error). A spatial dependence caused by spatial-lag/autoregressive will require spatial-lag model while spatial-error will require spatial-error model for correction (Anselin, 1999). The significance of Lagrange Multiplier value determines the cause of spatial dependence. However, where the Lagrange multiplier for spatial-lag and spatial-error statistics are significant, cause of spatial dependence is determined by higher Robust Lagrange Multiplier (Anselin *et al.*, 1996; Benson *et al.*, 2004).

2.2.4 Local Moran I test

The extent and nature of spillover in a geographical unit can be empirically and graphically analyzed using the local Moran's I (LISA), LISA Map and Moran's scatterplot. See Local Moran's I formula in appendix 27.

i) part of a concentration of senatorial districts in which similar levels of poverty clustered (low–low and high–high);
ii) a spatial outlier, that is, the poverty rate was much different from the poverty rates of nearby or surrounding senatorial districts (high–low and low–high); or
iii) neither part of a concentration of senatorial districts with similar values nor a spatial outlier.

2.2.5 Spatial econometrics models

Spatial models whether standard or modified (spatial-lag/ spatial-lag Probit or spatial-error/ spatial-error Probit models are mutually exclusive), take the general form of:

$$y^* = \rho W_{(l)} y^* + x_i \beta_i + u \qquad (1)$$

$$where: u = \lambda W_{(e)} u + \varepsilon, \quad \varepsilon \approx N(0, 1)$$

$$u = \left(1 - \lambda W_{(e)}\right)^{-1} \qquad (2)$$

Substituting equation (2) in equation (1):

$$y^* = \rho W_{(l)} y^* + x_i \beta_i + \left(1 - \lambda W_{(e)}\right)^{-1} \varepsilon \qquad (3)$$

where y^* is a nx1 vector of latent variables (unobserved), x_i a n x k matrix of covariates, β_i is the regression coefficient for the independent variables, ε is a zero-mean error term, $W_{(l)}$ and $W_{(e)}$ are n x n spatial lag and error weights matrices, respectively and {ρ, λ} the associated scalar spatial parameters.

Since $y*$ is a latent variable (unobserved), equations (3) cannot be estimated. However, y_i which is related to $y*$ can be observed (see Novo, 2003; Coughlin *et al.,* 2003; Anselin, 1999; and Garrett *et al.,* 2005).

There are two types of model in spatial econometrics analysis based on the cause of spatial dependence. The models are:

2.2.5.1 Spatial-error model

The Spatial-error model presupposes that only the error term (the residual) is spatially autoregressive: this residual term is supposed to capture unobserved factors, which on the one hand influence the dependant variable and on the other hand are spatially autocorrelated and therefore responsible for the autocorrelation of the residuals (Guilmoto, 2005). Spatial-error model is the required model when the error term in one location is correlated with error terms in its neighbouring locations. This kind of spillover (spatial dependence) occurs if there are variables that are omitted but do have an effect on the dependent variable and they are spatially correlated (Okwi *et al.,* 2007). If ρ = 0 in general spatial models (equation 3) above, a spatial-error equation is obtained:

$$y^* = x_i \beta_i + \left(1 - \lambda W\right)^{-1} \varepsilon \qquad (4)$$

where W is the binary weight matrix described earlier, and λ is a scalar that measures spatial error correlation. The errors are positively correlated if λ > 0, negatively correlated if λ < 0, and not correlated if λ = 0.

2.2.5.2 Spatial-lag model

The model with spatial dependence in the dependent variable is often referred to as a spatial-lag model or as a spatial autoregressive model. In spatial-lag model, the dependent variable in location *i* is not only determined by covariates (x_i) specific to location *i*, but also by the value of the same dependent variable at other locations.

If λ = 0 in equation (3) above, a spatial-lag equation is obtained:

$$y^* = \rho W_{(l)} y^* + x_i \beta_i + \varepsilon$$

$$y^* - \rho W_{(l)} y^* = x_i \beta_i + \varepsilon$$

$$y^* \left(1 - \rho W_{(l)}\right) = x_i \beta_i + \varepsilon$$

$$y^* = \left(1 - \rho W_{(l)}\right)^{-1} x_i \beta_i + \left(1 - \rho W_{(l)}\right)^{-1} \varepsilon \quad (5)$$

$$y^* = (1 - \rho W)^{-1} x_i \beta_i + (1 - \rho W)^{-1} \varepsilon \quad (6)$$

where scalar ρ is the spatial-lag coefficient and reflects positive spatial correlation in the dependent variable if ρ > 0, negative spatial correlation if ρ < 0, and no spatial correlation if ρ = 0.

In spatial-lag or spatial-error model, the individual elements of W = $\{\omega_{ij}\}$ was specified, using binary weight matrix. In binary weight matrix ω_{ij} = 1 if senatorial districts i and j ($i \neq j$) share a common border, and ω_{ij} = 0 otherwise. In this specification, the elements of matrix W were row-standardized by dividing each ω_{ij} by the sum of each row i.

Determination of probability in spatial econometrics requires the modification of standard spatial econometric model. The modification is necessary because standard spatial econometric model utilizes continuous dependent variable while the modified model utilizes binary dependent variable. Unless Spatial Probit model is used, the spatial dependence in the model introduces heteroscedasticity that renders the coefficient estimates inefficient.

Following Petrucci *et al.* (2003) and as required by Spatial-error Probit/Spatial-lag Probit model, a continuous dependent variable can be converted to binary dependent variable. For instance if the continuous dependent variable is average per capita household

consumption expenditure per senatorial district (the dependent variable), in order to determine the probability that a household in a senatorial district will be poor; this is converted to binary dependent variable. The Petrucci *et al.* (2003) procedure is as follows:

$$y_{ia} = 1 \text{ if } \text{Lns}_i < 0$$
$$y_{ia} = 0 \text{ if } \text{Lns}_i \geq 0.$$

Where: Ln represents the natural log, c_i denotes the average per capita consumption expenditure per household per senatorial district, z denotes the national poverty line of N23,733, and $s_i = \frac{c_i}{z}$ is the normalized welfare indicator per household. Bayesian Spatial Autoregressive Probit was used to estimate the choice model.

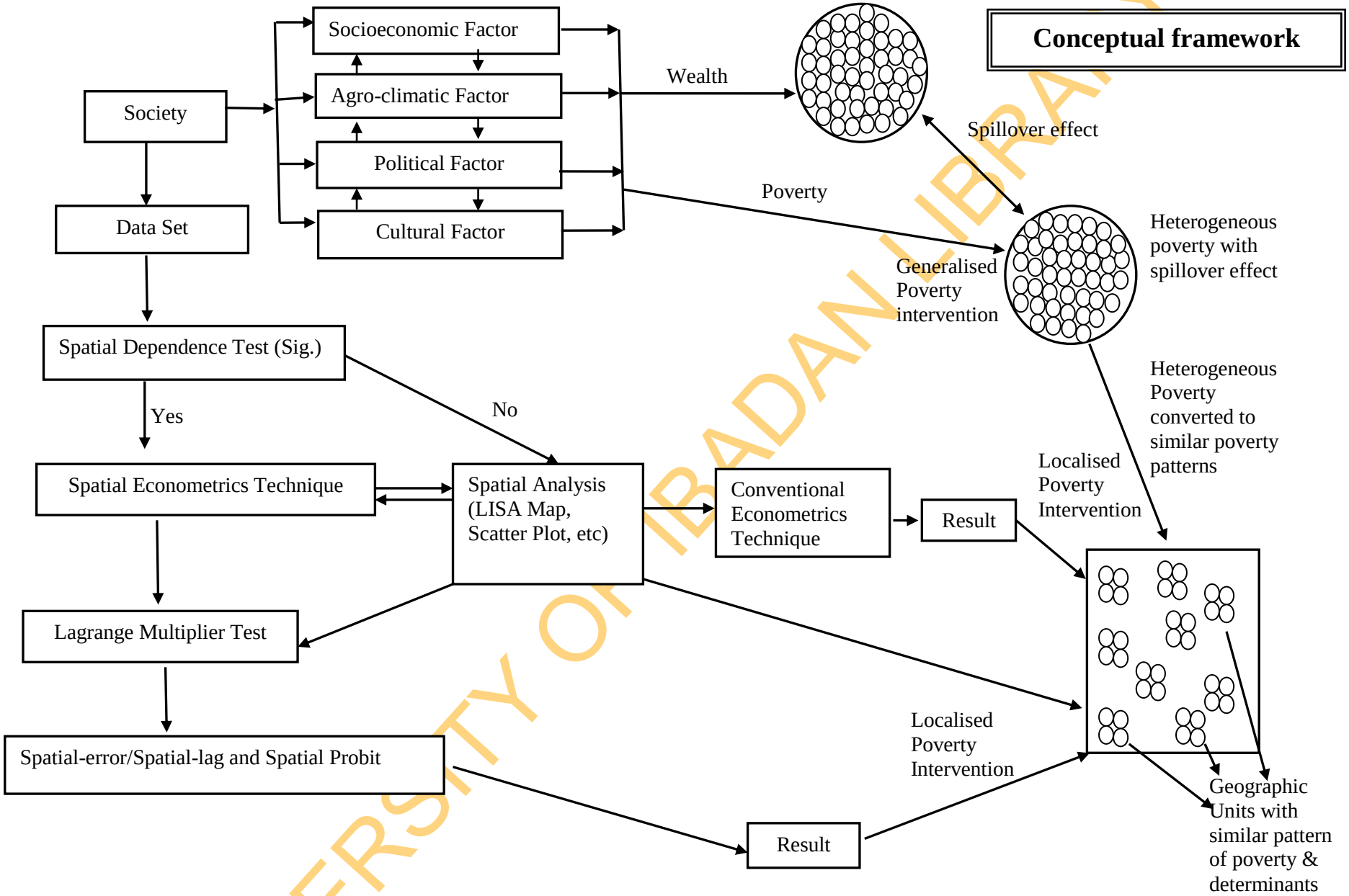


Figure 1: Spatial analysis and conventional approaches to poverty study

2.3 Literature review

The aim of this review is to establish knowledge gaps and provide background material for a full-scale study. This section provides a review of existing literature relating to the theme of the research. The section is divided into a review of poverty studies that utilized spatial analysis and the other conventional studies on poverty that adopted traditional approaches.

2.3.1 Review of applications of spatial analysis in poverty study

Poverty is not only a state of existence but also a process with many dimensions and complexities. Generally, poverty has attracted a lot of attention from the academia and non-academia globally. Few recent studies are based on the premise that individuals and households with common characteristics sometimes are found clustered together either by choice or because they are constrained to co-locate by coercive operation of social, economic, geographic or political forces. Identification of these households has been made possible through the advancement in spatial analytical techniques; which has also enabled the spatial pattern of poverty (concentration of poverty rates and outliers) to be quantified (Anselin, 1988, 2001a; Anselin and Bera, 1998). Studies (Minot *et al.*, 2003; Anselin, 2002) showed that poverty rate in nearby locations are likely to be similar to one another, or an error for the model in one area or location is correlated with the error terms in its neighbouring locations; hence the need to pay attention to the structure of spatial dependence or autocorrelation in our data. Minot *et al.* (2003) findings revealed that 10 per cent point increase in the poverty rate in a district results in 8 percent increase in the poverty rate in a neighbouring district. There are substantial literature on the use of spatial effects or spatial autocorrelation in poverty study (Voss *et al.*, 2006; Birungi *et al.*, 2005; Petrucci *et al.*, 2003; Okwi *et al.*, 2007; Minot *et al.*, 2003; Weber, 2006; Rupasingha and Goetz, 2007; Holt, 2007; Bichler *et al.*, 2004; and Amarasinghe *et al.*, 2006; among others). Holt (2007) posited that knowing precisely where concentration of poverty exits will help the policy maker, social scientist and all other stake-holders in continuing the challenge of combating this fundamental threat (poverty) to well-being. Ignoring spatial autocorrelation will make it:

- impossible to measure the strength of spatial concentration of poverty; and
- difficult to explain substantial variation in the incidence of poverty across senatorial districts.

Petrucci *et al.* (2003) conducted a research on the application of a spatial regression model to analysis and poverty mapping in Ecuador; their results confirmed the significant

effects of spatial autocorrelation variable that denotes the presence of clusters in the spatial distribution of poverty and the influence of neighbourhood households on the probability of being poor. A combination of processes (socioeconomic, political, demographic and geographic) operating in space over time has somehow conspired to partition countries into large regions of high and large regions of low poverty—with occasional ‘‘island’’ geographic units here and there that are very different from their neighbors (Voss *et al.*, 2006).

In a study on the topography of poverty in the US, Holt (2007) findings showed that 51.9% of the counties belong to similar spatial concentrations (low-low and high-high), whereas only 7.8% were categorized as being spatial outliers (high-low and low-high). The remaining 40.3% were neither. The categorization of spatial concentration into high or low poverty rate neighbourhood is in relationship with average national poverty rate. Most counties in the US are found in the high-high and low-low sub-regions (Voss *et al.*, 2006). That is, the counties whose poverty rate is above (below) the average poverty rate are surrounded by counties with poverty rate above (below) average national poverty rate. Similarly, Amarasinghe *et al.* (2006), in a study on spatial clustering of rural poverty in Sri Lanka, found that Divisional Secretariat (DS) with a high percentage of poor households are found in four rural districts where agriculture is the main source of livelihood of the majority of households. The clustering of DS divisions of low poverty around major urban centres suggests that, in predominantly agricultural areas, poor people have only limited economic opportunities to escape poverty. They revealed that availability of and access to water and land resources are the major factors of spatial concentration of poverty in rural areas. In another study on spatial approach to social and political forces as a determinant of poverty in the US, Rupasingha and Goetz (2007) stated that a positive and significant spatial dependence in the dependent variable (poverty rate) indicates that the poverty rate in a particular county is associated with the poverty rates in surrounding counties/local government areas. According to them, the value of the spatial autocorrelation coefficient (ρ = 0.21 in the model for all counties) obtained indicates that a 10 percentage point increase in the poverty rate in a county results in a 2% increase in the poverty rate in a neighbouring county. This is strong evidence that spillover effects exist between counties with respect to poverty. This finding is corroborated by Crandall *et al.* (2004). They reasoned that the poverty of a neighbourhood is tied to the fortunes of neighbouring areas: there are geographic spillovers in poverty reduction. Reducing poverty in particular neighbourhoods affects the poverty of neighbouring tracts.

2.3.2 Determinants of poverty among households

Spatial concentration of poverty is a reflection of differences in economic opportunities which can be attributed to variation in social, political, geographic, agro-climatic and demographic factors. Khan (2001) believes that to understand poverty, it is essential to examine the economic and social contexts, including institutions of the state, markets, communities and households. He opined that poverty differences cut across gender, ethnicity, age, location and income source. Specifically, World Bank (1996) reports showed that 66 per cent of the Nigerian population is poor while CBN (1996) and the National Bureau of Statistics (2005) reported 69.2 and 54.1 per cents respectively for the same year. The decomposition of 1996 poverty profile showed that 37 per cent of the Nigerian poor live in the urban areas while 51per cent live in the rural areas (Aigbokhan, 2000). Compared to 1997, NBS (2005) report revealed a higher incidence of poverty in the rural (63.27%) and urban (43.19%) areas in 2004. One important concensus in the literature on poverty is that it is a rural phenomenon (World Bank, 1990; and Fields, 2000). Unfortunately, the importance of the rural poor is not always understood partly because the urban poor are more visible and more vocal than their rural counterparts. According to Okumadewa *et al.* (2010), the rural sector is the predominant sector in the Nigerian economy; it plays some fundamental roles such as job creation at relatively low unit costs and thus remains the most important growth priorty of the country. Adeyeye (1999 and 2000a) reasoned that most of the rural poor in Nigeria rely mainly on income from agriculture. This assertion was affirmed in AERC Collaborative Poverty I research finding that poverty is concentrated among the rural population in Nigeria and it is everywhere higher than urban poverty for the period 1980-1996 (Okojie *et al.*, 2001)

The decomposition of Nigeria's poverty profile into regions and states is contained in Aigbokhan (2000), Sofo *et al.* (2003), NBS (2005) and Thomas and Canagarajah (2002). The studies showed an improvement in the incidence of poverty in southern zones than in the northern zones. Poverty incidence actually improved in the southern zones during the 1990s, but deteriorated in the north, particularly in the rural areas.

Sociologists complain that economists neglect the roles of social and institutional structure in the process of economic development and poverty alleviation [Rural Sociological Society (RSS) Task Force on Persistent Rural Poverty, 1993]. Writers in the sociological, political science, and regional science literature point out that certain community attributes are empirical correlates of successful communities [Glahe and Vorhies, 1989; Green *et al.*, 1990; Batten, 1993; McDowell, 1995; Granato *et al.*, 1996;

Rupasingha *et al*., 1999, 2002]. These and other studies suggest that many factors influence the level of community and economic development of a place. Farmer *et al.*(1989) for example, view poverty as a condition of the local social structure. The idea that institutions matter for economic development has received attention in the economics literature as well. Levitt and Poterba (1999) find that states in which the two major political parties compete with one another experienced faster income growth than did states with less competition. Rupasingha and Goetz (2007) reasoned that variables measuring political participation have been tied to the economic performance of communities. In a study involving the effects of political factors on poverty rate, they incorporated political competition in their models. Their result showed that the political competition variable is positive and highly significant. This according to them means that counties that are politically less competitive (vote outcome skewed towards a single party) have higher family poverty rates.

Community attributes such as the local social structure, community action, civic participation, ethnic diversity, the power of local governments, and commitment of leadership to economic development can also influence the economic success of an area and its population. Social capital, or the relationships of commitment and trust in a community and between individuals, can have an impact on the economic development of such a community. Duncan (1999), for example, finds that poverty persists when communities lack civic participation and is rigidly divided by class and race. The basic idea of "social capital" is that one's family, friends, and associates constitute an important asset, one that can be called upon in a crisis, enjoyed for its own sake, and/or leveraged for material gain. In the development literature, those communities endowed with a rich stock of social networks and civic associations have been shown to be in a stronger position to confront poverty and vulnerability (Moser, 1996; Narayan, 1997), resolve disputes (Schafft and Brown, 2000), and share beneficial information (Isham, 1999). As several sophisticated econometric studies have shown, diffuse sets of social ties are crucial for providing informal insurance mechanisms (Coate and Ravallion, 1993; Townsend, 1994) and have important impacts on the success of development projects (Isham, Narayan and Pritchett, 1995; Galasso and Ravallion, 2000).

Numerous studies have found a positive association between economic development and social capital. Studies in Nigeria (World Bank, 1996; Okumadewa, 1998; Olayemi *et al.*, 1999; and World Bank/DFID, 2000) have shown that the poor derive more benefits from membership of local assocations compared with public instituted organisations. The studies also affirmed the effectiveness of the different organisations in alleviating

poverty. Rupasingha and Goetz (2007) and Swaminathan *et al.* (2004) investigated the independent effects of social capital on family poverty rate; their result revealed that counties/local government areas rich in social capital have lower family poverty rates. In a study on spatial concentration of poverty and poverty dynamics in the United States, Crandall and Weber (2004) found that social capital appeared to be the most important in contributing to poverty decline in high-poverty areas. Specifically, they found that one-unit increase in the social capital index reduced poverty by an additional one per cent point for high-poverty tracts. According to them, social capital enhances the impact of job growth in medium poverty areas.

Availability and accessibility of credit facilities most especially micro-credit is another way of combating poverty in rural areas. According to Adeyeye (2001), micro-credit is a compelling anti-poverty and development strategy because of its ability to stimulate savings and promote asset accumulation among the poor people. She reasoned that the linkage between micro-credit programme and poverty can also be seen from its efficacy in increasing access to basic social services and enhancing the well-being of the very poor people. Olomola (2008) opined that at the level of individual livelihoods, financial markets can perform very crucial functions. They can be a principal means for the poor to get access to financial assets; through facilitating savings, they can be of importance in reducing the vulnerability associated with uneven and unpredictable year-to-year changes in circumstances, and they can help to convert 'illiquid' assets into liquid ones in the event of emergencies.

Many factors (as explained above) have been identified as major contributors to differences in standards of living of populations in different areas (both rural and urban areas). However, there has been little empirical work to ascertain the exact relationship between welfare levels and these factors (Okwi *et al.,* 2007). The effect of geographic and agro-climatic conditions such as rainfall, temperature, elevation, length of growing period, type of land cover, slope, and soil type on incidence of poverty is of great importance in Nigeria bearing in mind that 70% of Nigerians depend on agriculture as their source of livelihood. Out of this population, 80% reside in the rural areas (Dickinson, 2008 and Durojaiye, 1997). The effects of agro-climatic variables on rural poverty cannot be overemphasized. Specifically, the concentration of poverty in rural areas is closely related to agricultural productivity and market access, which by extension is dependent on agro-climatic conditions. The effect of rainfall uncertainty on measures of household vulnerability is analyzed in Christiaensen and Subbarao (2004). Using repeated cross-

sectional data with retrospective information on rainfall, the authors show that households in the arid regions of rural Kenya have the most volatile levels of consumption. This is because these households are exposed to the largest rainfall shocks. According to Minot *et al.* (2003), in most parts of Vietnam, higher rainfall is associated with lower poverty but in some areas, the reverse is true. This appears to reflect vulnerability to environmental stress, such as flooding.

Petrucci *et al.*(2003) and Okwi *et al.* (2007) posited that the results of their fitted spatial model demonstrate the statistical significance of environmental variables (regional dummies, land use, elevation, soil conditions/quality, and length of growing, period, travel time to roads and towns), and demographic variables on the spatial clustering of poverty and incidence of poverty in Ecuador. This suggests the presence of poverty-environmental relationship and hence the impact of environmental factors on the lives of the poor and on poverty reduction efforts. From the foregoing, environmental indicators could be an important tool for designing and evaluating poverty reduction strategies. Birungi *et al.* (2005) carried out a study on incorporating environmental factors in poverty analysis in Uganda. The spatial model utilized demonstrates the statistical significance of environmental variables which is not possible with the small-area estimation method that utilizes traditional econometric approach. They found that the low poverty concentration in the central province is neighboured by high poverty concentration regions of the north, east and west. The low poverty of the central province is attributed to very fertile soil, two rainfall seasons, wetlands and fairly developed infrastructures (markets, schools, roads and health facilities)

Mahbub (2004) found that high concentration of poverty is more among the neighbourhoods of marginal areas or areas that are prone to desertification, flood/erosion and oil spillage among others. In a study on spatial determinants of poverty in rural Kenya, Okwi *et al.*(2007) revealed that locations with good soils are associated with less concentration of poverty; making it possible for the residents to have absolute advantage of producing high-value perishable vegetables and other crops. Studies have shown that districts with a large area of sloped land have higher concentration of poverty than those with flat area. This is not surprising given the difficulties of cultivating and irrigating sloped land, as well as problems associated with erosion on steep land (Minot *et al.*, 2003; Okwi *et al.*, 2007). Their model showed that the agroclimatic explanatory variables explained 38 per cent and 74 per cent of the variation in urban and rural poverty

concentration respectively. As expected, this implies that urban poverty is much less affected by agro-climatic conditions than rural poverty.

A similar study carried out in two provinces of Bicol, Philippine by Vista and Murayama (2007) found that areas covered by land with a slope greater than 8% usually display high incidence of poverty, which is in agreement with Okwi *et al.*(2007) findings. Using traditional regression which did not consider spatial effect, their result also showed that the incidence of poverty has a negative causal relationship with mean annual rainfall and elevation.

Studies in the past have examined the causal relationship between the incidence of poverty and demographic variables. Varying educational and training levels among localities result in differing opportunities for economic advancement. According to Bankole *et al.* (2003), human beings are the critical subjects in poverty alleviation strategy. When they are deprived of necessary capapbilities that will make them productive, their poor status tends to be perpetuated. Raising human capital levels is one means of moving people out of poverty, and investments in human capital are frequently encouraged as public policy prescriptions (Rupasingha and Goetz, 2007). Education, particularly higher levels, can serve as an elevator for upward economic mobility. The higher the educational attainment in the household, the higher the household consumption, and hence the lower the chances a household living in poverty. The report further stated that having more than one member with an education also significantly increases consumption, and hence reduces the likelihood that a household will be poor. Working in agriculture (peasant farmer), blue collar jobs or as a casual labourer is strongly correlated with poverty. Households with the highest income-earner working in agriculture have significantly lower consumption levels (and hence are more likely to be poor) than those depending on work in other sectors (e.g., construction, commerce, transport or services) (GUAPA World Bank (2003) Report; Garza-Rodriguez, 2002; Mahbub, 2004; Both Székely, 1998; Cortés, 1997). According to World Bank (2003) report, Mason and Lee (2004) and Mahbub (2004), larger households tend to be poorer, particularly those with many young children. Overall, each additional child under six years old lowers total consumption by 23% (higher in rural areas than urban); each additional member from age 7-24 lowers total consumption by 17%. The magnitude of these values suggests that increased awareness and use of family planning methods could have a significant effect on reducing poverty. Greer and Thorbecke (1986a) observed that large Nigerian families are more prone to poverty than small families. UNDP (2005) report

revealed that Nigeria's total fertility rate (birth per woman) dropped from 6.9 from between 1970 – 1975 to 5.8 from 2000 – 2005.

Studies (NBS, 2005; Swaminathan *et al.*, 2004; Aigbokhan, 2000; Thomas and Canagarajah, 2002) have shown consistency in gender distribution of poverty over the year – that there is higher incidence of poverty among male-headed households. However, other studies found that poverty rate is higher among female-headed families (Farmer *et al.*, 1989; RSS Task Force on Persistent Rural Poverty, 1993; Levernier *et al.*, 2000; Garza-Rodriguez, 2000). In general, women are more in poverty than men. Kabeer (1996) remarks that women are less able than men to translate labour into income, income into choice and choice into personal well-being. Since women constitute more than half of the world's population and more than 70 per cent of the world's poor, reducing poverty among women will go a long way in reducing poverty globally (UNDP report, 2001).

O'Regan and Wiseman (1990) examine urban poverty concentrations, they assume that the prospect for leaving poverty are partly influenced by the neighbourhood access to education, good roads, portable water, regular supply of electricity and good health services, and its social environment, example is values of local communities which affect the individual aspiration and expectations. Households in towns with more access to basic utility services are significantly less likely to be poor. Disparities in access to basic utility services are quite large. Municipal electricity connections are associated with higher consumption levels in both urban and rural areas (Dasgupta *et al.*, 2003; GUAPA World Bank Report, 2003). Osinubi (2003) found that different poverty levels in urban towns is attributed to the level of education and type of occupation of the head of household, others are differences in household size and the number of persons working in a household.

CHAPTER THREE

METHODOLOGY OF THE STUDY

This chapter describes the study area, type of data utilized, methods employed in analyzing the data for the study in order to achieve the objectives of the study.

3.1 Area of study

The study covers the 109 senatorial districts of Nigeria (appendix 1 in the appendices). Each Senatorial district is composed of federal constituencies while a federal constituency is made up of local government areas. According to section five, sub-sections 71 and 72 of Nigeria's 1999 constitution, "the Independent National Electoral Commission shall divide each state of the federation into three senatorial districts. No senatorial district or federal constituency shall fall within more than one state, and the boundaries of each district or constituency shall be as contiguous as possible and be such that the number of inhabitants thereof is nearly equal to the population quota as is reasonably practicable." Figure 2 shows the senatorial districts map of Nigeria.

Nigeria with a total area of 923,770 km^2 (land area**:** 910,770 km^2; water area: 13,000 km^2) is bordered on the west by Republic of Benin (773 Km), on the east by Cameroon (1,690 Km), on the north by Chad (87 Km) and Niger (1,497 Km); and on the south by Atlantics Ocean. Generally, the terrain varies from rugged hills and undulating slopes in the south to gentle and fairly undulating in the north. The Nigerian climate varies from equatorial in the south, to tropical in the centre, and arid in north. The average annual rainfall ranges from 500 - 1800mm. The average annual minimum and maximum temperature ranges are: 20^0C - 25^0C and 28^0C - 32^0C respectively. In terms of administrative structure, Nigeria is made up of 36 states and the Federal Capital Territory; 774 local government areas, about 250 ethnic groups and 90,000 communities (Okojie, 1989).

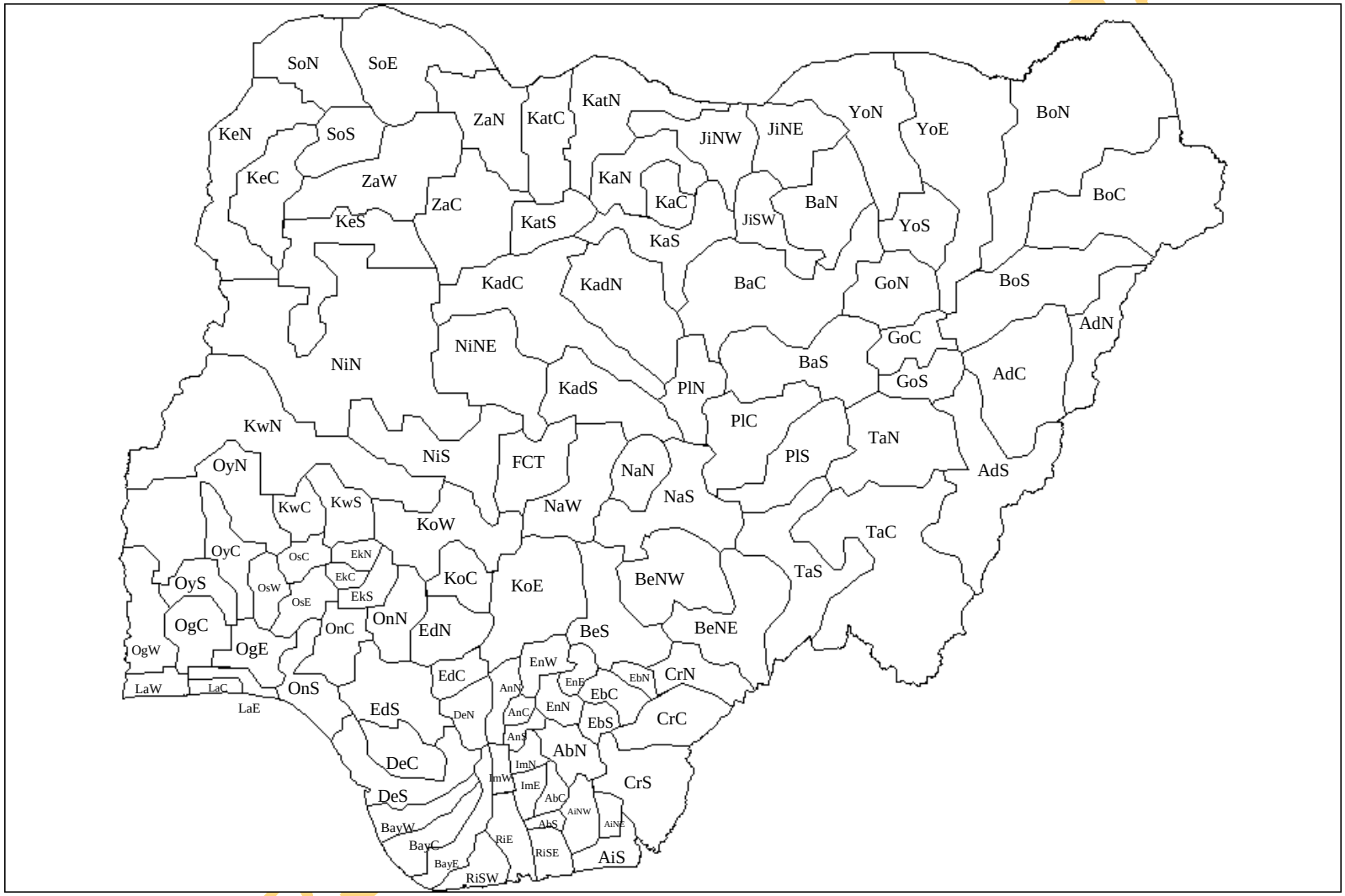


Figure 2: Senatorial district map of Nigeria
Source: Adapted from NBS (2007)
Note: See the meanings of the abbreviations in Table 2

Table 2: Senatorial districts codes and meaning of abbreviations

Senatorial District	ID	Senatorial District	ID	Senatorial District	ID	Senatorial District	ID	Senatorial District	ID
Abia Central	AbC	Borno North	BoN	Gombe South	GoS	Kwara Centarl	KwC	Oyo North	OyN
Abia North	AbN	Borno South	BoS	Imo East	ImE	Kwara North	KwN	Oyo South	OyS
Abia South	AbS	Cross-River Central	CrC	Imo North	ImN	Kwara South	KwS	Plateau Central	PlC
Adamawa Central	AdC	Cross-River North	CrN	Imo West	ImW	Lagos central	LaC	Plateau North	PlN
Adamawa North	And	Cross-River South	CrS	Jigawa North-east	JiNE	Lagos East	LaE	Plateau South	PlS
Adamawa South	AdS	Delta Central	DeC	Jigawa North-west	JiNW	Lagos West	LaW	Rivers East	RiE
Akwa Ibom North-west	AiNW	Delta North	DeN	Jigawa South-west	JiSW	Nasarawa North	NaN	Rivers South-east	RiSE
Akwa Ibom North-east	AiNE	Delta South	DeS	Kaduna Central	KadC	Nasarawa South	NaS	Rivers South-west	RiSW
Akwa Ibom South	AiS	Ebonyi Central	EbC	Kaduna North	KadN	Nasarawa Central	NaC	Sokoto East	SoE
Anambra Central	AnC	Ebonyi North	EbN	Kaduna South	KadS	Niger East	NiE	Sokoto North	SoN
Anambra North	AnN	Ebonyi South	EbS	Kano Central	KaC	Niger North	NiN	Sokoto South	SoS
Anambra South	AnS	Edo Central	EdC	Kano North	KaN	Niger South	NiS	Taraba Central	TaC
Bauchi Central	BaC	Edo North	EdN	Kano South	KaS	Ogun Central	OgC	Taraba North	TaN
Bauchi North	BaN	Edo South	EdS	Katsina Central	KatC	Ogun East	OgE	Taraba South	TaS
Bauchi South	BaS	Ekiti Central	EkC	Katsina North	KatN	Ogun West	OgW	Yobe East	YoE
Bayelsa Central	BayC	Ekiti North	EkN	Katsina South	KatS	Ondo Central	OnC	Yobe North	YoN
Bayelsa East	BayE	Ekiti South	EkS	Kebbi Cental	KeC	Ondo West	OnW	Yobe South	YoS
Bayelsa West	BayW	Enugu East	EnE	Kebbi North	KeN	Ondo East	OnE	Zamfara Central	ZaC
Benue North-east	BeNE	Enugu North	EnN	Kebbi South	KeS	Osun Central	OsC	Zamfara North	ZaN
Benue North-west	BeNW	Enugu West	EnW	Kogi West	KoW	Osun East	OsE	Zamfara West	ZaW
Benue South	BeS	Gombe Central	GoC	Kogi Central	KoC	Osun West	OsW	FCT	AbJ
Borno Central	BoC	Gombe North	GoN	Kogi East	KoE	Oyo Central	OyC		

3.2 Type and sources of data

The study utilized secondary data. These were obtained from 2006 Core Welfare Indicator Questionnaire Survey and 2003/2004 National Living Standard Survey (NLSS) data by the National Bureau of Statistics (NBS). Other sources were the Nigerian Institute of Meteorological Services (NIMET) for agro-climatic and environmental data, Independent National Electoral Commission for senatorial district election results (this is used to determine political competition) and Food and Agricultural Organisation for the fertility soil map of Nigeria.

The 2006 Core Welfare Indicator Survey (CWIS) provided a wide variety of data on demographic and socioeconomic characteristics of each senatorial district. These data included head of household, percentage of literate adult, dependency ratio, percentage of people employed in agriculture, access to credit facilities, health facilities, safe sanitation and safe source of water, connection to public electricity and primary and secondary schools net enrollment. Data on membership of clubs/business organization (social capital), household size, per capita consumption expenditure and poverty rate were obtained from 2004 National Living Standard Survey data. Apart from the percentage of people employed in agriculture, other agro-ecological and environmental data such as average annual rainfall (mm), length of growing period and susceptibility of senatorial districts to water erosion and desertification were sourced from the Nigerian Institute of Meteorological Services (NIMET) and Central Bank Statistical Bulletin.

3.3 Sampling procedure used by National Bureau of Statistics for NLSS

One hundred and twenty (120) EAs were selected in 12 replicates in each state from the National Integrated Survey of Households' (NISH) master sample frame in replicates (4-15). Sixty (60) EAs were selected in the Federal Capital Territory. Five (5) housing units (HUs) were scientifically selected in each of the selected EAs. One replicate consisting of 10 EAs in the state and 5 EAs in the Federal Capital Territory were covered every month. Fifty (50) HUs were covered in each state and 25 HUs in the Federal Capital Territory per month. This implied that the survey had an anticipated national sample size of twenty-one thousand and nine hundred (21,900) HUs, while the Federal Capital Territory had a sample size of 300. The sample size is robust enough to provide reasonable estimates at national and sub-national (state) levels.

3.4 Sampling procedure used by National Bureau of Statistics for CWIQ

The Core Welfare Indicator Questionnaire (CWIQ) Survey 2006 was a national survey covering all the states of the Federation and the Federal Capital Territory (FCT), Abuja. All the 774 local government areas in the country were canvassed with the coverage cutting across both the urban and rural areas.

A 2-stage cluster sample design was adopted in each LGA. Enumeration Areas (EAs) formed the 1st stage or Primary Sampling Units (PSUs) while Housing Units (HUs) formed the 2nd stage or Ultimate Sampling Units (USUs). The EAs as demarcated by the National Population Commission (NPC) for the 1991 Population Census served as the sampling frame for the selection of 1st stage sample units. In each LGA, a systematic selection of 10 EAs was made.

A complete listing of Housing Units (and of Households within Housing Units) was done prior to the second stage selection at each of the selected 1st stage units. These lists provided the frames for the second stage selection. Ten (10) HUs were then systematically selected per EA and all households in the selected HUs were interviewed. The projected sample size was 100 HUs at the LGA level. The sample size using other defined reporting domains (FC, senatorial, state and geo-political zones) varied, depending on the number of the LGAs that made the reporting domain. A total 77,400 HUs were considered as the national sample.

3.5 Analytical tools and models

The study employed a number of analytical tools based on the specific objectives of the study. The tools include:

3.5.1 Descriptive statistics

In descriptive analysis; charts, graphs, maps, measures of central tendency, measures of dispersion (skewness) and correlation coefficient were employed to throw more light on the results of empirical analysis obtained for senatorial districts. Specifically, descriptive analysis was employed to analyze poverty rate, per capita consumption expenditure, the demographic characteristics, agro-ecological and environmental characteristics, infrastructural characteristics and sociopolitical and economic characteristics of the senatorial districts. The descriptive analysis was also extended to senatorial districts that constitute each of the six geopolitical zones in Nigeria.

3.5.2 Empirical model

A diagnostic Ordinary Least Squares regression analysis was carried out by expressing the prevalence of poverty as a function of selected spatial variables. This is to detect spatial dependence, in addition to other standard diagnostics. The OLS regression model is estimated as:

$$y_i = \beta_i X_i + \varepsilon_i \qquad (7)$$

Where:

y_i is a vector average poverty rates;

X_i is a matrix of independent variables,

β_i is a vector of coefficients,

ε is a vector of random errors.

The geo-referenced independent variables data were grouped under demographic, agro-ecological and environmental, infrastructural, sociopolitical and economic characteristics. The data (household) were based on senatorial district.

If spatial autocorrelation is significantly present, the result of OLS regression diagnostics will reveal the cause (spatial-lag or spatial-error) as well as the appropriate model to correct the defect. Either of the models below corrects the defect:

(i) Spatial-error model:

$$y = x_i\beta_i + \left(1-\lambda W_{(e)}\right)^{-1}\varepsilon \qquad (8)$$

(ii) Spatial-lag model:

$$y = \left(1 - \rho W_{(l)}\right)^{-1} x_i\beta_i + \left(1 - \rho W_{(l)}\right)^{-1}\varepsilon \qquad (9)$$

Where:

y is an nx1 vector of dependent variable (average poverty rate),

x_i an n x k matrix of covariates (independent variables),

β_i is the regression coefficient for the independent variables,

ε is a zero-mean error term,

$W_{(l)}$ and $W_{(e)}$ are n x n spatial-lag and error weight matrices, respectively

{ρ, λ} the associated scalar spatial parameters (measures the extent of spillover).

Spatial analysis (Local indicator of Spatial Association Indices, Local indicator of Spatial Association Cluster Map, Local indicator of Spatial Association Significance Map

and Moran scatter plot) is employed to identify the senatorial districts with similar spatial pattern of poverty incidence. The analysis is carried out regardless of whether spatial autocorrelation is significantly present in the geo-referenced data set or not.

Local Moran's I is computed using the formula below:

$$I_{local} = \frac{\sum_i w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_i (x_i - \bar{x})^2} \qquad (10)$$

Where:

i and *j* index the area units of which there are n,

w_{ij} is a spatial weight measure of contiguity defining the connection between area unit *i* and area unit j.

w is 1 if location i is contiguous to location j and 0 (zero) otherwise.

The result from the spatial analysis above identifies the senatorial districts with similar patterns of spatial distribution of poverty incidence as well as outliers (high-high, low-low, low-high and high-low). However, to determine the factors influencing senatorial districts with similar spatial patterns of poverty incidence (High-high and low-low); the significance or non-significance of spatial autocorrelation is a prerequisite for the choice of analytical tool. While OLS estimation is appropriate in non-significance situation, maximum likelihood estimation (spatial-lag/spatial-error model) is required where the spatial autocorrelation is statistically significant.

The appropriate models are shown below:

(i) Statistically insignificant spatial autocorrelation

$$\mathrm{Pr}_{\mathrm{L-L}} = \beta_i \mathrm{X}_i + \varepsilon_i \qquad (11)$$

$$\mathrm{Pr}_{\mathrm{H-H}} = \beta_i \mathrm{X}_i + \varepsilon_i \qquad (12)$$

(ii) Statistically significant spatial autocorrelation

Spatial-error model:

$$\mathrm{Pr}_{\mathrm{L-L}} = \mathrm{x}_i \beta_i + \left(1 - \lambda \mathrm{W}_{(e)}\right)^{-1} \varepsilon \qquad (13a)$$

$$\mathrm{Pr}_{\mathrm{H-H}} = \mathrm{x}_i \beta_i + \left(1 - \lambda \mathrm{W}_{(e)}\right)^{-1} \varepsilon \qquad (13b)$$

Spatial-lag model:

$$Pr_{L-L} = \left(1 - \rho W_{(l)}\right)^{-1} x_i \beta_i + \left(1 - \rho W_{(l)}\right)^{-1} \varepsilon \qquad (14a)$$

$$Pr_{H-H} = \left(1 - \rho W_{(l)}\right)^{-1} x_i \beta_i + \left(1 - \rho W_{(l)}\right)^{-1} \varepsilon \qquad (14b)$$

Where:

$P_{rL\text{-}L}$ is the vector of poverty rate for only low poverty senatorial districts that are surrounded by low poverty senatorial districts.

$P_{rH\text{-}H}$ is the vector of poverty rate for only high poverty senatorial districts that are surrounded by high poverty senatorial districts.

The measures of fit in spatial regression model are the Log-Likelihood, Akaike Information Criterion (AIC) and Schwarz Criterion (SC).

The probability that a household taken at random from a senatorial district will be poor is determined using Spatial Probit model which confirmed the significant presence of spatial autocorrelation. Spatial Probit accounts for spillover effect where it is significantly present. Unlike the Spatial Regression model, the dependent variable in Spatial Probit is binary. For Spatial-lag Probit model, the probability that a household in a senatorial district will be poor is:

$$p\left(y_{ia} = 1 \middle| x\right) = \left(\left[\left(1 - \rho W\right)^{-1} x_i \beta_i\right]_i + \left[\left(1 - \rho W\right)^{-1} \varepsilon\right]_i > 0\right) \qquad (15)$$

While the probability that a household in a senatorial district will be poor for Spatial-error is:

$$p(y_{ia} = 1|x) = p\left(\left[x_i \beta_i + (1 - \lambda W)^{-1} \varepsilon\right]_i > 0\right) \qquad (16)$$

3.6 Data sources and *a priori* expectations of variables used for analysis

This section explained different types of variables used for the study, their sources as well as the *a priori* expectations of each variable from literature.

3.6.1 Dependent variables

Under this section the regressands used for the empirical analysis are explained. Two different dependent variables are used. Poverty rate per senatorial district was used for standard Spatial Regression while while per capita household expenditure converted to a binary value was used for Spatial Probit Regression.

3.6.1.1 Poverty rate (%) per senatorial district

Poverty rate is the dependent variable in Spatial Regression used in the study. The data were obtained from National Living Standard Survey data (NLSS) conducted by the National Bureau of Statistics in 2004. Poverty rate is a relative measure of poverty based on per capita household expenditure. The National Bureau of Statistics utilized Foster, Greer and Thorbeck (FGT) method and the poverty line of N23,733 (two-third of average per capita household expenditure) to arrive at the poverty incidence (%) per senatorial district.

3.6.1.2 Per capita household expenditure

Per capita household expenditure is a continuous variable. The per capita household expenditure is converted to binary variable following Petrucci *et al.* (2003). The binary form of per capita household expenditure is used as the dependent variable in Spatial Probit Model in the study to determine the probability that a household will be poor in a senatorial district. Like the poverty rate, per capita household expenditure data is obtained from the National Living Standard Survey data (NLSS) conducted by the National Bureau of Statistics in 2004. The Petrucci *et al.* (2003) procedure is as follows:

$$y_{ia} = 1 \text{ if } \text{Lns}_i < 0$$

$$y_{ia} = 0 \text{ if } \text{Lns}_i \geq 0.$$

Where: Ln represents the natural log, c_i denotes the average per capita consumption expenditure per household per senatorial district, z denote the national poverty line of

N23,733, and $s_i = \frac{c_i}{z}$ is the normalized welfare indicator per household. Bayesian Spatial Autoregressive Probit was used to estimate the choice model.

3.6.2 Explanatory variables

The explanatory variables used for the analysis were grouped under agro-ecological and Environmental characteristics (AEC), Demographic Characteristics (DEC), Sociopolitical and Economic Characteristics (SPC) and Infrastructural Characteristics (INC). The constituents of each group, the source of the data and the *a priori* expectations based on literature are discussed below.

3.6.2.1 Agro-ecological and environmental characteristics (AEC)

(i) Average annual rainfall (AvRa)

Average annual rainfall (mm) per senatorial district (1980 - 2004) data is obtained from the Nigerian Institute of Meteorological Services (NIMET). Average annual rainfall (AvRa) is expected to have a negative relationship with poverty rate. According to Minot *et al*. (2003), higher rainfall is associated with lower poverty but in some areas, the reverse is true. This appears to reflect vulnerability to environmental stress, such as flooding.

(ii) Length of growing period (LoGp)

Average length of Growing Period (days) per senatorial district data were obtained from the Nigerian Institute of Meteorological Services (NIMET) from 1980 – 2004. The length of growing period is determined by the average annual rainfall. Longer period of rainfall indicates longer growing period. A significant negative causal relationship is expected between poverty rate and length of growing period. Vista and Murayama (2007) and Okwi *et al*. (2007) showed that the incidence of poverty has a negative causal relationship with mean annual rainfall and elevation.

(iii) People employed in agriculture per SD (PEA)

The data on percentage of people employed in agriculture per senatorial district were obtained from the Core Welfare Indicator Survey data (2006) by the National Bureau of Statistics. The relationship between poverty rate and percentage of people employed in agriculture is expected to be positive [GUAPA World Bank (2003) Report; Garza-Rodriguez, 2000; Mahbub, 2004; Both Székely, 1998 and Cortés, 1997].

(iv) Soil classification (SOC)

The soil classification per senatorial district data were obtained from the Food and Agricultural Organization (FAO) soil map of Nigeria based on natural fertility and traditional agricultural practices. FAO classified Nigerian soil into very low productivity, no productivity, high productivity, medium productivity and low productivity. For this study, a dummy variable was used to capture the soil classification. The soil of very low productivity and no productivity are classified as bad soil (bad soil = 0) while soils of high productivity, medium productivity and low productivity are classified as good soil (good soil = 1). Good soil (soils of high productivity, medium productivity and low productivity) is expected to bring about reduction in poverty rate (Okwi *et al.*, 2007; Birungi *et al.*, 2005).

(v) Susceptibility of SD to water erosion (SuEr) and desertification (SuDe)

The Federal Ministry of Environment and the Nigerian Institute of Meteorological Services (NIMET) were the sources of data for the susceptibility of senatorial district to water erosion. A dummy variable is used to capture these characteristics. The binary variables are susceptible senatorial district to water erosion/desertification (SuEr/SuDe = 1) and non-susceptibility of senatorial district to water erosion/desertification (SuEr/SuDe = 0). High concentration of poverty is expected among the senatorial districts with substantial area prone to desertification or flood/erosion (Mahbub, 2004; Christiaensen and Subbarao, 2004).

(vi) Coastal bordered senatorial district (CBSD)

The coastal bordered senatorial districts are found in the southern part of Nigeria. The data were sourced from a senatorial district map of Nigeria by the National Bureau of Statistics (2007). These senatorial districts are bordered by the Atlantic Ocean. A dummy is used to capture the variable. CBSD = 1 for the coastal bordered senatorial districts while CBSD = 0 for other senatorial districts. A negative causal relationship is expected between poverty rate and coastal bordered senatorial districts.

(vii) International land bordered senatorial district (ILBSD)

A majority of international land bordered senatorial districts are found in the northern part (north-east and north-west) of Nigeria. Others are found in the south-west and the south-south geopolitical zones of Nigeria. The data were sourced from a senatorial district map of Nigeria by the National Bureau of Statistics (2007). A dummy is used to capture the variable. ILBSD = 1 for the international land bordered senatorial districts while ILBSD = 0 for other

senatorial districts. A negative causal relationship is expected between poverty rate and international land bordered senatorial districts.

3.6.2.2 Demographic characteristics (DEC)

(i) Percentage of male headed (MaH) and female headed households (FeH)

Data on male-headed and female-headed Households per senatorial district were sourced from Core Welfare Indicator Survey data (2006) by the National Bureau of Statistics. The relationship between poverty rate and male headed household is expected to be positive (NBS, 2005; Swaminathan *et al.*, 2004) while the relationship between poverty rate and female-headed household is expected to be negative (Aigbokhan, 2000; Thomas and Canagarajah, 2002).

(ii) Household size (HS)

Data on average household size per senatorial district were obtained from Core Welfare Indicator Survey data (2006) by the National Bureau of Statistics. A positive relationship is expected between poverty rate and average household size (Greer and Thorbecke, 1986a; Mason and Lee, 2004; Mahbub, 2004).

(iii) Primary (PnE) and secondary schools (SnE) net enrollment

Primary and secondary schools net enrollment data were obtained from Core Welfare Indicator Survey data (2006) by National Bureau of Statistics. The relationship between the poverty rate and the schools' (primary and secondary) net enrollment is expected to be negative (Bankole *et al.*, 2003; Rupasingha and Goetz, 2007; NBS, 2007).

(iii) Literate adult (LA)

The percentage of literate adult data per senatorial district was sourced from Core Welfare Indicator Survey data (2006) by the National Bureau of Statistics. Literacy is defined as ability to read and write in English or any other language.This is used in the study as a proxy for human capital. A negative relationship is expected between poverty rate and percentage of literate adult (Bankole *et al.*, 2003; Rupasingha and Goetz, 2007).

(iv) Dependency ratio (DeRa)

Data on dependency ratio were obtained from Core Welfare Indicator Survey data (2006) by the National Bureau of Statistics. A positive relationship is expected between poverty rate and dependency ratio (Mason and Lee, 2004; Mahbub, 2004).

3.6.2.3 Sociopolitical and economic characteristics (SPC)

(i) Household's Membership of Associations (HMA)

The data on the percentage of households that belong to professional and non-professional associations per senatorial district were obtained from Core Welfare Indicator Survey data (2006) by the National Bureau of Statistics. This variable is used as a proxy for social capital index. A negative relationship is expected between poverty rate and percentage of households that belong to associations (Okumadewa,1998; Olayemi *et al.*, 1999; World Bank, 1996; World Bank/DFID, 2000; Rupasingha and Goetz, 2007; Crandall and Weber, 2004; Narayan, 1997).

(ii) Political competition (PCom)

The data for computing political competition were obtained from the result of the 1999 general elections (senatorial district election) conducted by Independent National Electoral Commission (INEC). The 1999 election result was considered because the performance of the senators voted for in their respective senatorial districts is expected to reflect in poverty incidences of senatorial districts released by the National Bureau of Statistics in 2004. This variable is based on the People's Democratic Partys' share of the votes in the 1999 presidential election. Higher value of this variable means lower levels of political competition. The study employed Levitt and Poterba's (1999) method to measure political competition in senatorial districts. This approach involves constructing the absolute value of the difference between the senatorial district votes for the party that won the general elections (PDP) and the national average for the party that won national elections. Senatorial districts with vote outcomes closer to the national average (smaller absolute value difference) are expected to be politically more competitive. A positive relationship between poverty rate and political competition is expected.

Political competition is determined using election votes deviation (EVD) formulae below:

$$NA = \frac{TVP}{N} \quad \text{.....(8)}$$

$$EVD = \left|SDV_i - NA\right| \quad \text{.....(9)}$$

Where:

NA represents national average of senatorial district votes secured by the party that won general elections.

TVP represents the total senatorial district votes scored by the political party that won general elections.

N represents the total senatorial districts (109)

SDV represents number of votes secured by the party that won the general elections in SD_i (*i* runs from 1 to 109)

(iii) Party in-control of senatorial district (PiC)

The data for party in control of each senatorial district in relation to the party that won 1999 general elections is obtained from Independent National Electoral Commission (INEC). Dummy variable is used to capture this characteristic. PiC = 0 is used to capture senatorial districts that are controlled by the same party that won 1999 general elections while PiC = 1 captures senatorial districts that are controlled by other parties. A negative or positive causal relationship is expected between poverty rate and the party in control of senatorial district (Rupasingha and Goetz, 2007; Levitt and Poterba, 1999).

(iv) Number of years spent in the National Assembly By Senators (NYSNAS)

The data for the number of years spent by each legislator in the National Assembly from 1999 – 2004 is obtained from Independent National Electoral Commission (INEC). The data collection for this variable is restricted to 2004 in order to tally with the period that Nigeria's poverty rate data was released by the National Bureau of Statistics. A negative causal relationship is expected between poverty rate and the number of years spent by senators in the National Assembly (Rupasingha and Goetz, 2007; Levitt and Poterba, 1999).

(v) Senatorial district with state capital/seat of government (SdiC)

The data for senatorial districts with state capital/seat of government are obtained from the Independent National Electoral Commission (INEC) and the National Population Commission (NPC). The concentration of basic infrastructures in state capitals and adjoining local government areas is a common phenomenon. A dummy variable is used to capture this characteristic. For senatorial district with state capital SdiC = 1 while SdiC = 0 for non state capital senatorial district. The relationship between poverty rate and senatorial district with state capital is expected to be negative.

(vi) Access to credit facilities (ACF)

The data for access to credit facilities (%) per senatorial district were obtained from 2006 Core Welfare Indicator Survey data (National Bureau of Statistics). A negative causal relationship is expected between poverty rate and access to credit facilities by households (Adeyeye, 2001; Olomola, 2008; IFAD report, 2006).

3.6.2.4 Infrastructural characteristics (INC)

(i) Access to safe water sources (SwS)

The data for the percentage of households having access to safe water sources (tap water, borehole, and treated wells) per senatorial district were obtained from 2006 Core Welfare Indicator Survey data (National Bureau of Statistics). A negative causal relationship is expected between poverty rate and access to safe water sources by households (NBS, 2007; O'Regan and Wiseman, 1990).

(ii) Access to safe sanitation (SaS)

2006 Core Welfare Indicator Survey data (National Bureau of Statistics) is the source of data for the percentage of households having access to safe sanitation per senatorial district. A negative causal relationship is expected between poverty rate and access to safe sanitation sources by households (NBS, 2007; Dasgupta *et al.*, 2003; GUAPA World Bank Report, 2003).

(iii) Access to health facilities (AHF)

The data for the percentage of households having access to health facilities per senatorial district were obtained from 2006 Core Welfare Indicator Survey data (National

Bureau of Statistics). A negative causal relationship is expected between poverty rate and access to health facilities by households (NBS, 2007; Birungi *et al.*, 2005).

(iv) Connection to public electricity (CpElect)

The National Bureau of Statistics' 2006 Core Welfare Indicator Survey data is the source of data for the percentage of households connected to public electricity per senatorial district. The relationship between poverty rate and percentage of households connected to public electricity is expected to be negative (Dasgupta *et al.*, 2003; GUAPA World Bank Report, 2003).

All the data from the four sources (NLSS, CWISD, NIMET and INEC) were arranged in a GIS for managing the spatial dimension.

National Living Standard Survey data (NLSS) was conducted and released in Nigeria in 2004. It contains data on consumption expenditure and membership of association for each household as well as poverty rate based on states, geopolitical zones and senatorial districts. Core Welfare Indicator Survey data was conducted in 2006. It provides a wide variety of information on the demographic (household size, female- and male-headed households), socio-economic and basic infrastructural characteristics. It is presented based on states, geopolitical zones and senatorial districts. Although the 2006 Core Welfare Indicator Survey data were collected two years after the National Living Standard Survey (NLSS), the 2004 - 2006 periods was one of relatively slow growth and low inflation in Nigeria, so it is reasonable to assume that there was relatively insignificant change. Similar studies carried out with lagged data are:

(i) Petrucci *et al.* (2003) in Ecuador combined Census of population and households conducted in 1990 and the World Bank's Living Standard Measurement Surveys (LSMS) conducted in 1995.

(ii) Birungi *et al.* (2005) in Uganda utilized two household data sets collected by the Uganda Bureau of Statistics (UBOS): census data for 1991 and sample survey data from 1992 (IHS) to derive welfare estimates and maps.

(iii) Rupasingha and Goetz (2007) in the United States of America utilized family poverty rate from the 2000 Census while the explanatory variables were measured in 1990.

All these explanations on the explanatory variables are summarized in Table 3

Table 3: Variables used for empirical analysis (dependent variable: poverty rate/ per capita consumption expenditure)

SN	Explanatory Variables	Symbol	*a priori* Expectation	Literature
1.	***Agroclimatic and Environmental Characteristics (AEC)***			
	▪ Average annual rainfall per senatorial district (mm)	AvRa	-	Minot *et al*. (2003)
	▪ Length of growing period (days)	LoGp	-	Minot *et al*. (2003)
	▪ Percentage of people employed in agriculture	PEA	+/-	Garza-Rodriguez (2000), Mahbub (2004) Székely (1998)
	▪ International Land Bordered SD (Yes = 1, No= 0)	ILBSD	-	
	▪ Coastal Bordered SD (Yes = 1, No= 0)	CBSD	-	
	▪ Soil classification (good soil = 1, bad soil = 0)	SoC	-	Amarasinghe *et al.* (2006) Okwi *et al.* (2007)
	▪ Susceptibility of major part of senatorial district to water erosion (yes = 1, no = 0)	SuEr	+	Christiaensen and Subbarao (2004)
	▪ Susceptibility of major part of senatorial district to desertification (yes = 1, no = 0)	SuDe	+	Christiaensen and Subbarao (2004)
2.	***Demographic Characteristics (DEC)***			
	▪ Male headed household per senatorial district (%)	MaH	+/-	NBS (2005), Swaminathan *et al*. (2004)
	▪ Female headed household per senatorial district (%)	FeH	+/-	Aigbokhan (2000) and Thomas and Canagarajah (2002)
	▪ Average household size per senatorial district	HS	-	Mason and Lee (2004) and Mahbub (2004)
	▪ Primary school net enrollment per SD	PnE	-	Rupasingha and Goetzet (2007)
	▪ Secondary school net enrollment per SD	SnE	-	Rupasingha and Goetzet (2007)
	▪ Literate adult (%)	LA	-	Bankole *et al.* (2003), Rupasingha and Goetzet (2007)
	▪ Dependency ratio	DeRa	+	Mason and Lee (2004) and Mahbub (2004)
3.	***Sociopolitical and Economic Characteristics (SPC)***			
	▪ Proportion of households that belong to associations (social capital index) per SD	HMA	-	Okumadewa (1998), Olayemi *et al.* (1999), Rupasingha and Goetzet (2007), Crandall and Weber (2004), Narayan (1997)
	▪ Political competition	PoC	-	Rupasingha and Goetzet (2007), Levitt and Poterba (1999)
	▪ Party in-control of each senatorial district (same = 1, different = 0)	PiC	+/-	Rupasingha and Goetzet (2007), Levitt and Poterba (1999)
	▪ No of year(s) spent by legislator in the National Assembly	NYSNAS	-	Rupasingha and Goetzet (2007), Levitt and Poterba (1999)
	▪ SD with state capital/seat of government (Yes =1, No = 0)	SDIC	-	
	▪ Access to credit facilities (%)[1]	ACF	-	Adeyeye (2001), Olomola (2008), IFAD (2006) report
4.	***Infrastructural Characteristics (INC)***			
	▪ Access to safe water sources (%) per SD	SwS	-	NBS (2007), O'Regan and Wiseman (1990)
	▪ Access to safe sanitation (%) per SD	SaS	-	NBS (2007), Dasgupta *et al.* 2003, GUAPA
	▪ Access to health facilities (%) per SD	AHF	-	NBS (2007), World Bank (2003) Report
	▪ Connection to public electricity (%)	Cpelect	-	NBS (2007), Birungi *et al.* (2005)
				Dasgupta *et al.* 2003, GUAPA World Bank (2003) Report

3.7 Data limitations and other methodological problems

There are environmental variables that would have been included in the model, but due to lack of data on such variables at the senatorial level, they were excluded from the model. These variables are average slope and arable land per senatorial district. These variables are important in a farming community. Difficulties were encountered before getting the appropriate GIS map of the senatorial districts that was compartible with the major software (GeoDa 0.9.5.i) used for the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the results obtained from the descriptive analysis. Specifically, the descriptive statistics described the socioeconomic and demographic characteristic profiles of households in 109 senatorial districts. The descriptive result also described the profile of the senatorial districts in terms of agro-ecological and environmental, political and infrastructural characteristics. Measure of central tendency (mean), measure of dispersion (range and skewness), measure of association (correlation), tables, charts, maps and graphs are the descriptive statistics used for the explanations.

4.1 Distribution of poverty incidence among senatorial districts in Nigeria

The study shows a low poverty incidence (%) in the southern part of the country which ranges from 8.1% to 36.9%. In the north central, the poverty incidence ranges from 55.4% to 78.1%. The core north (which comprises north-west and north-east) has the highest range of poverty incidence ranging from 78.4 % in Zamfara Central to 97.7% in Jigawa Northeast. Generally, the study reveals an average poverty rate of 56.04% among the 109 senatorial districts. Federal Capital Territory, Kaduna Central, Kano Central and Borno Central are the three senatorial districts in the north where the poverty rates are substantially lower than the national poverty rate. This may be attributed to the location of state capitals (seat of government) in these senatorial districts. Basic infrastructures are often concentrated in state capitals as well as the environs. Moreover, the three senatorial districts in Lagos State (Lagos East, Lagos West and Lagos Central), one in Edo State (Edo Central) and Cross-River (Cross-River North) have the poverty rates higher than the national poverty rate.

Figure 3 and Table 4 show that Bayelsa West senatorial district (8.1%) in the south-south geopolitical zone has the lowest poverty rate while Jigawa North-east in the North-west geopolitical zone has the highest poverty rate (97.7%) in Nigeria.

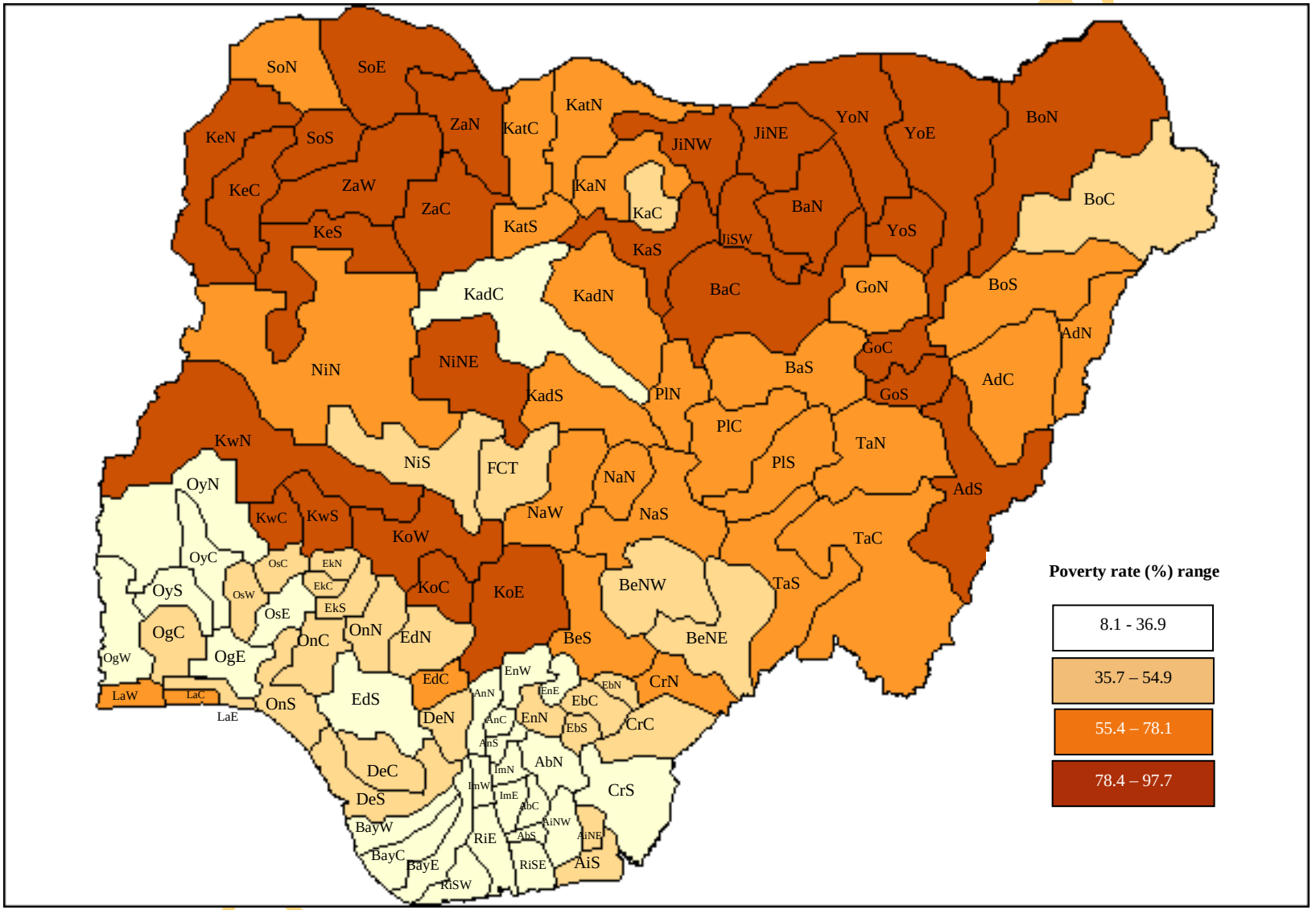


Figure 3: Map of poverty rate for 109 senatorial district

Source: The results of data analyses (2010)

The poverty rates in the six geopolitical zones corroborate the findings above (see Figure 4). Specifically, the average poverty rate in the south-east is the lowest (29.9%), while the average poverty rates of the south-south and south-west are 39.8% and 37.9% respectively. The north-west geopolitical zone has the highest average poverty rate (77.6%); this is followed by the north-east (74.5%) and northcentral (68.1%) [Data on poverty rate per senatorial district were sourced from NBS, 2007]. The high average poverty rates of northern geopolitical zones may be attributed to long-standing lags in the provision of health, education and other social services resulting in proportionately more poor in the north (Thomas and Canagarajah, 2002). Moreover, he reasoned that the southern zone has most of the industries and many export crops while the northern zone is largely rural and agricultural with a fragile agro-climatic environment and a different socioeconomic history.

Table 4: Distribution of Poverty Rate (%) Based on Geopolitical Zone

South-south	Poverty Rate (%)	South-east	Poverty Rate (%)	South-west	Poverty Rate (%)	North-central	Poverty Rate (%)	North-east	Poverty Rate (%)	North-west	Poverty Rate (%)
Bayelsa West	8.1	Abia Central	18.2	Oyo Central	17.2	FCT	43.4	Borno Central	42.1	Kaduna Central	33.6
Edo South	18.8	Abia South	18.9	Osun East	24.4	Benue North-west	50.5	Taraba North	59.0	Kano Central	52.1
Bayelsa East	20.6	Anambra South	19.7	Oyo North	25.2	Niger South	50.7	Taraba Central	59.6	Sokoto North	58.2
Cross-River South	27.3	Anambra Central	20.8	Ogun East	26.9	Benue North-east	52.3	Borno South	59.9	Kaduna South	59.8
Rivers East	27.3	Anambra North	20.9	Oyo South	27.0	Plateau North	55.4	Adamawa Central	60.7	Katsina Central	64.6
Rivers South-west	29.5	Enugu East	23.5	Ogun West	35.4	Niger North	55.8	Taraba South	67.3	Kaduna North	65.7
Rivers South-east	31.3	Imo East	25.9	Ekiti South	35.7	Nasarawa North	59.3	Adamawa North	68.8	Kano North	71.6
Bayelsa Central	31.5	Imo West	27.0	Osun West	35.8	Nasarawa South	60.1	Gombe North	73.4	Katsina South	75.7
Akwa Ibom North-west	31.9	Enugu West	30.7	Ogun Central	36.1	Plateau Central	62.4	Bauchi South	74.6	Katsina North	76.7
Akwa Ibom North-east	36.9	Imo North	33.3	Ekiti North	40.0	Nasarawa Central	64.6	Gombe Central	81.1	Zamfara Central	78.4
Akwa Ibom South	38.8	Abia North	35.1	Ondo Central	40.9	Benue South	64.9	Yobe North	82.0	Zamfara West	79.7
Delta North	39.3	Ebonyi North	39.0	Ondo South	41.1	Plateau South	68.3	Gombe South	83.5	Kano South	84.7
Cross-River Central	41.1	Enugu North	43.0	Ekiti Central	47.2	Niger East	81.8	Adamawa South	83.6	Kebbi Cental	85.7
Delta South	49.2	Ebonyi South	45.6	Ondo North	48.1	Kwara Central	82.0	Yobe South	84.5	Zamfara North	87.1
Delta central	50.2	Ebonyi Central	46.6	Osun Central	48.1	Kogi Central	82.5	Yobe East	85.3	Jigawa North-west	89.1

Southsouth	Poverty Rate (%)	South-east	Poverty Rate (%)	South-west	Poverty Rate (%)	North-central	Poverty Rate (%)	North-east	Poverty Rate (%)	North-west	Poverty Rate (%)
Edo North	50.6			Lagos East	54.9	Kwara South	85.1	Borno North	91.0	Sokoto South	90.1
Edo Central	71.9			Lagos Central	64.1	Kogi West	87.6	Bauchi North	91.5	Sokoto East	91.3
Cross-River North	78.1			Lagos West	65.8	Kogi East	92.5	Bauchi Central	93.0	Kebbi North	94.5
						Kwara North	94.9			Jigawa South-west	96.3
										Kebbi South	96.5
										Jigawa North-east	97.7

Source: NBS (2007)

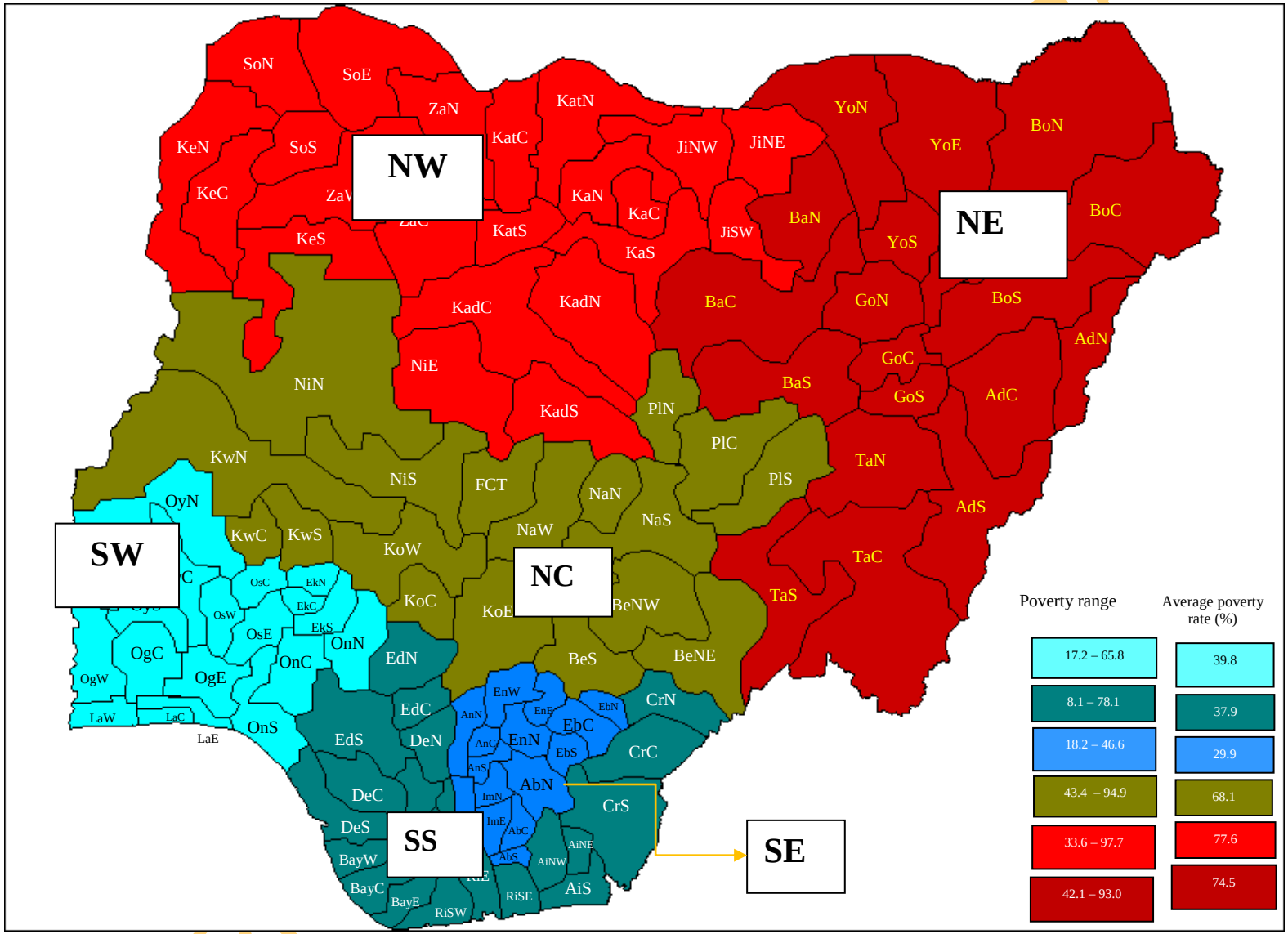


Figure 4: Map of poverty rates based on geopolitical zones

Source: The results of data analyses (2010)

Moreover, approximately 49% of the senatorial districts (53 SDs) have poverty rates below the national poverty rate (54.4%) while 51% is above the national poverty rate. The study showed that out of the 53 senatorial districts in which the poverty rates are below the national poverty line, 87% is in the southern part of the country while 13% (Borno central, Kano central, Kaduna Central, Niger South, FCT, Benue North-west and Benue North-east) is located in the northern part of the country. Also, 91% of the SDs having poverty rates above the national poverty rate is located in the north while 9% (Lagos East, Lagos West, Lagos Central, Edo Central and Cross-River North) is found in the south.

Table 5 shows that 21 senatorial districts in the north-east, 16 in the north-west and 15 in the north-central geopolitical zones have poverty rates above the national poverty rate (54.4%). Conversely, 2 senatorial districts in the south-south, 3 in the south-west and none in the southeast have poverty rates above the national poverty rate. Among the geopolitical zones, the south-east has the highest number of senatorial districts with poverty rates below the national poverty rate (100%). This is followed by the south-south and the south-west with 88.9% and 83.3% respectively.

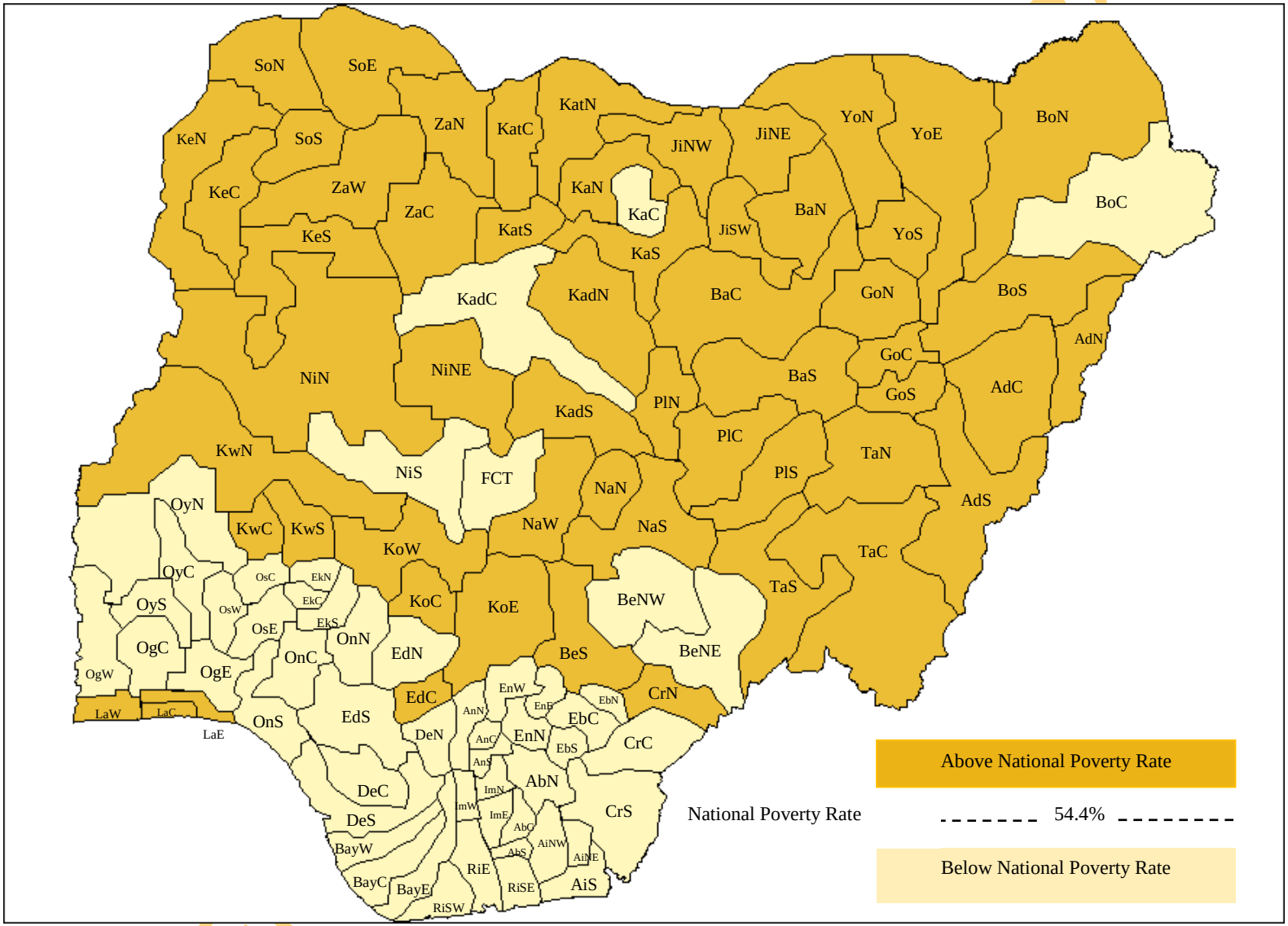


Figure 5: Map of poverty rate per senatorial district and national poverty rate

Source: The results of data analyses (2010)

Table 5: Distribution poverty rate among the geopolitical zones relative to national poverty rate

South-south	PoR	South-west	PoR	North-central	PoR	North-east	PoR	North-west	PoR	South-east	PoR
Bayelsa West	8.1	Oyo Central	17.2	FCT	43.4	Borno Central	42.1	Kaduna Central	33.6	Abia Central	18.2
Edo South	18.8	Osun East	24.4	Benue North-west	50.5	**Taraba North**	**59.0**	Kano Central	52.1	Abia South	18.9
Bayelsa East	20.6	Oyo North	25.2	Niger South	50.7	**Taraba Central**	**59.6**	**Sokoto North**	**58.2**	Anambra South	19.7
Cross-River South	27.3	Ogun East	26.9	Benue North-east	52.3	**Borno South**	**59.9**	**Kaduna South**	**59.8**	Anambra Central	20.8
Rivers East	27.3	Oyo South	27.0	**Plateau North**	**55.4**	**Adamawa Central**	**60.7**	**Katsina Central**	**64.6**	Anambra North	20.9
Rivers South-west	29.5	Ogun West	35.4	**Niger North**	**55.8**	**Taraba South**	**67.3**	**Kaduna North**	**65.7**	Enugu East	23.5
Rivers South-east	31.3	Ekiti South	35.7	**Nasarawa North**	**59.3**	**Adamawa North**	**68.8**	**Kano North**	**71.6**	Imo East	25.9
Bayelsa Central	31.5	Osun West	35.8	**Nasarawa South**	**60.1**	**Gombe North**	**73.4**	**Katsina South**	**75.7**	Imo West	27.0
Akwa Ibom North-west	31.9	Ogun Central	36.1	**Plateau Central**	**62.4**	**Bauchi South**	**74.6**	**Katsina North**	**76.7**	Enugu West	30.7
Akwa Ibom North-east	36.9	Ekiti North	40.0	**Nasarawa Central**	**64.6**	**Gombe Central**	**81.1**	**Zamfara Central**	**78.4**	Imo North	33.3
Akwa Ibom South	38.8	Ondo Central	40.9	**Benue South**	**64.9**	**Yobe North**	**82.0**	**Zamfara West**	**79.7**	Abia North	35.1
Delta North	39.3	Ondo South	41.1	**Plateau South**	**68.3**	**Gombe South**	**83.5**	**Kano South**	**84.7**	Ebonyi North	39.0
Cross-River Central	41.1	Ekiti Central	47.2	**Niger East**	**81.8**	**Adamawa South**	**83.6**	**Kebbi Cental**	**85.7**	Enugu North	43.0
Delta South	49.2	Ondo North	48.1	**Kwara Central**	**82.0**	**Yobe South**	**84.5**	**Zamfara North**	**87.1**	Ebonyi South	45.6
Delta central	50.2	Osun Central	48.1	**Kogi Central**	**82.5**	**Yobe East**	**85.3**	**Jigawa North-west**	**89.1**	Ebonyi Central	46.6
Edo North	50.6	**Lagos East**	**54.9**	**Kwara South**	**85.1**	**Borno North**	**91.0**	**Sokoto South**	**90.1**		
Edo Central	**71.9**	**Lagos central**	**64.1**	**Kogi West**	**87.6**	**Bauchi North**	**91.5**	**Sokoto East**	**91.3**		
Cross-River North	**78.1**	**Lagos West**	**65.8**	**Kogi East**	**92.5**	**Bauchi Central**	**93.0**	**Kebbi North**	**94.5**		
				Kwara North	**94.9**	**Jigawa South-west**	**96.3**				
						Kebbi South	**96.5**				
National Poverty Rate is 54.4%						**Jigawa North-east**	**97.7**				

Source: The results of data analyses (2010)

Note: The red colour indicates senatorial districts with poverty rate above national poverty rate

4. 2 Distribution of per capita household expenditure among senatorial districts

The study reveals an average per capita household expenditure of ₦28474.98 among the 109 senatorial districts. It also shows that Borno South has the least per capita household expenditure (₦7412.64) while Anambra Central has the highest per capita household expenditure (₦58647.22). The average per capita household expenditure of the senatorial districts in the north (Northwest, North-east and North-central) and south (South-west, South-east and South-south) are ₦21916.19 and ₦36620.00 respectively. Furthermore, the high per capita household expenditure obtained in the south confirmed the low poverty rate of the region explained above. The positively skewed distribution of the parameter means that the senatorial districts with per capita household expenditure less than the average per capita household expenditure are more than the SDs whose per capita household expenditure is greater than the average value (see Appendix 6).

Table 6: Distribution of average per capita household expenditure (₦) among the senatorial districts

South-west	APCE	South-east	APCE	South-south	APCE	North-west	APCE	North-east	APCE	North-central	APCE
Lagos East	17329.49	Ebonyi North	18653.27	Rivers Southwest	15045.74	Jigawa North-west	10915.42	Borno South	7412.64	Kogi East	9323.94
Oyo South	24194.38	Imo East	27806.96	Rivers East	25113.39	Jigawa North-east	11101.77	Bauchi North	13702.28	Kwara Central	10864.11
Lagos West	24472.06	Enugu West	27806.96	Rivers Southeast	25113.39	Kebbi North	11584.61	Bauchi South	13702.28	Kwara North	10864.11
Ondo Central	27561.76	Abia North	36228.50	Delta central	29062.89	Kebbi South	14326.67	Taraba South	15249.99	Kogi Central	11825.31
Ondo North	27561.76	Abia South	40472.77	Delta South	29062.89	Kebbi Cental	14332.28	Yobe North	15249.99	Kogi West	15116.10
Ogun West	28343.75	Anambra South	40472.77	Edo Central	30683.68	Sokoto North	15045.74	Gombe North	16661.25	FCT	16661.25
Lagos central	29573.17	Anambra North	45005.87	Edo North	30683.68	Zamfara Central	16210.54	Adamawa North	17620.83	Kwara South	17329.49
Ogun East	31182.31	Enugu East	45005.87	Cross-River Central	31370.36	Katsina South	17079.94	Adamawa South	17620.83	Nasarawa South	22130.23
Ekiti Central	31844.01	Imo West	45084.88	Cross-River North	31370.36	Kano Central	17726.92	Borno North	19430.10	Niger East	22130.23
Ekiti North	31844.01	Ebonyi South	45638.81	Akwa Ibom South	35139.58	Kano North	17726.92	Yobe East	20774.89	Nasarawa Central	23719.20
Ekiti South	33718.08	Ebonyi Central	45638.81	Delta North	36046.23	Katsina Central	17758.85	Taraba North	23789.87	Nasarawa North	23719.20
Ondo South	36504.36	Enugu North	45902.17	Akwa Ibom North-east	41247.69	Katsina North	17758.85	Taraba Central	25749.55	Plateau North	24194.38
Osun East	36504.36	Abia Central	52512.71	Akwa Ibom North-west	41247.69	Kaduna Central	23010.95	Yobe South	26388.31	Benue North-east	26103.08
Oyo Central	36852.09	Imo North	53803.73	Cross-River South	47969.07	Kaduna North	23010.95	Gombe Central	28791.16	Benue South	26103.08
Oyo North	36852.09	Anambra Central	58647.22	Bayelsa East	48029.17	Sokoto South	25749.55	Borno Central	31447.56	Niger South	31182.31
Osun	41442.94			Bayelsa West	48029.17	Zamfara	26388.31	Adamawa	33414.49	Niger North	32094.16

Central						North		Central			
South-west	**APCE**	**South-east**	**APCE**	**South-south**	**APCE**	**North-west**	**APCE**	**North-east**	**APCE**	**North-central**	**APCE**
Ogun Central	43785.30			Edo South	53305.98	Zamfara West	26837.39	Gombe South	45902.17	Benue North-west	36548.20
Osun West	45045.03			Bayelsa Central	55806.88	Sokoto East	28114.98	Bauchi Central	19715.59	Plateau South	37701.28
						Kaduna South	31598.01			Plateau Central	42510.95
						Jigawa South-west	35174.95				
						Kano South	36941.17				

Source: The results of data analyses (2010)

Figure 6 shows that among the geopolitical zones, South-east has the highest per capita household expenditure (₦41912.10) in the south and among the six geopolitical zones. North-west geopolitical zone has the lowest per capita household expenditure (₦20875.90) in the north and the geopolitical zones. The ranking of per capita household expenditures is in agreement with the ranking of poverty rate based on geopolitical zones (see Figure 4).

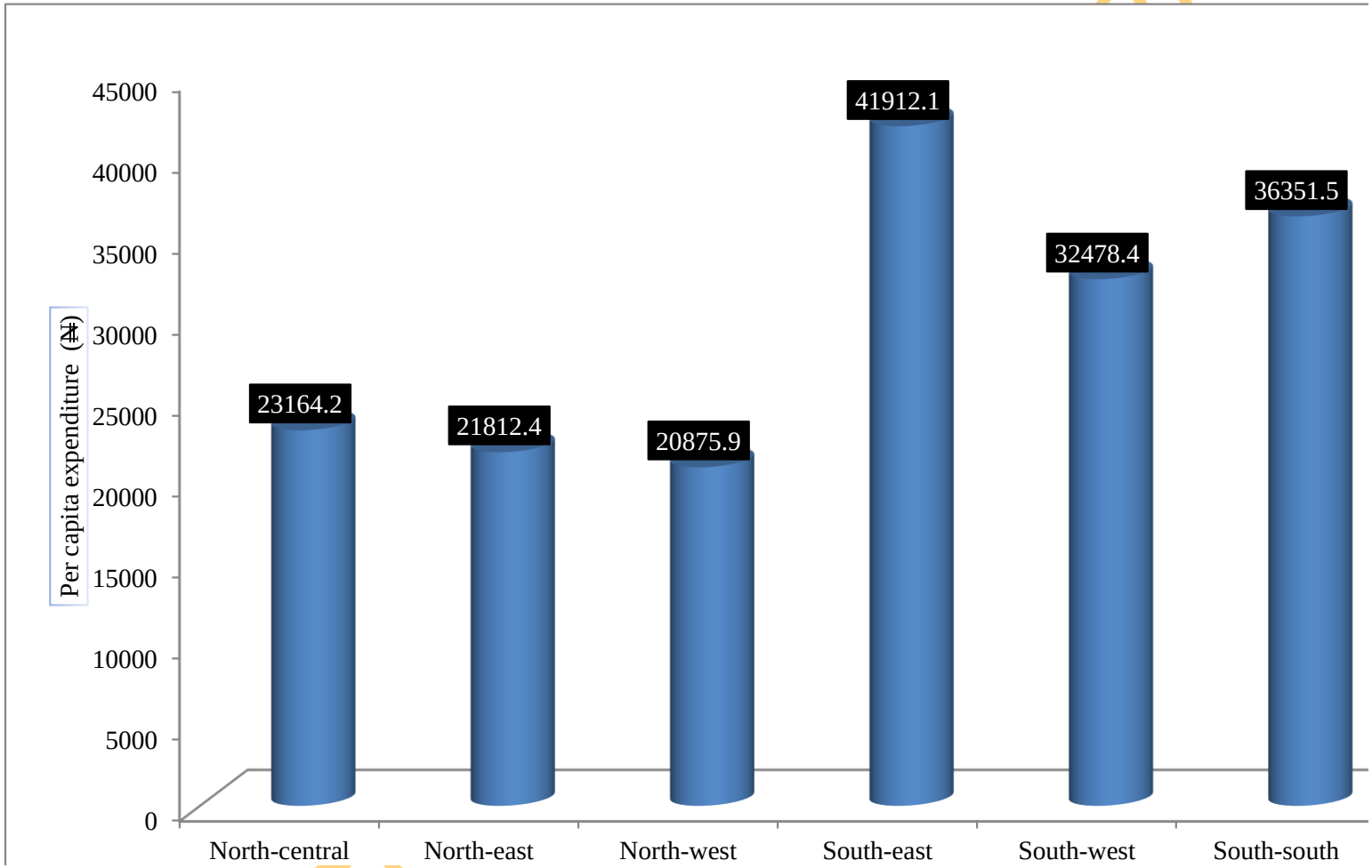


Figure 6: Distribution of per capita expenditure (₦) based on geopolitical zones
Source: The results of data analyses (2010)

4. 3 Distribution of agro-climatic and environmental characteristics among senatorial districts

This section describes the distribution of various agro-climatic and environmental characteristics that are important in determining the opportunities and challenges faced by residents most especially in a developing economy where a majority of the populace earn their living from agriculture.

4.3.1 Annual rainfall (AvRa) and length of growing period (LoGp)

The study shows a progressive decline in total annual rainfall and length of growing period from the south to the north. The longer the average annual rainfall, the longer the growing period. However, there are exceptions to this relationship in the northern part of the country where short cropping period brought about by inadequate rainfall is complemented with irrigation.

The average annual rainfall in the south's SDs ranges from 1491.61mm in the south-west geopolitical zone to 2290.83mm in the south-south geopolitical zone. In the north's SDs, annual rainfall ranges from 717.14mm in the north-west geopolitical zone to 1124.84mm in the north-central geopolitical zone (see Figure 7b). The importance of rainfall in Nigerian agriculture cannot be overemphasized.

Agriculture in Nigeria is rain-fed and 70% of Nigerians depend on agriculture as their source of livelihood (Dickinson, 2008 and Durojaiye, 1997). Figure 7a shows the average annual rainfall distribution map of Nigeria.

The study shows a statistically significant negative correlation (see Appendix 13) between poverty rate and average annual rainfall ($p<0.01$) as well as poverty rate and length of growing period ($p<0.01$). The longer duration of the growing period in the southern part of the country is not being effectively utilized due to rural-urban migration and the preference for white-collar jobs. Minot *et al*. (2003), opined that higher rainfall is associated with lower poverty but in some areas, the reverse is true. This appears to reflect vulnerability to environmental stress, such as flooding.

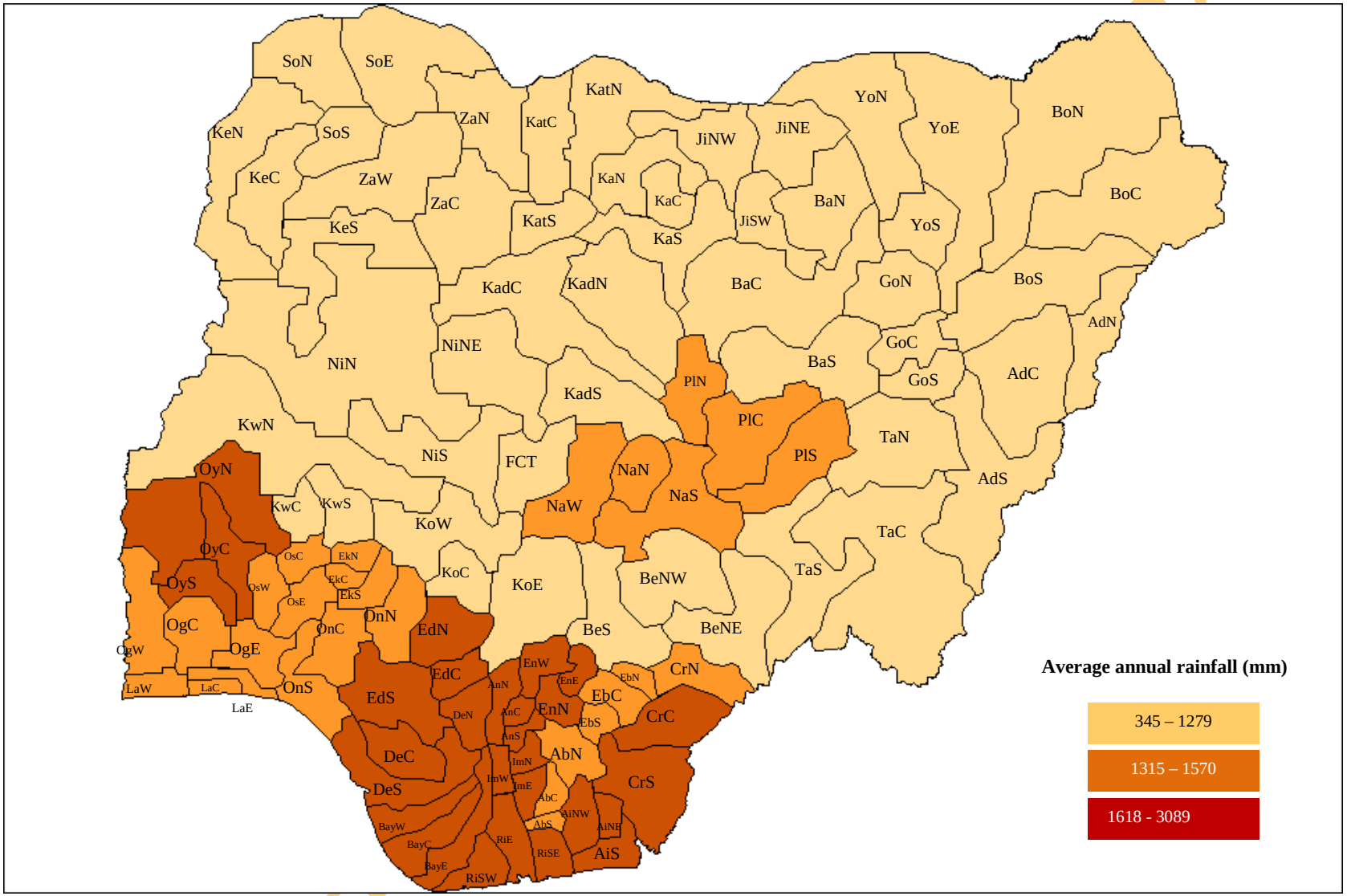


Figure 7a: Map of average annual rainfall distribution among SDs in Nigeria

Source: The results of data analyses (2010)

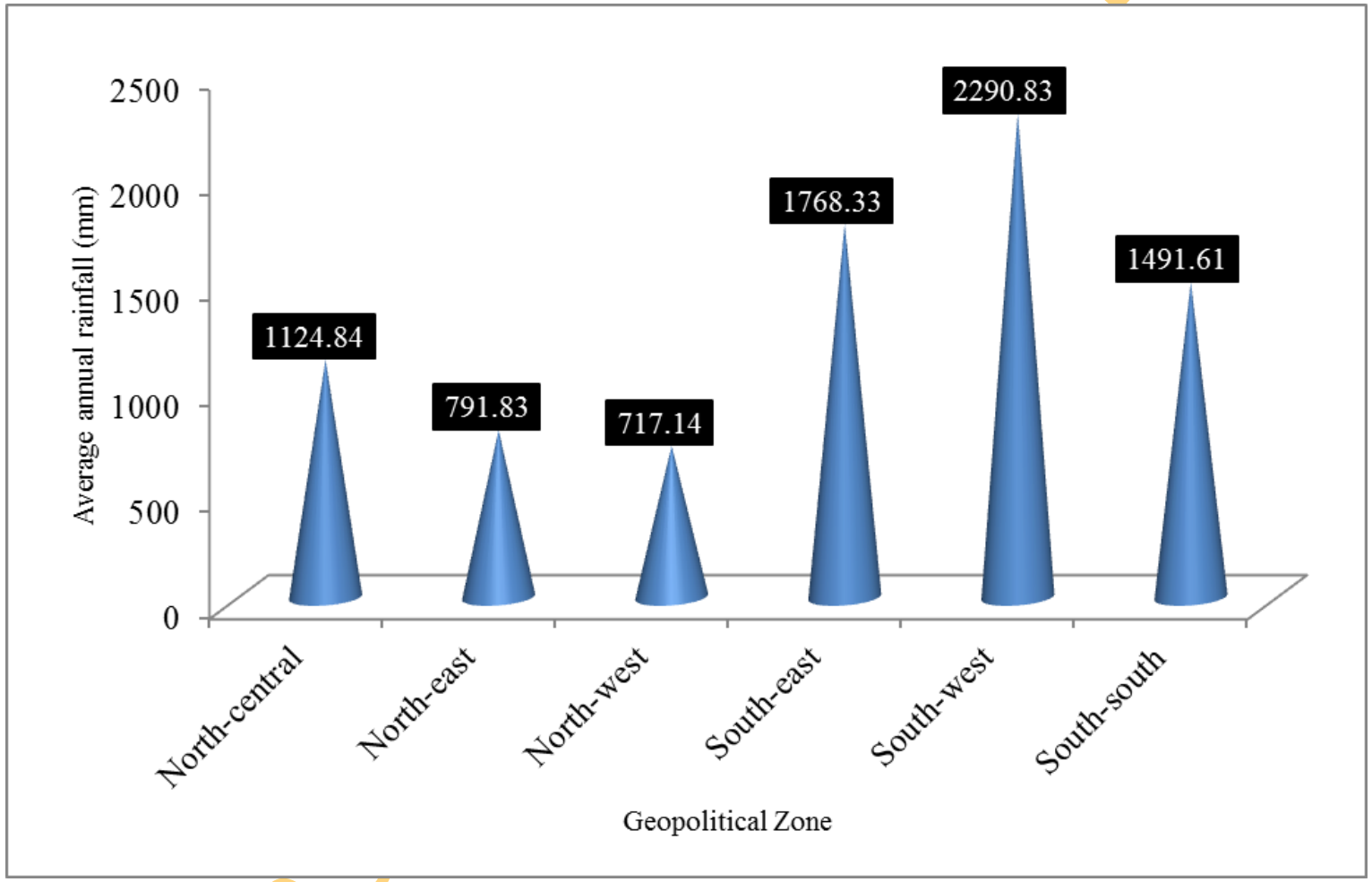


Figure 7b: Distribution of SDs' average annual rainfall among GPZs
Source: The results of data analyses (2010)

4. 3.2 Soil classification

Figure 8a shows the classification of soil productivity in Nigeria**.** The soil of very low productivity and no productivity are classified as bad soil. Soils of high productivity, medium productivity and low productivity are classified as good soil. The good soil constitutes 56% of the total senatorial districts. The SDs soil classification is derived from Food and Agricultural Organization's (FAO) classification of the Nigerian soil based on natural fertility and the use of traditional agricultural practices (see Appendices 2 and 3). Within this categorization, Borno Central, Yobe South and small part of Taraba Central SDs are of high soil productivity (about 3% of the total senatorial districts). Also about 36% of the senatorial districts in good soil category are of medium productivity while 61.4% are of low soil productivity.

This classification of soil in Nigeria based on natural fertility and traditional agricultural practices is important, bearing in mind the fact that a majority of Nigerian farmers are peasants who cannot afford fertilizer as a means of improving their soil fertility for better productivity.

The study reveals that 63.8% of the senatorial districts in the north (North-west, North-east and North-central geopolitical zones) have good soils where rainfall is inadequate while 47.1% of the senatorial districts have good soils in the south (South-west, South-east and South-south geopolitical zones) (see Figure 8b).

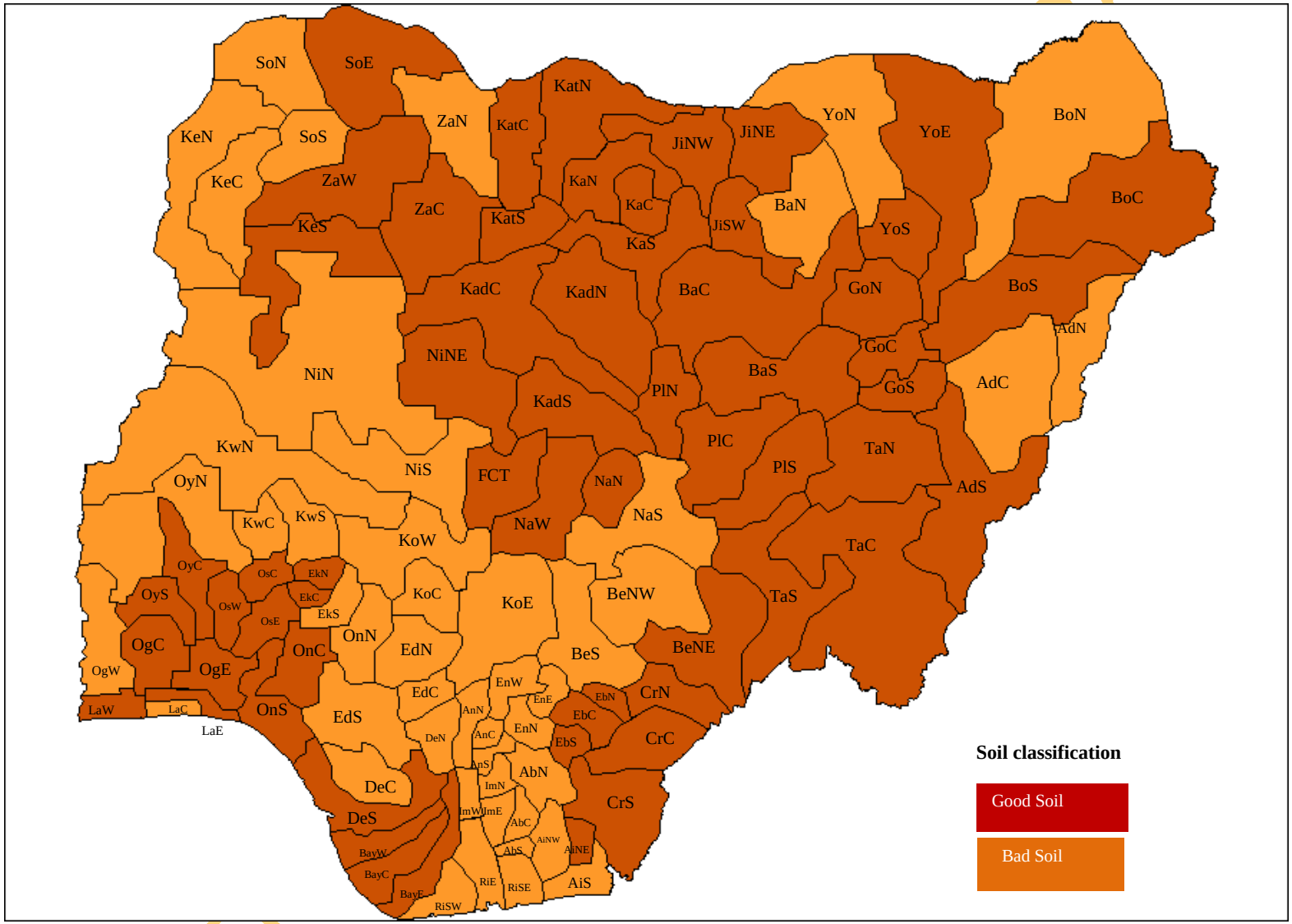


Figure: 8a: Map of soil classification among senatorial districts

Source: The results of data analyses (2010)

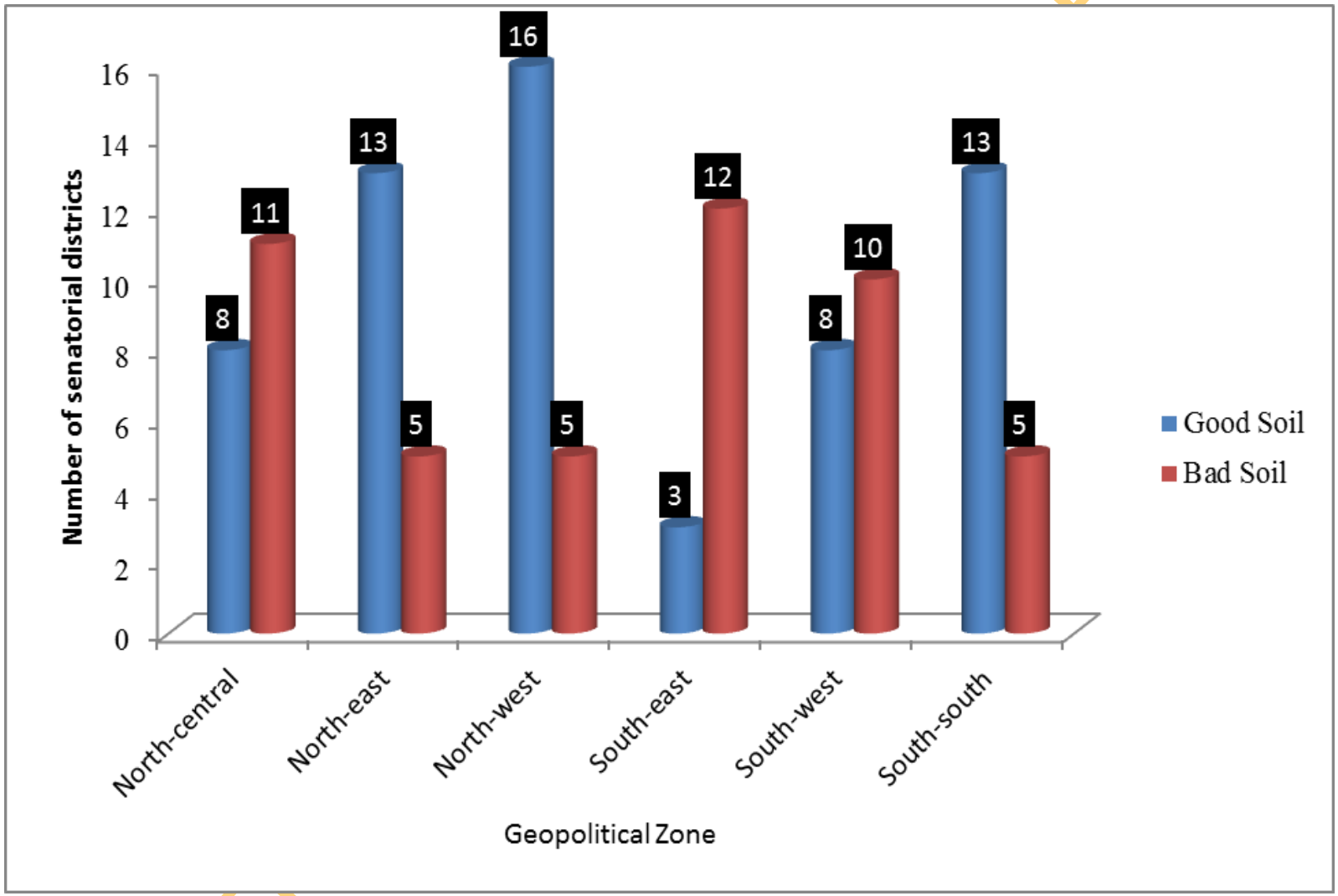


Figure: 8b: Soil classification based on geopolitical zones

Source: The results of data analyses (2010)

4.3.3 People employed in agriculture (PEA)

Furthermore, the study revealed that Lagos West senatorial district has the lowest number of people employed in agriculture (1.7%) while Benue North-east recorded the highest (85.4%) number of people employed in agriculture (agriculture, hunting or forestry and fishing). Sixty-five per cent (65%) of the senatorial districts employed less than 50% of its inhabitants in agriculture. Only South-south senatorial districts employed more than 50% of their inhabitants in agriculture; other geopolitical zones' SDs employed less than 50%. Senatorial districts in the south-west geopolitical zone recorded the lowest percentage (26.9%) of inhabitants employed in agriculture. The low level of inhabitants employed in agriculture in the geopolitical zones' SDs and southwest (see Figure 9b) in particular may be attributed to rural-urban migration, lack of basic infrastructures, and preference for white-collar jobs. Bearing in mind the small average farm size ranging from 0.41 – 0.73ha in the south and 1.5 – 3.5ha in the north (IDRC, 2008 and ILRI, 2006) and low productivity, high percentage of people going into farming is required in order to meet the food need of the ever increasing Nigerian population. Figure 9a shows the map of the percentage (%) of individuals employed in agriculture per senatorial districts.

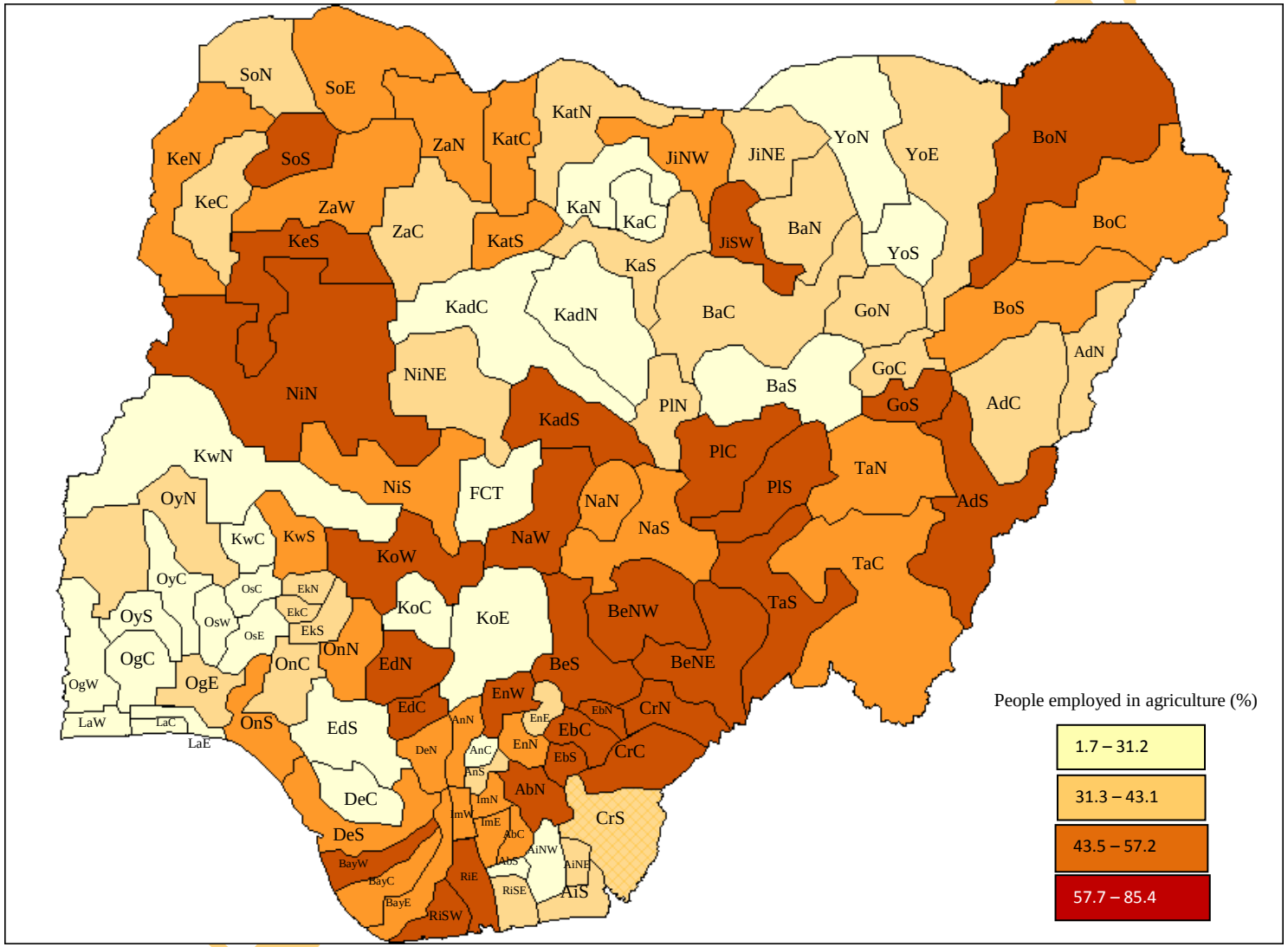


Figure 9a: Map of people employed in agriculture (%) among SDs in Nigeria

Source: The results of data analyses (2010)

Moreover, there is a very weak positive relationship that is statistically insignificant ($p>0.05$) between the percentage of individuals employed in agriculture per senatorial district and the poverty rate (see appendix 13). This finding may not be unconnected with low productivity of farmers which translates to low level of consumption. This is in agreement with several studies (GUAPA World Bank (2003) Report; Garza-Rodriguez, 2000; Mahbub, 2004; Both Székely, 1998 and Cortés, 1997) that households with the highest income-earner working in agriculture have significantly lower consumption levels (and hence are more likely to be poor) than those depending on work in other sectors (examples are construction, commerce, transport or services).

4. 3.4 Geographical location of senatorial districts

Figure 10a shows that 12% of the senatorial districts are bordered by the Atlantic Ocean, some of which have sea ports for importation and exportation of goods. The average poverty rate of coastal bordered senatorial districts is the lowest (35.9%) among the geographical locations. The coastal locations encourage commercial and industrial activities which are germane for economic growth. Out of these thirteen (13) senatorial districts, the six (6) located in Lagos and Rivers states have contributed significantly to the economic growth of their respective SDs as well as their neighbouring senatorial districts. However, while these sea-ports are enhancing the standard of living of their inhabitants on one hand; the senatorial districts along with their neighbours are also battling with the problems of urbanization and rural-urban migration. This may be attributed to why Lagos senatorial districts have the highest poverty rate among the coastal-bordered senatorial districts as well as the south-west's senatorial districts. Specifically, Lagos East SD has the poverty rate of 54.9% while those of Lagos West and Central SDs are 65.8% and 64.1% respectively.

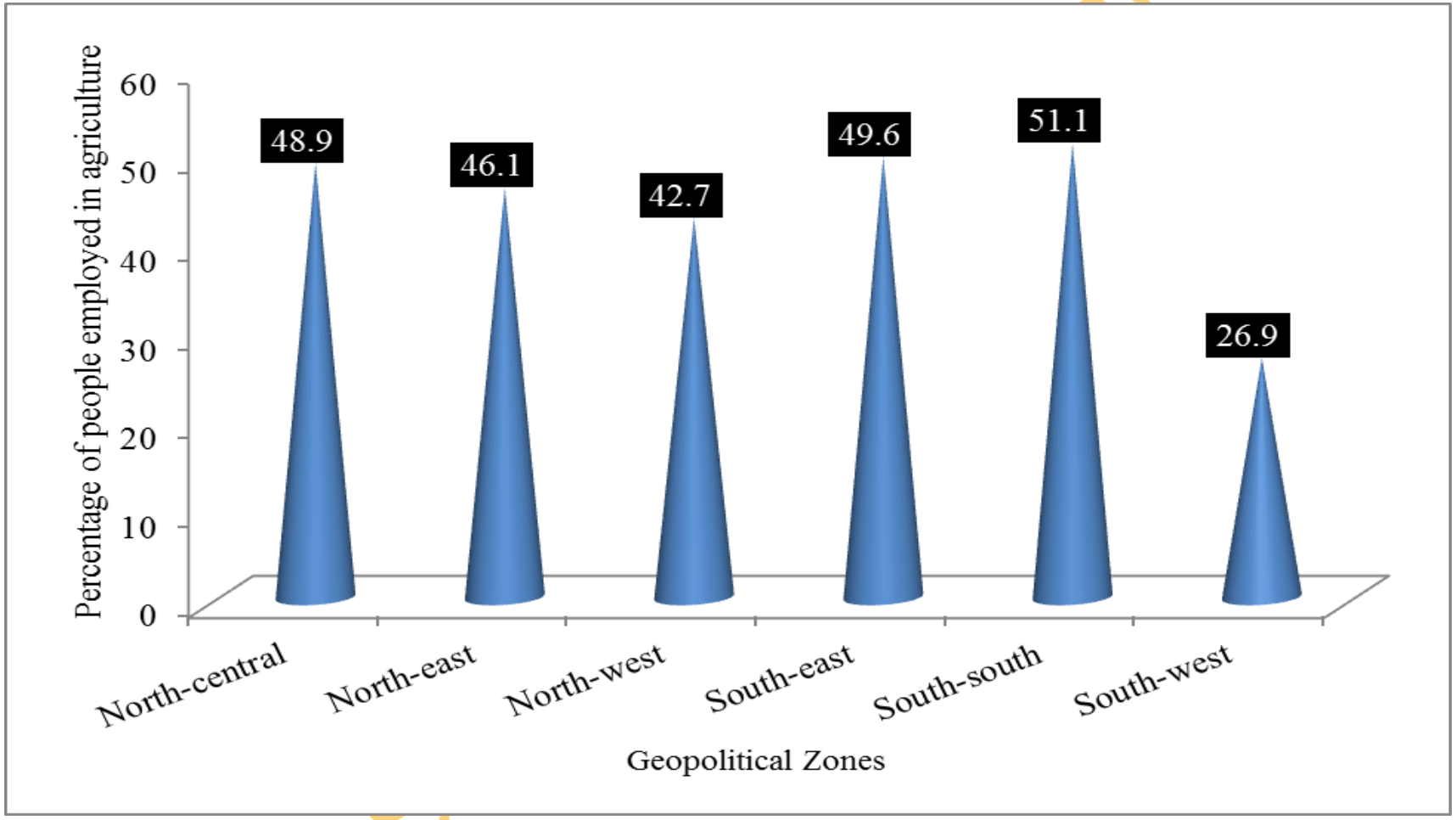


Figure 9b: Percentage of people employed in agriculture based on GPZs
Source: The results of data analyses (2010)

Twenty per cent (20%) of the senatorial districts are international land bordered (Figure 10a). Most of these neighbouring countries such as Chad and Niger are among the poorest countries in the world (UNDP, 2005 report). The average poverty rate of international land bordered senatorial districts is the highest (71.4%) among the geographical locations (see figure 10b). High poverty rate among the senatorial districts that bordered these countries may be attributed to spillover effects. The poverty rates of senatorial districts that bordered these countries range from 64.6 % in Katsina Central to 97.7% in Jigawa North-east. Apart from the spillover of poverty, desertification, low rainfall, poor infrastructures and overgrazing may be the reasons for the high poverty rate in this geographical location. The international land-bordered senatorial districts are often expected to be trade routes that can enhance the economic activities and by extension improve the standard of living of the residents. However, the porous nature of these land borders make them routes for smuggled contraband goods and illicit business activities.

Also, the study revealed that sixty-eight per cent (68%) of the senatorial districts are land-locked (see Figure 10a and Table 10). The average poverty rate of these senatorial districts was estimated to be 55.1% (see Figure 10b). This value is lower than the poverty rate of international land-bordered senatorial districts (71.4%) but higher than that of coastal-bordered senatorial districts (36.9%). Fifty-three per cent (53%) of the land-locked senatorial districts, 13.6% of the international land-bordered senatorial districts and 78.6% of the coastal-bordered senatorial districts have poverty rates lower than the national average poverty rate (54.4%). The low poverty rate of most land-locked senatorial districts may be attributed to the spillover of prosperity, among other reasons, from neighbouring coastal-bordered senatorial districts. The study revealed that the average poverty rate of SDs is significantly influenced by geographical location ($p<0.05$). From this result, the null hypothesis in the second hypothesis stated is rejected. The average poverty rate of coastal-bordered SDs was the lowest, followed by land-locked SDs and international land-bordered SDs respectively (see Appendices 11 and 12). Also, 47.9% of the land-locked senatorial districts, 9.1% of the international land-bordered senatorial districts and 100% of the coastal-bordered senatorial districts are found in the southern part of the country (South-west, South-east and South-south geopolitical zones).

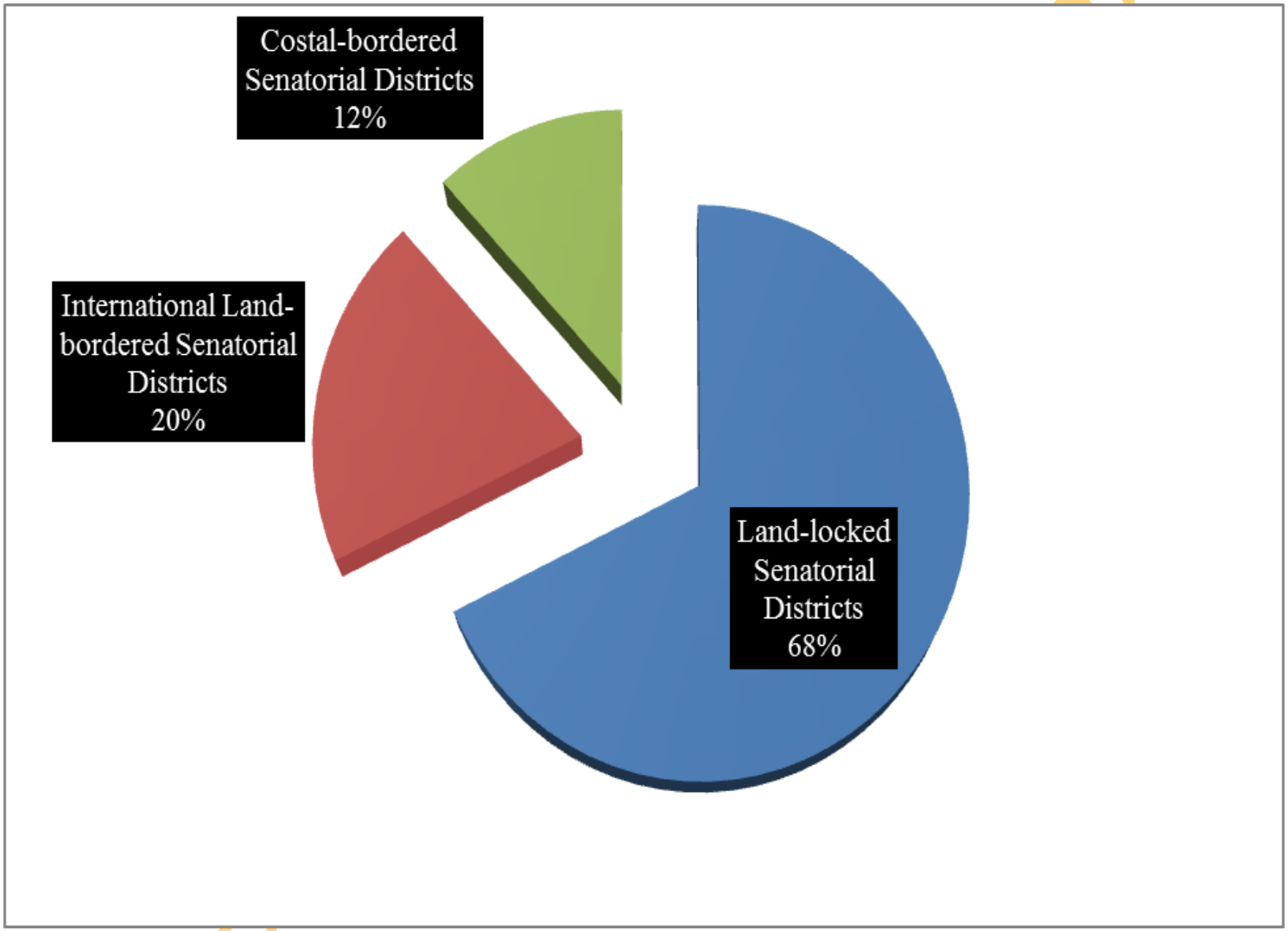


Figure 10a: Geographical locations of senatorial districts
Source: The results of data analyses (2010)

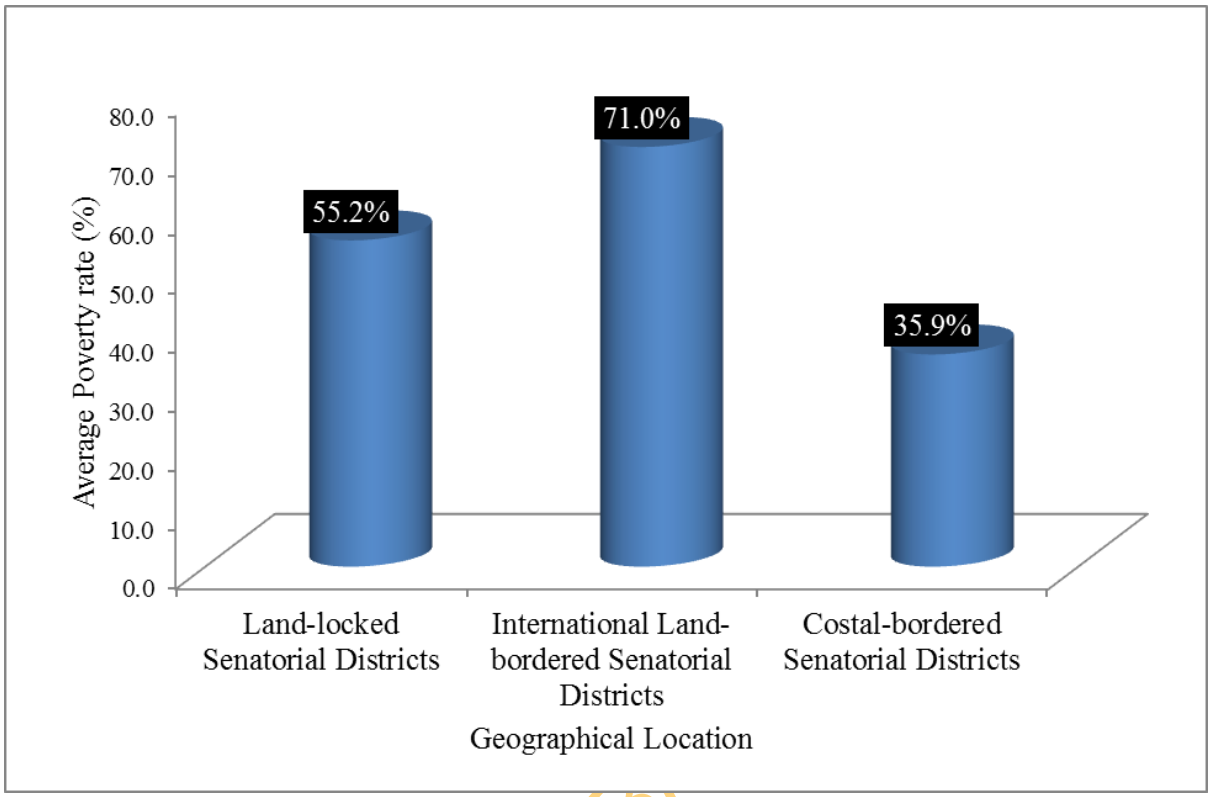


Figure 10b: Average poverty rate (%) of senatorial districts in different geographical locations

Source: The results of data analyses (2010)

4.3.5 Water erosion and desertification

Moreover, the study revealed that nine per cent (9%) of the senatorial districts are susceptible to water erosion while 12% are prone to desertification. The average poverty rate in water erosion susceptible senatorial districts is 27.3% while that of desert prone senatorial districts is 80.7%. While water erosion destroys farms and homes and depletes soil fertility; poverty is more severe in desert-prone senatorial districts. This may be attributed to the unfavourable nature of the environment for economic activities and very low average annual rainfall (673.1mm) which makes farming difficult. The dryness of the senatorial districts may account for the low percentage of residents employed in agriculture (42.5%). Conversely, the high percentage of residents employed in agriculture in Borno North (74.4%), Jigawa North-west (53.2%) and Jigawa South-west (64.5%) senatorial districts may be attributed to irrigation farming.

4. 4 Distribution of demographic characteristics among households in senatorial districts

This section explains the distribution of demographic characteristics such as household size, head of the household and percentage of literate adult as well as the correlate of each of these variables on poverty. Household size is a strong indicator of knowing whether a household is likely to be poor or not. This section also throws light on the geopolitical zones with the highest and lowest household size and literate adult.

4 .4.1 Household size (HS)

The study reveals that Bayelsa Central and Ondo south senatorial districts (SDs) have the lowest average household size (4.0) while Taraba Central senatorial district has the highest (11.6) average household size among the 109 senatorial districts. The overall average and skewness of the senatorial districts are 6.5 and 0.7 respectively (see Appendix 6). The positive skewness of household size indicates that the senatorial districts with household size greater than the overall average household size are fewer compared to the senatorial districts with household size less than the overall average household size. The average household size of the senatorial districts in the southern part of the country (South-west, South-east and South-south geopolitical zones) ranges from 4.0 in Bayelsa Central and Ondo South to 7.4 in Ebonyi Central senatorial district (EbC). Moreover, the average household size in the northern senatorial districts (North-west, North-east and North-central GPZs)

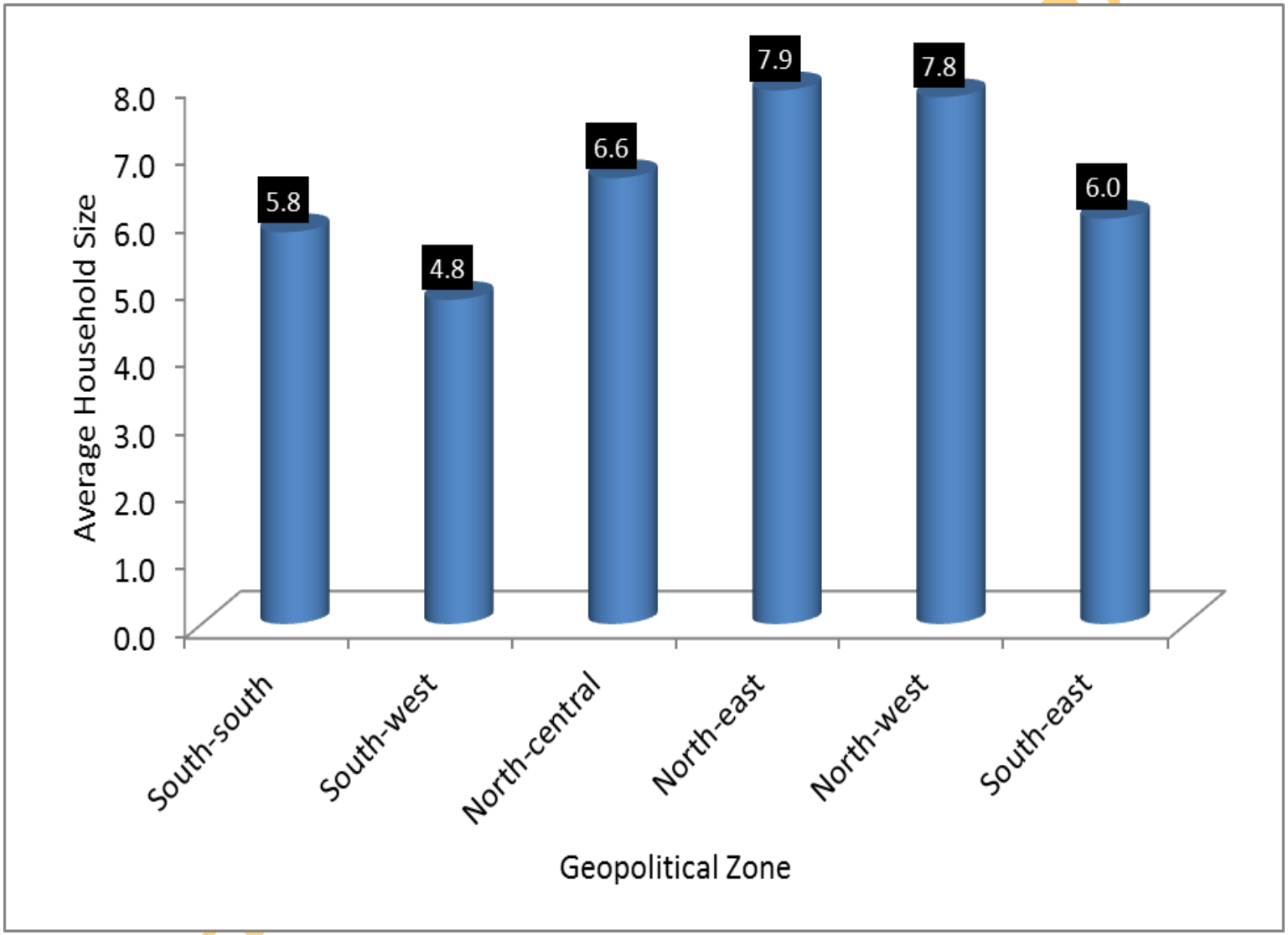


Figure 11a: Average household size based on geopolitical zones
Source: The results of data analyses (2010)

ranges from 5.1 in Niger North senatorial district to 11.6 in Taraba Central senatorial district (TaC).

Figure 11a shows that the senatorial districts in the north-east geopolitical zone have the highest average household size (7.9) while the SDs in the south-west geopolitical zone has the lowest average household size (4.8). This finding shows that the average household size increases from the south to the north. Also senatorial district's poverty rates increase northward (NBS 2006 Core Welfare Indicator Questionnaire Survey Report). The positive relationship between poverty rate and household size ($p<0.05$) is in agreement with Greer and Thorbecke (1986a), World Bank Annual World Development Report (2003), Mason and Lee (2004) and Mahbub (2004) that the larger households tend to be poorer, particularly those with many young children or the elderly (see Appendix 13). Generally, senatorial districts with state capitals recorded the highest average household size. This may be attributed to rural-urban migrations which often stretch available infrastructures beyond limit. Figure 11b shows the map of household size distribution in 109 senatorial districts of Nigeria.

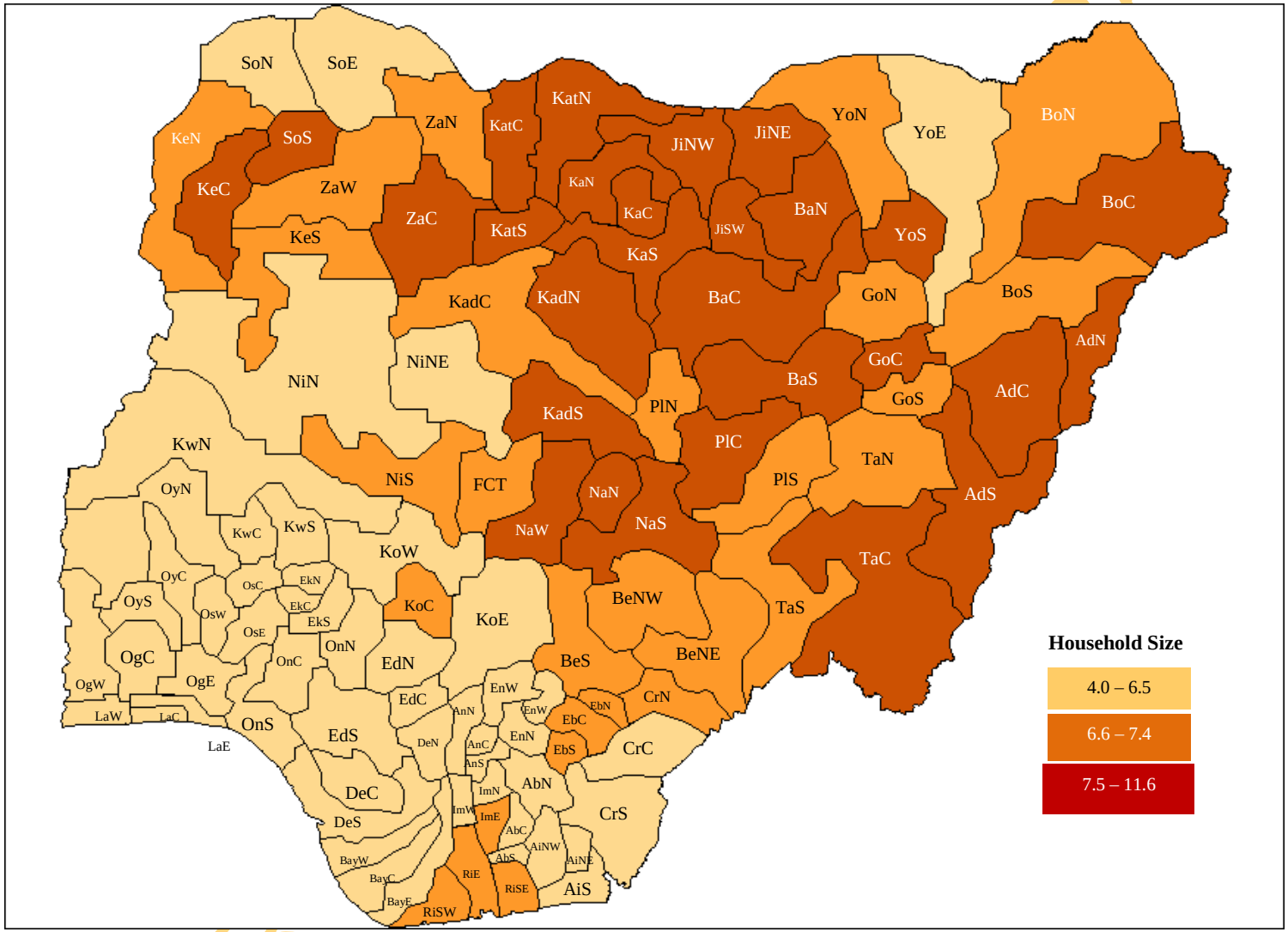


Figure 11b: Household size distribution in Nigeria
Source: The results of data analyses (2010)

4. 4. 2 Literate adult (LA)

The average percentage of literate adult in the 109 senatorial districts is 61.9%. Borno north senatorial district (18.3%) has the lowest literate adult in the country while Lagos Central has the highest percentage of literate adult (91.2%). The negative skewness indicates that the senatorial districts with percentage of literate adult greater than the national literate adult (51.1%) size are more in number compared to the senatorial districts with household size less than the national literate adult (see Appendix 6). Furthermore, the percentage of literate adult among the SDs in the south (South-west, South-east and South-south geopolitical zones) ranges from 47.8% in Ebonyi Central SD to 91.2% in Lagos Central SD while in the north's SDs (North-central, North-west and North-east geopolitical zones), the percentage literate adult ranges from 18.3% in Borno North SD to 81.6% in Plateau North SD (see Figure 12b). Figure 12a shows the map of literate adult (%) distribution in 109 senatorial districts of Nigeria.

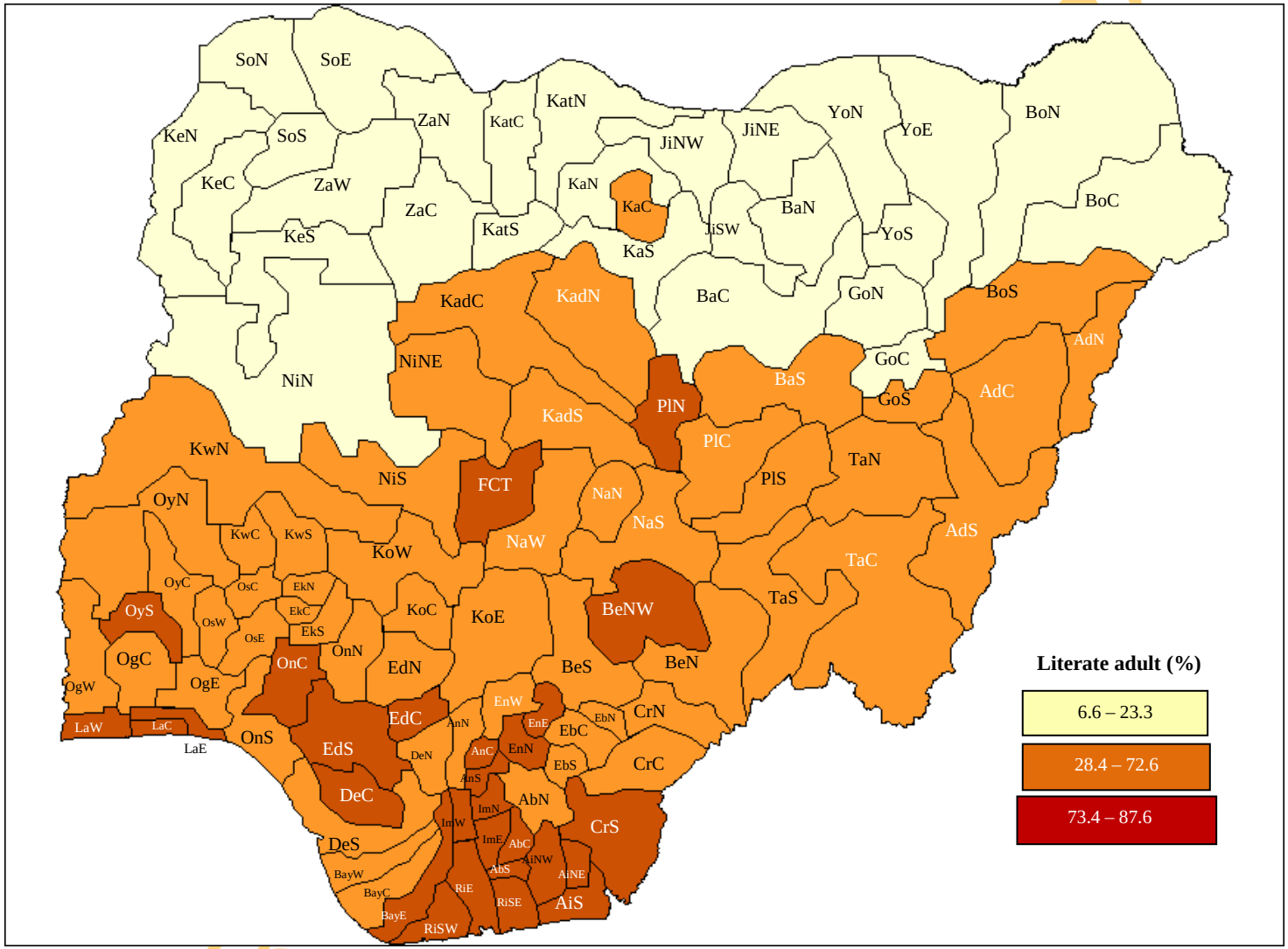


Figure 12a: Map of literate adult (%) distribution among senatorial districts in Nigeria
Source: The results of data analyses (2010)

Moreover, the result shows that the literate adult (%) decreases Northwards with few exceptions in Plateau North (73.4%) and Kano Central (44.2%) SDs. Specifically, Borno North SD has the least primary school net enrollment (17.5%) while Ekiti North SD has the highest primary school net enrolment (91.9%). Comparatively, Abia Central SD has the least secondary school net enrollment (9.6%) while Bauchi North SD recorded the highest secondary school net enrollment (74.0%). The significant negative relationship ($p<0.01$) between literate adult (%) and poverty rate (%) (see Appendix 13) agrees with the findings of Bankole *et al.* (2003) and Rupasingha and Goetz (2007) that having more than one educated member significantly increases consumption, and hence reduces the likelihood that a household will be poor. They reasoned that raising human capital level is one means of moving people out of poverty, and investments in human capital are frequently encouraged as public policy prescriptions. While the effect of literate adult (%) reflects in the present poverty rate, the primary and secondary school net enrollments effect as a form of investment in human capital on poverty rate manifest later in the future.

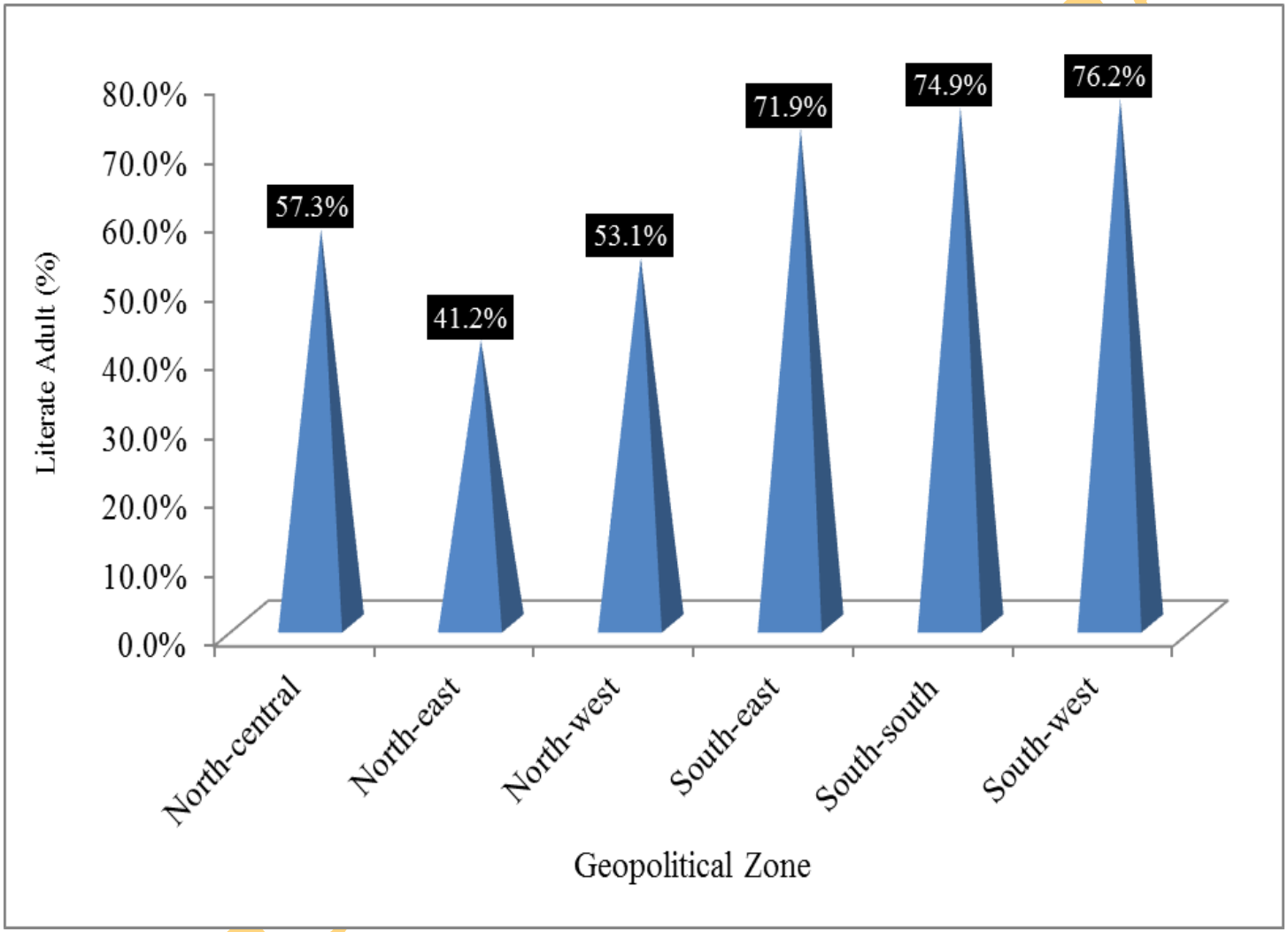


Figure 12b: Distribution of literate adult (%) among the geopolitical zones

Source: The results of data analyses (2010)

4.4.3 Female and male-headed household (FeH and MaH)

Moreover, the study finds that the overall average of female-headed household is 66.5%. Surprisingly, Gombe South SD is 100% female-headed households – a senatorial district located in the north-east geopolitical zone where cultural and religious belief do not give room for female as head of household. Figure 13a shows that the north-west and the south-east has the lowest and highest percentage of female-headed household respectively. The same reason may be adduced for the low number of female headed households in northwest and northcentral have (0 – 67.8). Specifically, Zamfara North and Kebbi South senatorial districts are 100% male-headed households. A majority of households in the south-east and north-east senatorial districts are headed by female. The percentage of female-headed households ranges from 68.3% in Adamawa Central SD to 98.4% in Cross-River North SD (see Appendix 17). This may be attributed to religious as well as communal and inter-tribal wars which often claim the life of the male. Most female-headed households in the south-east and south-south are mainly widows that lost their husbands during the Nigerian civil war.

According to UNDP Human Development Report (2008), the life expectancy of adult female in Nigeria is higher than that of adult male. Conversely, Zamfara West senatorial district has the lowest (18.6%) percentage of male headed household while Cross-river North SD has the highest (93.4%) percentage of male-headed households. Both the male and female headed households have negative skewness (see Appendix 6). The study shows a statistically significant ($p<0.05$) negative relationship between poverty rate and percentage of female headed households (see Appendix 13). The relationship between poverty rate and male-headed household although negative is not statistically significant ($p>0.05$). This finding is similar to studies by NBS (2005), Swaminathan *et al.* (2004) Aigbokhan (2000) and Thomas and Canagarajah (2002) that there is higher incidence of poverty among male-headed households compared to female-headed households.

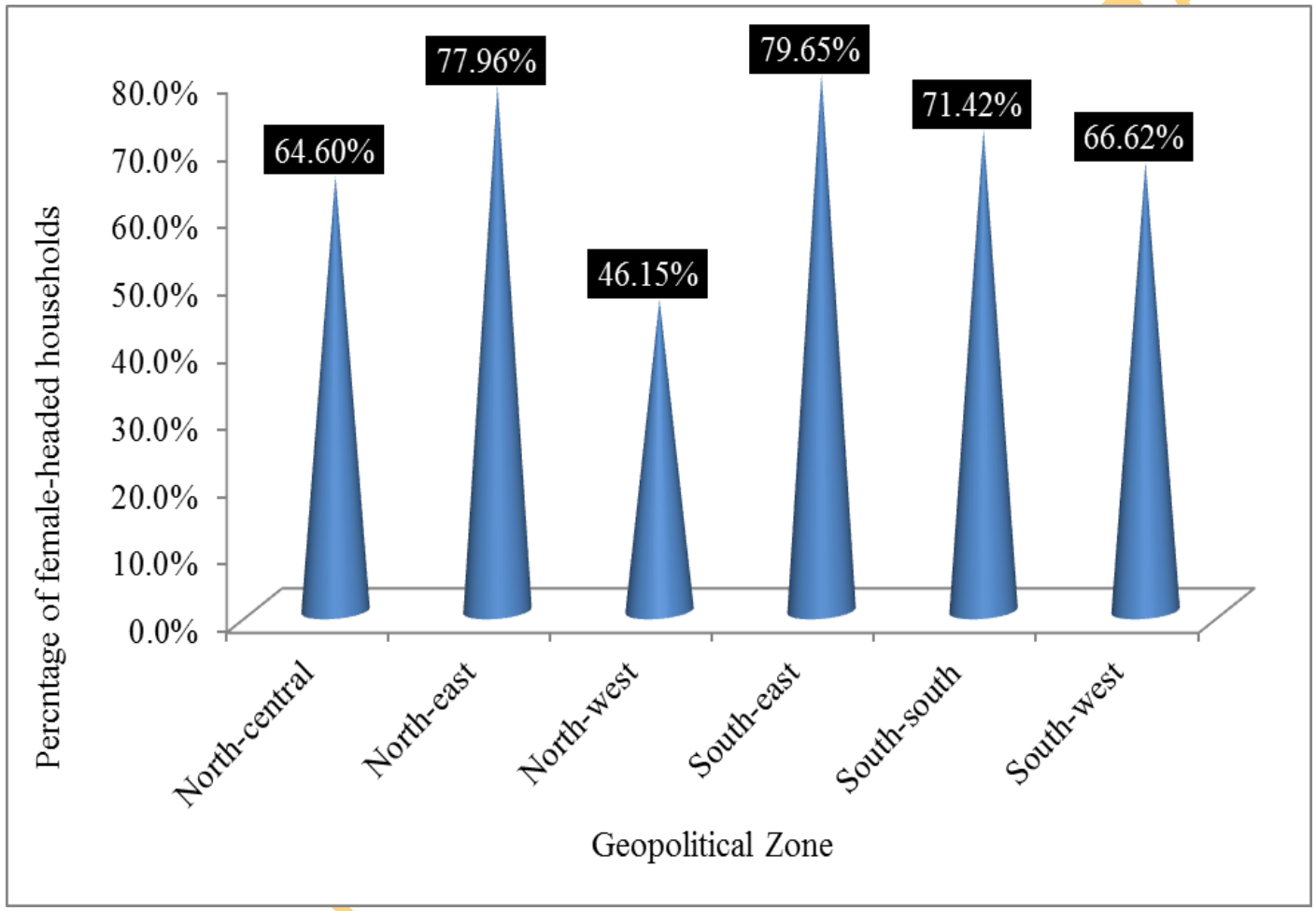


Figure 13a: Distribution of female-headed households based on GPZs
Source: The results of data analyses (2010)

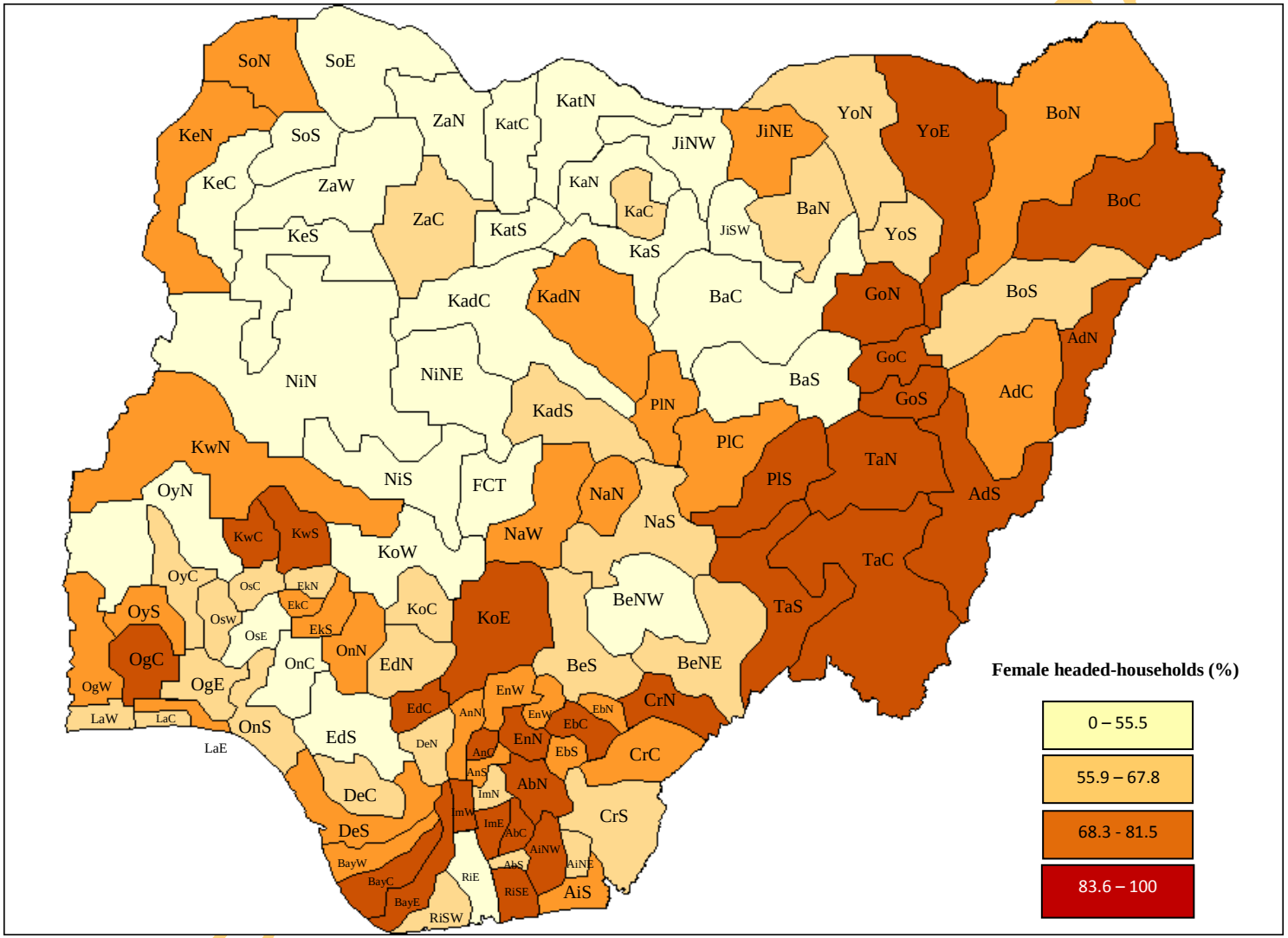


Figure 13b: Map of female-headed households among senatorial districts in Nigeria
Source: The results of data analyses (2010)

4. 5 Distribution of infrastructural characteristics among the senatorial districts

This section describes the distribution of infrastructural facilities among households in each senatorial district. The section does not reveal only the average access to these infrastructures but also the skewness of the distribution. Households having access to these infrastructures (safe water source, safe sanitation and health facilities) are less likely to be poor.

4.5.1 Access to safe water sources (SwS)

The result from the study shows that an average 46.2% of households in the senatorial districts has access to safe water sources (tap water, borehole, and deep well among others). Surprisingly, the senatorial district with the lowest poverty rate (Bayelsa West SD 8.1%) has the lowest access to safe water sources (5%) while Abia South senatorial district has the highest houshold's access to safe water (95.5%). Specifically, senatorial districts in the south-west geopolitical zone have the highest access to safe water source (70%). This is followed by the north-west and the north-central senatorial districts. North-east senatorial districts have the lowest average access to safe water sources (28.9%) (see the Figure 14a).

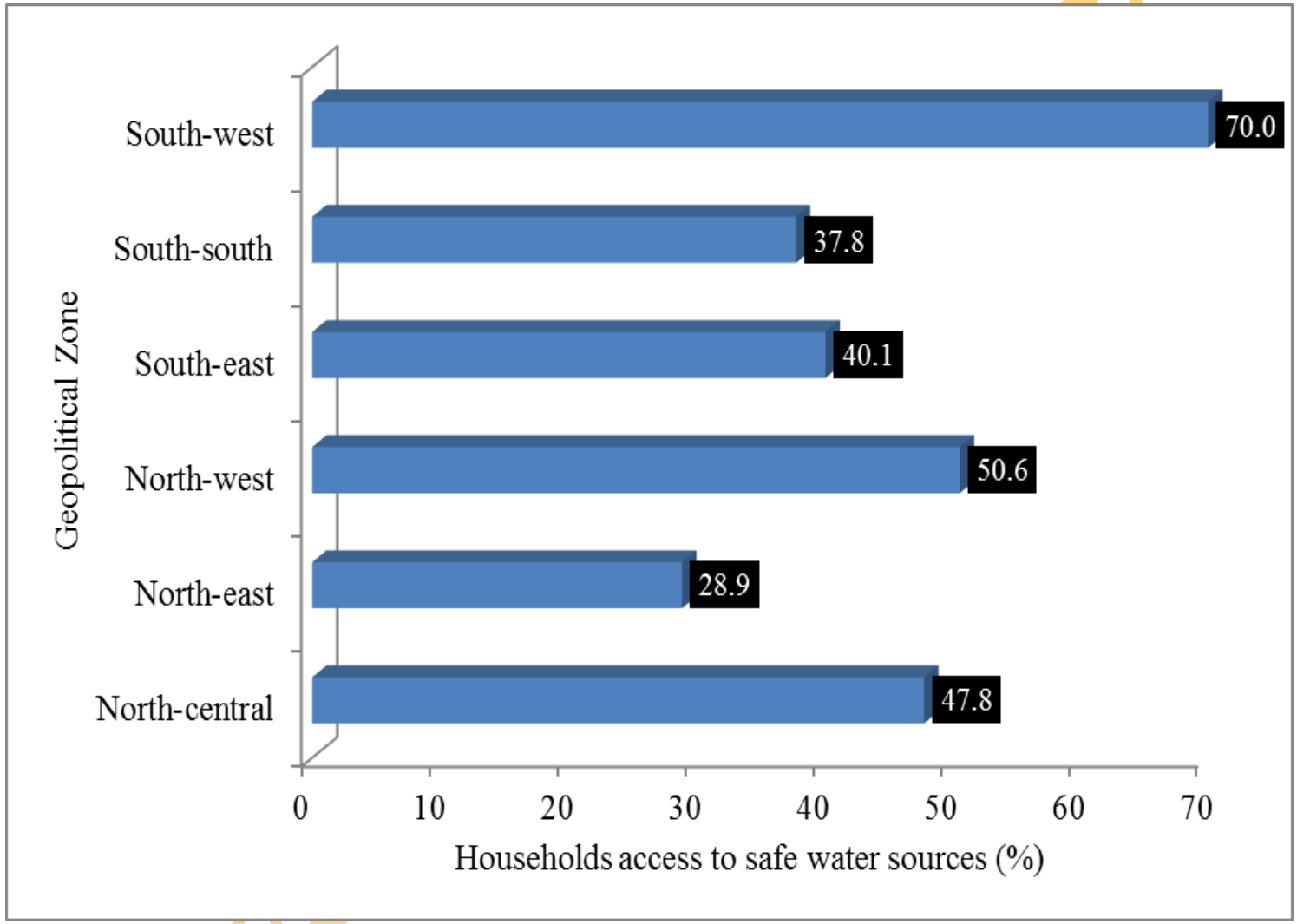


Figure 14a: Distribution of Households' Access to Safe Water Sources among the Geopolitical Zones
Source: The results of data analyses (2010)

The relationship between poverty rate and access to safe water sources is negatively weak and insignificant ($p>0.10$) (see Appendix 13). This may not be unconnected with the fact that the senatorial districts with very low poverty rate have low access to safe water sources (examples are Bayelsa West and Rivers South-east senatorial districts) while senatorial districts with high poverty rate equally have high access to safe water sources (examples are Sokoto South and Kwara Central senatorial districts). Furthermore, the result revealed that the average access to safe water sources in senatorial districts with state capitals is significantly greater (statistically) than the average access to safe water sources in other senatorial districts ($p<0.05$) (see Appendix 14). This means that governments concentrate on the provision of water like other social amenities in the state capitals and its environ at the expense of other senatorial districts. Figure 14b shows the map of Households' access to safe water sources (%) in 109 senatorial districts of Nigeria.

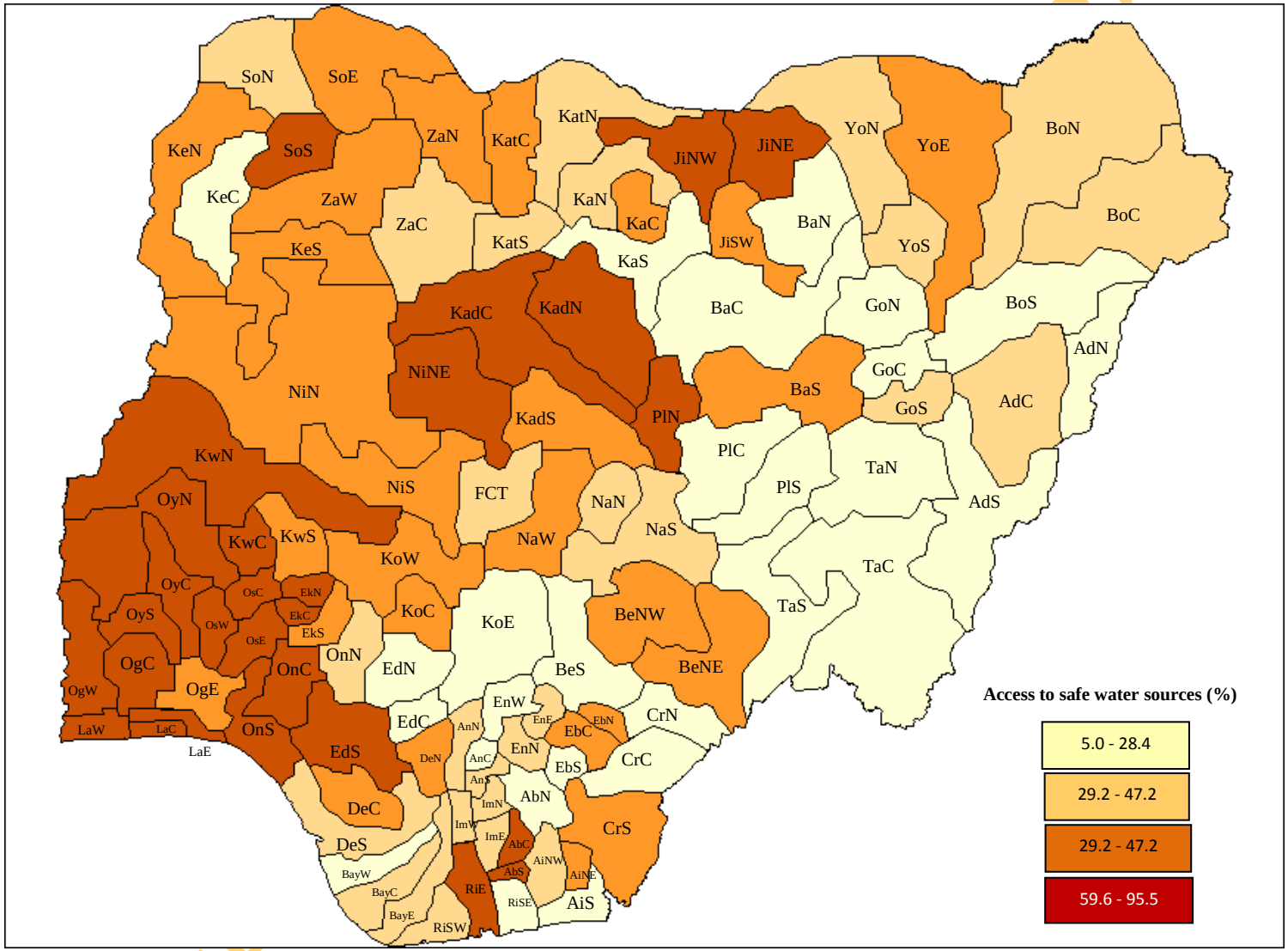


Figure 14b: Map of households' access to safe water sources (%) among senatorial districts in Nigeria

Source: The results of data analyses (2010)

4.5.2 Households' access to health facilities (AHF)

Moreover, the study reveals that the average access to health facilities in all the senatorial districts is 51.6%. Bayelsa West senatorial district has the lowest access to health (9.9%) while Osun central senatorial district has the highest access to health facilities (91.6%). South-east senatorial districts have the lowest access to health facilities (34.3%) while the south-west has the highest access to health facilities (70.8%) (see Figure 15a). The correlation coefficient of poverty rate and access to health facilities is positive and insignificant ($p>0.10$) (see Appendix 13). The positive sign contradicts the *a priori* expectation. The positive relationship may be attributed to many senatorial districts with high poverty rate having high access to health facilities. In this category are senatorial districts in Lagos, Nasarawa, Kogi, Kwara and Niger, Edo North, Kaduna North, Kebbi Central, and Kano South, among others. Like the access to safe water sources, senatorial districts with state capitals or seat of government have greater access to health facilities ($p<0.05$) (see Appendix 14). Figure 15b shows the map of access to health facilities (%) in 109 senatorial districts of Nigeria.

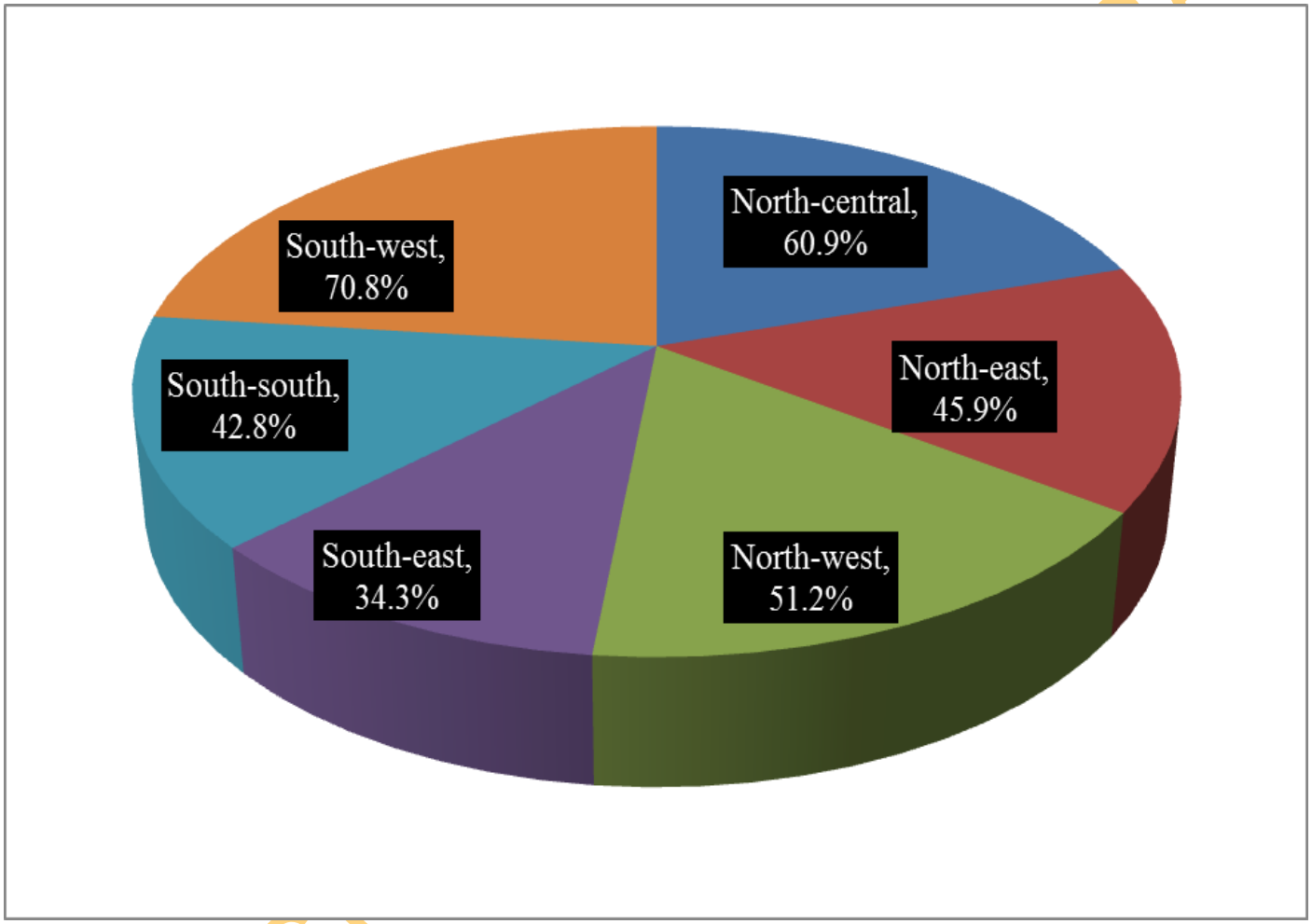


Figure 15a: Distribution of households' access to health facilities based on geopolitical zones
Source: The results of data analyses (2010)

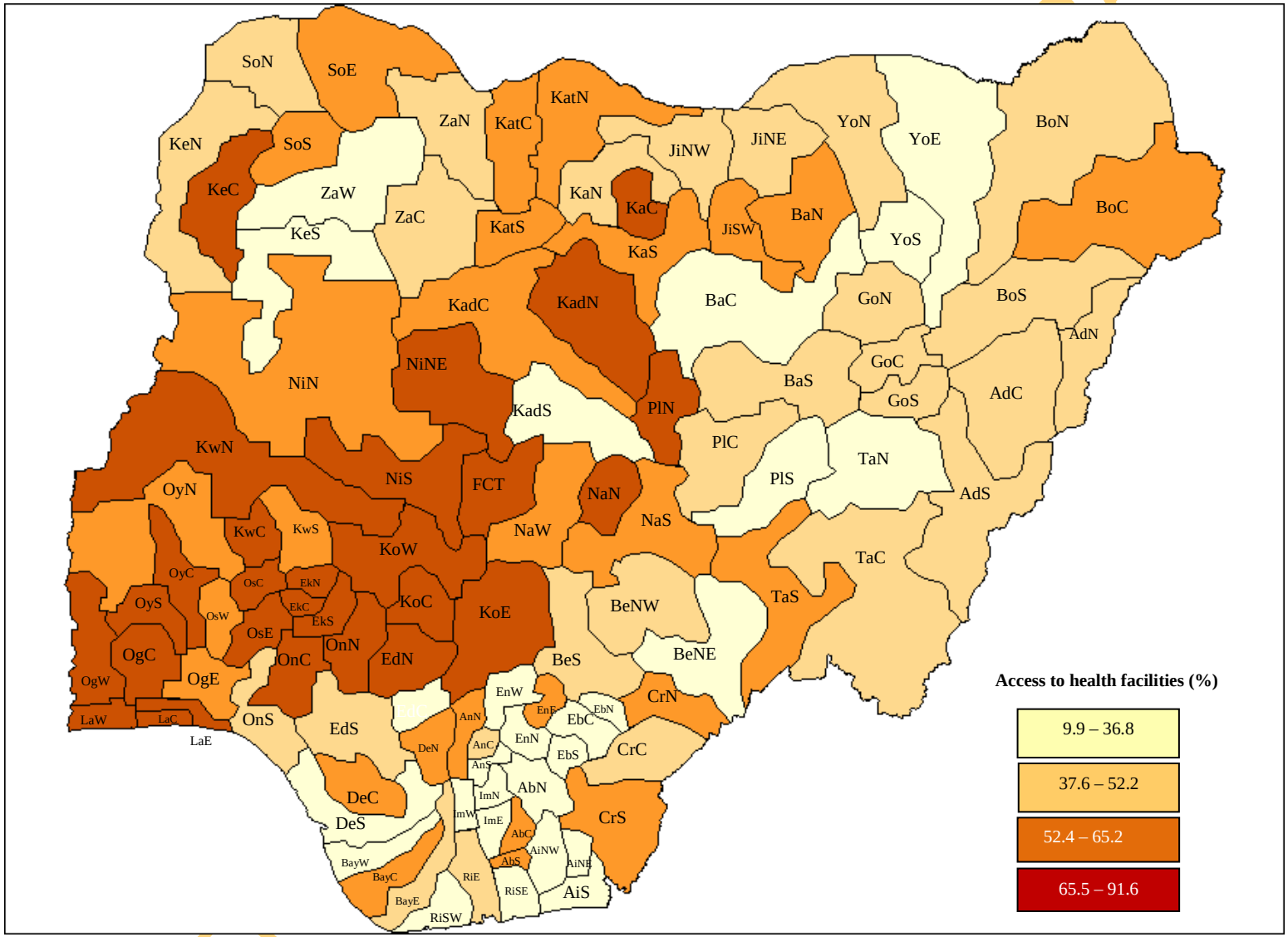


Figure 15b: Map of household's access to health facilities in Nigeria

Source: The results of data analyses (2010)

4.5.3 Household's connection to public electricity

Moreover, 4.7% households in Benue North-east senatorial district are connected to public electricity (the least among the senatorial districts) while 99.1% households in Lagos Central senatorial district are connected to public electricity (see Appendix 21). On average 44.8% of households are connected to public electricity in all the senatorial districts. Connection to pubic electricity in Kogi West (90.8%), Kogi East, Kwara Central (83.9%), Kwara South (76.2%), Lagos West (98.4), Lagos East (97.7%) and Lagos Central (99.1%) are high despite their high poverty rate. Specifically, connection to electricity in Kogi west, Kogi East, Kwara Central and Kwara South senatorial districts are high because of their closeness to major power generation facility in Nigeria (Kainji Dam) while high connection of Lagos senatorial districts to public electricity may be attributed to the location of Egbin Thermal Station and its (Lagos) being the economic nerve center of Nigeria.

Like other infrastructural facilities, households in senatorial districts with state capital are more connected to public electricity ($p<0.05$). The closer a senatorial district is to the state capital the higher the connection to public electricity. The study revealed a significant negative relationship between poverty rate and access to electricity ($p<0.01$) (see Appendix 13). This finding only showed those households that are connected to public electricity as well as households that can afford alternative sources to public electricity (generator and solar energy).

Senatorial districts in the south-west geopolitical zone have the highest average access to electricity (74.4%). This is followed by South-south (59.1%) and South-east (57.9%) geopolitical zones. The highest connection to public electricity in the north is recorded by North-central (46.6%) while North-west and North-east recorded 28.2% and 32.0% respectively (see Figure 16a). Figure 16b shows the map of access to electricity (%) in 109 senatorial districts of Nigeria.

These findings on infrastructural facilities agree with Thomas and Canagarajah (2002) that the southern zone has most of the industries and fairly developed infrastructures (schools, roads, health facilities, portable water and electricity) while there are long-standing lags in provision of health, education and other social services in the north which resulted in proportionately more poor.

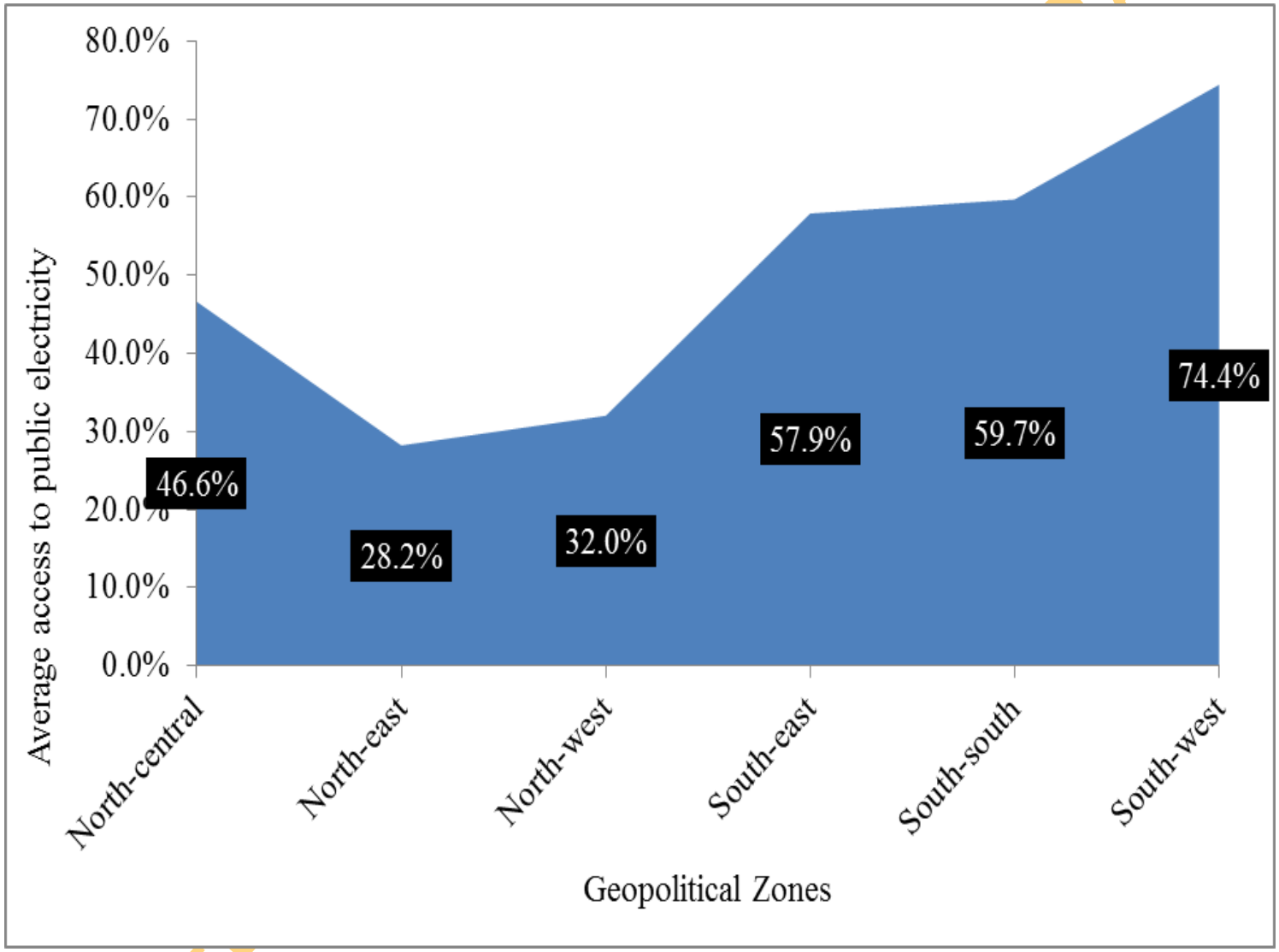


Figure 16a: Distribution of households' connection to public electricity among geopolitical zones' SDs
Source: The results of data analyses (2010)

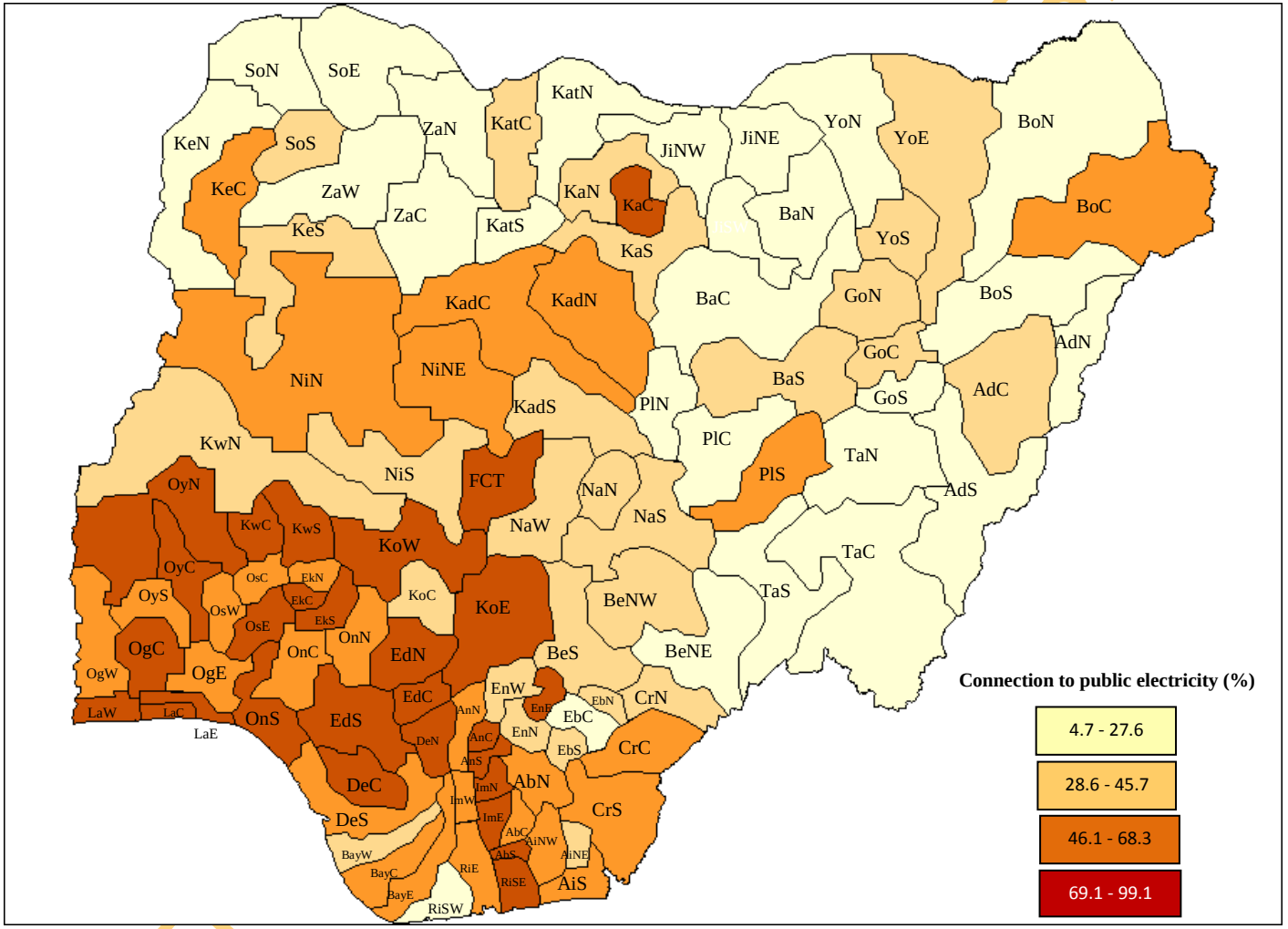


Figure 16b: Map of households' connection to public electricity among senatorial in Nigeria
Source: The results of data analyses (2010)

4.5.4 Households' access to safe sanitation (SaS)

Moreover, the average percentage of households in all the senatorial districts having access to safe sanitation is 43.8%. Kano South senatorial district has the lowest access to safe sanitation (0.2%) while Anambra South has the highest access to safe sanitation (92.3%). The positive skewness (0.107) indicates that the households in senatorial districts with access to safe sanitation greater than the overall average access to safe sanitation are fewer in number compared to the households in senatorial districts with access to safe sanitation less than the overall average (see Appendix 6). According to NBS (2006) CWIQ reports, safe sanitation is defined for households using flush toilet, covered pit latrine or ventilated improved pit latrine. Figure 17 shows that households in South-west senatorial districts' geopolitical zone has the highest access to safe sanitation (54.6%). This is followed by the south-south (46.8%) and the south-east (46.4%) respectively. The household in the north-west senatorial districts' geopolitical zone has the lowest access to safe sanitation (35.7%). Also, Figure 17 shows that the households in the south (South-west, South-south and South-east geopolitical zones) with the lowest poverty rate have the highest access to safe sanitation. A healthy environment is required for effective and efficient economic activities to take place. This finding is confirmed by negative relationship between poverty rate and access to safe sanitation ($p<0.05$). Moreover, the result shows that there is no significant (statistically) difference in average access to safe sanitation between senatorial districts with state capitals and other senatorial districts ($p>0.05$) (see Appendix 14).

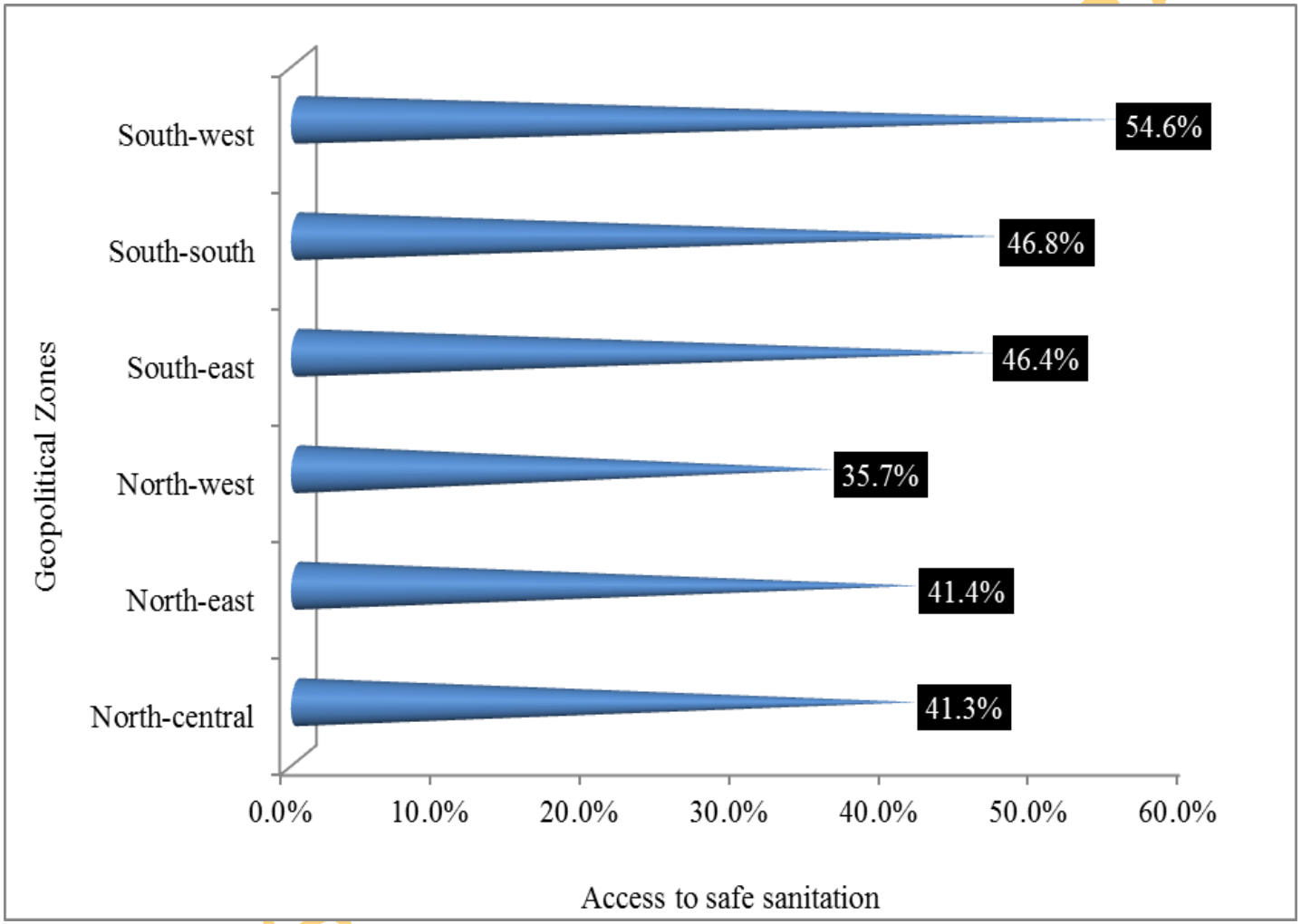


Figure 17: Distribution of households' access to safe sanitation based on GPZs
Source: The results of data analyses (2010)

4.6 Distribution of sociopolitical and economic characteristics among senatorial districts

The descriptive statistics in this section explained the distribution of household's membership of association, political competition, the number of years spent by senators representing each senatorial district and access to credit facilities. It also explained the correlates of these variables on poverty in Nigeria.

4. 6.1 Household membership of associations (HMA)

From the result of the analysis, average percentage of households that belong to associations in all the senatorial districts is 83.7%. Zamfara North senatorial district has the lowest household membership of association (52.7%) while Bayelsa West, Imo East, Cross-River South and Anambra South senatorial districts have the highest social capital index (100%). The distribution exhibits a negative skewness (see Appendix 6). This means that the senatorial districts with social capital index less than the national average (83.7%) are fewer than the senatorial districts with social capital index greater than the national average. Convergence of the senatorial districts into geopolitical zones (Figure 18a) revealed that South-east has the highest household membership of association (98.3%); followed by South-south (91.7%) and South-west (88.9%).

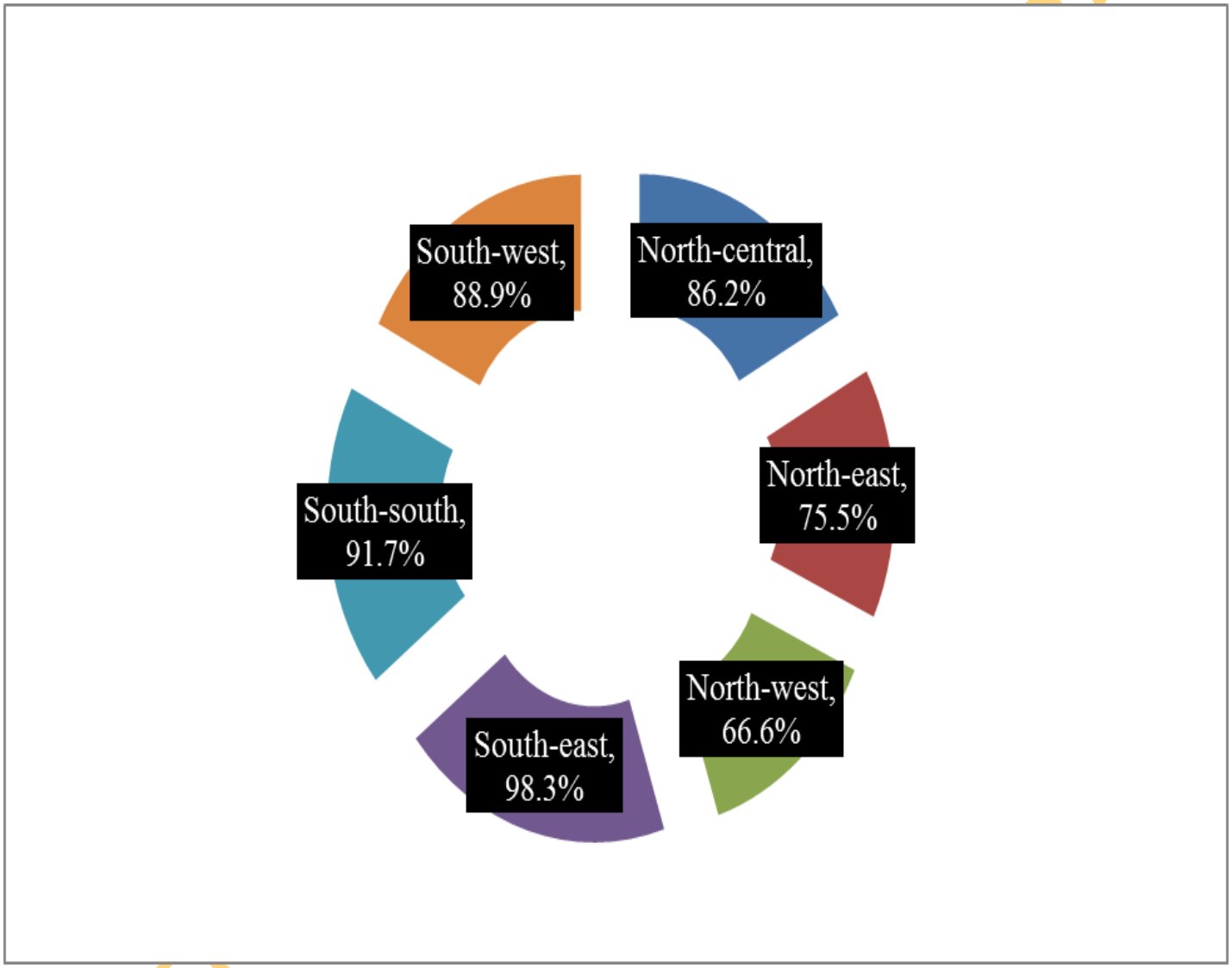


Figure 18a: Distribution of households belonging to associations based on GPZs
Source: The results of data analyses (2010)

Senatorial districts in the north-west geopolitical zone have the least household membership of associations (66.6%) among the geopolitical zones. From Figure 18b, household membership of associations is higher in the south (93.0%) compared to the north (76.1%) with few exceptions in Borno Central (89.9%) and Kebbi Central (90.1%) senatorial districts. Moreover, the result reveals a high negative relationship between poverty rate and household membership of associations ($p<0.01$) (see Appendix 13). This finding agrees with Okumadewa (1998), Olayemi *et al.* (1999), Moser (1996) and Narayan (1997) that those communities endowed with a rich stock of social networks and civic associations have been shown to be in a stronger position to confront poverty and vulnerability.

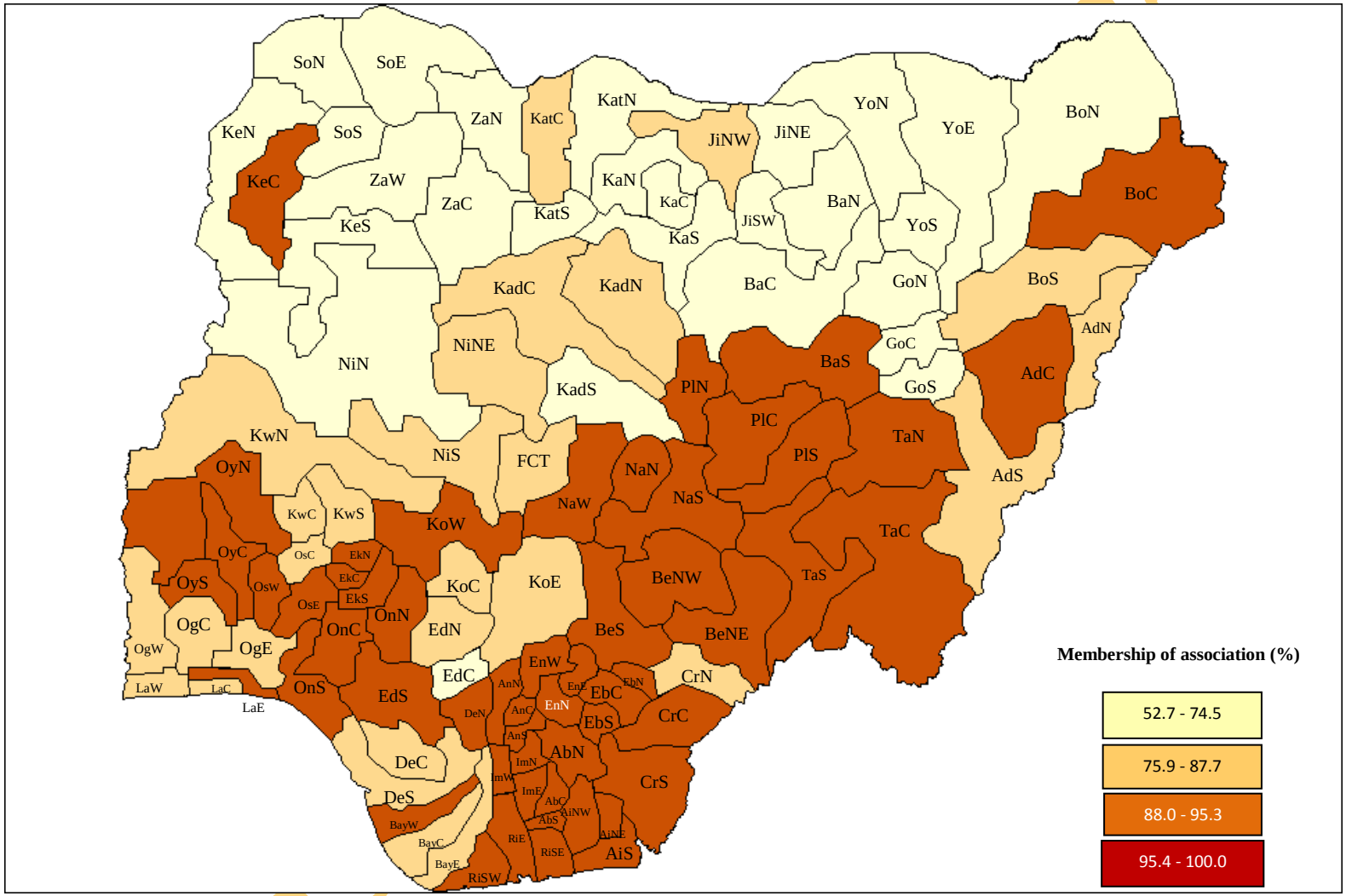


Figure 18b: Map of household's membership of associations (%) in Nigeria

Source: The results of data analyses (2010)

4. 6.2 Political competition (PCom)

Political competition and poverty rate shows a significant negative relationship ($p<0.10$) (see Appendix 13). Although significant, the sign did not conform with *a priori* expection. Hence, the normal interpretation, that the lower the political competition (election votes deviation) value the lower the poverty rate, did not hold. Figure 19a shows that the senatorial districts in the south-east geopolitical zone has the lowest election votes deviation (high political competition) (47709.31). This is followed by the north-east (51878.33) and the north-central (72368.88) geopolitical zones respectively. Senatorial districts in the south-south geopolitical zone has the highest election votes deviation (low political cometition) (107054.00) (see Appendix 9). The low poverty rate in the south-east geopolitical zone (29.9%) may be attributed to the low election votes deviation which indicates high political competition among political parties. Political competition is tied to economic performance of geopolitical zones. A high election votes deviation indicates a politically less competitive geopolitical zones (vote outcomes skewed towards a single party) (Rupasingha and Goetz, 2007). The figure below shows that based on the 1999 senatorial district elections, the southsouth was politically less competitive (high election votes deviation) among the geopolitical zones. This means that the votes recorded in the zone skewed towards a single party.

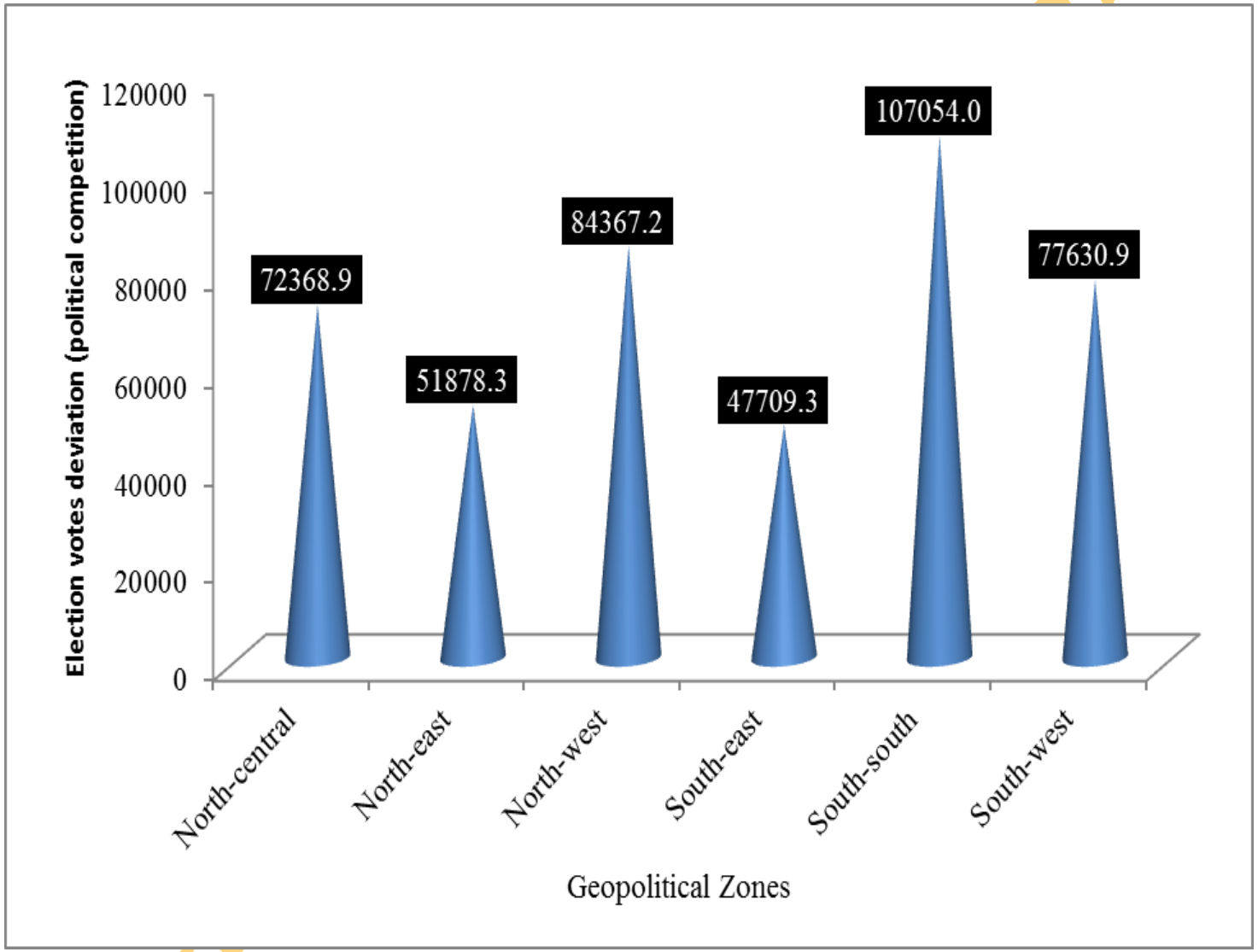


Figure 19a: Political competition based on geopolitical zones
Source: The results of data analyses (2010)

Seventy five percent (63%) of the senators in the upper legislative chamber belongs to Peoples Democratic Party (PDP) while 37% belongs to other parties (All Nigerian Peoples Party, Alliance for Democracy). The result shows that there is statistical significant difference ($p<0.10$) in the average poverty rate in PDP-controlled senatorial districts and SDs controlled by other parties (see Appendix 14). Specifically, the average poverty rate in SDs controlled by other parties (64.62%) is greater than the PDP-controlled SDs (58.12%). The low average poverty rate may be attributed to a substantial number of PDP-controlled SDs from the southsouth and southeast geopolitical zones known for their entrepreneurial ability and high literacy level among the households. This result is not due to the performance of the respective senators. The PDP-controlled senatorial districts in the north are very poor. The poverty rate ranges from 50.5% in Benue North-west to 97.7% in Jigawa North-east with the exception of Kaduna Central (33.6%). This is confirmed by statistically significant low average poverty rate of the south senatorial districts ($p<0.001$) compared to the north (see Appendix 14). Furthermore, the result shows that the average poverty rate of senatorial districts with state capitals is significantly greater than that of other senatorial districts($p<0.10$). This may be attributed to the migration of people from hinterland to the state capital in order to improve their economic well-being.

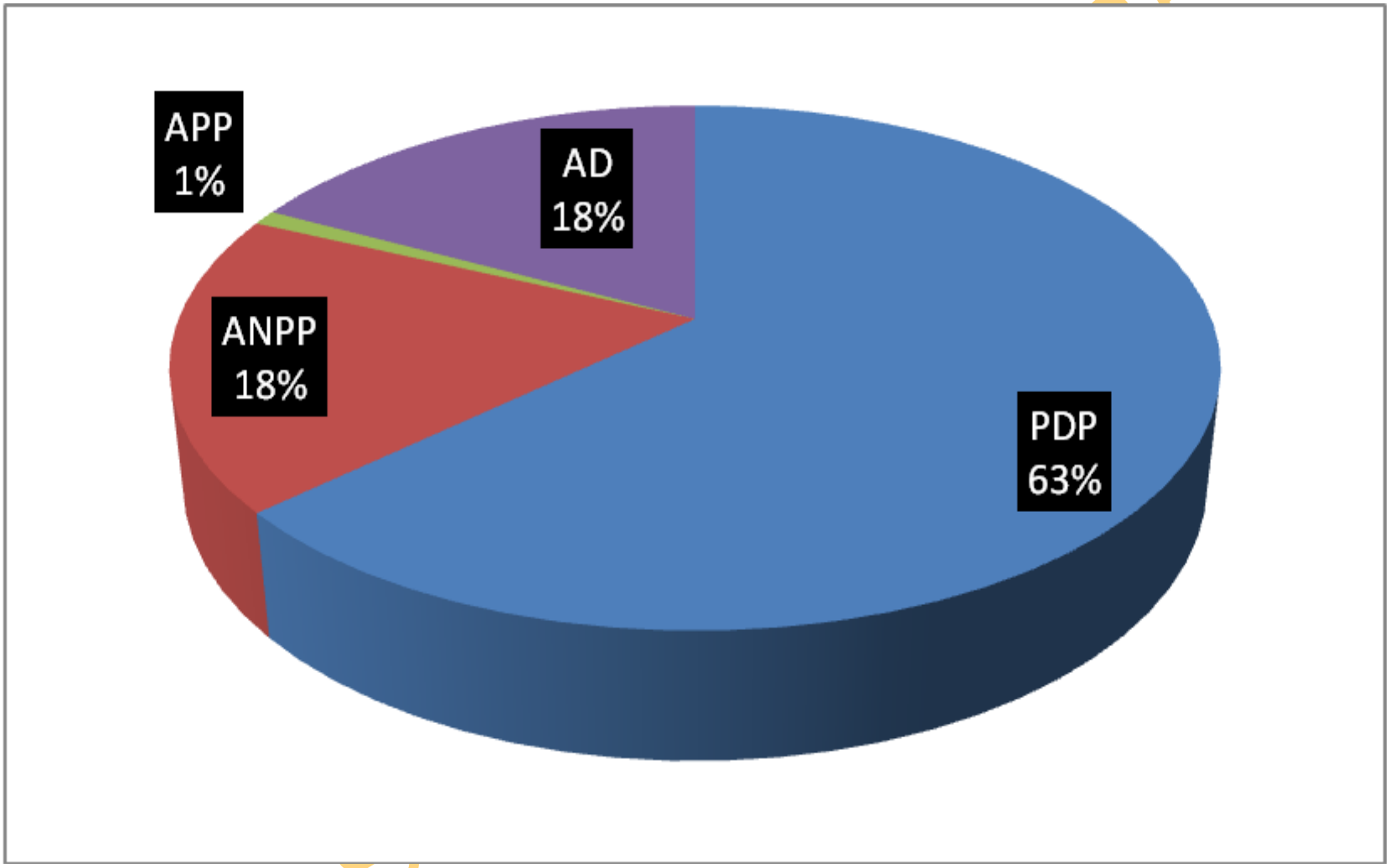


Figure 19b: Distribution of senators according to political parties
Source: The results of data analyses (2010)

Moreover, the study reveals that eighty one of the senators (69%) are first-timer in the national assembly, they spent 4years (1999 – 2003). Thirty-four of the senators (40%) were second-timer, they spent five years (1999 – 2004) (see Appendix 10). The distribution of second-term senators below (Figure 19c) shows that 29% are from the north-central, 24% from the north-west and 6% from the south-west geopolitical zones. The failed alliance that AD had with the PDP which lead to PDP capturing all the southwest except Lagos might have contributed to fewer number of second term senators in the south-west. Also, there is a weak positive relationship ($p>0.10$) between the number of years spent in the national assembly by senators and poverty rates (see Appendix 13). This means that the longer a senator represents a SD in the national assembly, the higher the poverty rate of the SD. Figure 19d shows the map of number of years the elected representative of each senatorial district spent in the national assembly.

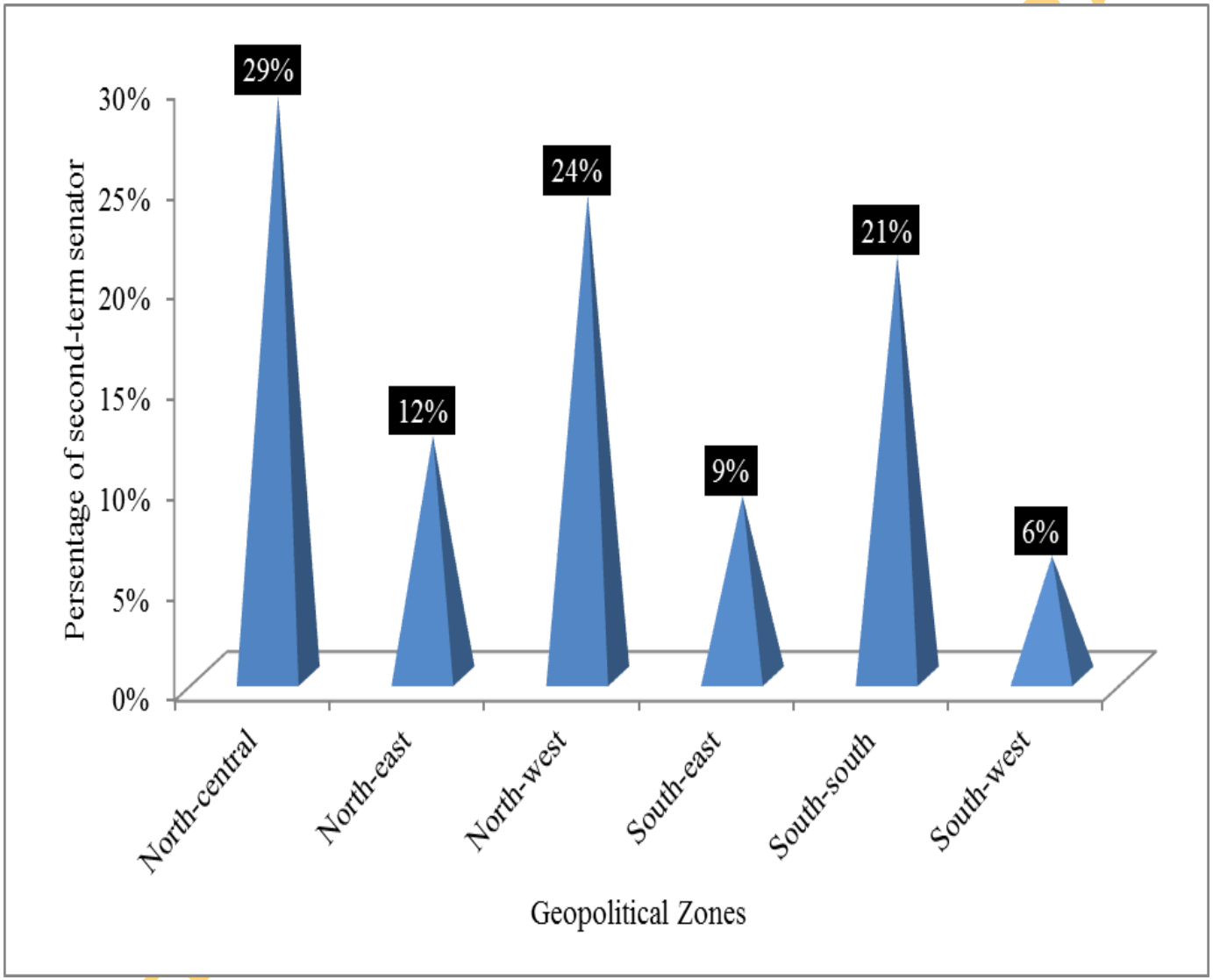


Figure 19c: Distribution of second term senators
Source: The results of data analyses (2010)

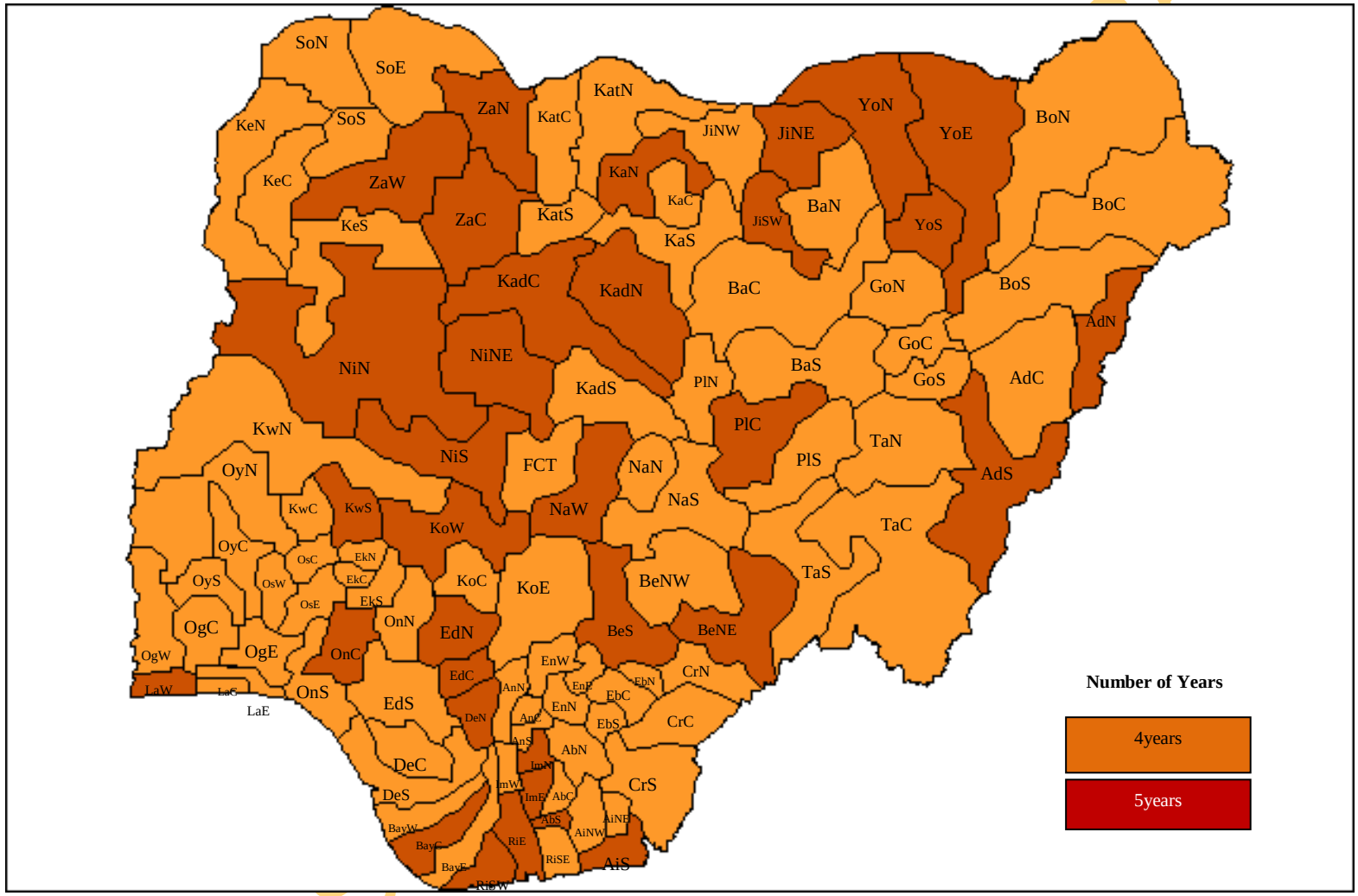


Figure 19d: Map showing the number of years spent by each senator in the national assembly
Source: The results of data analyses (2010)

4.6.3 Houselds' access to credit facilities (ACF)

Furthermore, the result shows that the average access to credit facilities in all senatorial districts is 10.5%. Edo Central senatorial district has the lowest access to credit facilities (0.6%) while Niger South recorded the highest access to credit facilities (36.7%). Generally, the access to credit facilities is low. None of the senatorial districts has up to 50% access to credit facilities (see Appendix 23). The relationship between poverty rate and access to credit facilities is negative and significant ($p<0.05$). This means that as access to credit facilities increases, poverty rate reduces (see Appendix 13). Moreover, there is no significant difference in average access to credit facilities between senatorial districts with state capital and other senatorial districts ($p>0.05$) (see Appendix 14).

Senatorial districts in the south-west geopolitical zone have the highest access to credit facilities (17.4%), this is followed by the north-central (13.9%) and the south-south (9.6%) geopolitical zones. The north-east geopolitical zone has the lowest access to credit facilities (5.0%) (see figure 20b below). The impact of high access to credit facilities in the south-west and some part of the south-south reflected in low poverty rate; the reverse is the case in Zamfara State senatorial districts (Central, West and North), Taraba South, Benue State senatorial districts (Northwest, Northeast and South SDs), Cross-River North and Ebonyi North. Access to credit facilities and poverty rate are high.

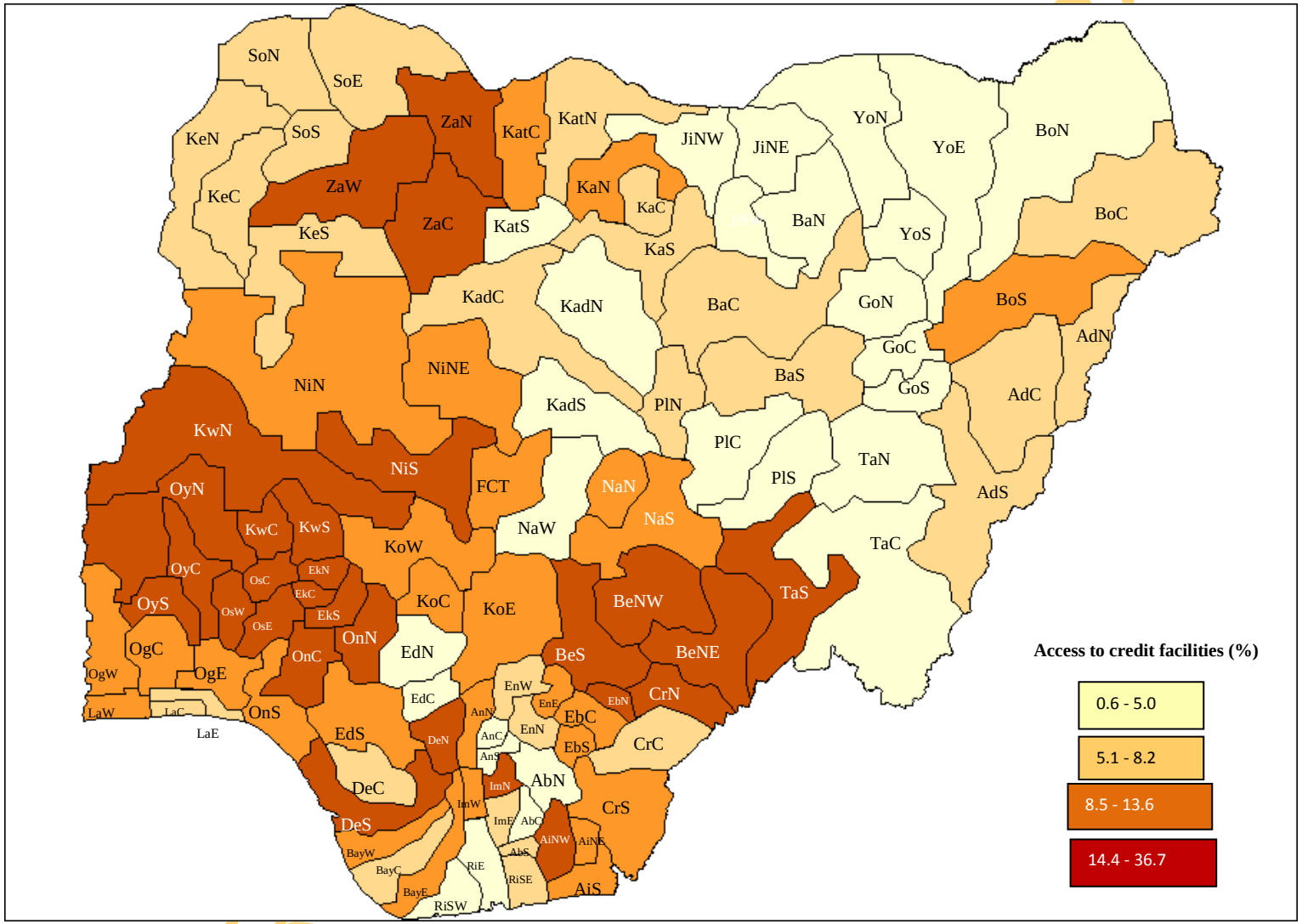


Figure 20a: Map showing the access to credit facilities in Nigeria

Source: The results of data analyses (2010)

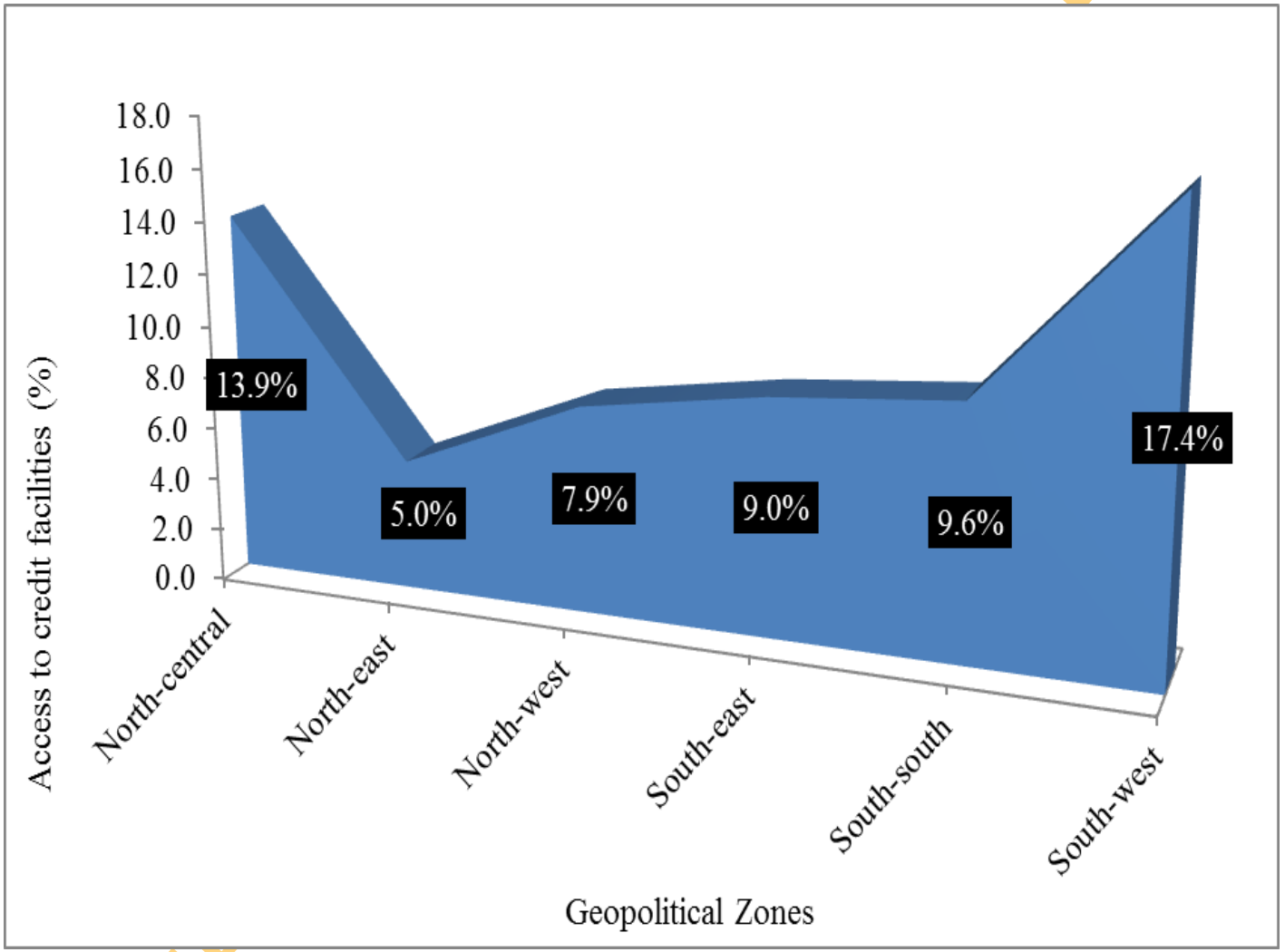


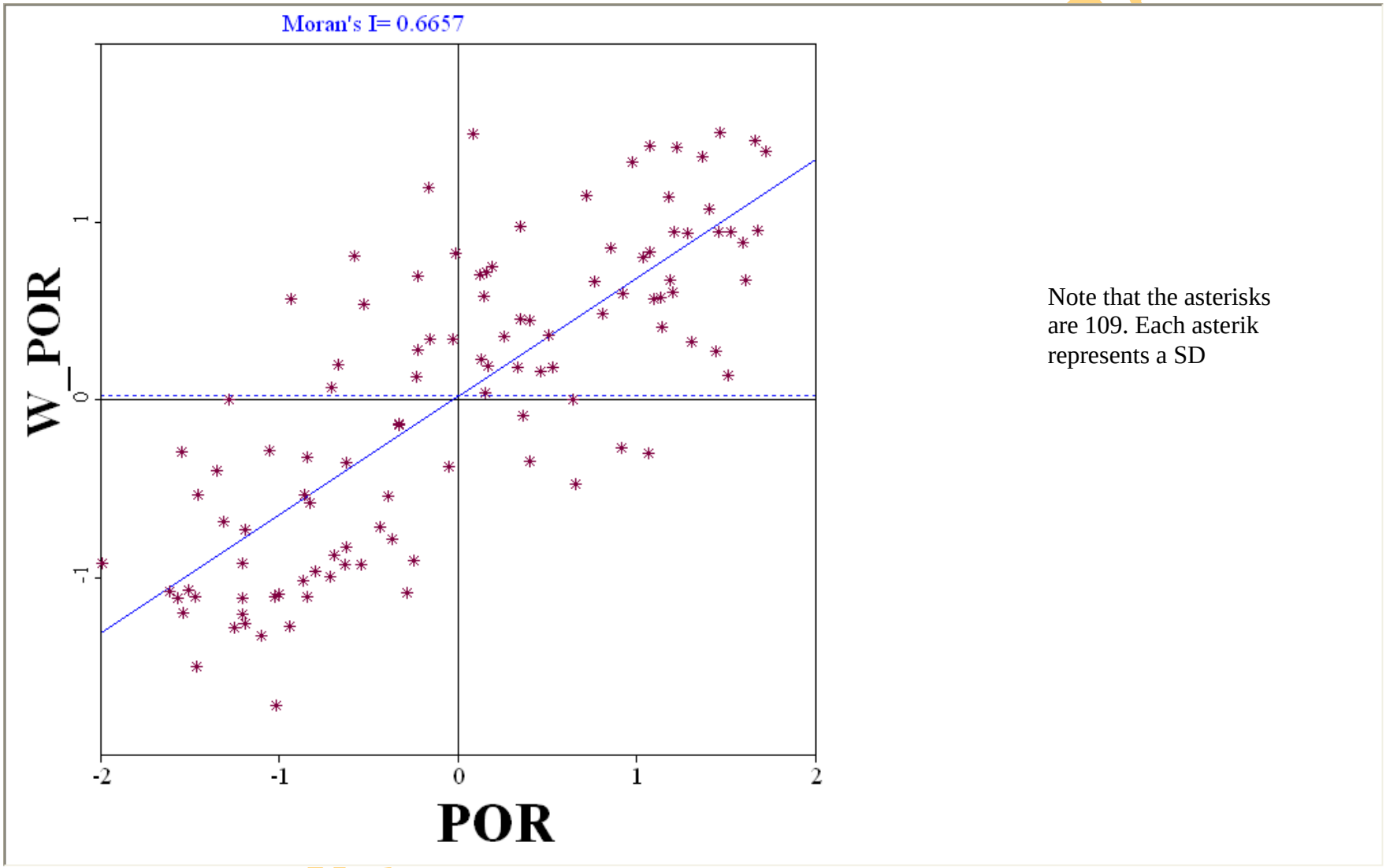
Figure 20b: Distribution of households' access to credit facilities based on geopolitical zones
Source: The results of data analyses (2010)

4.7 Nature of spatial clustering of poverty in Nigeria

This section explains the diagnostic result that determines whether spatial dependence (spillover of poverty from one senatorial district to the other) significantly affects poverty incidence in Nigeria or not using senatorial districts and the geographical units. It explains also the nature of spatial dependence in poverty incidence, using Moran's I and Moran scatter plot.

The result of the analysis shows that there is positive spatial autocorrelation (0.665) in poverty incidence across Nigeria (see Figure 21). The diagnostics for spatial dependence using a contiguity-based spatial weights matrix also reveals that it is not only present but significant ($p<0.001$). Figure 21 shows the Moran scatter plot of poverty rates for the senatorial districts in Nigeria. Anselin (1996) demonstrated that the slope of the regression line through these points expresses the global Moran's I value as in Figure 21. This figure shows that most senatorial districts are found in the high-high (47) or low-low (43) neighbourhoods in the country. Specifically, the upper right quadrant of the Moran Scatterplot shows the SDs with above average poverty rate that also share boundaries with neighbouring SD that have above national average value of poverty rate (high-high). The lower left quadrant shows SDs with below average poverty rate values and neighbours also with below national average values (low-low). The lower right quadrant displays SDs with above average poverty rate surrounded by SDs with below average values (high-low), and the upper left quadrant contains the reverse (low-high). The SDs in the lower right and upper left quadrants are the outliers.

This study does not only reveal the significant presence of spatial dependence but also the type of spatial dependence that is more likely, using the robust Lagrange Multiplier indicators (see also Anselin *et al.,* 1996; Benson *et al.,* 2004). The study reveals (see Table 7) that Spatial-lag is the type of spatial dependence present in poverty incidence in Nigeria. The value for robust Lagrange Multiplier (lag) is high and significant ($p<0.01$). This means that poverty incidence in one SD is not only influenced by factors within SDs but also by the poverty incidence in nearby SDs. That is, the proximity of senatorial districts influences the poverty incidences. The implication of this result is that spatial dimension has to be given consideration in any causal relationship between poverty rate and factors influencing it. Using Ordinary Least Square (OLS) method will lead to a violation of its assumptions because it cannot account for spatial dependence. Thus, a spatial regression (Spatial-lag model based on the type of spatial dependence) is required.



Note that the asterisks are 109. Each asterik represents a SD

Figure 21: Scatter plot of poverty incidence for 109 SDs
Source: The results of data analyses (2010)

Table 7: Diagnostics for spatial dependence

FOR WEIGHT MATRIX : **koloqueenPlA.GAL** (row-standardized weights)

Test	MI/DF	Value	Prob
Moran's I (error)	0.128670	3.3520293	0.0008023
Lagrange Multiplier (lag)	1	14.0564044	0.0001774
Robust LM (lag)	1	9.8452994	0.0017027
Lagrange Multiplier (error)	1	4.2297725	0.0397208
Robust LM (error)	1	0.0186675	0.8913241

Source: The results of data analyses (2010)

4.8 Spatial-lag Model Estimation

The choice of spatial-lag model is based on the significance of robust Lagrange Multiplier (lag) since the Lagrange multipliers for lag and errors are significant (see Table 7). Log-likelihood, AIC and SC values are -412.09, 876.17 and 946.15 respectively. These values determine the fit for Spatial-lag estimation (see Table 9).

Breusch-Pagan test for heteroskedasticity in error terms shows that the value obtained (34.65) is highly insignificant ($p>0.05$). This suggests that heteroskedasticity is not a problem in the model. Moreover, the superiority of Spatial-lag model to classical regression specification is further confirmed by the highly significant Likelihood ratio test ($p<0.001$) (see Table 8)

Table 8: Diagnostics for heteroskedasticity and spatial dependence tests

Test	*Value*	*P-value (probability)*
Breusch – Pagan	34.65	0.0737^{ns}
Likelihood Ratio	14.49	0.00014***

Source: The results of data analyses (2010)

Note: ***p-value < 0.01 and ns means not significant.

4.9 Determinants of poverty incidence in Nigeria

The significance of spatial parameter has an interesting implication. A positive and significant spatial dependence in the dependent variable (poverty rate) indicates that the poverty rate in a particular SD is associated with (not independent of) poverty rates in surrounding SDs. The value of the spatial autocorrelation coefficient (*rho)* estimated is 0.3084 and is highly significant ($p<0.001$). This value in the model indicates that a 10 percentage point increase (decrease) in the poverty rate in a high-high (low-low) SD results in approximately 3% increase (decrease) in the poverty rate in a neighbouring SD (see table 9). This is strong evidence that a spillover of poverty exists among SDs with respect to poverty incidence. From this result, the alternative hypothesis in the first hypothsis is accepted. That is, incidence of poverty in each SD is significantly influenced by a spillover of poverty.

The explanations of the significant explanatory variables based on spatial-lag model as well as the accompanied diagnostic parameters are contained in Table 9.

4.9.1 Agro-ecological and environmental characteristics

Specifically, the coefficient of percentage of people employed in agriculture (PEA) is significant ($p<0.05$) and the sign conforms to *a priori* expectation. This means that the lower the percentage of people in agriculture, the lower the poverty rate. Specifically, the result shows that with improved technology, 1% decrease in percentage of farmers will results in 0.11% reduction in poverty rate. A low percentage of people employed in agriculture having access to modern technology, good incentives, improved rural infrastructures and increase in cultivable land may result in poverty reduction. Idiong (2007) stated that productivity of farmers in Nigeria could be raised either by adoption of improved production technologies or an improvement in resource use efficiency or by both. Akinyosoye (2005) reasoned that farming is a harbinger of poverty for most of the participants, particularly the small scale farmers who barely make enough income to cater for their daily needs. This is attributable to low productivity because farmers practise traditional agriculture and also they do not possess any perceptible political voice. This finding agrees with several studies (GUAPA World Bank Report, 2003; Garza-Rodriguez, 2002; Mahbub, 2004; Both Székely, 1998; Cortés, 1997) that working in agriculture (peasant farmer), blue-collar jobs or as a casual labourer is strongly correlated with poverty. Households with the highest income-earner working in agriculture have significantly lower consumption levels (and hence are more likely to be poor) than those depending on work in other sectors (example are construction,

commerce and transport or services). The coefficient of average annual rainfall (AvRA) is negative and significant ($p<0.01$). The result showed that as annual rainfall increases (not torrential rainfall), farming activities also increase, thus enhancing the economic activities of farmers and, by extension, leading to a reduction in poverty incidence. The result reveals that a 1.0mm increase in annual rainfall will reduce poverty incidence in Nigeria by 0.0104%. Since 70% of Nigerian depends on rain-fed agriculture as their source of livelihood (Dickinson, 2008 and Durojaiye, 1997), adequacy and timeliness of annual rainfall is important for the sustainability of the rainfed agriculture (see Table 9).

The length of growing period's coefficient is significant ($p<0.05$) but the sign does not conform to *a priori* expectation. Like the average annual rainfall, the length of the growing period decreases northwards. Areas with functioning irrigation facilities are exceptions to low growing period in the north. Apart from the general low productivity in Nigeria; the long growing period in the southern senatorial districts is not being fully utilized for agricultural activities, hence the dependency on the north's senatorial districts with shorter length of growing period. The percentage of people employed in agriculture (42.5%) as well as average farm size in the south's senatorial districts is smaller than the average percentage of people employed in agriculture in the northern senatorial districts (45.9%) (see Figure 9b). The aftermath of the recent strike by the transporters conveying agricultural products from the north to the southern part of the country clearly showed that the longer growing period in the south, South-west in particular, is not being utilized for agricultural activities (http://allafrica.com/stories/201004120636.html). Although the percentage of people employed in agriculture is low and may continue to get lower due to rural-urban migration, an increase in agricultural productivity through improved technology and provision of basic amenities in the rural areas may help to raise food production above the present level in the south-east, south-west and south-south geopolitical zones' senatorial districts.

The coefficient of soil classification (SOC) is negative and significant ($p<0.01$). The result shows that the senatorial districts with good soil will be able to reduce poverty by 6.9% (see Table 9). Good soils have high productivity, medium productivity and low productivity (FAO)]. The bad soil ranges from that of very low productivity to no productivity. With little or no means of improving the soil fertility, most crop farmers rely on the natural fertility of their farms. Borno Central, Yobe South and a small part of Taraba Central are of high soil productivity (about 3% of the total senatorial districts).

Table 9: Determinants of poverty incidence in Nigeria using Spatial-lag model

Variables	Spatial-lag model - Maximum Likelihood Estimation
Agro-ecological & Environmental Characteristics	
PEA (People employed in agriculture)	0.11676(0.05476)**
AVRA (Average annual rainfall per SD)	-0.010433(0.003704)***
LOGP (Length of growing period per SD)	0.085895(0.041543)**
SOC (Binary soil classification of SD)	-6.8892(2.53904)***
ILBSD (International land bordered SD)	-1.8878(3.2773) ns
CBSD (Coastal land bordered SD)	-0.98733(4.4097) ns
SUDE (Senatorial district susceptible to desertification)	-0.042998(4.19668) ns
SUER(Senatorial district susceptible to water erosion)	-14.0022(4.4261)***
Demographic characteristics	
FEH (Percentage of female-headed household per SD)	-0.1367(0.0607)**
MAH(Percentage of male-headed household per SD)	0.3168(0.1127)***
LA (Percentage of literate adult per SD)	-0.3131(0.1861)*
HS (Average household size per SD)	1.83172 (1.10975)*
Infrastructural Characteristics	
CPELECT (Percentage of household connected to public electricity)	-0.03331(0.07421) ns
SAS (Percentage of household having access to safe sanitation)	-0.03204(0.05031) ns
SWS (Percentage of household having access to safe drinkable water)	0.09347(0.0534)*
AHF (Percentage of household having access to health facilities)	0.07731(0.03482)**
PNE (Percentage of primary school net enrollment per SD)	0.1443(0.17130) ns
SNE (Percentage of secondary school net enrollment per SD)	0.20357(0.20353) ns
Sociopolitical & Economic Characteristics	
PCOM (Political competition)	-6.34e-005(2.06e-005) ***
PIC (Party in control of SD relative to party in control of government)	-5.9795(2.876) **
SDIC (Senatorial district in state capital)	-1.1188(2.5916) ns
NYSNAS (Number of years spent in national assembly by senator)	1.9774(2.408) ns
HMA (Percentage of household membership of associations)	-0.7896(0.1492)***
ACF (Percentage of household having access to credit per SD)	-0.1749(0.1772) ns
Constant	71.667(20.9891) ***
Adjusted R^2/Pseudo R^2	0.8087
Lag Parameter (rho)	0.3084
Log Likelihood	-412.085
Akaike info criterion	876.171
Schwarz criterion	946.146

Source: The results of data analyses (2010)

Note: The parentheses contain estimated standard errors; its hypothesis tests assume asymptotic normality of calculated *t*-statistics. ***p-value < 0.01, **p-value< 0.05, *p-value < 0.10, ns means not significant.

Also about 36% of the senatorial districts in good soil category are of medium productivity while 61.4% are of low soil productivity. With availability, affordability and right applications of inorganic fertilizer, the full potential of the senatorial districts with low and medium soil productivity can be realized. The coefficients of senatorial districts that bordered the coast and international land boundary are insignificant ($p>0.10$), but the signs agreed with *a priori* expectations. While nearness to the coast encourages commerce and industries to thrive, the land borders often serve as routes for smuggling contraband goods and conducting illicit business activities. Also, the insignificance of coefficient of international land border may be attributed to a spillover of poverty from the neighbouring countries ranked among the poorest nations (Chad, Republic of Benin and Niger) (UNDP report, 2005). Senatorial districts in Ogun West, Oyo North and Borno Central are good exceptions (see Table 10). The insignificance of the coefficient of CBSD may also be attributed to spillover of poverty from senatorial districts with high poverty rates. Lagos East, Lagos West and Lagos Central are some of the coastal-bordered senatorial districts that are suffering from the immigration of the poor from all parts of Nigeria.

Water erosion and desertification are known to destroy soil, making it unproductive for agricultural activities. Few senatorial districts are affected by water erosion and desertification in the south-east and north-west geopolitical zones respectively. The coefficient of susceptible senatorial districts to water erosion (SUER) is negative and significant ($p<0.01$). The result reveals that control of water erosion in the concerned SDs will lead to 14.0% reduction in poverty rate. The coefficient of susceptible senatorial districts to desertification (SUER) is negative but insignificant ($p>0.10$)

Table 10: Poverty rates and geographical location of senatorial districts

Land-locked Senatorial Districts						International Land-bordered SD		Coastal-bordered SD	
Senatorial District	**PoR**	**Senatorial District**	**PoR**	**Senatorial District**	**PoR**	**Senatorial District**	**PoR**	**Senatorial District**	**PoR**
Abia Central	18.2	Jigawa South-west	96.3	Edo South	18.8	Adamawa Central	60.7	Akwa Ibom South	38.8
Abia North	35.1	Kaduna Central	33.6	Ekiti Central	47.2	Adamawa North	68.8	Bayelsa Central	31.5
Abia South	18.9	Kaduna North	65.7	Ekiti North	40.0	Adamawa South	83.6	Bayelsa East	20.6
Akwa Ibom North-east	36.9	Kaduna South	59.8	Ekiti South	35.7	Akwa Ibom South	83.6	Bayelsa West	8.1
Akwa Ibom North-west	31.9	Kano Central	52.1	Enugu East	23.5	Borno Central	42.1	Cross-River South	27.3
Anambra Central	20.8	Kano North	71.6	Enugu North	43.0	Borno North	91.0	Lagos Central	64.1
Anambra North	20.9	Kano South	84.7	Enugu West	30.7	Borno South	59.9	Lagos East	54.9
Anambra South	19.7	Katsina South	75.7	FCT	43.4	Jigawa North-east	97.7	Lagos West	65.8
Bauchi Central	93.0	Kebbi Cental	82.5	Gombe Central	81.1	Jigawa North-west	89.1	Ogun East	26.9
Bauchi North	91.5	Kebbi South	96.5	Gombe North	73.4	Katsina Central	64.6	Ondo South	41.1
Bauchi South	74.6	Kogi Central	82.5	Gombe South	83.5	Katsina North	76.7	Rivers East	27.3
Benue North-east	52.3	Kogi East	92.5	Imo East	25.9	Kebbi North	94.5	Rivers South-east	31.3
Benue North-West	50.5	Kogi West	87.6	Imo North	33.3	Kwara North	94.9	Rivers South-west	29.5
Benue South	64.9	Kwara Central	82.0	Imo West	27.0	Niger North	55.8		
Cross-River Central	41.1	Kwara South	85.1	Osun Central	48.1	Ogun West	35.4		
Cross-River North	78.1	Nasarawa Central	64.6	Osun East	24.4	Oyo North	25.2		
Delta Central	50.2	Nasarawa North	59.3	Osun West	35.8	Sokoto East	91.3		
Delta North	39.3	Nasarawa South	60.1	Oyo Central	17.2	Sokoto North	58.2		
Ebonyi Central	46.6	Niger East	81.8	Oyo South	27.0	Taraba Central	59.6		
Ebonyi North	39.0	Niger South	50.7	Plateau Central	62.4	Taraba North	59.0		
Ebonyi South	45.6	Ogun Central	36.1	Plateau North	55.4	Yobe East	85.3		
Edo Central	71.9	Ondo Central	40.9	Plateau South	68.3	Yobe North	82.0		
Edo North	50.6	Ondo North	48.1	Zamfara West	79.7	Zamfara North	87.1		
Taraba South	67.3	Sokoto South	90.1						
Yobe South	84.5	Zamfara Central	78.4						

4.9.2 Demographic characteristics

The coefficients of all the four variables considered under demographic characteristics are significant, using spatial-lag model while only two are significant when OLS is used. Specifically in spatial-lag estimation, the significance ($p<0.05$) of the coefficient of female (FeH) as head of household indicates that for every one per cent increase in female headship of household, poverty incidence is expected to reduce by approximately 0.14%. The significance is unexpected bearing in mind the patrilineal nature of the Nigerian society. It is not unlikely that most of these households are headed by widows that might have lost their husbands during the civil and religious wars or by the male head of the household who has lost his job. This result contradicts other studies (Farmer *et al.*, 1989; RSS Task Force on Persistent Rural Poverty, 1993; Levernier *et al.*, 2000; Garza-Rodriguez, 2002) that found poverty rate to be higher among female-headed families. The percentage of female-headed households in the south-east (79.65%) and the south-south (71.42%) geopolitical zones are high. The senatorial districts in northeast geopolitical zone have the lowest average female-headed households (46.15%). Surprisingly, Gombe south senatorial district has 100% female-headed households.

The coefficient of male-headed household is also significant ($p<0.01$) but the sign did not conform to expectation. The result revealed that for every one per cent increase in male-headed households, poverty incidence increases by 0.32%. This finding is in agreement with NBS (2005), Swaminathan and Findeis (2004), Aigbokhan (2000) and Thomas and Canagarajah (2002) that there is a higher incidence of poverty among male-headed households. The coefficient of literate adult is negative and significant ($p<0.10$). The result shows that for every one percent increase in percentage of literate adults, poverty rate reduces by 0.31%. The percentage of literate adults is the result of investment in human capital over the years. According to Rupasingha and Goetz (2007), raising human capital levels is one means of moving people out of poverty, and investments in human capital are frequently encouraged as public policy prescriptions. They stated further that the higher the educational attainment in the household, the higher the household consumption, and hence the lower the chances of a household living in poverty. This statement is an attestation to low poverty rate in senatorial districts located in the southern part of the country (South-west, South-east and South-south geopolitical zones) with average percentage literate adult of 71.0% compared to high poverty SDs in the north with average literate adult of 33.8%.

Household size is an important demographic characteristic. The study reveals that for an increase in average household size by one, poverty incidence is expected to increase by

1.83%. This finding is corroborated by World Bank (2003), Mason and Lee (2004) and Mahbub (2004) that larger households tend to be poorer, particularly those with many young children. Overall, each additional child under six years old lowers total consumption by 23% (higher in rural areas than in urban areas); each additional member from age 7-24 lowers total consumption by 17%. This is also in agreement with the situation in the senatorial districts. Poverty rate is high in the north's (North-east, North-west and North-central) senatorial districts where the average household size is equally high (7.4). Both the poverty rate and average household size are low in the south's (South-west, South-east and South-south geopolitical zones) senatorial districts.

4.9.3 Infrastructural characteristics

The coefficient of households connected to public electricity (CpElect) is negative but insignificant ($p>0.10$). Regular public electricity supply is necessary for economic activity to thrive. The insignificance of the coefficient may be due to irregular public electricity supply. Regular supply of electricity is the precursor to economic growth and not connection to public electricity. According to Mayah (2007), the extended hours of public electricity outages have inflicted crusting impact on small business and the average household. Seriously affected are Small and Medium Scale Industries (SMls) that may not be able to provide their own power supply alternative on account of low financial capacity.

Moreover, the coefficient of access to safe sanitation is insignificant ($p>0.10$). On the other hand, the coefficients of access to safe water sources and health facilities are negatives and significant at 1% and 5% level of significance respectively. The result shows that for every one per cent increase in household's access to safe water sources, poverty rate is expected to reduce by approximately 0.1% while same percentage increase in household's access to health facilities is expected to reduce poverty rate by approximately 0.08%. This finding agrees with Dasgupta *et al.* (2003) and GUAPA World Bank report (2003) that households in towns with more access to basic utility services are significantly less likely to be poor. Municipal electricity connections are associated with higher consumption levels in both urban and rural areas.

The insignificance of primary (PnE) and secondary (SnE) schools net enrollment ($p>0.10$) may be attributed to the fact that they are investments in human capital, the impact on poverty rate in form of increase in literate adult is expected many years after.

4.9.4 Sociopolitical and economic characteristics

Variables measuring political participation are tied to the economic performance of senatorial districts. The coefficients of the political characteristics [political competition (PCoM), and party in control in senatorial district (PiC) in relation to the party in government] are statistically significant. However, the coefficient of political competition's sign does not conform to *a priori* expectation. Statistically significant coefficient of political competition is expected to bring about vibrant opposition that will serve as checks and balances to the party controlling each senatorial district. Levitt and Poterba (1999) find that states in United States of America (SDs) in which the two major political parties compete with one another experienced faster income growth than do states with less competition.

Moreover, the coefficient of PiC (party in control of senatorial district in relations to party in government) is negative and significant ($p<0.05$). The result showed that poverty incidence in Nigeria will reduce by approximately 6.0% if senatorial districts are controlled by parties other than the party in government. In ideal democratic environment, an increase in federal government presence in terms of capital projects is a way of winning such senatorial districts in subsequent elections. In emerging democratic countries like Nigeria, sabotage on the part of a party (different from party at the centre) controlling such SD will not make such capital project to succeed. Also, the fear of not wanting the opposition parties to take over such SD in subsequent elections may compel the present party in control to embark on projects that will impact positively on the well-being of the electorates. The coefficients of NYSNAS (number of years spent in national assembly by senator) and SDIC (party in control of SD in relations to party in government) are insignificant.

Numerous studies have found a positive association between economic development and social capital (household membership of associations). This study investigates the effect of social capital on poverty rates. The results indicate that SDs rich in social capital have lower poverty rates. Specifically, for every one per cent increase in household membership of associations, poverty rate is expected to reduce by approximately 0.8% ($p<0.01$). This result agrees with Duncan's (1999) finding that poverty persists when communities lack civic participation and is rigidly divided by class and race.

The coefficient for access to credit facilities is negative and statistically insignificant ($p>0.10$). The insignificance may be due to low average access to credit facilities (10.5%) in all senatorial districts. Edo North senatorial district has the lowest access to credit facilities (0.6%) while Niger South has the highest access to credit facilities (36.7%) (see Appendix 23).

4.10 Determination of senatorial districts with similar and dissimilar spatial patterns of poverty incidence.

This section explains the result of Local Indicators of Spatial Association analysis. A map of the ‘‘local’’ Moran’s I statistic for poverty rate, called LISA map provides a corollary to the Moran Scatterplot (see figure 22a) by displaying the same data in a different way. The LISA maps show the geographic distribution of the various value combinations (high-high, low-low, low-high and high-low) for senatorial districts across Nigeria. Senatorial districts where the local Moran statistic is not significant (at the 0.05 level, based on a randomization procedure) are not shaded on the map.

The result obtained from Local Indicator of Spatial Association (LISA) reveals that out of 90 senatorial districts that have similar spatial pattern of poverty incidence (high-high and low-low), 51 SDs have similar spatial patterns that their LISA indices are statistically significant ($p<0.05$) (see Table 11). The high-high constitutes the senatorial districts with more pronounced poverty incidence as well as their neighbouring SDs. Out of 19 outlier (dissimilar patterns: high-low and low-high), 4 SDs have significant LISA indices (see Table 11). The part of the Figure 22a with white pattern shows the SDs patterns that the LISA indices are not statistically significant ($p>0.05$). The detailed identity of these SDs (white patterned SDs) in terms of spatial pattern is shown in Figure 22b. The significant cluster locations simply identify locations with a high correlation to the weighted average of the values of its neighbours (see Appendix 5). The red colour in Figure 22a shows the high poverty rate SDs that are equally bordered with high poverty SDs (high-high). This group of SDs is concentrated in the northern part of the country. The dark-blue colour shows the low poverty rate SDs that are neighboured by low poverty rate SDs (low-low). The light-blue colour depicts low poverty rates SDs that are bordered by high poverty rate SDs (low-high).

Table 12 shows the LISA indices and cluster types as reported by Geoda *0.9.5i*. The software (Geoda *0.9.5i*) utilized this table to construct LISA map. Knowing the factors responsible for the more pronounced incidence of poverty in the red-shaded senatorial districts is important in order to come up with workable a poverty reduction strategy in Nigeria.

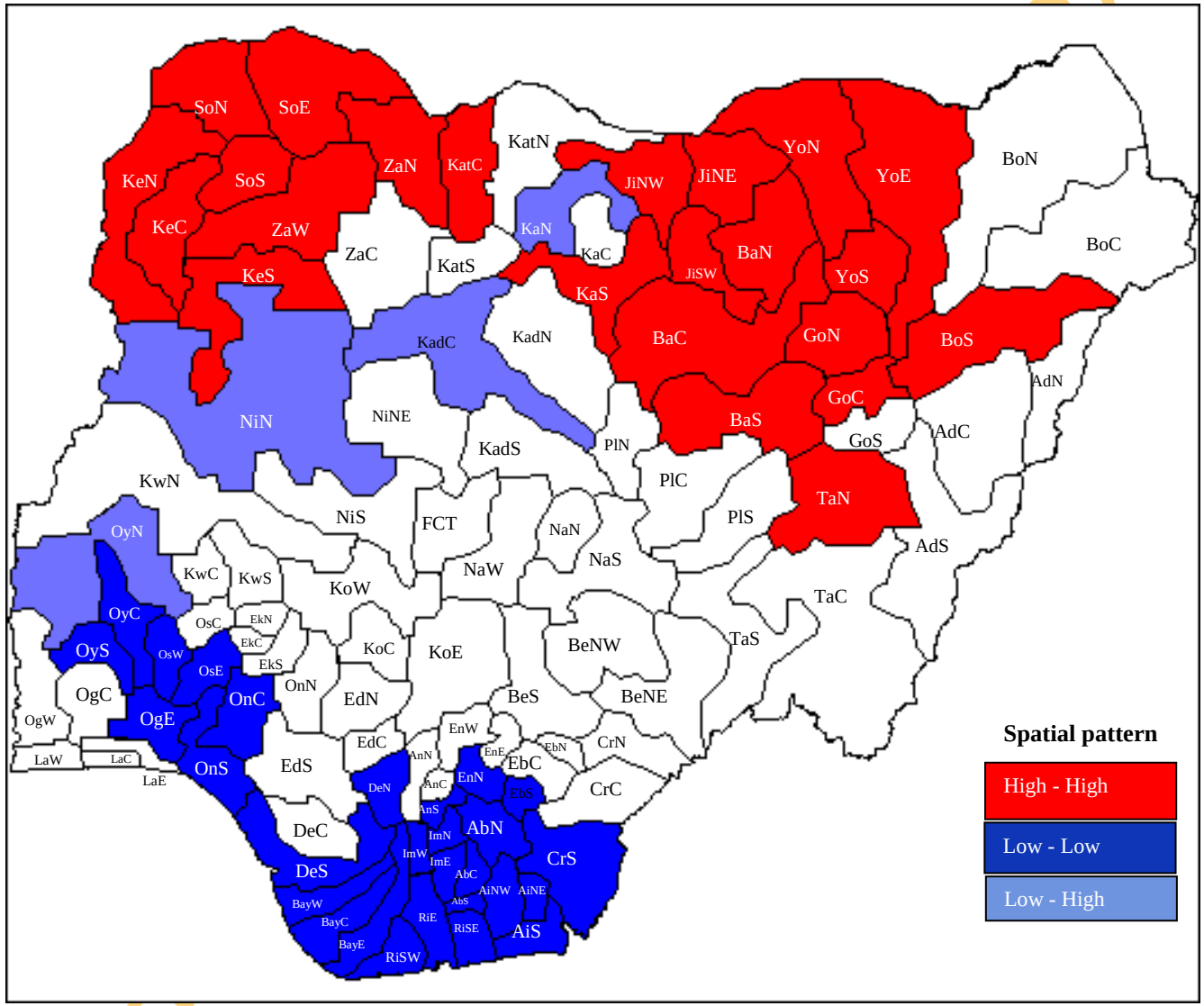


Figure 22a: LISA map for significant spatial pattern (coloured) of poverty incidence
Source: The results of data analyses (2010)

Table 11: LISA groupings of senatorial districts

LISA grouping	Total	Sig. (at most 0.05)	Not Sig.
Low–Low	43	28	15
High–High	47	23	24
Low–High	13	4	9
High–Low	6	NA	6

Source: The results of data analyses (2010), NA means Not Available

Table 12: LISA indices and cluster type for each senatorial district

Senatorial Districts	LISA Indices	Cluster Type	P - Value	Senatorial Districts	LISA Indices	Cluster Type	P - Value	Senatorial Districts	LISA Indices	Cluster Type	P - Value
Borno Central	-0.464223	0	0.138^{ns}	Bayelsa Central	1.755446	2	0.004***	Taraba North	0.085121	1	0.04**
Sokoto North	0.13299	1	0.002***	Bayelsa East	1.566994	2	0.002***	Plateau South	0.18165	0	0.218^{ns}
Sokoto East	1.375078	1	0.036**	Rivers south-west	1.461355	2	0.034**	Plateau Central	0.093344	0	0.234^{ns}
Kebbi North	1.399922	1	0.024**	Imo West	1.765913	0	0.073^{ns}	Bauchi South	0.456214	1	0.051**
Kebbi Central	1.737993	1	0.002***	Rivers East	1.440714	2	0.004***	Gombe South	0.603807	0	0.110^{ns}
Sokoto South	1.509702	1	0.008***	Rivers South-east	1.138337	2	0.021**	Kaduna South	0.005438	0	0.456^{ns}
Zamfara West	1.304532	1	0.002***	Abia South	1.84212	2	0.012**	Niger East	-0.326222	0	0.224^{ns}
Zamfara North	1.196622	1	0.021**	Abia Central	1.823817	2	0.006***	Katsina South	0.389789	0	0.152^{ns}
Katsina Central	0.349298	1	0.042**	Imo East	1.539762	2	0.016**	Kaduna Central	-0.52441	3	0.036**
Zamfara Central	0.589084	0	0.062^{ns}	Imo North	1.137035	2	0.022**	Kaduna North	0.176175	0	0.192^{ns}
Kebbi South	1.581005	1	0.014**	Anambra North	0.113077	0	0.446^{ns}	Bauchi Central	1.435214	1	0.002***
Niger North	-0.008198	3	0.014**	Anambra Central	2.197321	0	0.052^{ns}	Kano South	0.795111	1	0.031**
Kwara North	1.079825	0	0.072^{ns}	Abia North	0.889468	2	0.004***	Katsina North	0.723859	0	0.091^{ns}
Ogun West	0.463057	0	0.172^{ns}	Akwa Ibom North-west	1.084156	2	0.004***	Kano Central	-0.193821	0	0.148^{ns}
Lagos West	-0.339704	0	0.144^{ns}	Akwa Ibom South	0.715628	2	0.028**	Jigawa North-west	1.860673	1	0.002***
Lagos Central	-0.01579	0	0.486^{ns}	Akwa Ibom North-east	0.767667	2	0.036**	Jigawa South-west	2.428236	1	0.002***
Lagos East	0.027419	0	0.141^{ns}	Cross river South	0.815704	0	0.068^{ns}	Jigawa North-east	2.407263	1	0.004***
Ogun Central	0.480427	0	0.094^{ns}	Cross-River Central	0.170273	0	0.302^{ns}	Bauchi North	2.202587	1	0.002***
Oyo South	1.352365	2	0.006***	Ebonyi South	0.312115	0	0.074^{ns}	Yobe North	1.530074	1	0.002***
Oyo Central	1.742068	2	0.026**	Enugu North	0.503644	2	0.008***	Gombe North	0.823629	1	0.008***
Kwara Central	0.890275	0	0.066^{ns}	Enugu West	0.307916	0	0.244^{ns}	Gombe Central	0.829602	1	0.028**
Kwara South	0.721746	0	0.092^{ns}	Enugu East	0.543905	0	0.186^{ns}	Adamawa South	0.456606	0	0.212^{ns}
Osun West	0.933906	2	0.008***	Ebonyi Central	0.213703	0	0.096^{ns}	Adamawa Central	0.143101	0	0.072^{ns}
Osun East	0.90421	2	0.028***	Ebonyi North	-0.209278	0	0.338^{ns}	Adamawa North	0.093192	0	0.418^{ns}
Ogun East	1.112751	2	0.004***	Cross-River North	-0.254197	0	0.286^{ns}	Yobe South	1.336898	1	0.012**
Ekiti South	0.279504	0	0.182^{ns}	Kogi East	0.198294	0	0.34^{ns}	Yobe East	1.134799	1	0.013**
Ondo Central	0.582487	2	0.014**	Benue South	-0.034226	0	0.426^{ns}	Borno North	0.383302	0	0.332^{ns}

Senatorial Districts	LISA Indices	Cluster Type	P - Value	Senatorial Districts	LISA Indices	Cluster Type	P - Value	Senatorial Districts	LISA Indices	Cluster Type	P - Value
Ondo North	0.127022	0	0.216^{ns}	Benue North-east	-0.052246	0	0.200^{ns}	Borno South	0.113653	1	0.028**
Kogi West	0.417307	0	0.126^{ns}	Benue Northwest	-0.029074	0	0.372^{ns}	Ekiti Central	0.343983	2	0.042**
Kogi West	0.417307	0	0.126 ^{ns}	Benue Northwest	-0.029074	0	0.372 ^{ns}	Ekiti Central	0.343983	2	0.042**
Kogi Central	0.946763	0	0.064 ^{ns}	Taraba Central	0.084992	0	0.148 ^{ns}	Ekiti North	-0.129294	0	0.340 ^{ns}
Edo North	-0.062722	0	0.292 ^{ns}	Taraba South	0.073737	0	0.366 ^{ns}	Anambra South	1.433544	2	0.026**
Edo South	0.455539	0	0.192 ^{ns}	Niger South	-0.152671	0	0.081 ^{ns}	Kano North	0	3	0.002***
Edo Central	-0.156221	0	0.318 ^{ns}	Abuja	-0.278874	0	0.128 ^{ns}	Oyo North	0	3	0.002***
Delta North	0.567632	2	0.022**	Nasarawa Central	0.157945	0	0.148 ^{ns}	Osun Central	0.035184	0	0.428 ^{ns}
Delta Central	0.220928	0	0.136 ^{ns}	Nasarawa North	0.030504	0	0.358 ^{ns}	Ondo	0.517628	2	0.020***
Bayelsa West	1.832168	2	0.044**	Nasarawa South	0.030894	0	0.260^{ns}	Plateau North	-0.008957	0	0.178 ^{ns}
								Delta South	0.309415	2	0.008***

Source: The results of data analyses (2010)

Note: ***p-value < 0.01 and **p-value< 0.05, ns means not significant, 1 = HH, 2 = LL and 3 = LH (Geoda *0.9.5i* reports only the significant clusters)

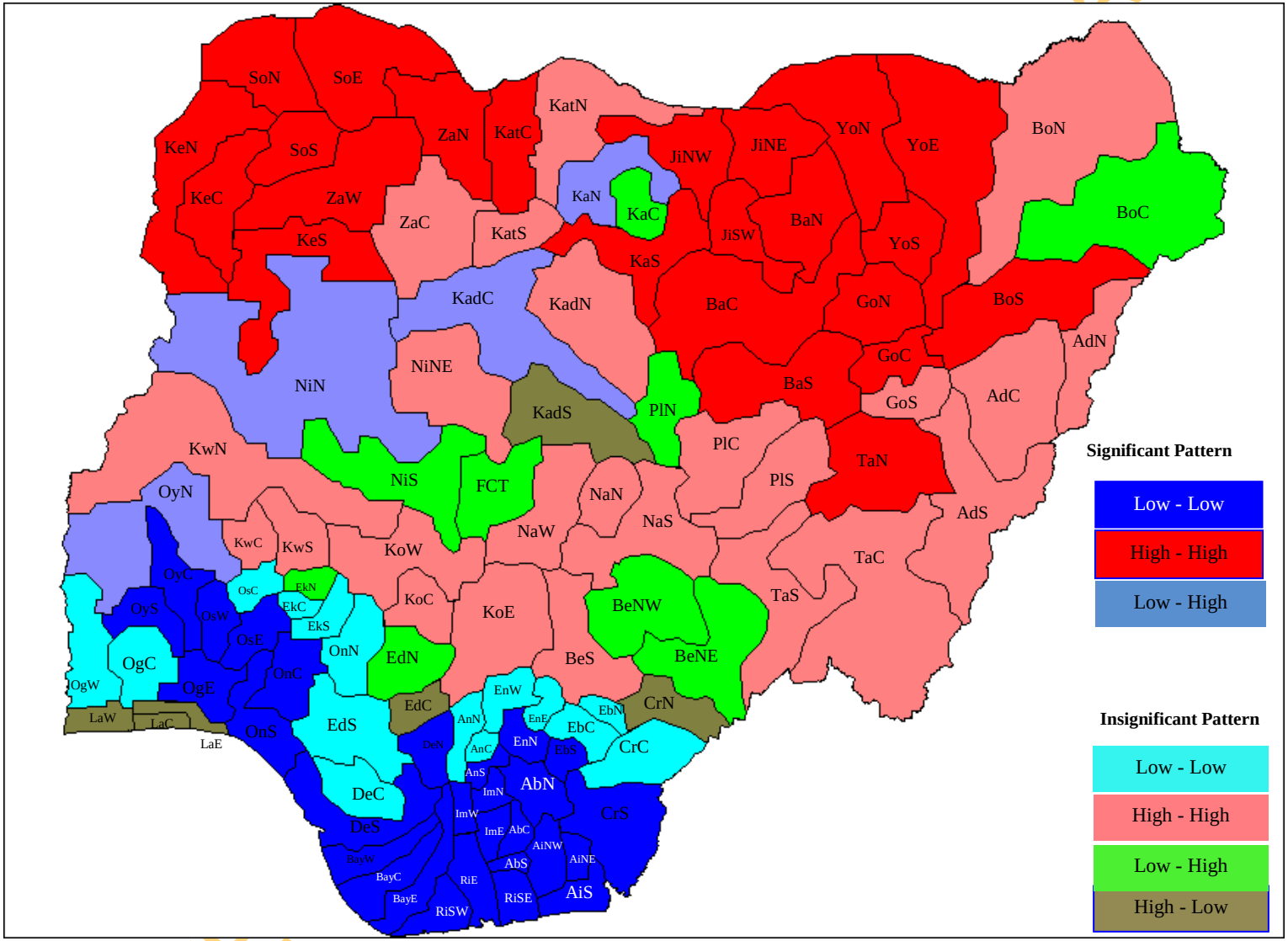


Figure 22b: LISA map for significant and insignificant spatial patterns

Source: The results of data analyses (2010)

4.11 Determinants of poverty incidence in similar spatially patterned (high – high and low–low) senatorial districts

This section identifies the factors affecting the similar spatially patterned senatorial districts. Separate factors are identified for the high-high and low-low senatorial districts. The significant effect of the spillover of poverty in Nigeria is considered in the choice of model. Hence, the spatial-lag model utilized for the whole data set that accounted for spatial dependence (see Section 4.9) is used to determine factors influencing poverty incidence in high-high and low-low senatorial districts. The high-high and low-low senatorial districts are subsets of Nigeria (109 SDs).

4.11.1 Determinants of high–high spatially patterned senatorial districts

This part explains the empirical result for factors influencing poverty incidence in statistically significant senatorial districts with high poverty rates bordered by high poverty rates senatorial districts (high-high). These senatorial districts are identified by the red colour in the LISA map. The excised map of high-high senatorial districts from LISA map of Nigeria is shown in Figure 23. These senatorial districts are found mainly in the northern part of the country.

The spatial-lag estimation for high-high senatorial districts is shown in Table 13. From the result the spatial autocorrelation coefficient (*rho)* was 0.3420. This means that 10% increase in poverty rate of SDs in high-high will bring about 3.4% increases in the poverty rate of the neighbouring SDs.

(i) Agro-ecological and environmental characteristics

Specifically, the result shows that for every 1% reduction in the number of people employed, achieved through improved technology, poverty rate is expected to reduce by 0.35% ($p<0.01$) for high-high SDs. This means that sustainable poverty reduction will be achieved with improved technology (improved planting material, availability and affordability of inorganic fertilizer, good soil management practices and sustainable irrigation practice, among others) that will bring about increased productivity. It is expected that the multiplier effect of increased agricultural productivity will absorb excess labour. Most senatorial districts in high-high grouping employed a large number of people in agriculture. This is more pronounced among the senatorial districts that are not with state capitals. For instance Borno South and Sokoto South SDs employed 79.7% and 61.2% in agriculture respectively.

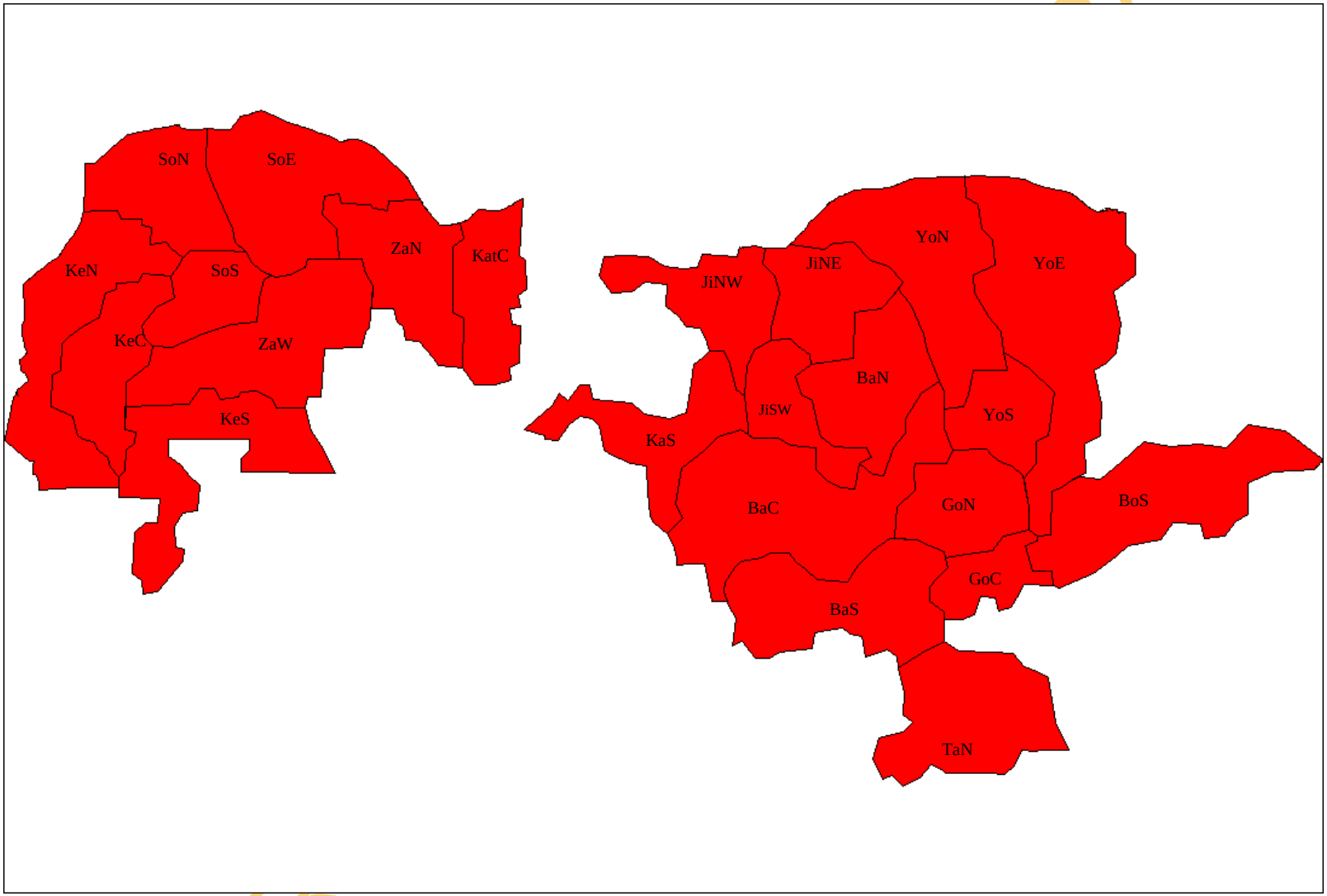


Figure 23: high–high (hot spots) spatially patterned senatorial districts
Source: The results of data analyses (2010)

Table 13: Determinants of poverty incidence in low-low and high-high SDs using spatial-lag techniques

Variables	Spatial-lag model-maximum likelihood estimation (low-low)	Spatial-lag model-maximum likelihood estimation (high-high)
Agro-ecological and Environmental Characteristics		
PEA	0.26531(0.08701)***	0.352097(0.052495)***
AVRA	-0.015143(0.003911)***	-0.017499(0.0070769)***
LOGP	0.13493(0.034321) ***	-0.15334 (0.063212)**
SOC	1.23109(4.17198)^{ns}	-5.20147(1.48753)***
CBSD/ILBSD	-15.7029(4.957032)***	-13.3856 (2.93743)***
SUER/SUDE	-19.9244(3.8825)***	-3.1688 (2.4846)^{ns}
Demographic characteristics		
FEH	-1.0374(0.20740) ***	-0.20277(0.0176382)***
MAH	0.773441(0.22314) ***	0.38514(0.049460)***
LA	-0.314257(0.1863123)*	-1.14437(0.11018)***
HS	3.870628 (1.745633)**	5.4767(3.85737)***
Infrastructural Characteristics		
CPELECT	0.13905 (0.06442)**	-0.26827(0.195534)^{ns}
SAS	-0.095845 (0.051569)*	-0.408176(0.036651)***
SWS	-0.13635(0.072805)*	-0.332549(0.030005)***
AHF	-0.344052(0.10811)***	-0.274043(0.082740)***
PNE	0.0799(0.4116)^{ns}	4.5549(3.8492)^{ns}
SNE	0.5922(0.3669)^{ns}	-6.6022(5.3888) ^{ns}
Sociopolitical and Economic Characteristics		
PCOM	-8.67e-005(1.53e-005)***	1.39e-004 (51.64e-005)***
SDIC	-10.9843(3.54083)***	-9.0881(1.08203)***
PIC	-0.015019(2.9533)^{ns}	1.7688(1.19322) ^{ns}
NYSNAS	-11.7024(2.9032)***	-6.5855(1.1850)***
HMA	-1.3944(0.341775)**	-0.8860(0.1679)***
ACF	-0.5731(0.2664)***	-0.8510(0.1855)***
Constant	225.833(34.4887) ***	228.5118(42.5780)***
Pseudo R^2	0.8765	0.8944
Lag Parameter (rho)	0.2114	0.3420
Log Likelihood	-72.7904	-30.9423
Akaike info criterion	189.581	105.885
Schwarz criterion	218.889	130.866

Source: The results of data analyses (2010)
Note: ***p-value < 0.01, **p-value< 0.05, *p-value < 0.10, ns means not significant.

The high percentages do not translate to a reduction in poverty incidence; rather, farming is seen as a harbinger of poverty for most of the participants, particularly the small-scale farmers who barely make enough income to cater for their daily needs (Akinyosoye, 2005).

Furthermore, the coefficient of the average annual rainfall is negative and significant ($p<0.01$). This result shows that for every one millimeter increase in average annual rainfall, poverty rate is expected to reduce by 0.14%. Rain as a source of water is required for farming activities, household uses and replenishment of water in dams for irrigation of crops and fish-rearing during the dry season. Generally, the high-high senatorial districts depend on irrigation for farming activities because of the short rainy season. The length of growing period is naturally short in high-high SDs (average of 116.3days) but with irrigation, farming is made possible all year round. For every one day increase in average length of growing period (days), 0.15% reduction is expected in poverty rate. The coefficient of soil classification is negative and significant ($p<0.01$). The result further reveals that approximately 70% of the senatorial districts in high-high spatial pattern have good soils that range from high productivity soil to low productivity soil. With good soil management practices, appropriate technology and availability of water all year round through irrigation, the high-high senatorial districts have potentials for increased agricultural productivity.

The coefficient of international land bordered SDs was negative and significant ($p<0.01$). With provision of basic infrastructures and proper policing of these land borders to reduce illegal business activities; reduction in poverty through legal means in these SDs is achievable. The result of the spatial-lag estimation for high-high SDs supports the initial postulate that as the percentage of literate adult increases, a reduction in poverty rate is more likely. SDs in high-high spatial pattern have low percentage of literate adult (17.4%). The result of this study revealed that increased investment in human capital (1% increase in percentage of literate adult) is expected to reduce poverty by 1.14%. Investment in human capital through increase in primary, secondary and tertiary school enrolment is expected to increase the percentage of literate adult investment in the future.

(ii) Demographic characteristics

The high-high spatially patterned SD is characterized by high average household size (7.6). The result of spatial-lag analysis shows that for every unit increase in average household size, the poverty rate is expected to increase by 5.5% ($p<0.01$). This finding agrees with World Bank (2003), Mason and Lee (2004) and Mahbub (2004) that larger households

tend to be poorer, particularly those with many young children. Overall, each additional child under six years old lowers total consumption by 23% (higher in rural areas than urban); each additional member from age 7-24 lowers total consumption by 17%. The magnitude of these values suggests that increased awareness and use of family planning methods could have a significant effect on reducing poverty.

(iii) Infrastructural characteristics

The coefficient for percentage of households connected to public electricity is negative but not significant. The insignificance of the coefficient of this variable may be attributed to the fact that connection to public electricity is different from regular supply of public electricity. Regular supply of public electricity is an important basic infrastructure for the economic growth of any nation. Its requirement by small, medium and large scale industries is enormous. Artisans like welders, hair dressers, electrician, 'Radionics'; computer operators, among others, may not operate without electricity. The need for electricity in our homes for domestic use as well as for security (lightening the environment) makes it indispensable. The result reveals that 28.5% of the households in high-high SDs are connected to public electricity compared to 62.3% in low-low SDs.

However, the coefficients of access to safe sanitation, safe water sources and access to health facilities are negative and significant ($p<0.01$). The result shows that for every one per cent increase in household access to safe sanitation, poverty rate is expected to reduce by 0.41% while one per cent increase in household's access to safe water sources and health facilities is expected to reduce poverty rate by 0.33% and 0.27% respectively. The study shows that 41.4% households in high-high senatorial districts have access to safe water sources; mostly through boreholes compared to approximately 50% households' accessibility in low-low senatorial districts (see Appendices 7 and 8). Access to health facilities is approximately 47% in high-high senatorial districts. Also, households in high-high SDs have less access to safe sanitation (35.68%) compared to low-low SDs (46.63%). These results showed that households having access to safe sanitation, safe water sources and health facilities are less likely to be poor. These findings on infrastructures in high-high spatially-patterned senatorial districts agree with Thomas and Canagarajah (2002) that the slower growth in the northern zone may not be unconnected with long-standing lags in provision of health, education and other social services which resulted in proportionately more poor in the north.

(iv) Sociopolitical and economic characteristics

The coefficient of household membership of associations (the proxy for social capital index) is negative and statistically significant ($p<0.01$). This result reveals that for every one per cent increase in household membership of associations, a 0.89% reduction is expected in poverty rate. This finding agrees with Rupasingha *et al.* (1999, 2000) that social capital has a significant positive effect on the rate of per capita income growth which is a precursor to reduction in poverty rate. Average household membership of associations in high-high SDs is 67.6% compared to 94.3% in low-low SDs.

The argument made at the beginning of this study that political competition is positively associated with poverty is confirmed by the empirical results. The result shows that the political competition variable is positive and significant in high-high SDs. This means that SDs with high election votes deviation are politically less competitive (vote outcomes skewed towards a single party), also have higher family poverty rates. Specifically, the result revealed that election votes deviation value was smaller in high-high SDs (62452.28) compared to low-low SDs (84491.04). Hence, the high-high SDs are politically more competitive than the low-low SDs (see Appendices for 7 and 8). Opposition parties are allowed to serve as check and balance to the parties controlling the senatorial district in high-high SDs. However, the high political competitiveness (small election votes deviation) of the high-high SDs did not translate to poverty reduction as expected. This may be attributed to low adult literacy level (17.4%) and poor basic infrastructure.

The coefficient estimate for the number of years senators represent each SD (NYSNAS) is negative and statistically significant ($p<0.01$). This means that for every additional year a senator represents a SD in high-high spatially-patterned grouping, the poverty rate is expected to reduce by 6.6%. The result supports the initial postulate that the longer a senator represents a senatorial district, the more likely the elected representative attracts long-term investments – precursor for economic growth. The descriptive analysis reveals that 70% of the senators in high-high SDs spent one term while approximately 30% were on second term (Appendix 10). The high poverty incidence (82.6%) in the subgroup may be attributed to small percentage of second term senators which do not allow for continuity. Also, Rauch (1995) argued that elected officials' desire to stay in power leads them to allocate public funds to the delivery of current local consumption services rather than

to long term infrastructure development or investments. In this manner, elected officials gain currency with local voters but fail to address long-term poverty problems.

Furthermore, the result supports the initial postulate that as the percentage of household access to credit facilities increases, poverty rate is likely to reduce. Specifically, one per cent increase in household access to credit facilities is expected to bring about 0.85% reduction in poverty rate in high-high spatially-patterned senatorial districts. Unless the poor can borrow, they are likely to remain trapped in poverty. The study reveals a smaller access to credit among households in high-high SDs (6.79%) compared to 12.03% in low-low SDs (see Appendices 7 and 8). According to IFAD (2006), the people who have been able to borrow have often seen their incomes rise and their future transformed.

Generally, with the average poverty rate of 82.6% (high-high senatorial districts), a consistent reduction in this grouping based on the aforementioned significant factors will go a long way in reducing the national average poverty rate in Nigeria.

4.11.2 Determinants of low – low spatially patterned senatorial districts

This section explains the factors influencing poverty incidence in statistically significant senatorial districts with low poverty rates bordered by low poverty rates senatorial districts (low-low). Spatial-lag model that accounted for spatial dependence (spillover of poverty) was used for the analysis. These senatorial districts are identified by the dark-blue colour in LISA map. The excised map of low-low senatorial districts from the LISA map of Nigeria is shown in Figure 24. These senatorial districts are found mainly in the southern part of the country.

The spatial-lag estimation for low-low senatorial districts is shown in Table 13. From the result, the spatial autocorrelation coefficient (*rho)* was 0.2114. This means that 10% increase (decrease) in poverty rates of SDs in low-low will bring about 2.1% increases (decreases) in the poverty rates of the neighbouring SDs.

(i) Agro-ecological and environmental characteristics

The study reveals that the average poverty rate in low-low spatially-patterned SDs is 31.8%. Among the variables under agro-ecological and environmental characteristics, the coefficients of percentage of people employed in agriculture, average annual rainfall, coastal-bordered SDs and susceptibility to water erosion are not only statistically significant but the signs conform to the *a priori* expectations. Specifically, the result shows that for every one

per cent reduction in the percentage of people employed in agriculture, poverty rate is expected to reduce by 0.27%.

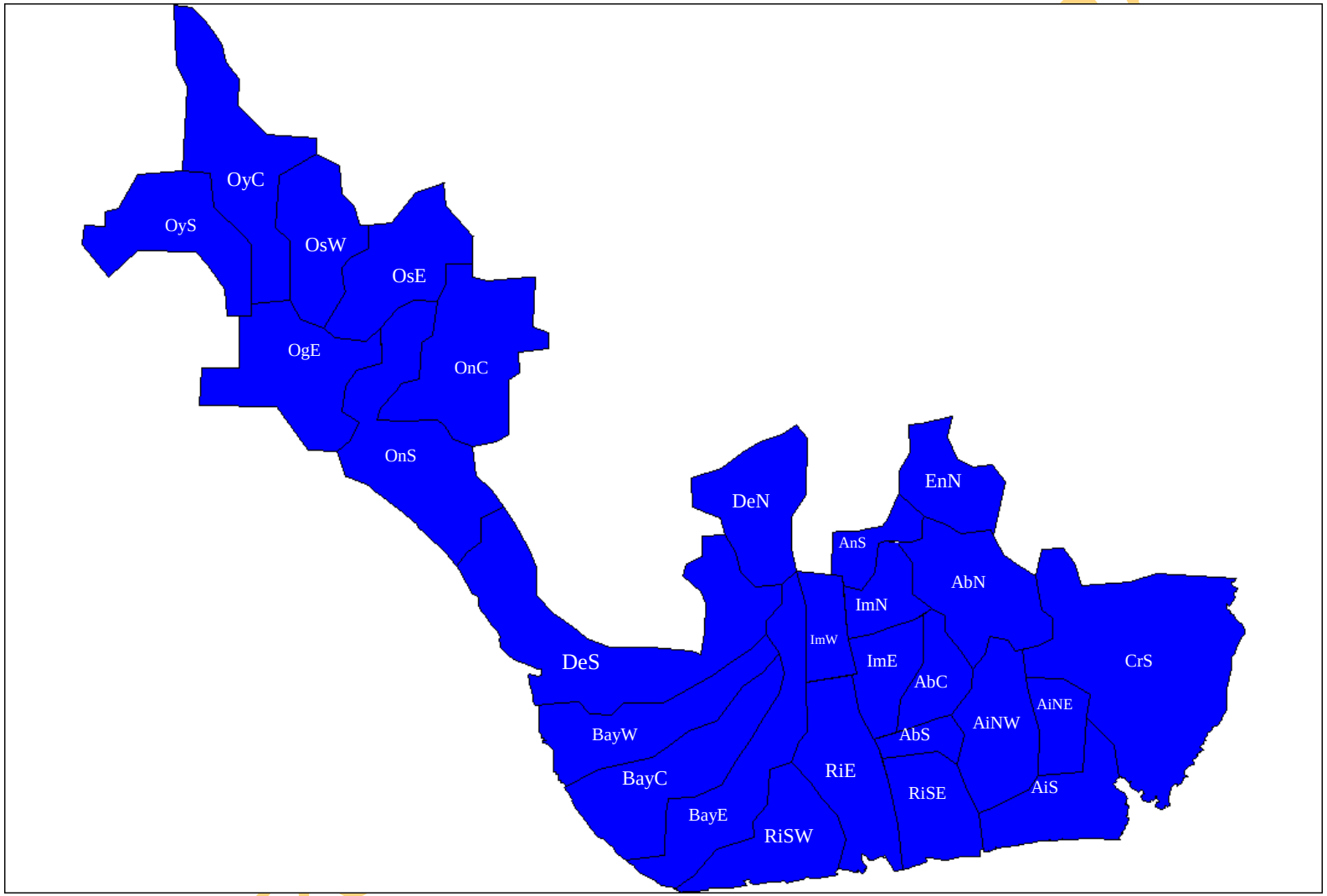


Figure 24: Low-low (cold spots) spatially patterned senatorial districts
Source: The results of data analyses (2010)

This means that in order to meet up with the food and raw material requirement in low-low SDs, productivity needs to be enhanced through improved technology and not by increasing the number of people employed in agriculture. Despite the higher percentage of people employed in agriculture in low-low SDs (44.4%) compared to high-high SDs (42.4%) as revealed by the study, improved productivity will further help to reduce average poverty rate in this spatial pattern (see Appendices 7 and 8). The low productivity of agriculture in the low-low SDs is confirmed by food shortages experienced in the southern part of the country during the recent strike embarked upon by the transporters of agricultural product from the north to the south.

Furthermore, the result posited that for every one millimeter increase in the average annual rainfall, poverty rate is expected to reduce by 0.015%. This result is in order bearing in mind the rain-fed nature of Nigerian agriculture. The significance of the coefficient of coastal bordered SDs means that poverty rate is expected to reduce by 15.7% among the coastal-bordered SDs. The neighbouring SDs are expected to benefit from the poverty reduction through spillover. Location of sea ports in coastal towns encourages commerce and industries to thrive in the immediate vicinity as well as the neighbouring SDs. The coefficient of the length of growing period is significant but the sign did not conform to *a priori* expectation. The coefficient of soil classification is positive and insignificant ($p>0.10$). This may not be unconnected with almost 48% of the SDs in low-low having bad soil (soil of very low productivity and no productivity) compared to 32% in high-high SDs.

(ii) Demographic characteristics

Coefficients of female head of household ($p<0.01$), percentage of literate adult ($p<0.10$) and average household size ($p<0.01$) are statistically significant; the signs also follow the *a priori* expectations. The result showed that for every one per cent increase in female head of household, poverty rate is expected to reduce by 1.04% (NBS, 2005, Swaminathan and Findeis (2004). Also, for every one per cent increase in literate adult, poverty rate is expected to reduce by 0.31%. The average percentage of literate adult in low-low senatorial districts is significantly higher than in high–high SDs (see Table 14). This wide gap is the result of past investments in education in the geographical grouping (low-low). Moreover, the result on the average household size ($p<0.05$) reveals that as it increases 1%, the poverty rate is expected to increase by 3.9% (World Bank, 2003; Mason and Lee, 2004; Mahbub, 2004).

(iii) Infrastructural characteristics

The coefficient estimate of percentage of household connected to public electricity is statistically significant ($p<0.05$) but the sign did not agree with *a priori* expectation. The coefficients of access to safe sanitation ($p<0.10$), safe water sources ($p<0.1$) and access to health facilities ($p<0.01$) are negative and statistically significant. Specifically, the result shows that for every one per cent increases in household access to safe sanitation and safe water sources, poverty rates are expected to reduce by approximately 0.1% and 0.14% respectively. Also, 0.34% reduction in poverty rate is expected from every one per cent increase in households having access to health facilities. From the foregoing, it means that households having access to these basic infrastructures are not likely to be poor. This finding agrees with O'Regan and Wiseman (1990) that the prospect for leaving poverty are partly influenced by the neighbourhood potable water and good health services, and its social environment, for example, the values of local communities affect the individual aspiration and expectations. Households in towns with more access to basic utility services are significantly less likely to be poor.

(iv) Sociopolitical and economic characteristics

Household membership of association (social capital) is another statistically significant factor ($p<0.05$) in low-low spatially patterned SDs. The result shows that for every one per cent increase in household membership of association, 1.39% decrease in poverty rate is expected. The percentage of household's membership of associations is higher in low–low SDs (94.3%) compared to high–high SDs (68.2%) (see Appendices 7 and 8). Religious, social, tribal and professional associations are common in this geographical grouping. This submission agrees with Moser (1996), Narayan (1997) and Schafft and Brown (2000) that those communities endowed with arich stock of social networks and civic associations have been shown to be in a stronger position to confront poverty and vulnerability, and resolve disputes.

The coefficient of political competition is statistically significant ($p>0.01$) but the sign did not agree with *a priori* expectation. However, the higher value of election votes deviation in low-low SDs (84491.04) is an indication that there is less political competition. This means that the voting pattern skewed towards a single party which may not tolerate opposition. Moreover, the result reveals that senatorial districts with state capital have higher poverty rate. This may be attributed to migration of people to state capitals and adjoining

geographical areas where basic infrastructures are concentrated and opportunities exist for better life. Like the high-high SDs, the coefficient of the number of years spent in the national assembly by senators is significant ($p<0.01$) but the expected reduction in poverty rate is higher in low-low SDs (11.7%) for every additional year spent. Also, the result posited that one percent increase in household's access to credit facilities leads to 0.57% reduction in poverty rate, all things being equal. An improvement in access to credit by households may further reduce the average poverty rate in this subgroup (low-low). Table 14 shows that with the exception of employment in agriculture, access to safe water sources and access to health facilities, all other variables showed greater significant differences between low-low and high-high spatially patterned senatorial districts. This result reveals a gap in basic infrastructures, demographic, agro-ecological and socioeconomic factors influencing poverty in low-low and high-high SDs.

Table 14: Results of difference of means comparing selected variables between high- high and low-low senatorial districts

Variables	Parameter	Low - Low	High - High	Z-Stat	P-value	
					One-tail	Two-tail
Percentage of Literate Adult	*Average*	72.81785	17.4208	23.9418	2.81E-08***	5.6183E-28***
	variance	(68.5593)	(66.7966)			
Access to Health Facilities	*Average*	46.2357	46.9913	-0.17488	0.43099^{ns}	0.86199^{ns}
	variance	(385.1216)	(112.999)			
Access to Public Electricity	*Average*	62.26428	28.6500	8.52355	1.80E-11***	3.6031E-11***
	variance	(253.6409)	(142.8702)			
Household Membership of Associations	*Average*	94.2500	68.1591	8.4549	3.09E-09***	6.1743E-09***
	variance	(30.7729)	(185.3206)			
Length of Growing Season (Days)	*Average*	266.8357	116.2727	14.6142	2.26E-18***	4.1596E-18***
	variance	(2230.4742)	(582.5887)			
Access to Credit Facilities	*Average*	12.1214	7.0409	2.5906	0.00633***	0.01265**
	variance	(55.6980)	(40.8482)			
Average Household Size	*Average*	5.5036	7.57728	-6.7165	3.39E-08***	6.78444E-08
	variance	(0.7722)	(1.4904)			
Employment in Agriculture (%)	*Average*	43.575	43.900	-0.08337	0.46695^{ns}	0.933904^{ns}
	variance	(204.12)	(173.88)			
Primary School Net Enrollment	*Average*	80.739285	36.918181	17.3087	3.96E-17***	7.9239E-17***
	variance	(29.9654)	(117.4682)			
Secondary School Net Enrollment	*Average*	60.6535	20.25217	21.2187	2.2683E-25***	4.5366E-25***
	Variance	(40.4344)	(50.1698)			
Access to Safe Water Sources	*Average*	49.732142	42.572727	1.30273	0.09944^{ns}	0.198888^{ns}
	variance	(435.04744)	(322.6335)			

Source: The results of data analyses (2010)

Note: ***p-value < 0.01, **p-value< 0.05, *p-value < 0.10, ns means not significant

4.12 Probability that a household chosen at random will be poor per SDs

In this section, the result of the Spatial Probit analysis is discussed. Unlike Ordinary Probit analysis, Spatial Probit addresses the problem of statistically significant spatial dependence (spillover) of variables. Also, the probability that a household will be poor in each senatorial district, state and geopolitical zone is discussed.

Markov Chain Monte Carlo (MCMC) method was used to estimate the Spatial Probit model to test the influence of individual variable on the probability that a household chosen at random from a senatorial district will be poor as well as to predict the probability of being poor. In addition, traditional Probit model was estimated and the results compared with Spatial Probit model. The Spatial Probit model reveals the significant presence of spatial dependence (Spatial-lag). Failure to account for the significant presence of dependence (Spatial-lag) may result in parameter estimates being biased and inconsistent. The result shows that Spatial-lag parameter (*rho*) is 0.34 and it is statistically significant ($p<0.05$). This means that a 10% increase in poverty rate in a senatorial district will result in 3.4% increase in poverty incidence of neighbouring senatorial districts.

The Spatial Probit result reveals that an increase in average household size increases the probability of a household continuously being in poverty by 0.52. The result also showed that one percentage increase in the number of people employed in agriculture increases the probability of a household remaining poor by 0.092. Moreover, one per cent increase in household membership of associations reduces the probability of a household being poor by 0.18. One per cent increase in female headship of household per SD reduces the probability of being poor by 0.12 (see Table 15).

The predicted probability of a household being poor per senatorial district from the model is shown in Table 16. The table shows that the probability of a household being poor is certain in Jigawa Northeast, Kebbi Central, Kebbi North, Kebbi South, Kwara North and Sokoto South. These senatorial districts are characterized by high poverty rate; low percentage of literate adult, large household size and low access to basic amenities.

The probability of a household being poor is lowest in Akwa Ibom North-west. Also Akwa Ibom has the lowest probability of a household being poor among the states. It is, however, certain that a household chosen at random in Kebbi State will be poor. The probability that a household chosen at random will be poor is very low in the Federal Capital Territory, Cross River, Imo and Oyo State. With the exception of Lagos State, the probability of being poor is low in the southern part of Nigeria. The high probability of a household being poor in Lagos State may be attributed to a spillover of poverty from other parts of the

country (see Table 17). Figure 25 shows that among the six geopolitical zones, the north-west has the highest probability of being poor (0.7023). This is in agreement with the fact that the zone has the highest poverty rate in Nigeria.

Among the southern geopolitical zones, the south-west has the highest probability that a household chosen at random will be poor (0.1083). This may not be unconnected with high poverty rate in Lagos state due to spillover. Generally, the low probability of being poor among the geopolitical zones in the south may be attributed to fairly developed infrastructural facilities, high adult literacy, small household size and awareness on the importance of social capital. Moreover, the result reveals that the probability that a household chosen at random from the high-high (hot spots) and low-low (cold spots) senatorial districts are 0.77 and 0.084 respectively.

Given the number of households in each senatorial district, these values will make it possible to determine the number of poor and non-poor households in each senatorial district.

Table 15: Result of Bayesian Spatial Autoregressive Probit analysis

Bayesian Spatial Autoregressive Probit Analysis Result				
Variable	*Coefficient*	*Std. Error*	*z-value*	*p-value*
PCom	-0.000019	0.000011	-1.72727	0.08364*
PiC	4.658348	1.371836	3.395703	0.000068***
SdIC	-2.080466	0.87527	-2.37694	0.01732**
NYSNAS	-0.277776	0.664932	-0.41775	0.67448^{ns}
ILBSD	0.584057	0.933138	0.625906	0.5287^{ns}
CBSD	3.124800	1.72532	1.811142	0.0703*
PoR	0.242791	0.034505	7.036401	0.0000002***
SwS	0.016561	0.02476	0.668861	0.50286^{ns}
PnE	-0.012322	0.057621	-0.21385	0.83366^{ns}
SnE	0.101505	0.075552	1.343512	0.18024^{ns}
AHF	-0.015628	0.025672	-0.60876	0.54186^{ns}
MaH	-0.018945	0.046946	-0.40355	0.68916^{ns}
FeH	-0.121193	0.037547	-3.22777	0.00124***
CpElect	-0.023975	0.022054	-1.0871	0.27572^{ns}
SaS	-0.038132	0.017442	-2.18622	0.01426**
AvRa	-0.000805	0.001242	-0.64815	0.5157^{ns}
HMA	-0.183248	0.055672	-3.291565	0.001***
LoGs	-0.078086	0.019402	-4.02464	0.000000***
ACF	-0.343128	0.074562	-4.60192	0.000000***
SuDe	-8.112599	1.39274	-5.82492	0.000000***
PEA	0.032799	0.015744	2.08327	0.03752**
HS	0.521634	0.287877	1.81188	0.0703*
SOP	0.960809	0.58023	1.655911	0.09692*
LA	-0.091651	0.046672	-1.96373	0.0496*
Rho	0.341915	0.145942	2.342814	0.01928**

Source: The results of data analyses (2010). Note: ***p-value < 0.01, **p-value< 0.05, *p-value < 0.10, ns means not significant

Table 16: Predicted probability that a household in a senatorial district will be poor

SN	Senatorial Districts	Probability	SN	Senatorial Districts	Probability	SN	Senatorial Districts	Probability
1	Abia Central	1.14E-07	37	Ekiti Central	0.00310318	73	Lagos West	0.345862
2	Abia North	0.00758028	38	Ekiti North	0.00019287	74	Nasarawa Central	0.999995
3	Abia South	1.92E-09	39	Ekiti South	1.10E-05	75	Nasarawa North	0.404345
4	Adamawa Central	0.218752	40	Enugu East	5.19E-09	76	Nasarawa South	0.206013
5	Adamawa North	0.854767	41	Enugu North	0.0472866	77	Niger East	0.999183
6	Adamawa South	0.610816	42	Enugu West	0.0382734	78	Niger North	0.899981
7	Akwa Ibom North-east	1.94E-09	43	FCT	1.19E-07	79	Niger South	9.68E-05
8	Akwa Ibom North-west	1.41E-17	44	Gombe Central	0.877642	80	Ogun Central	8.77E-10
9	Akwa Ibom South	7.53E-13	45	Gombe North	0.0313938	81	Ogun East	0.0748967
10	Anambra Central	0.0965232	46	Gombe South	0.999454	82	Ogun West	0.134014
11	Anambra North	2.06E-07	47	Imo East	7.07E-11	83	Ondo Central	0.00249266
12	Anambra South	7.58E-08	48	Imo North	2.91E-05	84	Ondo North	0.000173224
13	Bauchi Central	0.602958	49	Imo West	4.41E-08	85	Ondo South	0.279269
14	Bauchi North	0.871195	50	Jigawa North-east	1	86	Osun Central	0.0106269
15	Bauchi South	0.844533	51	Jigawa North-west	0.999869	87	Osun East	9.98E-08
16	Bayelsa Central	5.81E-12	52	Jigawa South-west	0.91004	88	Osun West	1.55E-05
17	Bayelsa East	8.09E-14	53	Kaduna Central	0.0469754	89	Oyo Central	5.02E-08
18	Bayelsa West	5.42E-06	54	Kaduna North	0.998711	90	Oyo North	6.13E-05
19	Benue North-east	0.0198425	55	Kaduna South	0.44349	91	Oyo South	1.00E-09
20	Benue North-west	8.86E-05	56	Kano Central	0.0138975	92	Plateau Central	0.165189
21	Benue South	0.441514	57	Kano North	0.549305	93	Plateau North	0.598566
22	Borno Central	0.00247596	58	Kano South	0.983627	94	Plateau South	0.110508
23	Borno North	0.908906	59	Katsina Central	0.65235	95	Rivers East	6.06E-14
24	Borno South	0.999237	60	Katsina North	0.999215	96	Rivers South-east	0.0118132
25	Cross-River Central	1.18E-05	61	Katsina South	0.999983	97	Rivers South-west	0.00921273
26	Cross-River North	0.000445377	62	Kebbi Cental	1	98	Sokoto East	0.999999
27	Cross-River South	3.89E-06	63	Kebbi North	1	99	Sokoto North	0.00272122
28	Delta Central	1.25E-09	64	Kebbi South	1	100	Sokoto South	1
29	Delta North	1.93E-08	65	Kogi Central	0.995954	101	Taraba Central	0.0121783
30	Delta South	0.00977132	66	Kogi East	0.999932	102	Taraba North	0.040544
31	Ebonyi Central	0.0344705	67	Kogi West	0.997107	103	Taraba South	0.00275348
32	Ebonyi North	7.88E-09	68	Kwara Central	0.993799	104	Yobe East	0.982193
33	Ebonyi South	4.71E-05	69	Kwara North	1	105	Yobe North	0.980433
34	Edo Central	0.717864	70	Kwara South	0.893904	106	Yobe South	0.966779
35	Edo North	0.115571	71	Lagos central	0.45853	107	Zamfara Central	0.122316
36	Edo South	6.41E-10	72	Lagos East	0.640613	108	Zamfara North	0.724993
						109	Zamfara West	0.300894

Source: The results of data analyses (2010)

Table 17: Predicted probability of a household being poor in a state including FCT

SN	State	Predicted Probability	SN	State	Predicted Probability
1	Abia	0.002526799	20	Kano	0.515609833
2	Adamawa	0.561445	21	Katsina	0.883849333
3	Akwa Ibom	6.45698E-10	22	Kebbi	1
4	Anambra	0.032174494	23	Kogi	0.997664333
5	Bauchi	0.772895333	24	Kwara	0.962567667
6	Bayelsa	1.8061E-06	25	Lagos	0.481668333
7	Benue	0.153815025	26	Nasarawa	0.536784333
8	Borno	0.636872987	27	Niger	0.63308694
9	Cross-River	0.000153693	28	Ogun	0.0696369
10	Delta	0.003257114	29	Ondo	0.093978295
11	Ebonyi	0.011505883	30	Osun	0.003547505
12	Edo	0.277811667	31	Oyo	2.04396E-05
13	Ekiti	0.001102361	32	Plateau	0.291421
14	Enugu	0.028520002	33	Rivers	0.007008643
15	FCT	0.000000119	34	Sokoto	0.667573407
16	Gombe	0.636163267	35	Taraba	0.018491927
17	Imo	9.73019E-06	36	Yobe	0.976468333
18	Jigawa	0.969969667	37	Zamfara	0.382734333
19	Kaduna	0.496392133			

Source: The results of data analyses (2010)

NB: The value of one for Kebbi State means that it is certain that any household randomly selected will be poor

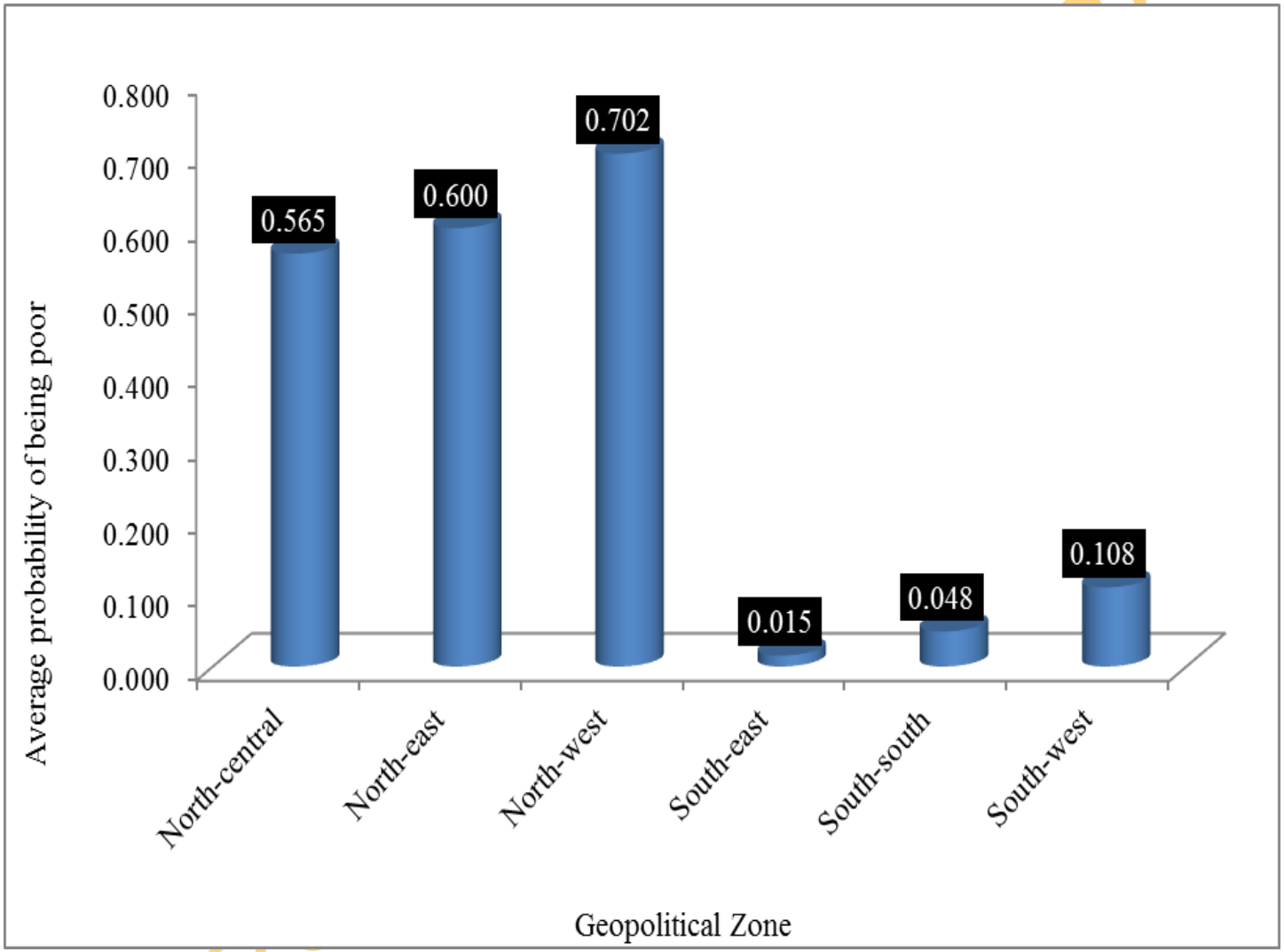


Figure 25: Average probability of being poor in a geopolitical zone
Source: The results of data analyses (2010)

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

This study examined the spatial concentration of poverty and its determinants. To achieve these objectives, georeferenced secondary data on the socioeconomic characteristics of households in 109 senatorial districts and environmental characteristics of the senatorial districts were used. The data were analysed using descriptive statistics, standard Spatial Regression, Local Indicator of Spatial Association (LISA) and Spatial Probit regression.

5.1 Summary of major findings

The landscape of poverty in Nigeria is a result of many forces acting independently and interactively to produce a set of phenomena that manifested in economic realities of wealth co-existing with poverty. This explains why poverty in Nigeria is heterogeneous and showing a wide range of spatial variability. The individual geographic units that made up the country are not independent and isolated entities, as individual entity is surrounded by other geographical units which interact with one another. This further explains why the various poverty reduction programmes initiated by government over the years have failed.

The study was pursued to find out how (and which) spatial factors are related to poverty and how this varies across Nigeria's diverse landscapes. Specifically, how much of the variation in poverty incidences across Nigeria can be explained by agro-ecological, sociopolitical, demographic and spatial factors existing in the Nigerian environment? The study also sought how results of the study can be used to design poverty alleviation strategy that is based on spatial contiguity of geographical units, in this case, senatorial districts.

The result of the analysis showed a progressive decline in annual rainfall and length of growing period from the south to the north. The longer the average annual rainfall, the longer the growing period. However, there are exceptions to this relationship in the northern part of the country where short cropping period brought about by inadequate rainfall is complemented with irrigation. Average annual rainfall in the south's senatorial districts ranges from 1491.61mm in the south-west geopolitical zone to 2290.83mm in the south-south geopolitical zone. In the north's senatorial districts, annual rainfall ranges from 717.14mm in the north-west geopolitical zone to 1124.84mm in the north-central geopolitical zone.

The study revealed that 65% of the total senatorial districts employed less than 50% of its inhabitants in agriculture. Only south-south senatorial districts employed more than

50% of its inhabitants in agriculture; other geopolitical zones' senatorial districts employed less than 50%. Senatorial districts in the south-west geopolitical zone recorded the lowest percentage (26.9%) of people employed in agriculture.

In addition, the result of the analysis affirmed that 12% of the senatorial districts are bordered by the Atlantic Ocean, some of which harbour sea ports for importation and exportation of goods. The average poverty rate of coastal-bordered senatorial districts is the lowest (35.9%) among the geographical locations. Twenty per cent (20%) of the senatorial districts are international land-bordered. Most of these land bordered countries (Chad and Niger) are among the poorest countries in the world (UNDP report, 2005). The average poverty rate of international land-bordered senatorial districts is the highest (71.4%) among the geographical locations. Moreover, 68% of the senatorial districts are land-locked. The average poverty rate of these senatorial districts is estimated to be 55.1%. This value is lower than the poverty rate of international land-bordered senatorial districts (71.4%) but higher than that of the coastal-bordered senatorial districts (36.9%).

The average household size of the senatorial districts in the southern part of the country (South-west, South-east and South-south geopolitical zones) ranges from 4.0 in Bayelsa Central and Ondo South to 7.4 in Ebonyi Central senatorial district. The average household size in the northern senatorial districts (North-west, North-east and North-central geopolitical zones) ranges from 5.1 in Niger North senatorial district to 11.6 in Taraba Central senatorial district. This finding showed that the average household size increases from the south to the north.

Furthermore, the percentage of literate adult among the senatorial districts in the south (South-west, South-east and South-south geopolitical zones) ranges from 50.2% in Ogun west SD to 87.6% in Lagos Central senatorial district while in the north's senatorial districts (North-central, North-west and North-east geopolitical zones), the percentage literate adult ranges from 6.6% in Borno north senatorial district to 77.5% in Federal Capital Territory senatorial district. The result showed that the literate adult (%) decreases northwards with few exceptions in Plateau North (73.4%) and Kano Central (44.2%) senatorial districts.

The result of the analysis affirmed that the senatorial district with lowest poverty rate (Bayelsa West senatorial district 8.1%) has the lowest access to safe water sources (5%) while Abia South senatorial district has the highest household's access to safe water (95.5%). Specifically, senatorial districts in South-west geopolitical zone have the highest household's access to safe water sources (70%). This is followed by North-west (50.6%) and

North-central (47.8%) senatorial districts. North-east senatorial districts have the lowest household's access to safe water sources (28.9%)

In addition, the study revealed that the average access to health facilities in all the senatorial districts is 51.6%. Bayelsa West senatorial district has the lowest access to health (9.9%) while Osun Central senatorial district has the highest access to health facilities (91.6%). Southeast senatorial districts have the lowest access to health facilities (34.3%) while the south-west has the highest access to health facilities (70.8%). Also, households in South-west senatorial districts' geopolitical zone have the highest access to safe sanitation (54.6%); this is followed by the south-south (46.8%) and the south-east (46.4%) respectively. The household in North-west senatorial districts' geopolitical zone has the lowest access to safe sanitation (35.7%). Results showed that the households in the south (South-west, South-south and South-east geopolitical zones) with the lower poverty rate compared to the north have the higher access to safe sanitation.

The study showed that the average percentage of households that belong to associations (professional, religious and social) in all the senatorial districts is 83.7%. Zamfara North senatorial district has the lowest household membership of associations (52.7%) while Bayelsa West, Imo East, Cross River South and Anambra South senatorial districts have the highest social capital indices (100%).

The finding affirmed that the senatorial districts in the south-east geopolitical zone has the lowest election votes deviation (47709.31). This is followed by the north-east (51878.33) and the north-central (72368.88) geopolitical zones respectively. Senatorial districts in the south-south geopolitical zone have the highest election votes deviation (107054.00). A high election votes deviation indicates a politically less competitive geopolitical zones (vote outcomes skewed towards a single party). Political competition is tied to economic performance of geopolitical zones. The low poverty rate in the south-east geopolitical zone (29.9%) may be attributed to the low election votes deviation which indicates high political competition among political parties. The average election vote's deviation for low-low senatorial districts (110024.48) is higher than that of high-high senatorial districts (88379.90). This indicates that political competition is higher in high-high senatorial districts while low-low senatorial districts are politically less competitive. This means that the votes recorded in low-low senatorial districts skewed towards a single party. However, the poverty rate in high-high senatorial districts does not reflect high political competition.

Furthermore, the result revealed that none of the households in the senatorial districts have 50% access to credit facilities. The relationship between poverty rate and access to credit facilities is negative and significant ($p<0.05$). This means that as access to credit facilities increases, poverty rate reduces. Moreover, there is no significant difference in average access to credit facilities between senatorial districts with state capitals and other senatorial districts ($p>0.05$). Senatorial districts in the southwest geopolitical zone have the highest access to credit facilities (17.4%); this is followed by the north-central (13.9%) and the south-south (9.6%) geopolitical zones. The north-east geopolitical zone has the lowest access to credit facilities (5.0%). While the impact of moderate access to credit facilities in the south-west and some part of the south-south reflected in low poverty rate; the reverse is the case in Zamfara State senatorial districts (Central, West and North), Taraba South, Benue State senatorial districts (North-west, North-east and South SDs), Cross-River North and Ebonyi North where there was moderate access to credit facilities and yet the poverty rates were high.

The study showed that there are 90 similar spatially-patterned senatorial districts. The breakdown shows that 47 senatorial districts with high poverty rate (compared to national poverty rate) are neighboured by high poverty rate (high – high) senatorial districts while 43 senatorial districts with low poverty rate were surrounded by low poverty rate (low-low) senatorial districts. Out of this number, 23 high-high and 28 low-low senatorial districts are statistically significant ($p<0.05$).

The significance of spatial dependence confirmed that spatial-lag regression model which accounts for spatial dimension is the appropriate model for the establishment of causal relationship between poverty rate and the identified factors. The spatial dimension value (rho) obtained from spatial-lag model (0.3084) indicates that 10% increase (decrease) in poverty rate of a senatorial district in high-high (low-low) category will lead to 3.1% poverty rate increase (decrease) in the neighbouring senatorial districts.

The result of spatial-lag regression analysis showed that people employed in agriculture (%), male-headed household, political competition and household size are significant and positively influenced poverty rate in high-high senatorial districts. Also, annual rainfall, literacy adult, soil fertility status, female-headed household, household membership of association, access to safe water sources, health facilities and safe sanitation are significant and negatively influenced poverty incidence in high-high senatorial districts. The same analysis carried out for the low-low senatorial districts revealed that people employed in agriculture, male-headed household and household size have positive influence

on poverty rate in the senatorial districts (low-low). Conversely, annual rainfall, coastal-bordered senatorial districts, female-headed household, literate adult, number of years a senator spent in the National Assembly, household membership of association, access to safe water, sanitation and health facilities negatively influenced poverty rate in low-low senatorial districts.

The Bayesian Spatial Autoregressive Probit analysis result revealed that the probability that a household chosen at random from the high-high (hot spots) and low-low (cold spots) senatorial districts will be poor are 0.77 and 0.084 respectively.

For a significant reduction to be achieved in poverty incidence in Nigeria and to safe-guard the low-low senatorial districts, special attention that is based on significant variables needs to be given to the high-high senatorial districts.

5.2 Conclusion of the study

The basis for this study centred on the spatial concentration of poverty and its determinants. Based on the empirical evidence emanating from both the descriptive and deductive statistics employed in this study, it could be concluded that spillover of poverty significantly affects poverty incidence in Nigeria. The methodological approach adopted in the study did not only reveal the extent of this spillover, but it was able to offer a more robust model in explaining the incidences and determinants of poverty in Nigeria than the conventional analytical tools. The study was able to categorize the senatorial districts based on the extent of spillover in poverty incidence and identify the factors influencing poverty incidence in similar spatially-patterened senatorial districts (high-high and low-low). Variation in determinants of poverty between hotspots and coldspots senatorial districts confirmed that specific poverty alleviation strategy rather than generalized strategy is required in combating poverty incidence in Nigeria. The study identified improved productivity of people employed in agriculture, provision of basic infrastructures, increasing investment in human capital and good political environment that will allow opposing views as factors that can bring about reduction in poverty incidence in the poverty prone senatorial districts (high-high).

5.3 Policy implications and recommendations

Based on the findings of this study and the conclusion drawn, a number of policy implications and recommendations are made towards ensuring an appreciable reduction in

poverty incidence in Nigeria. In terms of policy implications, these findings indicate several variables that can be influenced at the state and federal levels. The following are recommended:

- The need for government to improve the infrastructural facilities (safe water and health facilities) throughout the country is imperative for poverty reduction. Regular power supply and not just connection of households to public electricity will further lead to poverty reduction in low-low SDs. Regular power supply will not only enhance the productivity of the agricultural sector but enhance the emergence of small and medium scale industries of non agricultural sector.
- The intervention groups in form of cooperative societies and government (state and federal) is required to raise access to credit facilities in the senatorial districts. The present access to credit facilities is low. Government could increase access to credit facilities for those who genuinely need credit for economic activities through microfinance banks. For effective repayment, loans should be given out to group (cooperative societies, business groups, among others). Small and medium scale industries are more affected by low access to credit facilities.
- The study showed that households' membership of associations (social capital) has a big role to play in poverty reduction. Social capital has the potential to complement low access to credit facilities as revealed by this study. Compared to low-low senatorial districts, the percentage household's membership of associations is low in high-high senatorial district. There is not much a government can do to increase the investment in social capital, since it is basically up to the local communities to enhance the level of social capital in respective communities. However, government assistance may be in form of reducing the transaction costs facing local associations, and thereby move the associations to a higher level of efficiency. Also, enlightenment campaigns on radio and television in local languages on the importance of social capital is another way through which government can help to raise the social capital index per senatorial district.
- Water irrigation is required to boost the agricultural production in high-high senatorial districts that are characterized by short growing periods (due to inadequate rainfall) and good soil. This landscape of poverty (high-high) is regarded as the food basket of Nigeria. The need for the reorganization of river-basin authorities by government for better efficiency in provision of water for irrigation farming is imperative.

- The finding revealed that it is not the increase in the number of people that engaged in agriculture that leads to poverty reduction or improvement in household's well-being. Increased productivity is a way to improve farmers' well- being and reduce poverty rate. Accessbility of farmers to improved technology in form of improved seeds and cultivars and good soil management practices will enhance farmers' productitity. Increased productivity is expected to create employment oppoortunities along agricultural food chain, most especially processing and marketing. The development of rural areas by the federal and state governments will go a long way in making agriculture attractive to the youth and also reduce the preference for white-collar job in cities and towns. The need for reorganization of Agricultural Development Programmmes (ADPs) by government is germane in order to reclaim their role as a veritable link between farmers and research institutes for the reawakening of increased agricultural productivity.
- Investment in human capital by government is required to increase the percentage of literate adult. However, this investment requirement is greater in the high-high senatorial districts where the percentage of literate adults is at its lowest. These senatorial districts do not only require investment for increase in primary and secondary school enrolments but also proper monitoring in order to prevent parents from withdrawing their female wards for marriage.
- All the senatorial districts with high incidence of poverty are bordered by neighbouring countries where smuggling of contraband goods and engagement in illicit trade thrive. Proper monitoring of these areas by law enforcement agencies (immigration, police and customs) and provision of basic infrastructures (electricity, good road network and potable water) will enhance genuine economic activities and the emergence of small and medium scale industries in the area.

5.4 Contributions to knowledge

The study has contributed to knowledge as follows:

- Spatial dependence (spillover) had impact on the poverty incidence in Nigeria. The study revealed that the poverty incidence of a senatorial district (SD) is not only influenced by the factors within the SD but also by the poverty situation of neighbouring SDs.

- Spatial analysis made it possible for an expanded set of determinants of poverty, most especially political factors, that have previously been excluded from formal investigation.
- Poverty incidence in Nigeria was decomposed into four groups (high-high, low-low, low-high and high-low) based on the poverty situation of neighbouring SDs. The determinants of poverty in similar spatially patterned SDs (high-high and low-low) were established.
- Establishment of linkages in poverty between contiguous senatorial districts.

5.5 Suggestions for further study

For further study, attempts should be made to extend the application of spatial analysis to poverty study to wards, local government areas (774) or federal constituencies (360) in the country. In this way, firsthand information on spatial distribution of poverty and specific determinants according to each ward/local government area/federal constituency can be made known. This will enable policy makers, researchers and stakeholders to come up with location-specific poverty alleviation strategies.

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APPENDICES

Appendix 1: List of 109 senatorial districts in Nigeria

S/N	Senatorial District	Federal Constituency	Local Government Areas
1	Abia South	Aba North/Aba South, Obingwa/Ugwunagbo/Osisioma and Ukwa East/Ukwa west	Aba North, Aba South, Obingwa, Ugwunagbo, Osisioma, Ukwa East and Ukwa west
2	Abia North	Arochukwu/Ohafia, Isuikwuato/Umunneochi,	Arochukwu, Ohafia, Isuikwuato and Umunneochi
3	Abia Central	Isiala Ngwa North/South & Umuahia/North South/Ikwu/Ikwuhado	Isiala Ngwa North, Isiala Ngwa South, Umuahia North, Umuahia South and Ikwano
4	Adamawa South	Demsa/Numan/Lamurde, Guyuk/Shelleng and Jada/Ganye/Mayo Belwa/Toungo	Demsa, Numan, Lamurde, Guyuk, Shelleng, Jada, Ganye, Mayo Belwa and Toungo
5	Adamawa North	Mubi N/Mubi S/Maiha	Mubi North, Mubi South & Maiha
6	Adamawa Central	Fufore/Song, Hong/Igombi & Yola North/Yola South/Girei	Fufore, Song, Hong, Igombi, Yola North, Yola South & Girei
7	Akwa Ibom North-west	Abak, Ikono/ Ini, Ikot Ekpene/ Essien Udim/ Ubot Akara & Ukanafun/Orukanam	Abak, Ikono, Ini, Ikot Ekpene, Essien Udim, Ubot Akara, Ukanafun & Orukanam
8	Akwa Ibom North-east	Etinan, Itu/Ibiono Ibom & Uyo/Uruan/Nsit Ata/Ibeskip Asutan	Etinan, Itu, Ibiono Ibom, Uyo, Uruan, Nsit Ata & Ibeskip Asutan
9	Akwa Ibom South	Ikot Abasi, Mkpatenin and Eastern Obolo & Eket	Ikot Abasi, Mkpatenin, Eastern Obolo & Eket
10	Anambra North	Anambra East/West, Ogbaru, Onitsha North/South & Oyi/Ayamelum	Anambra East, Anambra West, Ogbaru, Onitsha North, Onitsha South, Oyi & Ayamelum
11	Anambra South	Aguta, Nnewi North/South/Ekwusigo	Aguta, Nnewi North, Nnewi South, Ekwusigo, Orumba North & Orumba South
12	Anambra Central	Anaocha,Njikoka, Dunukofia, Awka North/South & Idemili North/South	Anaocha,Njikoka, Dunukofia, Awka North, Awka South, Idemili North & Idemili South
13	Bauchi North	Gamawa, Jama'are/Itas-Gadau, Shira/Giade & Zaki	Gamawa, Jama'are, Itas-Gadau, Shira, Giade & Zaki
14	Bauchi South	Alkaleri/Kirfi, Bauchi, Bogoro/Dass/Tafawa Balewa & Toro	Alkaleri, Kirfi, Bauchi, Bogoro, Dass, Tafawa Balewa & Toro
15	Bauchi Central	Darazu/Ganjuma, Misau/Dambam & Ningi/Wanji	Darazu, Ganjuma, Misau, Dambam, Ningi & Wanji
16	Bayelsa West	Sagbama/Ekeremor	Sagbama & Ekeremor
17	Bayelsa East	Brass/Nembe & Ogbia	Brass, Nembe & Ogbia
18	Bayelsa Central	Southern Ijaw & Yenegoa/Kolokuma-Opokuma	Southern Ijaw, Yeneagoa & Kolokuma-Opokuma
19	Benue North-west	Buruku, Gboko/Tarka, Gwer East/Gwer West & Makurdi/Guma	Buruku, Gboko, Tarka, Gwer East, Gwer West, Makurdi & Guma
20	Benue North-East	Katsina-Ala/Ukum/Logo, Kwande/Ushongo & Vandeikya/Konshisha	Katsina-Ala, Ukum, Logo, Kwande, Ushongo, Vandeikya & Konshisha
21	Benue South	Ado/Ogbadigba/Opkokwu, Apa/Aguta	Ado, Ogbadigba, Opkokwu, Apa & Aguta
22	Borno North	Marte/Monguno/Nganzai, Mobbar/Abadam/Guzamala & Kaga/gubio/Magumeri	Marte, Monguno, Nganzai, Mobbar, Abadam, Guzamala & Kaga, Gubio, Magumeri
23	Borno South	Askira uba/Hawul, Biu/Shani,Bayo,K.kusar & Damboa/Gwoza Chibok	Askira uba, Hawul, Biu, Shani, Bayo, Kwaya-Kusar Damboa, Gwoza & Chibok

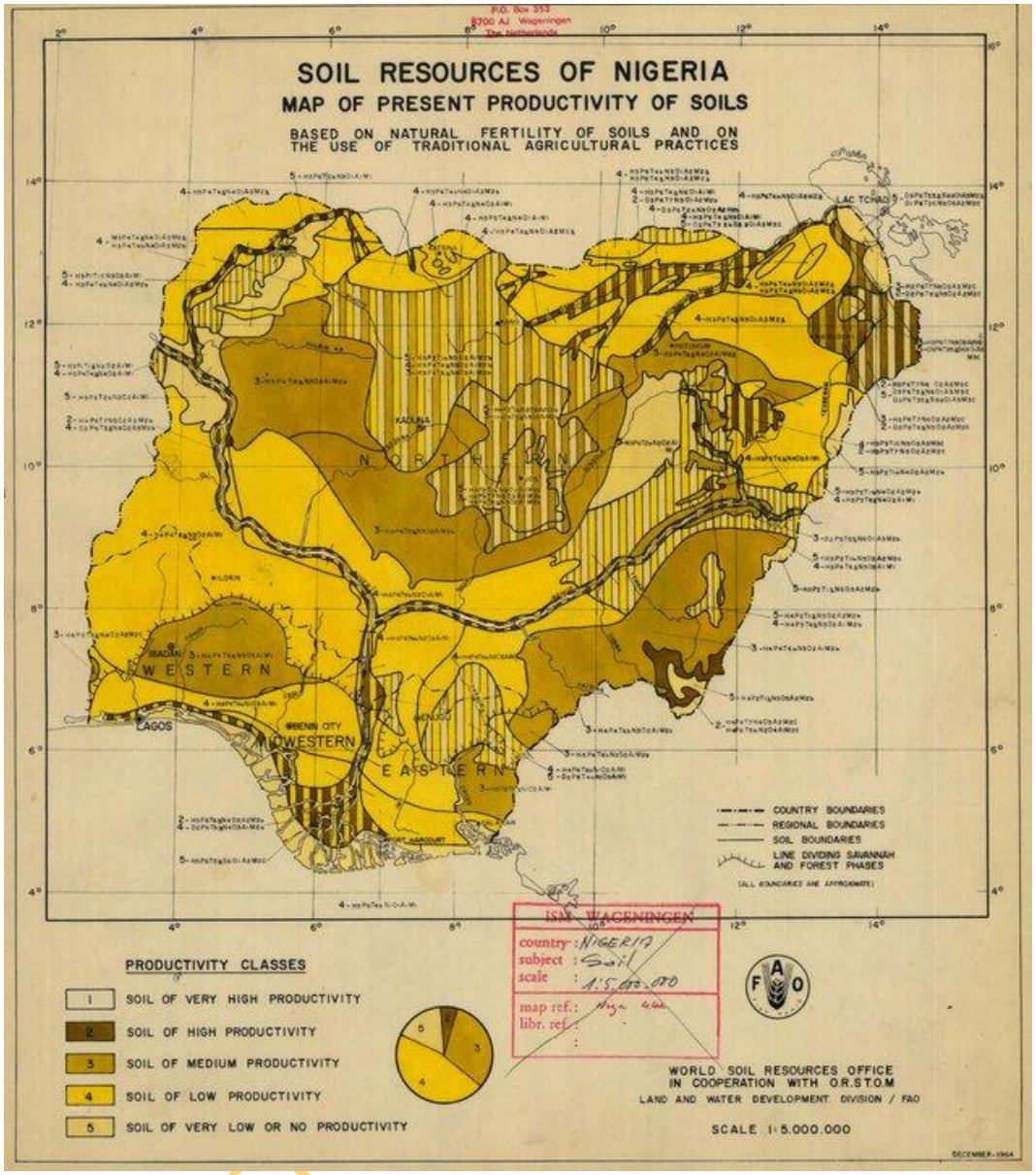
24	Borno Central	Bama/Gala/Kala-Balge, Dikwa/Mafa/konduga, Jere & Maiduguri Metropolitan	Bama, Gala, Kala-Balge, Dikwa, Mafa,Konduga, Jere & Maiduguri Metropolitan
25	Cross-River North	Bekwarra/Obudu/Obanliku & Ogoja/Iyala	Bekwarra, Obudu, Obanliku Ogoja & Iyala
26	Cross-River South	Akamkpa/Biase, Akpabuyo/Bakassi/Calabar South, Calabar Munincipal/Odukpani	Akamkpa, Biase, Akpabuyo, Bakassi, Calabar South, Calabar Municipal & Odukpani
27	Cross-River Central	Ikom/Boki, Obubra/ Etung & Yakurr/Abi	Ikom, Boki, Obubra, Etung Yakurr & Abi
28	Delta North	Aniocha North/South,Oshimili North/South & Ndokwa/Ukwani	Aniocha North, Aniocha South, Oshimili North, Oshimili South, Ndokwa & Ukwani
29	Delta South	Bomadi/Patani, Burutu, Isoko North/South & Warri	Bomadi, Patani, Burutu, Isoko North, Isoko South & Warri
30	Delta Central	Ethiope, Opke/Sapele/Uvwie & Ughelli North/South/Udu	Ethiope, Opke, Sapele, Uvwie Ughelli North, Ughelli South & Udu
31	Ebonyi North	Abakaliki/Izzi & Ebonyi Ohaukwu	Abakaliki, Izzi, Ebonyi & Ohaukwu
32	Ebonyi South	Afikpo North/South & Ohoazara/Ivo	Afikpo North, Afikpo South, Ohoazara & Ivo
33	Ebonyi Central	Ishielu/Ezza North & Ezza south /Ikwo	Ishielu, Ezza North, Ezza south & Ikwo
34	Edo North	Akoko-Edo , Etsako East/West/Central & Owan West/East	Akoko-Edo , Etsako East, Etsako West, Etsako Central, Owan West & Owan East
35	Edo South	Oredo, Egor and Ikpoba-okha, Orhionmwon/Uthmwode & Ovia South/West-Ovia North/East	Oredo, Egor, Ikpoba-Okha, Orhionmwon, Uthmwode, Ovia South West, Ovia North & Ovia East
36	Edo Central	Esan Central/West/Igueben & Esan North-East/Esan South-East	Esan Central, Esan West, Igueben, Esan North-East & Esan South- East
37	Ekiti North	Ikole/Oye (EN I) & Ido-Osi/Ilejemeje/Moba (EN II)	Moba, Ilejemeje, Ido-Osi, Oye & Ikole
38	Ekiti South	Ekiti South,West/Ikere/Ise-Orun (ES I) & Ekiti East/Emure/Gbonyin (ES II)	Ekiti South-West, Ikere, Ise-Orun, Emure, Gbonyin & Ekiti East
39	Ekiti Central	Ado/Irepodun/Ifelodun (EC I) Ijero/Efon/Ekiti West (EC II)	Ijero, Efon, Ekiti West, Irepodun & Ado-Ekiti
40	Enugu North	Aninri/Agwu/Oji River & Udi/Ezeagu	Aninri, Agwu, Oji River, Udi & Ezeagu
41	Enugu West	Igbo Etiti/Uzo-Uwani, Igbo-Eze North/Udenu & Nsukka/Igbo-Eze South	Igbo Etiti, Uzo-Uwani, Igbo-Eze North, Udenu, Nsukka & Igbo-Eze South
42	Enugu East	Isi-Uzo/Enugu East & Nkanu East/West	Isi-Uzo, Enugu East, Nkanu East & Nkanu West
43	FCT, Abuja (Federal Capital Territory)	Abaji/Kuje/Kwali Gwagwalada & Abuja Municipal/Bwari	Abaji, Kuje, Kwali Gwagwalada, Abuja Municipal & Bwari
44	Gombe North	Dukku/Nafada & Gombe/Kwami/Funakaye	Dukku, Nafada, Gombe, Kwami & Funakaye
45	Gombe South	Kaltungo/Shongom & Balanga/Billiri	Kaltungo, Shongom, Balanga & Billiri
46	Gombe Central	Yamaltu-Deba & Akko	Yamaltu-Deba & Akko
47	Imo North	Ehimembano/Ihitte Uboma/Obowo & Okigwe North	Ehimembano, Ihitte, Uboma, Obowo & Okigwe North
48	Imo West	Ideato North /South, Nwangele/Isu/Njaba, Ohaji/Egbema,Oru-West & Orlu/Oru East	Ideato North, Ideato South, Nwangele, Isu, Njaba, Ohaji, Egbema, Oru-West, Orlu & Oru East
49	Imo East	Aboh Mbaise/Ngor Okpala, Ahiazu Mbaise/Ezinihitte,	Aboh Mbaise, Ngor Okpala, Ahiazu Mbaise, Ezinihitte,

		Mbaitolu/ikeduru & Owerri Municipal/Owerri North/West	Mbaitolu, Ikeduru, Owerri Municipal, Owerri North & Owerri West
50	Jigawa North-west	Babura/Garki, Gumel/Maigatari/Sule Tankarkar/Gagarawa, Kazaure/Roni/Gwiwa/ Yankwashi & Taura/Ringim	Babura, Garki, Gumel, Maigatari, Sule Tankarkar, Gagarawa, Kazaure, Roni, Gwiwa, Yankwashi, Taura & Ringim
51	Jigawa North-east	Birniwa/Guri/Kasamma, Hadejia/Kafin Hausa/Auyo & Malammadori/Kaugama	Birniwa, Guri, Kasamma, Hadejia, Kafin Hausa, Auyo, Malammadori & Kaugama
52	Jigawa South-west	Birnin-Kudu/Buji, Dutse/kiyawa, Gwaram & Jahun/Miga	Birnin-Kudu, Buji, Dutse, Kiyawa, Gwaram, Jahun & Miga
53	Kaduna North	Ikara/Kubau, Lere, Makarfi/Kudan, Soba & Zaria	Ikara, Kubau, Lere, Makarfi, Kudan, Soba & Zaria
54	Kaduna South	Jema'a/Sanga, Kachia/Kagarko, Kaura, Kauru & Zangon Kataf/Jaba	Jema'a, Sanga, Kachia, Kagarko, Kaura, Kauru, Zangon Kataf & Jaba
55	Kaduna Central	Birnin-Gwari/Giwa, Chikun/Kajuru, Igabi, Kaduna North & Kaduna South	Birnin-Gwari, Giwa, Chikun, Kajuru, Igabi, Kaduna North & Kaduna South
56	Kano North	Danratta/Makoda, Bawga/Shanono, Bichi, Ditofa/Tofa/Rimin-Gado, Gwarzo-Kabo, Gezawa/Gabasawa & Tsanyawa/kunchi	Danratta, Makoda, Bawga, Shanono, Bichi, Ditofa, Tofa, Rimin-Gado, Gwarzo-Kabo, Gezawa, Gabasawa, Tsanyawa & Kunchi
57	Kano South	Albasu/Ajingi/Gaya, Bunkure/Rano/Kibiya, Karaye/Rogo, Kiru/Bebeji, Sumaila/Takai, Tiwada/Doguwa & Wudil/Garko	Albasu, Ajingi, Gaya, Bunkure, Rano, Kibiya, Karaye, Rogo, Kiru, Bebeji, Sumaila, Takai, Tiwada, Doguwa,Wudil & Garko
58	Kano Central	Dala, Dawakin/Kuru/Waraw a, Fagge, Kano Municipal,Kumbutso, Kura/Madobi/Garunm alam, Tarauni & Ungogo/Minjibir	Dala, Dawakin, Kuru, Warawa, Fagge, Kano Municipal,Kumbutso, Kura, Madobi, Garunmalam, Tarauni, Ungogo & Minjibir
59	Katsina North	Baure/Zango, Daura/Sandamu/Mai'A dua, Kankia/Ingawa/Kusad a, Mani/Bindawa, Mashi/Dvisi & Safana/Batsari/Dan-Musa	Baure, Zango, Daura Sandamu, Mai'Adua, Kankia, Ingawa, Kusada, Mani, Bindawa, Mashi, Dvisi, Safana, Batsari & Dan-Musa
60	Katsina South	Bakori/Danja, Funtua/Dandume, Kankari/Faskari/Sabu wa, Malum Fashi/Kafur & Musawa/Matazu	Bakori, Danja, Funtua, Dandume, Kankari, Faskari, Sabuwa, Malum Fashi, Kafur, Musawa & Matazu
61	Katsina Central	Rimi/Charanchi/Batag arawa, Katsina, Kaita/Jibia & Dutsin-ma/Kurfi	Rimi, Charanchi, Batagarawa, Katsina, Kaita, Jibia, Dutsin- ma & Kurfi
62	Kebbi North	Arewa/Dandi, Argungu/Augie & Bagudu/Suru	Arewa, Dandi, Argungu, Augie, Bagudu & Suru
63	Kebbi South	Auri, Zuru/Fakai/Sakaba/Da nko Wasagu	Auri, Zuru, Fakai, Sakaba & Danko Wasagu
64	Kebbi Central	Gwandu/Aliero/Jege, Kalgo/Birnin kebbi/Kalgo & Koko/Besse-Maiyama	Gwandu, Aliero, Jege, Kalgo, Birnin kebbi, Kalgo, Koko & Besse-Maiyama
65	Kogi Central	Adaui/Okehi, Ajaokuta & Okene/Ogori/Magongo	Adaui, Okehi, Ajaokuta, Okene, Ogori & Magongo
66	Kogi West	Yauba East/West/Modamuko, Lokoja/Kogi/KK & Ijunu/Kabba-Bunu	Yauba East, Yauba West, Modamuko, Lokoja, Kogi/KK Ijunu & Kabba-Bunu
67	Kogi East	Ankpa/ Olamaboro/ Omala, Bassa/Dekina	Anpka, Olamaboro, Omala, Bassa,

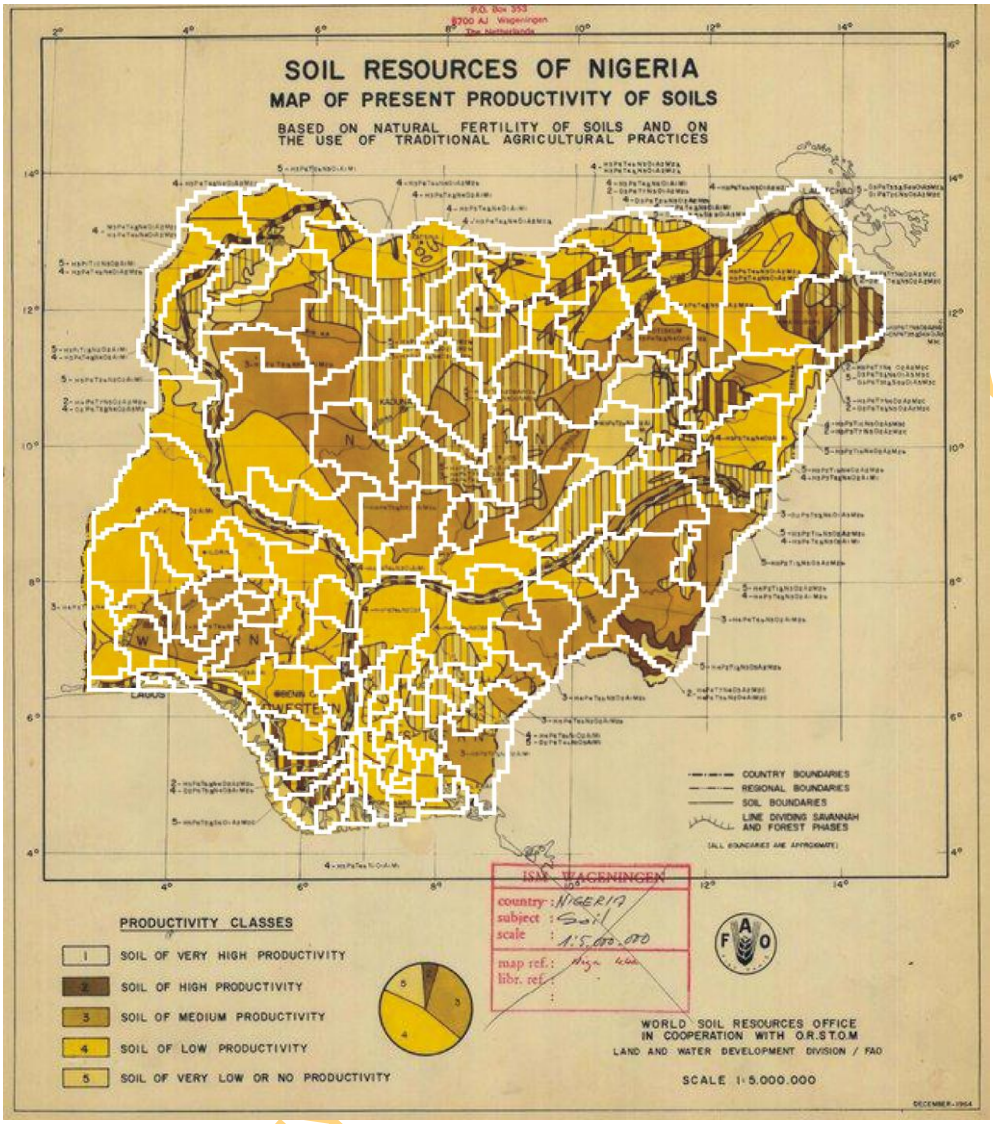
		& Idah/Ofu/Ibaji/Igala-Lamela-Odolu	Dekina, Idah, Ofu, Ibaji & Igala-Lamela-Odolu
68	Kwara North	Baruten/Kaiama, & Edu/Moro/Patigi	Baruten, Kaiama, Edu, Moro & Patigi
69	Kwara South	Ekiti/Isin/Irepodun/Oke-ero & Offa/Oyun/Ifelodun	Ekiti, Isin, Irepodun, Oke-ero Offa, Oyun & Ifelodun
70	Kwara Central	Asa/Ilorin West & Ilorin East/South	Asa, Ilorin West, Ilorin East & Ilorin South
71	Lagos West	Agege, Ajeromi Ifelodun, Alimosho, Amuwo-Idofin, Badagry, Ifako-Ijaiye, Ikeja, Mushin 1, Mushin 2, Ojo, Oshodi-Isolo & Oshodi-Isolo2	Agege, Ajeromi Ifelodun, Alimosho, Amuwo-Idofin, Badagry, Ifako-Ijaiye, Ikeja, Mushin 1, Mushin 2, Ojo, Oshodi-Isolo & Oshodi-Isolo2
72	Lagos East	Epe Central, Ibeje-Lekki, Ikorodu & Kosofe	Epe Central, Ibeje-Lekki, Ikorodu & Kosofe
73	Lagos Central	Apapa, Eti-Osa, Lagos Island 1, Lagos Island2, Surulere 1 & Surulere 2	Apapa, Eti-Osa, Lagos Island 1, Lagos Island 2, Surulere 1 and Surulere 2
74	Nasarawa North	Akwanga/Nasarawa Egon/Wamba	Akwanga, Nasarawa Egon and Wamba
75	Nasarawa South	Awe/Doma/Keana & Lafia/obi	Awe, Doma, Keana, Lafia and Obi
76	Nasarawa West	Keffi/Kokona/Karu & Nasarawa Toto	Keffi, Kokona, Karu & Nasarawa Toto
77	Niger North	Agwara/Borgu, Kotangora Mariga Wushishi Mashegu & Rijau/Magama	Agwara, Borgu, Kotangora Mariga, Wushishi, Mashegu, Rijau and Magama
78	Niger South	Agaie/Lapai, Bida/Gbako/Katcha & Mokwa/Lavun/Edati	Agaie, Lapai, Bida, Gbako, Katcha, Mokwa, Lavun and Edati
79	Niger East	Bosso/Piakoro, Chanchaga, Gurara, Suleja/Tapa & Shiroro/Rafi/Munya	Bosso, Piakoro, Chanchaga, Gurara, Suleja, Tapa, Shiroro, Rafi and Munya
80	Ogun East	Sagamu/Ikenne/Remo North & Ijebu-Ode/Odogbolu/ijebu north East	Sagamu, Ikenne, Remo North, Ijebu-Ode, Odogbolu and Ijebu North East
81	Ogun West	Ado-Odo/Ota, Egbado South and Ipokia & Imeko Afon/Egbado	Ado-Odo, Ota, Egbado South, Ipokia, Imeko Afon and Yewa North
		North	
82	Ogun Central	Abeokuta North,Odeda,Obafemi-Owode, Abeokuta South & Ifo/Ewekopo	Abeokuta Noth, Odeda, Obafemi-Owode, Abeokuta South, Ifo and Ewekopo
83	Ondo North	Owo/Ose, Akoko North East/north-west & Akoko South-East/South-West	Owo, Ose, Akoko North-East, Akoko North-West, Akoko South-East and Akoko South-West
84	Ondo South	Ile-Oluji Okeigbo/Odigbo & Irele/Okitipupa	Ile-Oluji, Okeigbo, Odigbo, Irele and Okitipupa
85	Ondo Central	Akure North /South, Idanre/Ifedore & Ondo East/ West	Akure North and Akure South, Idanre, Ifedore, Ondo East and Ondo West
86	Osun East	Atakumosa/East/West,Ilesha East and West, Ife/North /South/Central and East & Obokun/Oriade	Atakumosa East, Atakumosa West, Ilesha East, Ilesha West, Ife North, Ife South, Ife Central, Ife East,Obokun and Oriade
87	Osun West	Ayedaade Isokan/Iirewole, Ayedire/Iwo/Ola-Oluwa & Ede North/South/Egbedore/Ejigbo	Ayedaade, Isokan, Iirewole, Ayedire, Iwo, Ola-Oluwa, Ede North, Ede South, Egbedore and Ejigbo
88	Osun Central	Boluwaduro/Ifedayo/Ila, Odo-Otin/Boripe/Ifelodun & Osogbo/Olorunda/Irepodun/Orolu	Boluwaduro, Ifedayo, Ila, Odo-Otin, Boripe, Ifelodun, Osogbo, Olorunda, Irepodun and Orolu
89	Oyo South	Ibarapa Central/Ibarapa North and Ibarapa East/Ido	Ibarapa Central, Ibarapa North, Ibarapa East and Ido
90	Oyo North	Atisbo/Saki East/Saki West, Itesiwaju/Olurunssogo/ Dorelope, Iseyin/Kajola/Iwujolaand Itesiwaju and Ogbomosho/North/South/Orire	Atisbo, Saki East, Saki West, Itesiwaju, Olurunssogo, Dorelope, Iseyin, Kajola, Iwajowa, Itesiwaju, Ogbomosho North Ogbomosho South and Orire
91	Oyo Central	Ibadan North-East/South-East, Ibadan North, Ibadan North-West/South-West, Lagelu/Akinyele/Afijo, Ogo-oluwa, Oluyole, Ona-Ara/Egbeda and	Ibadan North- East, Ibadan South- East, Ibadan North, Ibadan North-West, Ibadan South-West, Lagelu, Akinyele, Afijo, Ogo-Oluwa, Oluyole, Ona-Ara,

		Oyo Alafin	Egbeda and Oyo Alafin
92	Plateau South	Langtang North and South, Mikang/Quan.Pan/Shendam and Wase	Langtang North, Langtang South, Mikang, Quan.Pan, Shendam and Wase
93	Plateau North	Barkin Ladi/Riyom, Bassa/Jos North and Jos South/West	Barkin Ladi, Riyom, Bassa, Jos North, Jos South and Jos West
94	Plateau Central	Mangu/Bokkos and Pankshin/Kanke/Kanam	Mangu, Bokkos, Pankshin, Kanke and Kanam
95	Rivers South-West	Ahoada East/Abua/Odual, Ahoada West/Ogba-Egbema-Ndoni and Bonny/Degema	Ahoada East, Abua, Odual, Ahoada West, Ogba-Egbema-Ndoni, Bonny and Degema
96	Rivers South-East	Andoni/Opobo/Nkoro, Eleme/Tai/Oyigbo, Khana/Gokana and Obio/Akpor	Andoni, Opobo, Nkoro, Eleme, Tai, Oyigbo, Khana, Gokana, Obio and Akpor
97	Rivers East	Etche/Omuma, Ikwerre/ Emohua, Okrika/Ogu-bolo, Port Harcourt 2 and Port Harcourt 1	Etche, Omuma, Ikwerre, Emohua, Okrika, Ogu-bolo, Port Harcourt 2 and Port Harcourt 1
98	Sokoto South	Kebbe/Tambuwal, Bodinga/Dange-Shuni/Tureta and Shagari/Yabo	Kebbe, Tambuwal, Bodinga, Dange-Shuni, Tureta, Shagari and Yabo
99	Sokoto North	Binji/Silame, Gudu/Tangaza, Kware/Wamakko and Sokoto North/Sokoto South	Binji, Silame, Gudu, Tangaza, Kware, Wamakko, Sokoto North and Sokoto South
100	Sokoto East	Gorondo/Gada, Gwadaba/Illiza, Isa-Sabon-Birni and Wurno/Rabah	Gorondo, Gada, Gwadaba Illiza, Isa-Sabon-Birni, Wurno and Rabah
101	Taraba North	Jalingo/Yorro/Zing, Karim Lamido/Lau/Ardokola	Jalingo, Yorro, Zing, Karim Lamido, Lau and Ardokola
102	Taraba South	Ibi-Wukari and Donga-Takun-Ussa	Ibi-Wukari and Donga-Takun-Ussa
103	Taraba Central	Kurmi/Sarduana/Gashaka and Bali/Gassol	Kurmi, Sarduana, Gashaka, Bali and Gassol
104	Yobe North	Bade/Jakusko and Yusufari/Nguru/Machinaand Karasuwa	Bade, Jakusko, Yusufari, Nguru, Machinaand and Karasuwa
105	Yobe South	Fika/Fune and Nangere/Pootiskum	Fika, Fune, Nangere and Pootiskum
106	Yobe East	Bursari/Geidam/Yunusari and Gulani/Gujba/Damaturu/Tarmuloa	Busari, Geidam, Yunusari, Gulani, Gujba, Damaturu and Tarmuloa
107	Zamfara West	Anka/Mafara, Bakura/Maradun and Gummi/Bukkuyum	Anka, Mafara, Bakura, Maradun, Gummi and Bukkuyum
108	Zamfara North	Kaura Namoda/Birnin Magaji and Zurmi/Shinkafi	Kaura Namoda, Birnin Magaji, Zurmi and Shinkafi
109	Zamfara Central	Bungudu/Maru and Tsafe/Gusau	Bungudu, Maru, Tsafe and Gusau

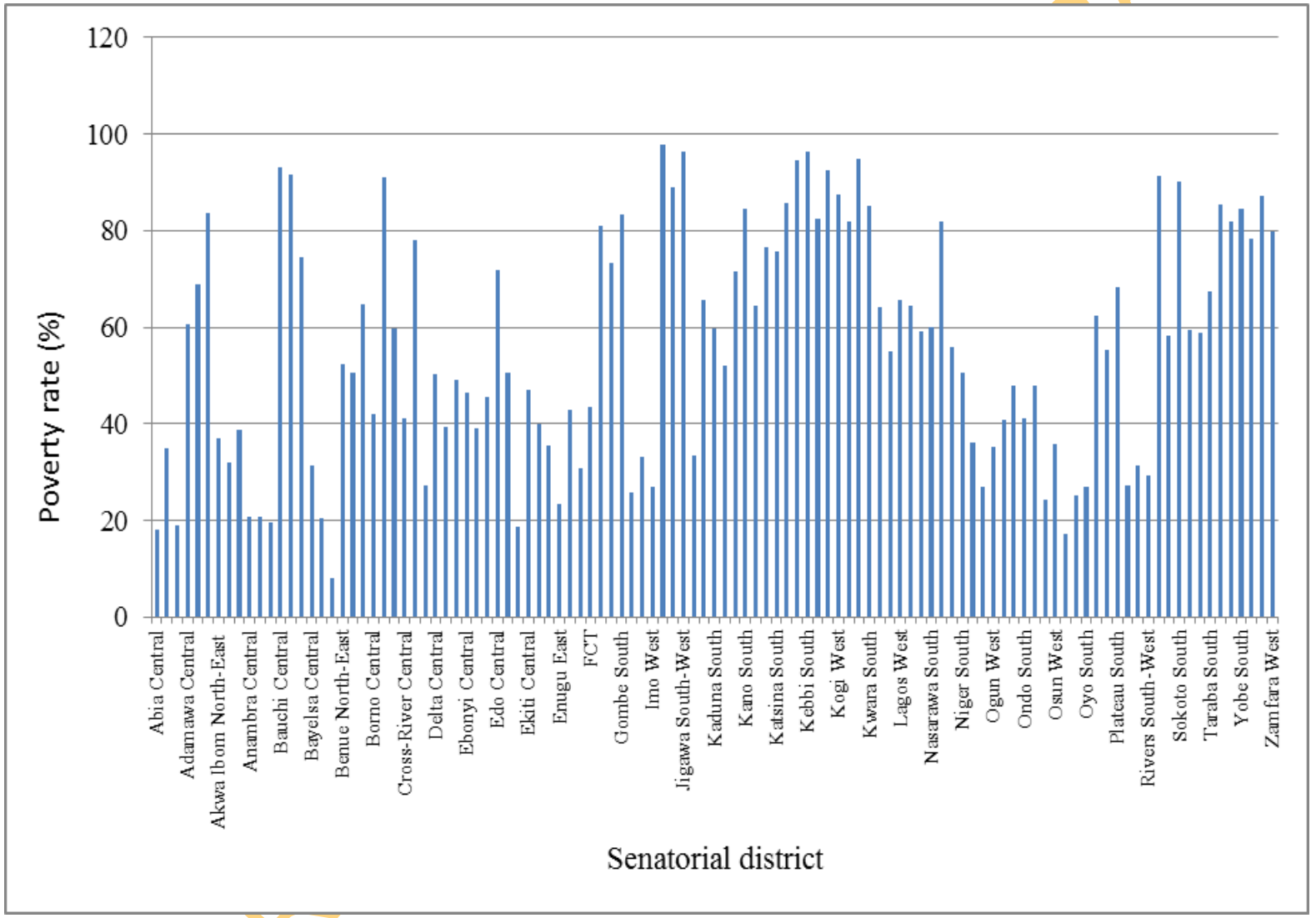
Source: Independent National Electoral Commission (1999)



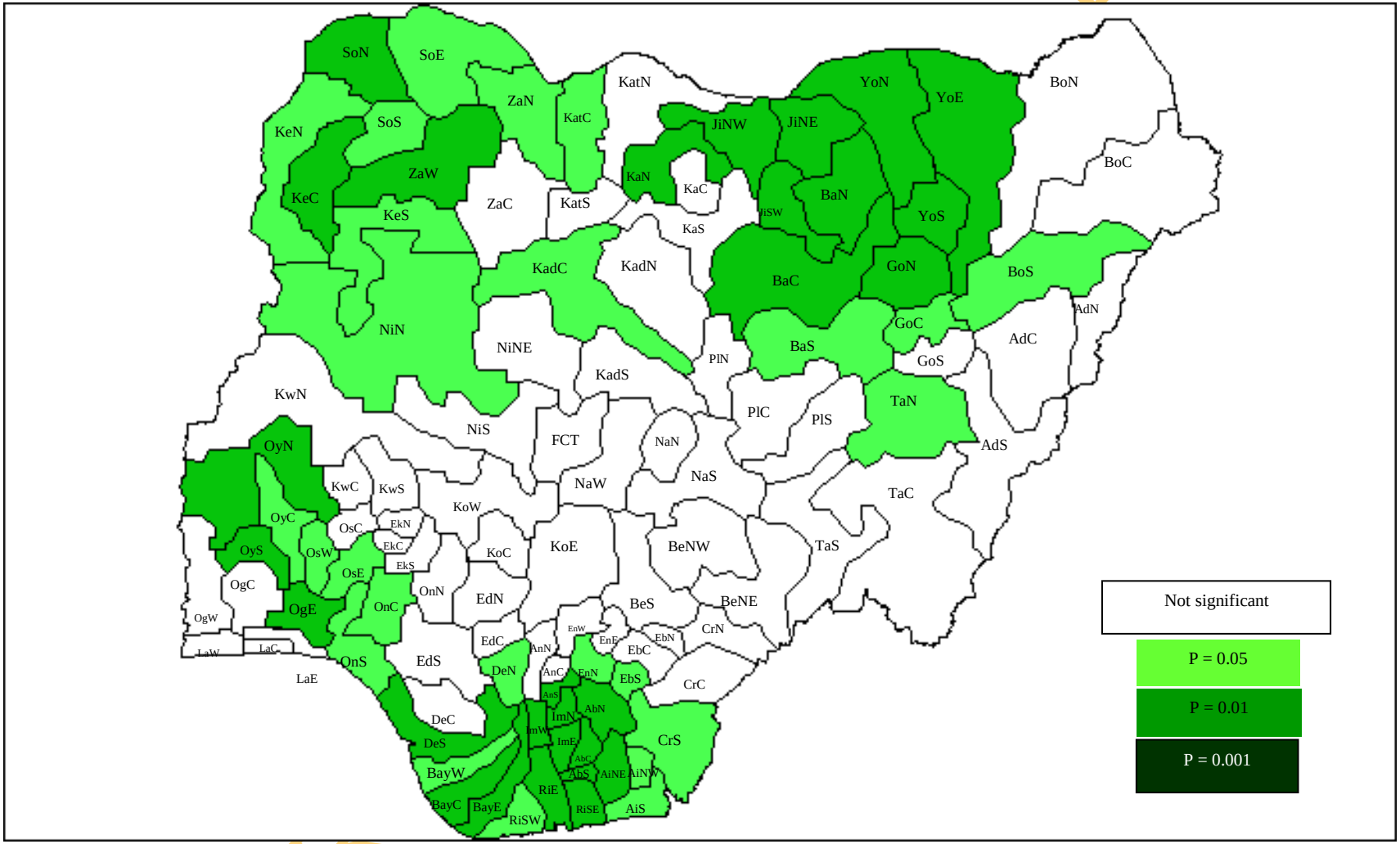
Appendix 2: Food and Agricultural Organization map of Nigeria



Appendix 3: Food and Agricultural Organization map of 109 senatorial districts of Nigeria



Appendix 4: Distribution of poverty rate (%) in 109 senatorial districts



Appendix 5: Local Indicator of Spatial Association (LISA) significance map
Source: The results of data analyses (2010)

Appendix 6: Descriptive analysis result for 109 senatorial districts

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Skewness	
Variable	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Std. Error
PCOM	109	369969	2431.33	372400.33	8120497.09	74499.97	5330.46	55651.65	1.951	0.231
PIC	109	1	0	1	37	0.34	4.56E-02	0.48	0.688	0.231
SDIC	109	1	0	1	38	0.35	4.59E-02	0.48	0.644	0.231
APCEX	109	51234.58	7412.64	58647.82	3103772.46	28474.98	1146.28	11967.49	0.405	0.231
BPCEX	109	1	0	1	39	0.36	4.61E-02	0.48	0.602	0.231
NYSNAS	109	1	4	5	470	4.31	4.46E-02	0.47	0.823	0.231
LLSD	109	1	0	1	73	0.67	4.53E-02	0.47	-0.732	0.231
ILBSD	109	1	0	1	22	0.2	3.86E-02	0.4	1.507	0.231
CBSD	109	1	0	1	14	0.13	3.22E-02	0.34	2.252	0.231
DERA	109	0.8	0.4	1.2	85.9	0.788	1.66E-02	0.173	0.482	0.231
POR	109	89.6	8.1	97.7	6108.6	56.042	2.312	24.143	0.051	0.231
SWS	109	90.5	5	95.5	5033	46.174	2.066	21.568	0.173	0.231
PNE	109	74.4	17.5	91.9	7228.2	66.314	1.999	20.866	-0.853	0.231
SNE	109	64.4	9.6	74	4964.9	45.55	1.837	19.176	-0.346	0.231
AHF	109	81.7	9.9	91.6	5619.8	51.558	1.741	18.172	-0.225	0.231
MAH	109	74.8	18.6	93.4	6899.1	63.294	1.615	16.857	-0.46	0.231
FEH	109	100	0	100	7243.3	66.452	1.969	20.561	-0.754	0.231
CPELECT	109	94.4	4.7	99.1	5322.4	48.829	2.349	24.523	0.175	0.231
SAS	109	92.1	0.2	92.3	4769.3	43.755	2.475	25.841	0.107	0.231
AVRA	109	2744	345	3089	145294	1332.97	59.75	623.81	0.785	0.231
HMA	109	47.3	52.7	100	9119.6	83.666	1.349	14.08	-0.773	0.231
LOGS	109	253	90	343	21725	199.32	6.79	70.87	0.243	0.231
ACF	109	36.1	0.6	36.7	1141.7	10.474	0.713	7.44	1.044	0.231
SOP	109	1	0	1	61	0.56	4.78E-02	0.5	-0.244	0.231
SUDE	109	1	0	1	13	0.12	3.12E-02	0.33	2.382	0.231
SUER	109	1	0	1	10	9.17E-02	2.78E-02	0.29	2.868	0.231

Variable	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Std. Error
PEA	109	83.7	1.7	85.4	4816.4	44.187	1.763	18.41	0.035	0.231
HS	109	7.6	4	11.6	713	6.541	0.143	1.491	0.7	0.231
LA	109	72.9	18.3	91.2	5564.5	61.9	2.377	24.821	-0.404	0.231

Source: The results of data analyses (2010)

Appendix 7: Descriptive analysis result for low-low senatorial districts

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Skewness	
Variable	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Std. Error
PCOM	28	259636.6	4930.2	264566.8	3080685.7	110024.488	12347.111	65334.772	0.455	0.441
PIC	28	1	0	1	26	0.93	4.96E-02	0.26	-3.52	0.441
SDIC	28	1	0	1	10	0.36	9.22E-02	0.49	0.631	0.441
BPCEX	28	0	0	0	0	0	0	0	.	.
NYSNAS	28	8	3	11	128	4.57	0.48	2.52	1.398	0.441
CBSD	28	1	0	1	9	0.32	8.99E-02	0.48	0.809	0.441
POR	28	32	17.2	49.2	890.8	31.814	1.717	9.083	0.177	0.441
SWS	28	84.8	10.7	95.5	1392.5	49.732	3.942	20.858	0.342	0.441
PNE	28	22	67	89	2261	80.74	1.03	5.47	-0.752	0.441
SNE	28	25.6	46	71.6	1698.3	60.654	1.202	6.359	-0.377	0.441
AHF	28	73.6	12	85.6	1294.6	46.236	3.709	19.625	0.183	0.441
MAH	28	50.8	41.7	92.5	1870.7	66.811	2.547	13.48	0.206	0.441
FEH	28	53.4	42.3	95.7	2016.1	72.004	2.768	14.645	-0.17	0.441
CPELECT	28	63	28	91	1743	62.26	3.01	15.93	-0.344	0.441
SAS	28	89.4	2.9	92.3	1305.9	46.639	5.146	27.228	0.144	0.441
AVRA	28	1774	1315	3089	55099	1967.82	102.62	543.02	0.444	0.441
HMA	28	19.5	80.5	100	2639	94.25	1.048	5.547	-0.806	0.441
LOGS	28	143	200	343	7471	266.84	8.93	47.23	0.186	0.441
ACF	28	29.5	1.7	31.2	339.4	12.121	1.41	7.463	0.784	0.441
SOC	28	1	0	1	14	0.5	9.62E-02	0.51	0	0.441
SUER	28	1	0	1	5	0.18	7.37E-02	0.39	1.775	0.441
PEA	28	64.8	10.4	75.2	1220.1	43.575	2.7	14.287	-0.124	0.441
HS	28	2.8	4	6.8	154.1	5.504	0.166	0.879	-0.06	0.441
LA	28	36	50.2	86.2	2039.1	72.825	1.563	8.273	-0.668	0.441

Source: The results of data analyses (2010)

Table 8: Descriptive analysis result for high-high senatorial districts

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Std. Error
PCOM	23	106274	4969.67	111243.67	1436402.37	62452.28	6543.16	31379.90	-0.387	0.481
PIC	23	1	0	1	9	0.39	0.1	0.5	0.477	0.481
SDIC	23	1	0	1	9	0.39	0.1	0.5	0.477	0.481
BPCEX	23	1	0	1	17	0.74	9.36E-02	0.45	-1.167	0.481
NYSNAS	23	1	4	5	99	4.3	9.81E-02	0.47	0.911	0.481
LLSD	23	1	0	1	13	0.57	0.11	0.51	-0.282	0.481
ILBSD	23	1	0	1	10	0.43	1.10E-01	0.51	0.282	0.481
POR	23	39.5	58.2	97.7	1899.8	82.6	2.557	12.263	-0.885	0.481
SWS	23	69.4	12.1	81.5	951.2	41.357	3.856	18.493	-0.006	0.481
PNE	23	39.7	21	60.7	838.5	36.457	2.26E+00	10.818	1.178	0.481
SNE	23	23.3	12.7	36	465.8	20.252	1.477	7.083	1.061	0.481
AHF	23	37.6	27.9	65.5	1080.8	46.991	2.217	10.63	-0.025	0.481
MAH	23	72.8	18.6	91.4	1325.1	57.613	4.411	21.153	-0.337	0.481
FEH	23	00:00.0	0	100	1244.8	54.122	6.01	28.824	-0.152	0.481
CPELECT	23	33.4	12.7	46.1	654.5	28.457	2.443	11.715	0.206	0.481
SAS	23	90.9	0.2	91.1	876	38.087	5.389	25.846	-0.027	0.481
AVRA	23	576	345	921	16369	711.7	31.73	152.17	-0.672	0.481
HMA	23	43	53	95	1556	67.63	2.82	13.54	0.999	0.481
LOGS	23	108	92	200	2676	116.35	4.92	23.58	2.082	0.481
ACF	23	26.5	1.3	27.8	156.2	6.791	1.326	6.358	2.259	0.481
SOC	23	1	0	1	16	0.7	9.81E-02	0.47	-0.911	0.481
SUDE	23	1	0	1	10	0.43	0.11	0.51	0.282	0.481
PEA	23	42.5	22	64.5	976.1	42.439	2.272	10.894	0.21	0.481
HS	23	4.6	5.3	9.9	174.5	7.587	2.49E-01	1.194	0.312	0.481
LA	23	29.3	9.2	38.5	400.8	17.426	1.704	8.173	1.327	0.481

Source: The results of data analyses (2010)

Appendix 9: Senatorial districts' political competition from 1999 general elections

SD	Vote Scored 1999	PCOM 1999	SD	Vote Scored 1999	PCOM 1999	SD	Vote Scored 1999	PCOM 1999	SD	Vote Scored 1999	PCOM 1999
AbC	193431	65750.33	DeS	60508	67172.67	KatS	227315	99634.33	OyS	48413	79267.67
AbN	36640	91040.67	EbC	130112	2431.33	KeC	71902	55778.67	PlC	182396	54715.33
AbS	73452	54228.67	EbN	130902	3221.33	KeN	40885	86795.67	PlN	239644	111963.33
AdC	71450	56230.67	EbS	119692	7988.67	KeS	101268	26412.67	PlS	53499	74181.67
AdN	49940	77740.67	EdC	113607	14073.67	KoW	40553	87127.67	RiE	500081	372400.33
AdS	101205	26475.67	EdN	156554	28873.33	KoC	102667	25013.67	RiSE	271811	144130.33
AiNW	293180	165499.33	EdS	222580	94899.33	KoE	189830	62149.33	RiW	355541	227860.33
AiNE	330360	202679.33	EkC	55563	72117.67	KwC	36251	91429.67	SoE	40198	87482.67
AiS	187826	60145.33	EkN	33133	94547.67	KwN	67234	60446.67	SoN	42767	84913.67
AnC	276993	149312.33	EkS	41208	86472.67	KwS	47998	79682.67	SoS	35308	92372.67
AnN	298661	170980.33	EnE	90767	36913.67	LaC	26251	101429.67	TaC	181294	53613.33
AnS	193217	65536.33	EnN	124562	3118.67	LaE	35690	91990.67	TaN	120835	6845.67
BaC	179319	51638.33	EnS	100810	26870.67	LaW	63774	63906.67	TaS	111557	16123.67
BaN	201115	73434.33	GoC	122711	4969.67	NaN	68623	59057.67	YoE	54785	72895.67
BaS	224747	97066.33	GoN	101744	25936.67	NaS	121048	6632.67	YoN	16437	111243.67
BayC	193896	66215.33	GoS	55215	72465.67	NaW	107236	20444.67	YoS	37956	89724.67
BayE	173203	45522.33	ImE	138501	10820.33	NiE	204030	76349.33	ZaC	41985	85695.67
BayW	67291	60389.67	ImN	106697	20983.67	NiN	143876	16195.33	ZaN	25734	101946.67
BeNE	301056	173375.33	ImW	121238	6442.67	NiS	347906	220225.33	ZaW	57217	70463.67
BeNW	183342	55661.33	JiNE	60582	67098.67	OgC	70379	57301.67	FCT	50202	77478.67
BeS	150559	22878.33	JiNW	102335	25345.67	OgE	34231	93449.67			
BoC	64613	63067.67	JiSW	76789	50891.67	OgW	18110	109570.67			
BoN	133476	5795.33	KadC	246516	118835.33	OnC	33946	93734.67			

BoS	156223	28542.33	KadN	256229	128548.33	OnN	33427	94253.67			
CrC	287442	159761.33	KadS	310258	182577.33	OnS	78203	49477.67			
CrN	103464	24216.67	KaC	279438	151757.33	OsC	43194	84486.67			
CrS	96778	30902.67	KaN	111775	15905.67	OsE	92780	34900.67			
DeC	58234	69446.67	KaS	167664	39983.33	OsW	59019	68661.67			
DeN	34898	92782.67	KatC	212300	84619.33	OyC	54762	72918.67			
DeS	60508	67172.67	KatN	242332	114651.33	OyN	78812	48868.67			

Source: Independent National Electoral Commission (1999)

Appendix 10: Number of years spent by legislator in National Assembly (1999 – 2004)

Senatorial District	Years	Senatorial District	Years	Senatorial District	Years	Senatorial District	Years	Senatorial District	Years
Abia Central	4	Borno North	4	Gombe North	4	Kwara North	4	Oyo South	4
Abia North	4	Borno South	4	Gombe South	4	Kwara South	5	Plateau Central	5
Abia South	5	Cross-River Central	4	Imo East	5	Lagos central	4	Plateau North	4
Adamawa Central	4	Cross-River North	4	Imo North	5	Lagos East	4	Plateau South	4
Adamawa North	5	Cross-River South	4	Imo West	4	Lagos West	5	Rivers East	5
Adamawa South	5	Delta Central	4	Jigawa North-East	5	Nasarawa Central	5	Rivers South-East	4
Akwa Ibom North-East	4	Delta North	5	Jigawa North-West	4	Nasarawa North	4	Rivers South-West	5
Akwa Ibom North-West	4	Delta South	4	Jigawa South-West	5	Nasarawa South	4	Sokoto East	4
Akwa Ibom South	5	Ebonyi Central	4	Kaduna Central	5	Niger East	5	Sokoto North	4
Anambra Central	4	Ebonyi North	4	Kaduna North	5	Niger North	5	Sokoto South	4
Anambra North	4	Ebonyi South	4	Kaduna South	4	Niger South	5	Taraba Central	4
Anambra South	4	Edo Central	5	Kano Central	4	Ogun Central	4	Taraba North	4
Bauchi Central	4	Edo North	5	Kano North	5	Ogun East	4	Taraba South	4
Bauchi North	4	Edo South	4	Kano South	4	Ogun West	4	Yobe East	5
Bauchi South	4	Ekiti Central	4	Katsina Central	4	Ondo Central	5	Yobe North	5
Bayelsa Central	5	Ekiti North	4	Katsina North	4	Ondo North	4	Yobe South	5
Bayelsa East	4	Ekiti South	4	Katsina South	4	Ondo South	4	Zamfara Central	5
Bayelsa West	4	Enugu East	4	Kebbi Cental	4	Osun Central	4	Zamfara North	5
Benue North-East	5	Enugu North	4	Kebbi North	4	Osun East	4	Zamfara West	5
Benue North-West	4	Enugu West	4	Kogi East	4	Osun West	4	Kebbi South	4
Benue South	5	FCT	4	Kogi West	5	Oyo Central	4	Kogi Central	4
Borno Central	4	Gombe Central	4	Kwara Central	4	Oyo North	4		

Source: Independent National Electoral Commission (1999)

Appendix 11: **Result of analysis of variance for comparing poverty rate in geographical locations**

SUMMARY				
Geographical locations	***Count***	***Sum***	***Average***	***Variance***
LLSD	73	4073.8	55.81	583.11
CBSD	13	467.2	35.94	283.58
ILBSD	23	1583.7	68.86	459.61

Source: The results of data analyses (2010)

Appendix 12

ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Geographical locations	9032.56	2	4516.28	8.63	0.00034	3.08
Within Geographical locations	55498.07	106	523.57			
Total	64530.62	108				

Source: The results of data analyses (2010)

Appendix 13: Correlates of poverty rate and non-binary independent variables

Demographic Characteristics	Correlation Coefficient	p - value
HS	0.516	0.000***
LA	-0.724	0.000***
FeH	-0.216	0.024**
MaH	-0.113	0.241^{ns}
PEA	0.059	0.541
Agro-climatic & Environmental Characteristics		
AvRa	-0.700	0.000***
Logp	-0.645	0.000***
Infrastructural Characteristics		
SWS	-0.122	0.207^{ns}
AHF	0.081	0.400^{ns}
CpElect	-0.484	0.000***
SAS	-0.266	0.005***
Sociopolitical & Economic Characteristics		
Pcom	-0.186	0.053^{ns}
HMA	-0.746	0.000***
NYSNAS	0.155	0.108^{ns}
ACF	-0.211	0.027**

Source: The results of data analyses (2010)
Note: *** indicates 0.01, **indicates 0.05 and ns indicates not significant

Appendix 14: Result of difference of means comparing selected variables between senatorial districts with state capital and other senatorial districts

Parameter	Variable	Mean	Variance	Z-Stat	P-value	
					One-tail	Two-tail
Poverty Rate	*SD with State Capital*	58.472	609.998	1.517	0.0667^{*}	0.1333^{ns}
	Other SDs	51.314	510.804			
Poverty Rate	*PDP Controlled SDs*	53.218	610.100	2.379	0.01049**	0.02098**
	SDs controlled by others	64.619	418.974			
Political Competition	*SDs with State Capital*	109819.317	8048853968	0.145	0.4425^{ns}	0.88507^{ns}
	Other SDs	107103.278	9596058491			
Connection to Public Electricity	*SDs with State Capital*	54.273	577.144	1.685	0.04808**	0.09616^{ns}
	Other SDs	46.032	598.754			
Access to Health Facilities	*SDs with State Capital*	57.295	287.853	2.469	0.00787***	0.01574**
	Other SDs	48.610	330.390			
Access to Safe Water Sources	*SDs with State Capital*	52.829	410.228	2.454	0.00814***	0.01630**
	Other SDs	42.613	463.961			
Access to Safe Sanitation	*SDs with State Capital*	45.919	667.680	0.626	0.2667^{ns}	0.5334^{ns}
	Other SDs	42.643	673.543			
Access to Credit Facilities	*SDs with State Capital*	10.727	38.488	0.275	0.3920^{ns}	0.784^{ns}
	Other SDs	10.344	64.624			
Poverty Rate	*Southern SDs*	36.167	210.372	12.788	$1.38 \times 10^{-23***}$	$2.77 \times 10^{-23***}$
	Northern SDs	73.518	255.621			

Source: The results of data analyses (2010)
Note: ***p-value < 0.01, **p-value< 0.05, *p-value < 0.10, ns means not significant.

Appendix 15: Distribution of average household size

4.0 – 6.5		6.6 - 7.4	7.5 - 11.6
Bayelsa Central	Lagos central	Kogi Central	Kebbi Central
Ondo South	Delta North	Rivers East	Sokoto South
Ogun West	Anambra North	Ebonyi North	Adamawa North
Ogun East	Niger East	Benue South	Nasarawa Central
Ondo North	Delta South	Yobe North	Katsina South
Ekiti North	Sokoto North	Gombe North	Adamawa South
Osun West	Imo North	Rivers South-West	Yobe South
Osun East	Kogi East	Benue North-East	Kano South
Ekiti South	Imo West	Niger South	Nasarawa North
Bayelsa West	Anambra Central	FCT	Bauchi South
Ogun Central	Kwara Central	Kebbi North	Bauchi North
Ondo Central	Edo Central	Kebbi South	Katsina North
Osun Central	Delta Central	Rivers South-East	Kano North
Bayelsa East	Lagos East	Imo East	Borno Central
Ekiti Central	Lagos West	Ebonyi South	Kaduna North
Oyo South	Akwa Ibom South	Gombe South	Kano Central
Niger North	Cross-River Central	Plateau North	Kaduna South
Abia North	Akwa Ibom North-West	Taraba North	Jigawa North-West
Oyo North	Enugu North	Zamfara West	Plateau Central
Oyo Central	Kogi West	Taraba South	Jigawa South-West
Kwara South	Akwa Ibom North-East	Plateau South	Nasarawa South
Abia South	Cross River South	Kaduna Central	Katsina Central
Sokoto East	Enugu West	Borno North	Adamawa Central
Kwara North	Enugu East	Zamfara North	Gombe Central
Edo North	Yobe East	Ebonyi Central	Bauchi Central
Edo South	Cross-River North	Borno South	Jigawa North-East
Abia Central	Benue North-West		Zamfara Central
Anambra South			Taraba Central

Source: The results of data analyses (2010)

Appendix 16: Distribution of literate adult (%) in 109 senatorial districts

6.6 - 23.3	28.4 - 58.1	58.8 - 72.6	73.4 - 87.6
Borno North	Taraba Central	Ekiti North	Plateau North
Zamfara West	Gombe South	Osun West	Oyo South
Yobe East	Borno South	Ebonyi North	Edo Central
Jigawa South-West	Niger East	Benue South	Ondo Central
Gombe Central	Kaduna North	Abia North	Imo North
Jigawa North-West	Bauchi South	Enugu West	Imo West
Bauchi Central	Kwara South	Bayelsa West	Enugu North
Jigawa North-East	Plateau South	Ondo North	Benue North-West
Kano South	Taraba North	Kaduna South	Akwa Ibom South
Sokoto South	Nasarawa South	Bayelsa Central	Anambra Central
Katsina South	Niger South	Oyo Central	Imo East
Bauchi North	Adamawa South	Ebonyi South	Anambra South
Zamfara North	Plateau Central	Cross-River North	Akwa Ibom North-East
Sokoto East	Kano Central	Ekiti South	FCT
Kebbi Cental	Nasarawa North	Ogun Central	Lagos East
Borno Central	Ebonyi Central	Osun Central	Rivers South-East
Yobe North	Adamawa North	Edo North	Delta Central
Kebbi North	Ogun East	Ekiti Central	Edo South
Zamfara Central	Kaduna Central	Osun East	Akwa Ibom North-West
Katsina North	Adamawa Central	Kogi West	Abia Central
Katsina Central	Ogun West	Delta South	Rivers South-West
Niger North	Oyo North	Kogi Central	Enugu East
Kano North	Benue North-East	Ondo South	Abia South
Sokoto North	Kwara North	Delta North	Cross-River South
Gombe North	Kwara Central	Cross-River Central	Lagos West
Yobe South	Kogi East	Anambra North	Rivers East
Kebbi South	Taraba South	Bayelsa East	Lagos central
	Nasarawa Central		

Source: The results of data analyses (2010)

Appendix 17: Distribution of female-headed household (%) in the constituents (SDs) of geopolitical zones

South-west	FeH	North-central	FeH	North-east	FeH	North-west	FeH	South-east	FeH
Osun East	42.3	Benue North-West	30.2	Bauchi Central	27.4	Kebbi South	0.0	Imo North	60.2
Oyo North	43.4	Niger East	32.4	Bauchi South	48.4	Zamfara North	0.0	Abia South	61.6
Ondo Central	46.8	Niger North	42.4	Bauchi North	55.9	Sokoto South	19.5	Anambra North	69.7
Osun West	56.8	Niger South	50.4	Yobe North	58.5	Kano South	29.0	Enugu East	69.8
Lagos West	57.3	Kogi West	52.4	Yobe South	66.0	Katsina North	34.3	Enugu West	73.4
Osun Central	58.5	FCT	55.5	Borno South	67.2	Zamfara West	34.8	Anambra South	74.9
Ogun East	60.1	Kogi Central	55.9	Adamawa Central	68.3	Sokoto East	37.6	Ebonyi South	80.8
Ondo South	61.0	Benue North-East	56.1	Borno North	79.8	Katsina Central	41.4	Ebonyi North	81.3
Lagos central	66.6	Benue South	64.0	Taraba Central	84.4	Kano North	44.5	Abia Central	83.6
Oyo Central	67.4	Nasarawa South	66.6	Adamawa South	87.2	Jigawa South-West	45.8	Anambra Central	85.0
Ekiti North	67.8	Plateau Central	71.3	Adamawa North	88.2	Kebbi Cental	46.1	Enugu North	87.3
Ekiti South	68.4	Nasarawa North	73.8	Gombe North	91.0	Katsina South	46.8	Imo West	89.3
Ogun West	71.8	Nasarawa Central	74.0	Borno Central	94.8	Kaduna Central	53.5	Ebonyi Central	89.5
Lagos East	73.4	Plateau North	76.8	Taraba South	94.9	Jigawa North-West	54.0	Abia North	92.7
Ekiti Central	76.5	Kwara North	79.2	Taraba North	95.5	Zamfara Central	57.5	Imo East	95.7
Ondo North	78.5	Kwara Central	82.8	Yobe East	95.7	Kano Central	58.5		
Oyo South	81.5	Kogi East	85.5	Gombe Central	100.0	Kaduna South	62.8		
Ogun Central	85.0	Plateau South	88.9	Gombe South	100.0	Jigawa North-East	69.2		
		Kwara South	89.1			Kaduna North	72.1		
						Sokoto North	80.6		
						Kebbi North	81.2		

Source: The results of data analyses (2010)

Appendix 18: Distribution of residents employed in agriculture (%) per SD

1.7 - 31.2	31.3 - 43.1	43.5 - 57.2	57.7 - 85.4
Lagos West	Yobe East	Katsina Central	Plateau Central
Lagos central	Enugu East	Anambra North	Rivers East
Lagos East	Katsina North	Zamfara West	Edo Central
Oyo South	Kano South	Ondo South	Kebbi South
Kogi East	Oyo North	Kebbi North	Enugu West
Kwara North	Bauchi Central	Taraba North	Rivers South-West
Osun Central	Anambra South	Niger South	Ebonyi North
Kano Central	Zamfara Central	Ondo North	Niger North
Kwara Central	Plateau North	Kwara South	Kogi West
Ogun West	Adamawa Central	Katsina South	Sokoto South
Kaduna Central	Ekiti Central	Borno South	Nasarawa Central
Yobe North	Ekiti South	Abia Central	Jigawa South-West
Abia South	Gombe North	Enugu North	Benue North-West
Kaduna North	Sokoto North	Bayelsa Central	Taraba South
Oyo Central	Ekiti North	Imo West	Bayelsa West
Yobe South	Jigawa North-East	Imo North	Kaduna South
Osun East	Gombe Central	Zamfara North	Abia North
Osun West	Adamawa North	Sokoto East	Gombe South
Akwa Ibom North-West	Kebbi Cental	Imo East	Edo North
FCT	Akwa Ibom South	Delta North	Borno North
Delta Central	Cross-River South	Nasarawa South	Adamawa South
Anambra Central	Niger East	Jigawa North-West	Ebonyi South
Bauchi South	Ondo Central	Delta South	Cross-River Central
Edo South	Rivers South East	Bayelsa East	Ebonyi Central
Kano North	Akwa Ibom North-East	Nasarawa North	Plateau South
Kogi Central	Bauchi North	Borno Central	Benue South
Ogun Central	Ogun East	Taraba Central	Cross-River North
			Benue North-East

Source: The results of data analyses (2010)

Appendix 19: Distribution of households' access to safe water sources (%)

5.0 - 28.4	29.2 - 47.2	47.8 - 59.0	59.6 - 95.5
Bayelsa West	Kano South	Kebbi South	Osun East
Plateau South	Adamawa Central	Kwara South	Ekiti Central
Abia North	Yobe South	Ebonyi Central	Sokoto South
Cross-River Central	Anambra South	Katsina Central	Kaduna North
Kogi East	Enugu North	Benue North East	Jigawa North-West
Gombe North	Nasarawa South	Sokoto East	Ondo South
Bauchi North	Delta South	Delta Central	Ogun Central
Plateau Central	Bayelsa East	Kano Central	Rivers East
Taraba North	Bayelsa Central	Akwa Ibom North-East	Ekiti North
Enugu West	Imo West	Yobe East	Oyo Central
Benue South	Imo North	Cross River South	Ondo Central
Anambra Central	Enugu East	Ogun East	Oyo North
Edo Central	Kano North	Zamfara North	Niger East
Bauchi Central	Gombe South	Niger South	Abia Central
Edo North	Borno North	Jigawa South-West	Ogun West
Kebbi Cental	Nasarawa North	Ebonyi North	Kwara Central
Taraba South	Borno Central	Nasarawa Central	Plateau North
Taraba Central	Zamfara Central	Ekiti South	Lagos central
Adamawa South	Katsina North	Delta North	Osun West
Borno South	Katsina South	Kebbi North	Lagos East
Adamawa North	Yobe North	Niger North	Kwara North
Rivers South-East	Rivers South-West	Zamfara West	Jigawa North-East
Ebonyi South	FCT	Bauchi South	Edo South
Akwa Ibom South	Imo East	Kogi Central	Oyo South
Gombe Central	Ondo North	Kogi West	Osun Central
Cross-River North	Anambra North	Kaduna South	Kaduna Central
	Sokoto North	Benue North-West	Lagos West

Source: The results of data analyses (2010)

Appendix 20: Distribution of households' access to health facilities per SD

9.9 - 36.8	37.6 - 52.2	52.4 - 65.2	65.5 - 91.6
Bayelsa West	Kebbi North	Delta Central	Bayelsa Central
Ebonyi Central	Borno North	Katsina North	Cross-River North
Imo West	Zamfara North	Anambra North	Nasarawa Central
Ebonyi North	Taraba Central	Sokoto East	Borno Central
Akwa Ibom North-West	Plateau Central	Katsina South	Kaduna Central
Edo Central	Bayelsa East	Enugu East	Jigawa South-West
Benue North East	Zamfara Central	Niger North	Abia South
Akwa Ibom South	Jigawa North-West	Ogun East	Nasarawa North
Plateau South	Gombe South	Katsina Central	Kebbi Cental
Imo East	Cross-River Central	Delta North	Plateau North
Enugu North	Kano North	Abia Central	Ogun Central
Anambra South	Adamawa North	Kwara South	Kogi Central
Kebbi South	Gombe Central	Taraba South	Ekiti North
Abia North	Yobe North	Osun West	Kano Central
Yobe East	Jigawa North-East	Cross-River South	Ekiti Central
Ebonyi South	Edo South	Nasarawa South	Kaduna North
Enugu West	Bauchi South	Sokoto South	Niger East
Kaduna South	Adamawa Central	Kano South	Ekiti South
Imo North	Benue South	Oyo North	Ondo North
Delta South	Anambra Central	Bayelsa Central	Oyo Central
Bauchi Central	Adamawa South	Cross-River North	Niger South
Akwa Ibom North-East	Borno South	Nasarawa Central	Kogi East
Rivers South East	Sokoto North	Borno Central	Osun East
Zamfara West	Gombe North	Kaduna Central	Lagos West
Taraba North	Ondo South	Jigawa South-West	Edo North
Yobe South	Benue North-West	Abia South	Lagos East
Rivers South West	Rivers East	Nasarawa North	Lagos central
	Bauchi North		Kwara Central
			Ondo Central
			Kwara North
			FCT
			Ogun West
			Oyo South
			Kogi West
			Osun Central

Source: The results of data analyses (2010)

Appendix 21: Distribution of households' connection to public electricity per SD

4.7 - 27.6	28.6 - 45.7	46.1 - 68.3	69.1 - 99.1
Benue North-East	Nasarawa Central	Kebbi Cental	Delta North
Plateau Central	Benue South	Akwa Ibom North-West	Ekiti Central
Plateau North	Enugu West	Kaduna North	Ekiti South
Jigawa North West	Kogi Central	Borno Central	Kogi East
Sokoto North	Kebbi South	Rivers East	Oyo North
Taraba North	Ebonyi North	Bayelsa East	Rivers South-East
Gombe South	Kano North	Imo West	Enugu East
Zamfara West	Akwa Ibom North-East	Niger North	Edo Central
Taraba South	Cross-River North	Kaduna Central	Kano Central
Zamfara Central	Niger South	Cross-River Central	Kwara South
Taraba Central	Benue North-West	Ondo Central	Ondo South
Bauchi Central	Ebonyi South	Osun Central	Imo East
Ebonyi Central	Kano South	Akwa Ibom South	Edo South
Jigawa North-East	Gombe North	Anambra North	Osun East
Adamawa North	Enugu North	Plateau South	Anambra Central
Jigawa South-West	Kaduna South	Delta South	Abia South
Sokoto East	Kwara North	Ogun East	Edo North
Adamawa South	Adamawa Central	Bayelsa Central	Kwara Central
Yobe North	Nasarawa South	Ogun West	Ogun Central
Borno South	Yobe East	Ondo North	FCT
Borno North	Katsina Central	Abia Central	Delta Central
Zamfara North	Bauchi South	Abia North	Oyo Central
Kebbi North	Yobe South	Osun West	Kogi West
Bauchi North	Nasarawa North	Oyo South	Anambra South
Katsina South	Bayelsa West	Cross-River South	Lagos East
Katsina North	Gombe Central	Ekiti North	Lagos West
Rivers South-West	Sokoto South	Imo North	Lagos central
	Niger East		

Source: The results of data analyses (2010)

Appendix 22: Distribution of households' membership of associations per SD

52.7 - 74.5	75.9 - 87.7	88.0 - 95.3	95.4 - 100.0
Zamfara North	Kaduna North	Osun West	Rivers South-West
Borno North	Kogi Central	Benue South	Rivers South-East
Zamfara West	Kwara Central	Plateau South	Enugu West
Zamfara Central	Edo North	Plateau Central	Oyo Central
Bauchi Central	Adamawa South	Oyo South	Ebonyi South
Bauchi North	Bayelsa Central	Oyo North	Ebonyi Central
Jigawa South-West	Kwara North	Ondo Central	Rivers East
Jigawa North-East	Kogi East	Nasarawa North	Ebonyi North
Sokoto East	Osun Central	Borno Central	Enugu East
Sokoto South	Katsina Central	Kebbi Cental	Benue North East
Yobe South	FCT	Adamawa Central	Edo South
Yobe East	Ogun West	Taraba South	Akwa Ibom South
Kano South	Ogun Central	Ondo South	Akwa Ibom North-East
Sokoto North	Niger South	Lagos East	Abia North
Yobe North	Lagos West	Ekiti Central	Imo North
Katsina South	Delta Central	Ekiti North	Akwa Ibom North - West
Katsina North	Niger East	Plateau North	Benue North-West
Gombe South	Delta South	Nasarawa Central	Anambra North
Gombe Central	Lagos central	Delta North	Anambra Central
Kano North	Kaduna Central	Ondo North	Cross-River Central
Niger North	Kwara South	Ekiti South	Imo West
Kano Central	Ogun East	Osun East	Abia South
Gombe North	Bayelsa East	Enugu North	Abia Central
Kebbi North	Adamawa North	Nasarawa South	Bayelsa West
Kebbi South	Borno South	Bauchi South	Imo East
Kaduna South	Cross-River North	Taraba Central	Cross-River South
Edo Central	Kogi West	Taraba North	Anambra South
Jigawa North West			

Source: The results of data analyses (2010)

Appendix 23: Distribution of households' access to credit facilities per SD

0.6 - 5.0	5.1 - 8.2	8.5 - 13.6	14.4 - 36.7
Edo Central	Kebbi North	Katsina Central	Benue North-East
Gombe South	Rivers South-East	Niger North	Taraba South
Bauchi North	Kano Central	Akwa Ibom North-East	Delta South
Yobe North	Sokoto North	Kano North	Delta North
Gombe North	Kano South	Ogun East	Zamfara Central
Anambra South	Adamawa South	Akwa Ibom South	Ekiti Central
Yobe East	Sokoto South	FCT	Imo North
Taraba Central	Delta Central	Lagos West	Benue South
Katsina South	Borno Central	Bayelsa West	Kwara Central
Jigawa South-West	Cross-River Central	Ondo South	Ondo Central
Anambra Central	Katsina North	Ebonyi Central	Akwa Ibom North-West
Plateau Central	Bauchi South	Bayelsa East	Osun Central
Yobe South	Plateau North	Enugu East	Kwara North
Abia Central	Adamawa North	Edo South	Ebonyi North
Gombe Central	Enugu North	Ogun West	Ekiti South
Abia North	Sokoto East	Nasarawa North	Osun West
Kaduna North	Bauchi Central	Ogun Central	Kwara South
Kaduna South	Imo East	Ebonyi South	Zamfara North
Borno North	Lagos East	Cross-River South	Ondo North
Nasarawa Central	Abia South	Kogi Central	Oyo North
Plateau South	Kebbi Cental	Niger East	Cross River North
Rivers South-West	Lagos central	Kogi West	Oyo South
Taraba North	Bayelsa Central	Anambra North	Oyo Central
Jigawa North-East	Adamawa Central	Imo West	Benue North-West
Edo North	Kaduna Central	Kogi East	Ekiti North
Jigawa North-West	Kebbi South	Nasarawa South	Zamfara West
Rivers East	Enugu West	Borno South	Osun East
			Niger South

Source: The results of data analyses (2010)

Appendix 24: Spatial pattern distribution of poverty incidence

Low – High	Low-Low		High-High		High - Low (NS)
Kaduna Central SC	Abia Central SC	Ondo Central SC	Bauchi Central SC	**Adamawa Central NS**	**Cross River North NS**
Kano North SC	Abia North SC	Osun East SC	Bauchi North SC	**Adamawa North NS**	**Edo Central NS**
Niger North SC	Abia South SC	Osun West SC	Bauchi South SC	**Adamawa South NS**	**Kaduna South NS**
Oyo North SC	Akwa Ibom North-east SC	Oyo Central SC	Borno South SC	**Benue South NS**	**Lagos Central NS**
Abuja NS	Akwa Ibom North-west SC	Oyo South SC	Gombe Central SC	**Borno North NS**	**Lagos East NS**
Benue North-east NS	Akwa Ibom South SC	Rivers East SC	Gombe North SC	**Gombe South NS**	**Lagos West NS**
Benue North-west NS	Anambra South SC	Rivers South-east SC	Jigawa North-east SC	**Kaduna North NS**	
Borno Central NS	Bayelsa Central SC	Rivers south-west SC	Jigawa North-west SC	**Katsina North NS**	
Edo North NS	Bayelsa East SC	**Anambra Central NS**	Jigawa South-west SC	**Katsina South NS**	
Ekiti North NS	Bayelsa West SC	**Cross River Central NS**	Kano South SC	**Kogi Central NS**	
Kano Central NS	Cross River South SC	**Delta Central NS**	Katsina Central SC	**Kogi East NS**	
Niger South NS	Delta North SC	**Ebonyi Central NS**	Kebbi Central SC	**Kwara North NS**	
Plateau North NS	Delta South SC	**Ebonyi North NS**	Kebbi North SC	**Nasarawa Central NS**	
	Ebonyi South SC	**Edo South NS**	Kebbi South SC	**Nasarawa North NS**	
	Enugu North SC	**Ekiti Central NS**	Sokoto East SC	**Nasarawa South NS**	
	Imo East SC	**Ekiti South NS**	Sokoto North SC	**Niger East NS**	
	Imo North SC	**Enugu East NS**	Sokoto South SC	**Plateau Central NS**	
	Imo West SC	**Ogun Central NS**	Taraba North SC	**Plateau South NS**	
	Ogun East SC	**Ogun West NS**	Yobe East SC	**Taraba Central NS**	
	Ondo SC	**Ondo North NS**	Yobe North SC	**Taraba South NS**	
		Osun Central NS	Yobe South SC	**Zamfara Central NS**	
		Anambra North NS	Zamfara North SC	**Kogi West NS**	
		Enugu West NS	Zamfara West SC	**Kwara Central NS**	
				Kwara South NS	

Source: The results of data analyses (2010). Note: NS means not significant spatial pattern, SC means significant spatial pattern

Appendix 25: Analysis of objectives

SN	Objectives	Data Required	Method of Analysis	Analytical Tools
1.	To analyze the nature of spatial clustering of poverty in Nigeria	Geo-referenced data on average poverty rate (%) per senatorial district, agro-ecological, social and political, demographic, economic and infrastructural characteristics.	Local Indicator of Spatial Association (LISA), Global Moran I and Scatter plot	Geoda 0.95i, Arc View & ArcGIS 9.2
2.	To determine senatorial districts with similar and dissimilar patterns of poverty incidence.	Geo-referenced data on average poverty rate (%) per senatorial district, agro-climatic, social and political, demographic, economic and infrastructural characteristics.	Local Indicator of Spatial Association (LISA) /Local Moran I and LISA Map	Geoda 0.95i, Arc View & ArcGIS 9.2
3.	To determine the factors influencing senatorial districts with similar patterns of poverty incidence.	Average poverty rate (%) per senatorial district (as dependent variable) for similar spatial pattern of poverty as dependent variable. The independent variables shall be social and political characteristics, economic characteristics, infrastructural characteristics, demographic characteristics and geographic and agro-climatic condition.	Standard Spatial regression model	SpaceStat, Avis Map Free Viewer & Arc View
4.	To determine the probability that a household will be poor in each senatorial district.	Average consumption expenditure per household per senatorial district (C_i), consumption expenditure (N) for National poverty line (Z), $S_i = \frac{C_i}{Z_i}$. The dependent variable shall be one when $LnS_i < 0$	Spatial-Lag Probit model	Matlab R2008b Arc View & ArcGIS 9.2

		and zero when $LnS_i \geq 0$. The independent variables are economic characteristics, infrastructural characteristics, demographic characteristics, social and political characteristic, and geographic and agro-climatic characteristics.		

Appendix 26: Bayesian Spatial Autoregressive Probit analysis code

```
% Bayesian Spatial Autoregressive Spatial Propit:
% LeSage, James, R. Kelley Pace, Nina Lamm, Richard Campanella and
% Xingjian Liu, New Orleans business recovery in the aftermath of
% Hurricane Katrina
 clear all;
 % ========== read data for 109 senatorial Districts in Nigeria
 XX=xlsread('Sissimo.xls','Sheet1','A2:AA110');
y=XX(:,3);
x=XX(:,4:27);
% col1 long
% col2 lat
% col3  y = bpcex, 1 = poor, 0 = not poor
% col4  pcom
% col5  pic
% col6  sdic
% col7  nysnas
% col8  ilbsd
% col9  cbsd
% col10 por
% col11 sws
% col12 pne
% col13 sne
% col14 ahf
% col15 mah
% col16 feh
% col17 cpelect
% col18 sas
% col19 avra
% col20 hma
```

```
% col21 logp
% col22 acf
% col23 sude
% col24 pea
% col25 hs
% col26 sop
% col27 la
y = XX(:,3);
long = XX(:,1);
latt = XX(:,2);
W = make_neighborsw(latt,long,8);
x = XX(:,4:27);
vnames = strvcat('y=bpcex','pcom','pic','sdic','nysnas','ilbsd',...
         'cbsd','por','sws','pne','sne','ahf','mah','feh',....
         'cpelect','sas','avra','hma','logp','acf','sude',...
         'pea','hs','la');
ndraw = 1200;
nomit = 200;
prior.nsample=5;
results = sarp_g(y,x,W,ndraw,nomit,prior);
prt(results,vnames);
total = results.total_ob
```

Appendix 27: The formulae for global and local Moran's I

$$I_{global} = \left(\frac{n}{\sum_i \sum_{j \neq 1} w_{ij}}\right)\left(\frac{\sum_i \sum_{j \neq 1} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_i (x_i - \bar{x})^2}\right)$$

$$I_{local} = \frac{\sum_i w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_i (x_i - \bar{x})^2}$$

Where:

i and j index the area units of which there are n,

wij is a spatial weight measure of contiguity defining the connection between area unit i and area unit j.

w is 1 if location i is contiguous to location j, and 0 (zero) otherwise.