Climate Variability and Livelihood Vulnerability in the Rural Areas of Lagos State.

By

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Abstract

Over the years, agriculture has remained an important livelihood strategy for the rural people of Lagos State of Nigeria. While a large majority of these people are predominantly farmers, many others practice farming as supplementary enterprise. This study therefore investigates the effect of climate variability on agricultural livelihood in the State. Using data on climate, socioeconomic and livelihood statistics of rural households, it develops a precipitation adequacy index, which incorporates the spatial and temporal variability of precipitation. The results indicate that precipitation variability has the most dominant climate influence on agricultural livelihood. Humidity is associated with significant negative influence on agricultural livelihood while temperature has little significant effect. Given that about 36% of households in Lagos State are rural, these results have considerable implications for rural income, quality of life and the growing rate of urbanization in the Lagos Metropolis. It is therefore imperative to consider adaptation measures such as staggered planting, crop diversification and water resources development as crucial strategies for the preservation of livelihoods of the rural people of Lagos State of Nigeria.

Keywords: Livelihood, Climate, Variability, Precipitation and Adaptation

1. Introduction

In the rural areas of Lagos State of Nigeria today, livelihood is experiencing some considerable challenges accentuated by rural urban migration, high level of rural disguised unemployment and poor generative nature of the rural economy.

Lagos State covers about 3,600km^2 with a marine shoreline of about 180km which extends inland to a maximum distance of about 32km. It lies entirely within the Southern rainforest zone of the humid tropics. Topographically, it is characterized by undulating plains in the north interspersed with extensive swamps in the flood plains of sandy ridges, which is intersected by lagoons and creeks, making the State rich in water resources (Akolade 1996).

With a population of over 16 million people, the State is the most populous State in Nigeria. About thirty-seven percent of this population is rural based with agriculture being the dominant occupation (Akolade 2003). But the seasonal nature of agricultural production coupled with the unpredictable pattern of rainfall has made livelihood volatility a notable feature of the State's agriculture. By so doing, rural areas of the State are plagued with high rate of rural-urban migration, growing unemployment and underemployment and stagnating labour productivity.

But according to Todaro (2002), to enhance meaningful development, the agricultural sector far from playing a passive and supportive role must actually play a dynamic and leading role in the overall strategy of economic development. This must be in form of accelerated output through technical changes designed to raise productivity in the agricultural sector and raising rural demand for agricultural output through sound employment development strategy.

Interestingly, Lagos State has a strong potential for agricultural production considering its natural vegetation zones, its alluvial soil, favourable ecological conditions, its islands and lakes and the over 180 km stretches of water along the Guinea Coast of the Atlantic ocean.

In spite of these advantages, food production in the state has not been adequate to meet the requirement of the teeming population nor its prices kept down to the reach of all its inhabitants. (Akolade 2008)

There are four ways by which this problem is accentuated:

First, the growing unpredictability of weather often lead to spurts of flood and drought particularly in the rural areas of the State.

Second is the daunting socioeconomic instability. This is highlighted by the slow growth of the State's rural income, the high incidence of poverty and the deterioration of even the very basic social and economic infrastructure (Lagos State Ministry of Planning 2010).

Third is the growing level by which ecological balance is being undermined. The ecology is known to perform several functions, one of which is to provide resources for human economic activities. One of these resources is the ranges of fishes available in ocean, lagoon, estuaries, lakes, island, creek and other water bodies. Unfortunately in Lagos State, the rate of harvesting of fishes from the oceans, lagoon and other available water bodies is more than the reproductive capacity of these fishes in the water bodies.

Fourth, is the growing level of economic dualism in the state. While most of the economic sectors are market oriented, the agricultural sector is subsistence and backward in nature. It is highly labour intensive, with poorly organised money market charging very high interest rate. By so doing, the agricultural sector has no advantage of exploring the organised money and capital markets available within the economy with low interest rate and abundant credit facility.

Ironically, Nigeria's national macroeconomic stability exemplified by economic growth, reduced fiscal deficit, reduced external debt burden, single-digit inflation and relative exchange rate stability actually accentuates the problem in several ways. In the first instance, it accelerates the growth of urban areas and sapped the rural areas of the much needed capital and entrepreneurs. It equally saps the rural areas of valuable knowledge and skills required for mitigation and adaptation. It promotes social inequity by increasing the gap between the rich and the poor and entrenches poverty in the rural areas where technological and economic backwardness are more pronounced. But given that a major objective of agricultural development is the progressive improvement in rural level of living through increase in output, income and productivity, the principal sources of agricultural progress have been identified by Todaro (2002) as technology and innovation. In Lagos State in the past, increased agricultural output could be achieved without the need for new technology simply by extending cultivation into unused but potentially

productive land. But none of these opportunities can be exploited in the face of uncertainty regarding weather condition in the area.

Moreover, because of the low level and often high variability of agricultural incomes, weather and other shocks present farm households with substantial and even catastrophic risks. The fact that agricultural production exhibits a great deal of correlation across farms implies that rainfall variability and shocks can have considerable impact on the growth and stability of rural income in the State.

Besides, the structure of Lagos, and the levels of emissions that accompany various economic activities have considerable impacts on the characteristics of the climate, climatic components, and rainfall distribution in the State (Adalemo 1981). This paper therefore intends to examine the effect of climate variability on vulnerability of livelihood in the rural areas of the State.

2. Literature Review

There is no denying that Lagos State is a potentially strong agricultural State considering its natural vegetation zones, its alluvial soil, favourable ecological conditions and its network of lagoons. The socioeconomic environment of the rural areas of Lagos state and the economic activities undertaken therein have received considerable attention by researchers who are intrigued by the low level of correlation between available natural resources and development. According to the World Bank (2001), the level of income growth and socioeconomic development of most African rural areas including the rural areas of Lagos State are at variance with their endowment. Thus, without prejudice to resource endowment, climate and socio cultural factors, income growth and hence, development in the rural areas must of necessity increase through build up of large stock of productive assets, skills and infrastructure all of which are considerably influenced by agricultural activities.

Unfortunately, economic crisis of two and half decades ago in Nigeria has deeply affected agricultural activities in the rural areas of Lagos State leading to reduced investment and rising unemployment. Therefore, agricultural productivity and rural infrastructure development have declined in the State leading to growing rate of rural urban migration and a growing decline in the proportion of land use for agriculture.

A cursory look at the economic structure of Lagos State does provide some insight into the factors behind this lopsided development. With a population of about 16 million (NPC, 2009) about 80% of which are urban dweller. Lagos State is the most urbanized State in Nigeria, even though a sizeable proportion of its inhabitants are rural based with agriculture being the dominant occupation.

About 37% of the total area of the State is earmarked for agriculture and to this, an authority was established with the power to control and manage all agricultural land in the state. This agency in pursuance of its main function allocates land to private and corporate bodies exclusively for agricultural purposes.

The major agricultural activities carried out in the State include all season crop production, fishing, livestock and agro-processing. Major arable crops in order of importance are maize, cassava, vegetable, rice, yam, cocoyam, cowpea and groundnut. Agricultural activities in the state are mainly rain-fed with increased number of small scale irrigation scheme supported by the State government. Integrated agriculture is growing while mixed cropping is a common place among the farmers to minimize risks.

The rise and development of Lagos have been comprehensively discussed in Adalemo (1981). From this study, it is evident that Lagos State began as an aggregation of a number of non-urban settlements which were established long before the present dominant urban role was perceived and that the State has grown by expanding and absorbing non-urban settlements located around its edges. The characteristics of Lagos State are result of land-use and land-use changes which have occurred and which have brought about changes in its meso-climate and rainfall pattern and its resultant shocks on agricultural production.

Attention to the importance of rainfall shocks on agricultural output growth is first explored by Raddatz (2005) His work reveals the importance of weather shocks to overall growth performance in low income countries like Nigeria. He finds that climatic changes including floods, droughts, extreme temperatures and windstorms have adverse implication for growth.

But irrespective of shocks, food is indeed a basic necessity of life and a key requirement for healthy and productive life. It is also essential for enhancing the economic, political and strategic

conditions of a nation as well as the states within the nation. Driven by the oil boom, the Lagos State government has strived to ensure sustainable physical and economic access to food. In the process, a number of agricultural policies and programmes were put in place since agriculture was one of the major occupations of the state's indigenes and residents. Indeed by 1974, when the imbalance between food production and consumption was evident, the state government introduced a number of interventions whose outcomes had oscillated between success and failure, but was considerable withered down by poor institutional arrangements and low commodity prices as a result of competition from imported agricultural products (Akolade 1996).

Thus, the politics of poor generative economy of the rural areas of Lagos state is a natural consequence of failed agricultural policies, dependence of agriculture on the vagaries of weather and the large number of producers in the sector which make farmers to be vulnerable to market imperfection. These have increased the level of risk and uncertainty inherent in the State's agriculture. Moreover, Olomola (1998) shows that for all regions of Nigeria, income in agricultural occupation is lower than every other occupation including self-employment in other sectors. More importantly agricultural income is unstable making it difficult for farmers to determine the market basket of consumption that can be attained at any period of time.

These factors more than anything else, have fuelled rural-urban migration in Lagos state as able-bodied men and women often migrate to urban areas to seek paid employment which consequently entrench the urban status of Lagos State (Akolade, 2008).

Akolade (2003) further argued that farm households in the state use a number of strategies to cope with the adverse effects of increased shortfall and safety nets failure arising from shocks. Among the approaches described is the risk coping strategy which aims to cushion the impact of income risk on consumption through mutual support networks as a risk sharing device. Other important strategy identified by him is the risk management strategy. This aims at reducing the impact of risk directly before it occurs. For example staggering planting and other operations, scrambling crops on available plots and instituting moisture conservation techniques such as mulching helps to reduce impact of shocks.

Other traditional ways of rural risk management in Lagos State include holding multiple parcels of land, diversification of income sources, the extended family system and reliance on transfer from relatives living in urban areas (Akolade, 2003).

Deaton (1997) shows that if farmers have access to appropriate scheme, they are likely to save a large proportion of transitory income increases, in order to cushion themselves against unanticipated fall in income in future. But in the rural areas of Lagos state however, there is lack of robust financial markets which limits the scope for formal credit, savings and agricultural insurance services. Indeed Townsend (1995) remonstrates that in low income countries like Nigeria problems of asymmetry of information and covariance of risks make it difficult for households to smoothen consumption through borrowing and self help insurance schemes.

3. Methodology

3.1 Sampling Procedure and Size

Data used in this study to generate livelihood index was obtained through a cluster sampling of three hundred households (300) households in Ikorodu, Epe and Badagry division of the State for twelve months each in 2008, 2009 and 2010. Lagos State of Nigeria is divided into three main divisions for administrative conveniences. This indeed forms the basis for our sampling.

Thus, pooled cross sectional household socio-economic characteristics are compiled from this survey. This approach follows the pattern of Deaton (1997) and Wooldridge (2000). Wooldridge (2000) explain that apart from increasing sample size, pooled cross-sectional data help to achieve more precise estimators and test statistics with more power.

Our livelihood index consists of four major components. We used educational attainment as a proxy for socioeconomic characteristics. Second is access to basic needs of life. We used access to portable water as its proxy. Third are the types of livelihood strategies of the people. Income generated from livelihood strategy was used as proxy in this respect. And fourth is the number of social networks. We use respondents' membership of social and economic associations as proxy.

We combine these four variables to generate a livelihood index. This index enables us to uniformly measure the level of livelihood vulnerability in the rural areas of the state.

$$L = \sum_{it}^{n} \left\{ 1 + \left(100 - 1 \left| U_{it} - L_{it} \right) \right) \right\} V_{it} \qquad \text{...eq 1}$$

We obtained the index by converting values obtained through interval scale measurement in our questionnaire to values based on ratio scale (eq 1).

Interval scale graduates variables by rank and order and measures the distance between rank positions in equal units. In other words, it is a scale designed to rank objects from the highest to the lowest or from maximum to minimum by attaching equal values to the differences among the objects. By so doing, it has both order and distance but has no origin.

In this respect, it does not permit the understanding of multiplicity of values since it has no specific origin. This effect necessitates the need to convert the values of the variables into values obtained through the ratio scale. Ratio scale has the advantage of having all the attributes required in a complete scale namely specific origin, order and distance. By so doing, it does not only graduate variables by rank and order, it also measures the distance between rank positions in equal distance. Above all, it starts with a specific origin. Therefore, L is the composite index of livelihood vulnerability and *UL, LL,* and *V* represent upper and lower limit of the components' variables and the actual measurement obtained respectively.

Climatic data was obtained from the National Meteorological station, Oshodi and the Lagos State Polytechnic Meteorological station, Ikorodu. The climatic data obtained were rainfall, humidity and atmospheric temperature data for the period. The National Meteorological station at Oshodi provided monthly climatic data of Epe and Badagry while the Lagos State Polytechnic Meteorological station provided the data of Ikorodu. The monthly rainfall data for periods 2008, 2009 and 2010 was used to determine the measure of precipitation variability. The approach is called the Weighted Anomaly Standardized Precipitation WASP (see Brown et'al 2010). The WASP calculates deviations in monthly precipitation from their mean and sums the anomalies weighted by the average contribution of each month to the annual total.

$$\sum_{t=1}^{n}(P_i - \bar{P}|\sigma_i)\frac{\overline{P_t}}{\bar{P_a}}$$

P_i and $\bar{P}_i$ are the observed precipitation in the *ith* month and the long term average precipitation

for the *ith* month, σ_i is the standard deviation of monthly precipitation for the *ith* month and $\bar{P}_a$ is

the mean annual precipitation. The number of months over which the index is calculated is

indicated by *n*. We use $n = 12$ to capture annual precipitation anomalies. The WASP is designed

such that rainfall anomalies are measured relative to the typical rainfall for a given month.

This approach is superior for identifying associated impacts than other methods such as spatially
averaged or population weighted precipitation.

In order to merge the household data with the climatic data, we used the month and year in
which the household was interviewed and attached the climatic data for that locality for the same
month and year. This is to enable us capture the impact of climate variability on livelihood of the
respondents.

3.2   Data Analytical Technique

The problem with simple correlation is that it cannot identify the causality link between two
variables such as climate and livelihood. Secondly, climatic conditions and rural livelihood
often exhibit a "cobweb pattern" in which previous condition of climate often plays considerable
roles in determining pattern of rural livelihood.

In order to provide evidence of the impact of climate on rural livelihood, we use non-linear
regression with livelihood vulnerability index as dependent variable and climate data of WASP,
humidity and temperature as independent variables. It is hypothesized that rainfall and other
climatic shocks will result in vulnerability of livelihood in the   rural areas of the State.

$$Log\ P = \ \alpha_1 + \beta_1\ logR + \beta_2\ log\ H + \beta_3\ log\ T \qquad\qquad eq..(3)$$

Where *P, R, H* and *T* are livelihood vulnerability, weighted anomaly standardized precipitation (WASP), humidity and atmospheric temperature respectively.

4. Results and Discussion

We present information about the demographic characteristics of the respondents. Results of the analysis in Table 1 reveals that 70 percent of the respondents were male while 30 percent were female. This implies that although the majority of the listed respondents were males, there is growing participation of women in food production. In the past, women used to be active in food processing leaving the production aspect to the men folks.

The majority of the group of respondents fell within the ages of 41 to 60 which implied that majority of the farmers were in their middle age. The findings also indicated that majority of the respondents had some form of formal education. This supports the position of Oladipo (1999) which concluded that apart from age, education is an important determinant of access to productive resources. Furthermore, income of farmers is relatively high with majority of them earning over three thousand dollars annually.

Table 1: Distribution of Groups of Respondents Demographic Characteristics (n = 300)

Variables	Categories	Frequency	Percentage
Gender	Male	210	70
	Female	90	30
Age	Below 30	75	25
	31 – 40	51	17
	41 – 50	114	38
	51 – 60	54	18
	Above 60	6	2
Education	No formal education	---	---
	Primary	---	---
	Secondary	81	27
	Tertiary	219	73
Marital status	Single	---	---

	Married	231	77
	Divorce	69	23
Annual income ($000)	Below 100	---	
	1 – 2.9	111	37
	3.0 and 4.9	189	63
	5.0 and above	-	-

Source: survey (2008-2010)

5.1 Estimated Results

The estimated result of our findings is presented below

$$Log\ P = -51.3^{**} + 0.42^{***} log\ R - 0.27^{***} log\ H + 0.34\ log\ T \qquad eq...(4)$$

$$(11.2) \qquad (0.013) \qquad (0.009) \qquad (0.22)$$

$$R^2 = 0.67$$

*** = Significant @ 1% level
** = Significant @ 5% level

An examination of equation (4) reveals that it gives good result with good R^2 and significant t-value for the precipitation and humidity variables. However, the temperature variable is not significant even at ten percent. This shows that the main drivers of vulnerability of livelihood in the climatic equation chain in Lagos State are the variability of precipitation and humidity. This is also in line with the findings of Akolade (2010) on influence of environmental factors on agricultural production in Lagos State. His results showed that if rainfall variability increases by one percent, on the average, land use for agricultural activities decreases by more than four percent.

One other interesting aspect of our findings is the fact that the intercept coefficient is negative and significant implying the growing tendency of urbanisation in Lagos state. In general, this finding supports some earlier studies on hydrological and climatological aspect of urban Lagos which show positive growth of urban areas of Lagos State in spite of in-depth changes in its hydrological and climatological processes (Ojo, 1990; Oyebande, 1990).

Two possible reasons could have accounted for the findings. Agricultural production is biological and seasonal and highly dependent on the vagaries of weather and can therefore not be guaranteed to ensure stable income to the farmer. Thus, as the variation in weather becomes entrenched, more seek other forms of livelihood and more land are turned into non-agricultural activities especially given the demand for non agricultural activities in all parts of Lagos State. Second, the failure of government to provide adequate socioeconomic infrastructure in the rural areas often entrench the vulnerability of rural livelihood.

5. Policy implications

No doubt, there is a need to discuss the policies and options germane to food production and livelihood enhancement in the rural areas of Lagos State. However to enhance a proper focus and pragmatism of the discussions, we need to clarify certain issues.

First there is the necessity to establish a mechanism that can accelerate the reduction of income poverty in the rural areas of Lagos state.

Secondly, there is need for clarification regarding agricultural development policy of government so as to enhance the understanding of the economic approach to reducing livelihood vulnerability and income poverty in the rural areas of the state.

Results of the quantitative analysis of the link between livelihood vulnerability, climatic shocks have been examined. Because, a considerable proportion of Lagos State's residents live in the rural areas, this examination is important to understanding the effect of climatic shocks on rural household welfare. Overall, the variability in climate and its resultant effect on livelihood implies that farmers who are dependent on natural weather condition need protection through for example, irrigation scheme and storage services. This can help farmers to stabilize income during the period of low rain and poor output. There is also the need to encourage staggered planting and crop diversification.

There is a whole constellation of factors that have influenced the path of rural development in Lagos State. There is no denying that land resource endowment is an important factor of rural development pattern. Thus, high population density needs to induce increased funding of research and development on adaptation and mitigation mechanisms so that increased productivity can create suitable conditions for introduction of modern high land saving technologies and moisture resistant varieties of crops.

It is a matter of fact that the dearth of infrastructural facilities especially road network within rural areas of Lagos state has negatively affected rural livelihood. Interestingly, the quantity and quality of road network play crucial roles in facilitating trade at the intra and interstate levels. This dearth is responsible for the prevailing high transportation cost, high spread between farm gate and consumer prices, and segmented agricultural product market. It is also partly responsible for limited orientation on the part of farmers to produce largely for subsistence with low market surplus.

In short all these factors together with technological constraints and discriminatory policies against agriculture go a long way in explaining the growing vulnerability of livelihood in the rural areas of Lagos State.

6. Summary and Conclusion

In this paper, efforts have been made to expose the implications of climate variability on vulnerability of livelihood in the rural areas of Lagos State. We have been able to show that agriculture in the state suffers from inherent inflexibility and structural rigidities that constraint its ability to respond to external shocks. Despite the fact that Lagos state has extensive and diversified farming system, it has always been rain-dependent and has been frequently exposed to unfavourable weather and other climatic conditions. Dynamism is severely lacking as a result of low level of technology and poor development of infrastructure such as roads and irrigation. This has resulted in vulnerable livelihood, declining productivity, persistent poverty, unequal distribution of income and growing population explosion in the urban areas. By so doing, new agricultural labour entrants cannot be absorbed productively in sufficient number either in rural non-farm activities or in urban activities.

Therefore, until government gets the economics, politics and institutional building of the rural areas right, agricultural investment and development will be difficult to attain in the rural areas of the State.

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