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Effect of population dynamics on household sustainable food security among the rural households of Jigawa state, Northwestern Nigeria

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Abstract

The study examines the effect of population dynamics on sustainable household food security among rural households in Jigawa State, Nigeria. Data collection were based on direct household survey of dietary intake from 266 households using structured questionnaire and supplementary secondary data on aggregate food production and population dynamic parameters were collected from 2001 to 2017 and analysed using food security index and double logarithmic regression model. Empirical results show the dominance of male headed households (93%) with average age of 45 years and household size of 12 members. Result of the construct of household food security index shows that 58% of the households were food insecure; subsisting on 1,667kcal/day/person as against the food security threshold of 2,730. The estimates from regression analysis show that population growth and birthrates increase significantly and consistently the likelihood of food insecurity while death rate and life expectancy exert positive and significant influence on food security. The study contributes to the on-going debate of understanding the effect of population dynamics on food security by modelling population parameters as core determinants of household food security. Through this, a coordinated approach by stakeholders is recommended to check unbridled birthrate and population growth that weaken household food security.

Key words: Population dynamics, rural household, effect, sustainability, food security, Nigeria

Background

The post-2015 development agenda identified population dynamics as critical determinant for the attainment of food security and other sustainable development goals. These dynamics comprise the trends and changes in population growth, migration, urbanization, population density and age structures and without paying due attention to them, none of the greatest challenges of our time can be resolved (UNDESA and UNFPA, 2015). In response to this, global attention has shifted from the concept of just producing more food to meet the dietary requirements of the people, but of understanding the population dynamics and changes in food consumption (APPG, 2015). This paradigm shift underscores the fact that about 795 million people (FAO, 2017b), especially the resource poor in developing countries are chronically hungry, despite the fact that the world as a "food basket" has 1½ times enough to feed everyone (UNFPA, 2012; WEF, 2016; FAO, 2017a).

A cursory look at the food security situation in Nigeria using the available indicators attest that food insecurity is prevalent. For instance, the Global Hunger Index for 2017 ranked Nigeria 84th out of 119 countries with index scores of 25.5. This rating placed Nigeria under countries with serious hunger problems (von Grebmer *et al*., 2017). The Global Food Security Index on the other hand ranked Nigeria as the 92nd country with food affordability score of 38.4/100, 98th on the basis of food availability with GFSI score of 25.0/100 and 93rd country in terms of food safety with GFSI score of 46.4/100 out of 113 sampled countries. These statistics placed Nigeria among the 20th least globally food secure nations (The Economist, 2017). In a similar fashion, Nigerian's population has quadrupled within the fifth decades of the nation's existence (45 million in 1963 to over 182 million in 2015 – UN, 2015) and is estimated to hover around 262 and 398 million people in 2050 and 2100 respectively (UN, 2004; ACF/IRIS, 2016).

However, what causes the crisis in Nigeria and other parts of the world is a subject of debate among scholars. Whereas others scholars argued from the viewpoint of budgetary allocation (Fadiji and Omokore, 2010; Holmes *et al*., 2012), some attributed the problem to poor agricultural policies (Metu *et al*., 2016; Metemilola and Elegbede, 2017) yet, others to poverty (Akinyele, 2009; WEP, 2013; ACF, 2017). This study however, argues that food insecurity in Nigeria is caused by the recursive effect of population dynamics other than the failure of the agricultural system to meet the food needs of the populace. Thus, attempts are made to assess the food security statuses of the households and to examine the effects of population dynamics on sustainable household food security.

Population dynamics and food security: Contextual issues

The concept of population dynamics refers to changes in the size, demographic structure and spatial distribution of a given population over time. Such changes can be traced to natural environmental changes, changes in economic and political circumstances, changes in reproductive health management technology and, ultimately changes in human reproductive and location decisions (UNDESA/UNDFPA, 2013; ACF/IRIS, 2016). Food security on the other hand is said to exist when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life (FAO, 2009; FAO 2012; CFS, 2012).

Global population is expected to grow from about 7 billion people currently inhabiting the earth to about 9.6 billion by the year 2050 (UNFPA, 2012; FAO, 2012; GIZ, 2013; UNDESA, 2015). The implication of this surge is that, agricultural production is expected to grow by 70% to guarantee food security (GIZ, 2013). These interactions evolve close interconnections between food security and population dynamics (NCAPD, 2011) where both concepts influenced each other (Figure 1). Whereas population growth is influenced by the processes of migration, ageing, urbanization, fertility and mortality, these demographic factors are also directly influenced by the quantity and quality of food supply. Conversely, the food security is greatly affected by concomitant effects of population dynamics. For instance, most of the countries with the highest numbers of people facing food insecurity obviously have high rural-urban migration, fertility rates, ageing population, life expectancy, mortality rates and urbanization (PAI, 2011; NCAPD, 2011). Therefore, successful gains in the fight against food insecurity has to address holistically the relationship of population dynamics and the intertwining issues of poverty, patterns of production and consumption and inequality (UNFPA, 2012).

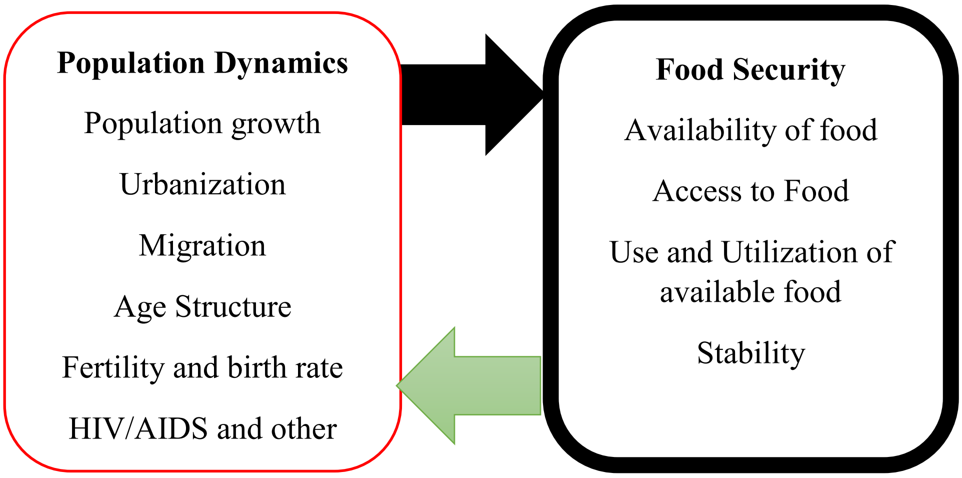

Figure 1: The nexus of population dynamics and food security. Adapted from NCAPD (2011)

Methodology

The study's location, Jigawa State, is situated in the North-Western part of Nigeria between Latitudes 11.00° to 13.00° North and Longitudes 8.00° and 10.15° East of the Greenwich Meridian. Bordered by Kano and Katsina States to the West, Bauchi State to the East and Yobe State to the Northeast, the State shares an international boundary with Zinder region, Republic of Niger to the North, providing an opportunity for cross-border trade and migration (CDF, 2013). The state has an estimated population of 5,828,200 million people (NPC, 2016) of which 50.4% were males and 49.6% females. About 42.2% of the population is below 15 years of age, 49% between 15 – 59 years while 8.8% are 60 years and above and life expectancy of 47.8 and 48.5 years for males and females respectively (Sanusi *et al*, 2013).

Sampling and data collection procedures

The study made use of primary and secondary data. A multi-stage sampling procedure was deployed to select randomly two LGAs from each of the four agricultural zones from where 106 communities were projected (VLS, 2016) and a proportionate sampling of clusters of villages (20-30 families equivalent – USAID, 2012) was made at 15% in each LGA. Then, 20% of the households were sampled from each village and a sample of 266 households were obtained. Three interviewer schedules were done for each selected family by interviewing the household head or the most knowledgeable member on food consumption patterns (Mjonomo *et al.*, 2009 and Vhurumuku, 2014) between the July, 2017 to February, 2018. The study used the individual intake approach (modified into a household concept by extending the duration of assessment to 7 days' recall) (Mjonomo *et al.*, 2009; Vhurumuku, 2014; WFP, 2015, Lele *et al.*, 2016). Time series data for food production and population indices were sourced from diverse agencies (National Population Commission, National Bureau of Statistics, Ministry of Agriculture and Rural Development (state and federal), Jigawa State Agricultural Development

Authority) between 2001 to 2017. Then food security index (FSI) and multiple regression were used to analysed the data collected.

Household Food Security Index

$$\mathbb{Z}_i = \frac{Household's\ daily\ per\ capita\ calorie\ avaibility\ (A)}{Household's\ daily\ per\ capita\ \ calorie\ requirement\ (R)} \quad (1)$$

Where $\mathbb{Z}_i$ denotes the status of i^th household food security ($\mathbb{Z} \geq 1$ food secure and $\mathbb{Z}<1$ food insecure, i.e $1 > \mathbb{Z}_i \geq 1$).

The study adopted the FAO recommended daily caloric intake for an adult aged man (30-60 years) of 2,730 kcal as a threshold for food security status (FAO, 1996).
Based on Z_i the shortfall/surplus index, P was calculated (Babatunde *et al.,* 2007; Tefera and Tefera, 2014*):*

$$\boldsymbol{P_i = \frac{1}{M}\sum_{i=1}^{N} GK_i} \quad (2)$$

Where $\boldsymbol{P_i}$ denotes the shortfall or surplus index for the i^th household,

$\boldsymbol{GK = \frac{X_{ki}-I}{I}}$ which is the deficiency or surplus faced by i^th household,

X_{ki} = Average daily caloric available to the i^{th} household.

M = the number of families that are food secure (surplus index) or food insecure (short fall index)

I = the food security line (2,730 kcal/capita/day).

The Head count ratio (H) is given as $H = \frac{M}{N}$

Where M = the number of food secure or insecure members of the sample population

N = total population under study.

Regression model

The recursive effect of population dynamics parameters on food security (proxy - food production) was examined by multiple regression analysis (Double Logarithmic Function) using STATA® version 11. The average food production of statistics in the state was modeled as the dependent variable against a set of population.

$$\mathrm{FS_i} = \alpha \mathrm{X_i}^{\beta_i}\varepsilon \quad (3)$$

Explicitly, equ (3) is rendered;

$$\mathrm{Log\_FS_i} = \alpha + \beta_1\mathrm{logX_1} + \beta_2\mathrm{logX_2} + \beta_3\mathrm{logX_3} + \beta_4\mathrm{logX_4} + \beta_5\mathrm{logX_5} + \beta_6\mathrm{logX_6} + \beta_7\mathrm{logX_7} + \beta_8\mathrm{logX_8} + \beta_9\mathrm{logX_9} + \beta_{10}\mathrm{logX_{10}} + \beta_{11}\mathrm{logX_{11}} + \beta_{12}\mathrm{logX_{12}} + \mathrm{log}\varepsilon \quad (4)$$

Where,

$\mathrm{FS_i}$ = Average food production (food security proxy) of i^th household (Dependent variable)

α = constant term

β_1 - β_{12} = parameters to be estimated, corresponding to the independent variables as defined

X_1 = Population growth; X_2 = Birthrate; X_3 = Death rate; X_4 = Fertilityrate; X_5 = Fecundityrate; X_6 = Internal migration; X_7 = Household Income; X_8 = Gender; X_9 = Life expectancy; X_{10} = Urbanisation; X_{11} = Household size; X_{12} = households average ages

Log = Logarithmic in base 10

ε = error term.

However, the dearth of information on population parameters in the database of the relevant agencies, to some extent, limited the scope of this study and some variables were excluded from the model and equation 4 is re-parametrised thus;

$$\text{Log\_FS}_i = \alpha + \beta_1\text{log\_popgrowth} + \beta_2\text{log\_birthrate} + \beta_3\text{log\_deathrate} + \beta_4\text{log\_fertilityrate} + \beta_5\text{log\_male} + \beta_6\text{log\_female} + \beta_7\text{log\_lifeexp} + \beta_8\text{log\_urbanisation} + \beta_9\text{log\_HHsize} + \log\varepsilon \quad (5)$$

Results and Discussion

Household Food Security profiling

Food security profiling has a number of policy implications: it ensures proper identification of households based on their state of food security (food secure and food insecure), and it provides opportunity to vulnerable households with appropriate policy instruments. The estimates show that about 58% of the sampled households subsisted below the food security line of 2,730kcal/person/day while 42% was classified as food secure (Table 1). This result shows marked semblance with the findings of Babatunde *et al.* (2007) and Ogundari (2017). Further analysis shows similar inclination to food insecurity in both male and female-headed households (60 and 63% respectively) whose average age was 49 years. However, it can be inferred that the younger the head of the household, the less likely s/he is food insecure. This assertion is in contrast with the findings of Agboola (2005) and Ayantoye (2009) in Nigeria and Ahmed *et al.* (2017) in Pakistan, who affirmed that household food security diminishes as the household head becomes older.

The analysis also showed that households with large members (14) were twice the risk of food insecurity than those with less members (7). This result is supported by the views of Liverpool-Tessie *et al*., 2011; Adeniyi and Ojo (2013) and Ahmed *et al.* (2017) who differently reported that large household size exerts negative influence on food security status.

The mean food security index (Z) of 0.61 for the food secure households is an indication that their food consumption is below the food security line by 39% while the food secure households with an index of 1.40 exceeded the benchmark by 40.0%. To bring the food insecure households out of food poverty requires the addition of 1,062.46 kcal/day/person.

Table 1: Summary Statistics of Socio-demographic and Food Security Indices

Food Security Indices	**Food Insecure**	**Food Secure**	**Total/mean**
Recommended/Capita Calorie Intake or Requirement (I), 2730 kcal	2730	2730	2730
No. of Households	154	112	266
Percentage of Households	57.89	42.11	100
Household characteristics			
Male headed Households	147	100	247
Female headed Households	12	7	19
Age of Household Head	48.08	41.67	44.88
Household Size (adjusted to adult equivalent)	14.00(7.00)	8.00(3.00)	12.00(6.00)
Household own production (grain equiv. kg)	3944.77 (6366.49)	2798.11 (2916.52)	3371.44 (4641.51)
Per Capita Annual Household Income (₦)	36175.93 (34451.00)	57353.48 (67444.80)	46764.71 (50947.90)
Mean Food Security (**Z)**	0.61(0.21)	1.40(0.32)	1.05 (0.265)
Household daily/capita calorie availability (kcal)	1667.54 (582.55)	3832.17 (872.95)	2749.86 (737.75)
Household daily calorie requirement (kcal)	38432.73 (18676.00)	23034.38 (8545.30)	30733.56 (13610.65)
Shortfall or Surplus Index (P) of recommended calories	0.389 (0.21)	0.404 (0.32)	0.397 (0.265)
Head Count Ratio/incidence, $(H = \frac{M}{N})$	0.579	0.421	1.00

*Values in parenthesis indicate standard deviations
Source: Field Survey, 2018

Effect of Population Dynamics on Food Security

Using the Double Logarithmic regression model (STATA® version 11), the deterministic effects of population dynamics parameters on household food security status (proxy food production) of households in Jigawa State were empirically established. The result (Table 2) showed that the explanatory variables accounted for about 90.4% (R^2) of the food security outcome. The result further attests that probability of household food security decreases significantly and consistently with population growth and birth rates, but increases significantly on the other hand, with increased death rate and life expectancy.

The marginal influence of population growth (-25.63) on household food security was negative and significant at 5% level of significance, implying that an increase in population growth will significantly worsen food security status of the households. This result could be justified on the grounds that population growth increases the demographic vulnerability and imperil human and economic development, thus, putting many people at risk of hunger (Prowse, 2012; ACF/IRIS, 2016). The concomitant effect of birth rate on food security was negative (-5.28) and statistically significant ($p<0.10$). The negative relationship between birthrate and food security conforms to the *a priori* expectation in the short run. This may imply that increased number of births increases the dependency ratio, reduces the workhours especially for the mother, increases the number of mouths to be fed, and increases the total population of the area. So also, the State ranked prominently among regions with the highest number of births per woman (7 births/woman) in the country (NBS, 2015) as against the national average of 5.5 children per woman. To this effect, it can be argued that food insecurity exacerbates in the area because frequent births and child bearing can impair the productivity of the parents, especially the mother who is often times withdrawn from most economic activities to cater for the growing demands of the newborn

Table 2: Population Dynamics determinants of Food Security

Variables[a]	Coefficient	Std. Error	t-Value	P>|t|
Log_Popgrowth (X_1)	-25.62721**	10.39245	-2.47	0.033
Log_Birthrate (X_2)	-5.277007*	2.467122	-2.14	0.058
Log_Deathrate (X_3)	28.17255**	10.61268	2.65	0.024
Log_Fertrate (X_4)	-.0207893	1.307477	-0.02	0.988
Log_Lifeexp (X_5)	3.923986***	1.213766	3.23	0.009
Log_Urbanization (X_6)	2.350124	5.884445	0.40	0.698
Log_HHsize (X_7)	-.394976	.5448035	-0.72	0.485
Constant	48.65622**	21.4382	2.27	0.047
Prob>F	0.0002			
R^2	0.9038			
$\bar{R}^2$	0.8365			

***, **, * indicates that the estimated parameters are significantly different from zero at 1, 5 and 10% significance level respectively.

[a]Dependent Variable: Log_Foodprod is used as proxy for Household Food Security

Death rate and life expectancy on the other hand exert positive influence on food security status of the households. The marginal influence of death rate (28.17) on food security status was statistically significant at 5% level of significance. This implies that death incidences can reduce the number of people to be fed. The positive effect of life expectancy (3.92) on food security is significant at 1% level of probability. This implies that improvement in the life span of the populace can significantly increase food security status. According to Juma (2011), life expectancy will lower dependency ratio on the population, thus resulting in a larger population available to participate as workforce in the agricultural sector. These findings are contrary to the views (ACF/IRIS, 2016) that increased longevity and declining death rates are expected to increase the proportion of older people (dependents) in the population. In reality however, improve life span has some advantages such as rich reservoir of skills and experience which can be leverage upon to increase food production and nutrition security.

It is rather surprising that fertility rate and household size which were expected to exert greater influence on food security were not significant, though in conformity with *a priori* expectation, despite the high birth rates (7.3 births/woman) and household size (12 persons/household) in relation to the national averages of 5.5 births/woman and 4.6 persons/household respectively. This might be due to a corresponding mortality rates, especially infant and child mortality, which tends to provoke excess replacement births to insure against such loses. This is unsurprising because a rational response by poor households in the face of such risk and uncertainty, most especially in the context of limited or non-existent social protection measures is to be self-insure through a large family (Anyanwu, 2013).

Conclusion

Population dynamics as critical determinant in the actualization of many of the sustainable development goals including food security. This is because the trends and changes in population growth, migration, urbanization, population density and age structures affect all facets of developmental drive. Thus, an understanding of population dynamics and the accompanying changes in food consumption is the ideal measurement indicator in assessing the household food security challenges in Jigawa State and Nigeria at large. The study concentrated on the effect of population dynamics on sustainable food security among farming households in Jigawa State. By employing the multistage sampling procedure, 266 households were sampled and food security index was used to determine the food security statuses based on the ratios of calorie availability and requirement for the households. Furthermore, multiple regression (double logarithm) model was used to examine the effect of population dynamics on the likelihood of household food (in)security.

Empirical results show that 58% of the sampled households had less food, requiring about 1,062.46 kcal/day/person to meet the dietary requirement of members. Consequently, the food insecure households had twice the household size as compared to the food secure category, suggesting that food security deteriorate with increase household size. The estimates from regression model show that the likelihood of food security wanes significantly and consistently with increased population growth and birthrate. Conversely, death rate and life expectancy increase the probability of household food security.

Therefore, understanding the effect of population dynamics on food security is important in policy formulation that will strengthen those parameters that enhance food security. In this regard, the study suggests investment in voluntary family planning and education to increase the productivity of the teeming population.

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