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Effect of Population Dynamics on Household Sustainable Food Security among the Rural Households of Jigawa State, Nigeria

Ahungwa GT[1], **Sani RM**[2]

[1]Department of Agricultural Economics and Extension, Federal University Dutse, PMB 7156, Dutse, Jigawa State, Nigeria
[2]Department of Agricultural Economics and Extension, Abubakar Tafawa Balewa University, PMB 0248, Buachi, Nigeria

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ABSTRACT

The study attempts to examined the effect of population dynamics on sustainable household food security among rural dwellers in Jigawa State, Nigeria. The results are based on direct household survey of dietary intake using questionnaire with supplementary information on aggregate annual food production and population trends from relevant agencies. A food security index was estimated based on data collected. It was established that 58% of the households are food insecure; subsisting on 1,667kcal/day/person on a threshold of 2,730kcal/day/person. By implication, the food insecure households require about 1,062kcal/day/person to be brought of food poverty. Population parameters were correlated with food security status and it was found that population growth, death and fertility rates and urbanization correlate positively with food security; indicating that if these parameters are well-managed, they can bring some demographic dividends such as increased workforce, income and own-production. The association of birth rate with household food security was negatively correlated. This study contributes to the on-going debate of understanding the effect of population dynamics by modelling population dynamics parameters as core

determinants of household food security and recommends a need for coordinated approach by all stakeholders to check unbridled birth rate that lowers the likelihood of household food security.

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

BACKGROUND

The task of providing food whether at the household, state, or government is a corporate responsibility of the heads of such institutions. Anything short of adequate provision will amount to gross violation of the fundamental right of the citizenry. Thus, lack of food self-sufficiency connotes loss of sovereignty at all levels (Fraser and Rimas, 2010). Available statistics attest that; Nigerian's population has quadrupled within the sixth decades of the nation's existence (45 million in 1963 to over 182 million in 2015–UN, 2015a) and is estimated to hover around 262 and 398 million people in 2050 and 2100 respectively (UN, 2004; ACF/IRIS, 2016). Conversely, the fertility rate of 5.5 births per woman is also high when compared with countries of similar economic level (NDHS, 2013; Akinyemi and Isiugo-Abanihe, 2014). The incidence of population growth and high fertility rate are sufficient indicators that are intensifying food insecurity in Nigeria.

In the post-2015 sustainable development agenda, global attention to food security has shifted from that 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 underscore the fact that the world as a "food basket" has 1½ times enough to feed everyone (Oxfam, 2009, UNFPA, 2012; WEF, 2016; FAO, 2017a). The paradox however, is that about 795 million people, especially, the resource poor in developing countries are chronically hungry (FAO, 2017b).

The nexus of population dynamics and food security (Figure 1) has rekindled the social discourse of Malthus essay in spite of overt technological advancement in food production. In the FAO (1996; 2002) summits, several population factors – changes in population growth rates, age structures and distributions of people - were recognized as relevant to sustainable agricultural and rural development. As stressed by UNDESA and UNFPA (2015), none of the greatest challenges of our time can be resolved without attention to population dynamics.

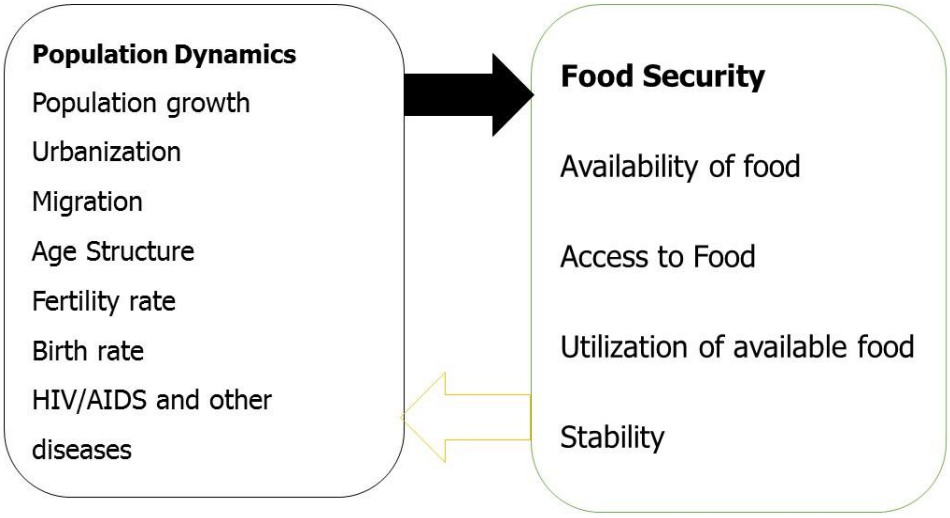

Figure 1: The nexus of population dynamics and food security. Adapted from NCAPD (2011) with modifications by the authors

The question of access and/or equitable distribution of food has assumed the focal point of discussion at several fora (NEPAD, Abuja Declaration, 2002; Maputo Declaration, 2003; NEPAD, 2015) in Africa as the likely causes of high incidence of food insecurity (FAO, 2009; Abduraman, 2013). This scenario re-echoes Sen's position on why people die of hunger: not just from absolute lack of food, but from lack of entitlement or access to food (Sen, 1981). In Nigeria however, greater emphasis has been laid on one aspect of food sustainability challenge: the goal of producing more food as evident in many of her policy frameworks in ensuring sustainable

food security (see Ojo and Adebayo, 2012; Osagie, 2013).It has been argued that increased food production is necessary but emphasize must be made that this alone, as a response to the food security challenges, is not sufficient (Charles & Garnett, 2014). The objective of increased food production needs to pursued concurrently with equally important goals of reducing the population pressure that determine in essence, the food security status of a population.

A cursory review of food security situation in Nigeria using the available indicators attest that food insecurity is prevalent in Nigeria. For instance, the Global Hunger Index (2017) and Global Food Security Index (2017) placed Nigeria among the 20th least globally food secure nations (The Economist, 2017).In pursuance of the food security objective in Jigawa State and Nigeria at large, the paper examined the socio-demographic characteristics as they relate to food security and the interplay of population dynamics parameters on rural household food security in the study area.

METHODOLOGY

The study's location, Jigawa State, is situated in the North-Western part of Nigeria between Latitudes 11.00° to13.00° 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 (Figure. 2), providing an opportunity for cross-border trade and migration (CDF, 2013). With estimated population of 5,828,200 million people (NPC, 2016) and 628,010 farm families (VLS, 2016) across the 27 Local Government Areas, 85% of this population resides in rural areas and 90% of the population is predominantly engaged in subsistence agriculture (Sanusi, *et al*., 2013; MTSS, 2013).

Data Description

The study employs a multi-stage sampling procedure. The first stage was a random selection of two LGAs from each of the four existing agricultural zones (8 LGAs). In the second stage, the number of political wards in each of the selected LGA was projected (106 wards) and a proportionate sampling of clusters of villages (20-30 households equivalent) was made at 15% in each LGA (16 villages). Then, 20% of the households were sampled from each ward to obtained a sample of 266 households for the purpose of data collection. There were three interviewer schedules to each selected household (once a month) to interview the household head or the most knowledgeable member on food consumption patterns between the July to December, 2017. At each visit, a 7 days' recall of all food consumed was made and the average taken at the end of the interview schedule. Questionnaires were used to obtain information on socio-economics and demographic parameters, food production, availability, utilization and consumption patterns, as well as food security indicators**.** Others information obtained (secondary sources) include demographic variables such as:gender, birth rate, population growth rate, fertility rate, mortality rate, urbanization and life expectancy.

The study used the individual intake approach (modified into a household concept by extending the duration of assessment to 7 days' recall) (see Babatunde *et al*., 2007; Maxwell and Caldwell, 2008; Mjonomo *et al*., 2009; Kuwornu *et al*., 2013; Vhurumuku, 2014; WFP, 2015, Lele *et al*., 2016). Thus, Descriptive Statistics, Household Food Security Index (HFSI) and correlation analyses were used for data analysis.

Household Food Security Index

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

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

The study adopted the FAO recommended daily caloric intake for an adult aged man (30-60 years) of 2730 kcal as a threshold for food security status (FAO, 1996b).

Based on Z_i, several food security indices were calculated using the shortfall/surplus index, P, as:

$$\boldsymbol{P_i = \frac{1}{M}\sum_{i=1}^{M} GK_i}$$

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 households that are food secure (surplus index) or food insecure (short fall index)

I = the food security line (2730 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.

Correlation Analysis

The empirical model is defined within the framework of average food production statistics (food security proxy), ranging from 2003 to 2016 and was modelled as dependent variable against a set of population dynamics indicators as predictive variables: population growth rate, birth rate, death rate, fertility rate, fecundity rate, internal migration, income, gender, life expectancy and age structures.

$$\mathbf{R} = \frac{\sqrt{\mathbf{r}_{\mathbf{y_{in}}}^2}}{\mathbf{1} - \mathbf{r}_{\mathbf{X_{in}}}^2}$$

Given that,

$$\mathbf{r} = \frac{\mathbf{N}\sum \mathbf{x_i y} - (\sum \mathbf{x_i})(\sum \mathbf{y})}{\sqrt{\{\mathbf{N}\sum \mathbf{x_i}^2 - (\sum \mathbf{x_i})^2\}\{\mathbf{N}\sum \mathbf{y}^2 - (\sum \mathbf{y})^2\}}}$$

Then,

R = Multiple Correlation Coefficient

$\mathbf{y_i}$ = Food production (MT) (proxy of food security), $\boldsymbol{x_1}$ = Population growth, $\boldsymbol{x_2}$ = Birthrate, $\boldsymbol{x_3}$ = Death rate, $\boldsymbol{x_4}$ = Fertilityrate, $\boldsymbol{x_5}$ = Fecundityrate, $\boldsymbol{x_{6=}}$ Gender, $\boldsymbol{x_7}$ = Life expectancy, $\boldsymbol{x_8}$= Urbanization.

RESULTS AND DISCUSSION

Socio-demographic Characteristics and 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. Using 2730kcal/person/day benchmark, it is found that 57.89% of the population was food insecure while 42.11% was classified food secure. This finding shows some semblance to previous researches in other parts of Nigeria and selected African countries (Babatunde et al., 2007; Aidoo et al., 2013; Ogundari, 2017). The age of household head and food security shows no marked difference in the ages of both categories. 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 Babatunde et al. (2007); Ayantoye (2009) and Agboola (2005) in Nigeria and Ahmed et al. (2017) in Pakistan, who affirmed that household food security diminishes as the household head becomes older.

The analysis of household size 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 Garret and Ruel (1999); Okwuche and Asogwa (2012); Adeniyi and Ojo (2013); Tshediso (2013) and Ahmed et al. (2017) who reported that larger household sizes are associated with a negative food security status as larger household sizes require increase food expenditure and competition for limited resources. Household own production (grain equivalent)as a measure of food availability showed that the food insecure category produced an average of 3,944.77 kg while the food secure households produced 2,798.11 kg. A number of studies by Omotseho et al. (2010); Babatunde et al. (2007) and Ojeleye (2015) recorded similar quantities of own production in Nigeria. However, the varying degree of calorie availability in these results connote that sustainable household food security is an indication that household own production alone cannot guarantee food security (Ogundari, 2017), implying that purchases must be made to augment to meet the dietary need of

members. This however, is unattainable since collective household earnings is far below minimum standard of $1.25 (MDG, 2013; NBS, 2015).

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 Farm Size (ha)	4.54(2.87)	4.08 (3.04)	4.57(2.84)
Household own production (grain equiv. kg)	3944.77	2798.11	3371.44
	(6366.49)	(2916.52)	(4641.51)
Household Annual Income (₦)	474564.94	454361.61	464463.28
	(458858.00)	(596312.00)	(527585.00)
Per Capita Annual Household Income (₦)	36175.93	57353.48	46764.71
	(34451.00)	(67444.80)	(50947.90)
Mean Food Security (**Z)**	0.61(0.21)	1.40(0.32)	1.05 (0.265)
Household daily calorie availability (kcal)	22087.44	31126.47	26606.95
	(11267.62)	(10119.32)	(10193.47)
Household daily/capita calorie availability (kcal)	1667.54	3832.17	2749.86
	(582.55)	(872.95)	(737.75)
Household daily calorie requirement (kcal)	38432.73	23034.38	30733.56
	(18676.00)	(8545.30)	(13610.65)
Shortfall or Surplus Index (P) of recommended calories	0.389	0.404	0.397
	(0.21)	(0.32)	(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

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 lift bring the food insecure households out of food poverty requires the addition of 1,062.46 kcal/day/person.

Influence of Population Dynamics on Food Security

The dynamism of population is not uniform across regions of the world. Whereas such changes can provide opportunities to others, they could increase the vulnerabilities in other regions. Evidence are that most countries with the highest number of people facing food insecurity also have some demographic challenges: high fertility rates, rapid population growth, ageing population, unbalanced migration and other population parameters that affect food security.

The results herein show that food security is positively correlated with population growth (0.909), indicating that increase in population can be an advantage by increasing food production. This is in accordance with the views of UNFPA (2013) and Jenkwe and Magaji (2016) that population growth has benefits of increased workforce and income. In similar fashion, the positive effect of total fertility and urbanization rate on food security negate the a priori expectations. *The* micro-economic arguments in favour of high fertility rate in Nigeria is that, children are considered as essential part of the household's work force to generate household income, and as insurance against old age (Anyanwu, 2013). This assertion is also supported by the findings of Goni (2005), that

increased household size (through birth or other means) influenced positively the availability of manpower needed on the farm which in turn increases the stock of own-produced food as well as increased economic access to food.

However, the correlation between food security and birthrate was negative, conforming to the a priori expectation that child dependency ratio increases food insecurity. This is not surprising because the State is ranked 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. It can be inferred that child bearing impaired the productivity of the parents, especially the mother who is withdrawn from most economic activities to cater for the growing demand of the newborn.

Table 2: Correlation between population dynamics and food security

Correlations[c]

		Foodprod	Popgrowth	Birthrate	Deathrate	Fertrate	Male	Female	Lifeexp	Urbaniz
Foodprod	Pearson Correlation	1								
	Sig. (2-tailed)									
Popgrowth	Pearson Correlation	.909**	1							
	Sig. (2-tailed)	.000								
Birthrate	Pearson Correlation	-.156	-.191	1						
	Sig. (2-tailed)	.595	.512							
Deathrate	Pearson Correlation	.909**	1.000**	-.191	1					
	Sig. (2-tailed)	.000	.000	.512						
Fertrate	Pearson Correlation	.824**	.928**	-.444	.928**	1				
	Sig. (2-tailed)	.000	.000	.112	.000					
Male	Pearson Correlation	.912**	1.000**	-.197	1.000**	.929**	1			
	Sig. (2-tailed)	.000	.000	.500	.000	.000				
Female	Pearson Correlation	.907**	1.000**	-.186	1.000**	.927**	.999**	1		
	Sig. (2-tailed)	.000	.000	.524	.000	.000	.000			
Lifeexp	Pearson Correlation	.598*	.443	-.225	.443	.390	.454	.432	1	
	Sig. (2-tailed)	.024	.112	.440	.112	.168	.103	.123		
Urbaniz	Pearson Correlation	.909**	1.000**	-.191	1.000**	.928**	1.000**	1.000**	.443	1
	Sig. (2-tailed)	.000	.000	.512	.000	.000	.000	.000	.112	

** Significant at the 0.01 level (2-tailed).

* Significant at the 0.05 level (2-tailed).

c. Listwise N=14

Source: Field Survey, 2018

CONCLUSION

Population dynamics is a critical determinant in the attainment of food security and other Sustainable Development Goals (SDGs). This is because the trends and changes in population growth, migration, urbanization, population density and age structures affect all facets of developmental drive. Population trends in Nigeria over the years have quadrupled and by implication, greater pressure is exerted on the fragile food security situation.

To this effect, the study uses the individual calorie intake (FSI) approach with reference to 2730kcal/day/person to assess the food security situation of the populace and the result attests that 58% of the population subsist below the minimum calorie threshold and would require at least, 1,062.24kcal/day/person to attain food security. In order to explain the poor food security states, population parameters were correlated with food production (food security proxy) and it was discovered that population growth, fertility rates and urbanization correlate rather positively with food security; implying that if parameters are properly managed, they could bring about some demographic dividends such as increased workforce, productivity and income.

The study suggests that urgent attention greater emphasis should be given to the management of demographic trends to reap the dividends thereof. This notwithstanding, household heads need to understand that unbridled birth rate lowers the likelihood of

household food security due to large household size. Nevertheless, the nation's quest in reducing her population should be pursued within the ambit of voluntary acceptance of family planning methods in accordance with fundamental human rights of the populace. Therefore, food security and nutrition advocates should add their voices to support investments in voluntary family planning, that would not compromise people choices, to achieve sustainable food security.

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Conflict of Interest:
The authors declare that there are no conflicts of interests.

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Data and materials availability:
All data associated with this study are present in the paper.

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