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The Chasm of Persistent Food Calorie Intake Deficiency of Proletarians in Nigeria's Northern States: A Perception or a Reality?

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Abstract

Objectives: Food calorie deficiency due to poor purchasing power has been a nightmare affecting the labour efficiency and productivity of the proletarians. The worsening state of the general price level with direct consequences on the purchasing power has relinquished the regional workforce to the ebb income class, thus facing the known middle-income class, which is a characteristic of this working class. Thus, based on this crux, this research was conducted to establish whether the chasm of the regional state civil servant's retrogression into the trough-income category is real or a myth.

Methods: A total of 375 sampled respondents were obtained through a multi-stage sampling procedure, and valid data were sequestrated via structured questionnaires. Both descriptive and inferential statistics were used to analyze the data.

Results: It was established that a large chunk of the regional workforce fell below the recommended food security threshold level, both in energy and expenditure dimensions. Besides, evidence of a significant and positive correlation was found to exist between the two dimensions of food security. In addition, household size was observed to be the major driver of food security status in the studied area. Furthermore, it was established that the food security gap between the secured and unsecured owes to the interaction effect in the case of calorie intake, and the structural effect termed food security discrimination in the dimension of expenditure.

Conclusions: Based on the results, this study is a clarion call for policymakers to improve the mechanisms that regulate the macroeconomic policies, especially the multiplier factor that drives inflation, thus containing the food insecurity plaguing its labour force. This intervention will not only be a plus for labour efficiency and productivity enhancement but a leverage for economic growth and development at both the region and the country levels.

Keywords: Calorie intake; Expenditure; Gap; Food security; Proletarians; Nigeria.

مأساة السعرات الحرارية الغذائية المستمرة تستوعب النقص لدى البروليتاريين في الولايات الشمالية لنيجيريا: تصور أم حقيقة؟

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ملخّص

الهدف: كان نقص السعرات الحرارية بسبب ضعف القوة الشرائية بمثابة كابوس يؤثر على كفاءة العمل وإنتاجية البروليتاريين. أدت الحالة المتدهورة لمستوى السعر العام مع العواقب المباشرة على القوة الشرائية إلى التخلي عن القوى العاملة الإقليمية لفئة الدخل المد والجزر، وبالتالي مواجهة الطبقة المتوسطة الدخل المعروفة، وهي سمة من سمات هذه الطبقة العاملة. وبالتالي، وبناءً على هذا الجوهر، تم إجراء هذا البحث لتحديد ما إذا كانت الفجوة في تراجع موظفي الدولة الإقليميين إلى فئة الدخل المنخفض حقيقية أم أسطورة.

الطرق: تم الحصول على ما مجموعه 375 من المشاركين في العينة من خلال إجراء أخذ العينات متعدد المراحل، وتم عزل البيانات الصحيحة عبر استبيانات منظمة. تم استخدام كل من الإحصاء الوصفي والاستنتاجي لتحليل البيانات.

الخلاصة: نتيجة لذلك، هذه دعوة واضحة لصانعي السياسات لتحسين الآليات التي تنظم سياسات الاقتصاد الكلي، وخاصة العامل المضاعف الذي يحرك التضخم، وبالتالي احتواء انعدام الأمن الغذائي الذي تعاني منه قوتها العاملة. لن يكون هذا التدخل ميزة إضافية لكفاءة العمل وتحسين الإنتاجية فحسب، بل سيكون بمثابة دعم للنمو الاقتصادي والتنمية في كل من المنطقة والبلد بشكل عام.

الكلمات الدالة: السعرات الحرارية المتناولة. المصروفات؛ الفارق؛ أمن غذائي؛ البروليتاريين. نيجيريا.

INTRODUCTION

Nigeria has a lot of natural, human, and material resources, but it has not been able to utilize them effectively enough to meet the country's poor people's food demands (Sadiq *et al*., 2020a). More disturbing is the reality that the majority of the population (70% = 210.87 million) still lives on less than $1 per day, and wealth distribution remains unequal and exclusive (Sadiq *et al*., 2020b). These figures clearly demonstrate the growing nature of poverty in Nigeria, which has resulted in an increase in food insecurity. In Nigeria, a lack of national food self-sufficiency has remained a persistent problem.

Inadequate nutrition is likely the most pressing issue confronting the world's impoverished today (Food and Agriculture Organization (FAO), 2017). Despite improvements in nutrient availability over the last decade, a large proportion of impoverished households in developing countries still lack adequate food access (Kharas *et al*., 2018; FAO, 2017; Hirvonen *et al*., 2016). Despite the fact that per capita daily calorie intake in developing countries has improved significantly over the last decade, there are still over 923 million people who are undernourished, and recent food price hikes have contributed to a global increase in hunger (Adekunle *et al*., 2020; Eguwma *et al*., 2019).

It has been revealed that calorie consumption significantly impacts human health and productivity. The human body requires dietary calorie energy to maintain regular body metabolic function and engage in tasks related to good health and hygiene. Furthermore, calorie consumption is the primary determinant of people's under nutrition and malnutrition. It is required for children's growth and micronutrient assimilation. Inadequate calorie availability reduces productivity, impedes learning, and raises the risk of disease (Aromolaran, 2004a &b; Babatunde *et al.*, 2010).

Nutritional improvements are considered to have a multiplier effect on all of the Sustainable Development Goals (SDGs). Nigeria, like other low- and middle-income nations, will face challenges in reaching the SDGs due to the coexistence of undernutrition and micronutrient deficiencies. In the previous two decades, there has been a heated debate about the calorie consumption of rural and urban populations, but no one has specifically looked at the livelihood of government machinery custodians, who hold the key to economic growth and development. This social class is noted for serving as a link between the ebb-income and peak-income classes.

This middle-income class is currently non-existent, as the majority of its members, primarily government proletariats, have drifted or somersaulted into the income trough. The government's proletariats' deteriorating welfare status has been a point of contention between their pressure union and the government, resulting in a series of strikes that have slowed, crippled, and paralyzed the country's growth and development.

Despite the insinuation and narrative of the proletariats' pressure union, no scholar has summoned the zeal to establish an empirical fact regarding the welfare status of Nigerian public servants. Consequently, this research was conceptualized with the aim to verify whether this persistent welfare retrogression of government proletariats is a myth or a reality. Besides, this research was skewed toward Nigeria's Northern states' government proletariats. The outcome of this research will be very useful to policymakers as it will address the multitude of challenges lingering between them and the proletariats, thus overcoming the barriers affecting growth and development in the region in particular and the country in general. The broad objective of this research was to determine the calorie intake of the states' government proletariats while the specific objectives were to determine the calorie intake and expenditure food securities of the respondents, the nexus between calorie intake and expenditure food securities alongside determinants of food security, and the causes of the food security gap due to the food security status.

RESEARCH METHODOLOGY

The Northern region locally called *Arewa* is occupied the upper hemisphere of Nigeria, stretching from latitudes 10˚ 30′ to 59˚ 99′ and longitudes 7˚ 29′ to 59˚ 99′ of the Greenwich meridian time. The region has a long history of being very workaholic in public service since the colonial masters' era. The region's prowess in agriculture is unrivalled when compared to the southern part of Nigeria, thus the food basket of the country, likewise that of the neighbouring sub-Saharan African countries. The region is stratified into three geo-political zones *viz*. North-east, North-central, and North-west and consists of 19 states. The west consists of seven states while the east and the central parts consist of six states each. The union territory of the country named FCT Abuja is situated in the region. The study adopted a multi-stage sampling technique to come up with a representative sample size. Firstly, the geo-political stratification of the region into three strata, *viz*. North-east, North-central, and North-west, was adopted. Secondly, from each of the strata, the most populous civil service states were purposively selected. The chosen states are Bauchi, Kano, and Niger respectively, from North-East, North-West, and North-Central. Lastly, applying Krejcie and Morgan's (1970) sampling formula (Equation 1) to the workforce sampling frame (Table 1), a total of 384 representative sample size was randomly selected for the exercise. Using the easy-cost-route approach, a pre-tested questionnaire was administered to a total of 384 respondents for data elicitation. However, only 375 retrieved questionnaires were found to be valid and thus used for the analysis. Objective 1 was achieved using descriptive statistics, calorie and expenditure food security index methods; Objective 2 was achieved using Bivariate probit and Heckit's regression models, while Objective 3 was achieved using the Blinder-Oaxaca decomposition model.

Table 1: Sampling frame of states' public service in Nigeria's Northern region

States	Population	Sample size
Bauchi	101,199	118
Kano	151,000	177
Niger	76,000	89
Total	**328,199**	**384**

Source: Agency Reports, 2017; Anonymous, 2017; Haruna, 2019

The following is the Krejcie and Morgan (1970) formula:

$$n = \frac{N(X)}{X+(N-1)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

$$X = \frac{Z^2 P(1-P)}{e^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

Where, n = finite sample size, N = finite population size, z = confidence interval at two- tail (t-statistic at 5% probability level: 1.96), p = sample proportion (50%) and e = degree of freedom (5%).

Model Specification

1. Calorie intake index model

Calorie intake food security index (CI): A threshold value of 2260kcal recommended by FAO was used as a benchmark that defines calorie intake food security. The formula is as follows (Abdulrahman *et al*., 2017; Oladimeji *et al*., 2018):

$CI_i = \frac{P_i}{R}$ …………………………………..………… (3)

Where, CI_i is the calorie intake food security index of the ith household, P is the daily per capita calorie intake of the ith household, while 'R' is the FAO recommended daily per capita calorie threshold value (2260kcal/day/head). Therefore, a household is deemed calorie deficient if his/her daily per calorie intake is less than unity (1), and calorie adequate if greater than 1. Based on the estimated CI_i the following calorie intake food security measures were estimated.

Calorie intake surplus or deficit index (P): It is specified as follows (Oladimeji *et al*., 2018):

$P = \frac{1}{m} \int_{i=1}^{m} G_i$ ………………………………….…… (4)

$G_i = \frac{X_i - R}{R}$ ………………………………………… (5)

Where,G_i is the calorie deficiency or surplus of the ith household, X_i is the average daily/per capita calorie intake of ith household, and 'm' is the number of calorie sufficient (surplus index) or deficient households (deficit index). The 'P' as the aggregate indicates the extent to which the households were above or below the calorie intake threshold level.

Calorie intake head count ratio (H): The formula is as follows:

$H = \frac{m}{n}$ ……………………………………..… (6)

Where, '*n'* is the total sampled population.

Cost of minimum calorie intake threshold (S): Foster *et al*. (1984) suggested a cost of calorie intake index to find the minimum cost that can finance the minimum calorie required to maintain the body and the soul together. Below is the formula (Abdulrahman *et al*., 2017; Oladimeji *et al*., 2018):

$E_i = \alpha + \beta C_i + \varepsilon_i$ ………………………………..… (7)

$S = e^{\alpha + \beta L}$ ……………………………………….….. (8)

Where, E_i is the stochastic food expenditure of ith household per day; C_i is the actual daily per capita calorie intake of the ith household; α is the intercept; β is the regression coefficient; S is the minimum threshold cost of procuring per capita daily calorie intake; e is the Euler's coefficient (2.718); and *'L'* is the FAO recommended daily per capita calorie intake (2260kcal). Based on S, a household is categorized as calorie deficient or sufficient.

Table 2: Calorie composition in foods

Food	Calorie per 100gm	Food	Calorie per 100gm
White Rice	400	Yam Flour	118
brown Rice	690	Cassava Flour	298
Red Beans	333	Garri	363
White Beans	337	Beef	250
Semovita	322	Mutton	267
Maize Flour	370	Fish	129

Food	Calorie per 100gm	Food	Calorie per 100gm
Sorghum Flour	316	Sphaggetti	348
Yam	126	Indomie noodles	450

Source: www.fitbit.com/food

The household size was adjusted to adult equivalent using the Organization for Economic Co-operation and Development (OECD) scale. It considers both the size and makeup of the household (Sadiq et al., 2019). The scale is as follows:

$N_i = 1 + (N_{adult} - 1) * 0.7 + (N_{child} * 0.5)$ …..…. (9)

Where, N_i is the adjusted adult equivalent for i^{th} household. The first adult-male (≥ 15 years) is given a weight of 1; the other adult- female (≥ 15 years) is given a weight of 0.7, to reflect economies of scale; and the children (≤ 15 years) is given a weight of 0.5).

2. Expenditure food insecurity index

Given that food security is centred on a component of income *viz*. consumption, it will be surreptitious and ridiculous to use income as the basis for food security measurement. Income comprises consumption in the short run and saving and investment in the long run. Being food unsecured does not unilaterally imply being poor due to some subjective factors, *viz*. individual and business motives, that affect consumption. However, being poor unilaterally implies being food insecure as the inability to meet up with the basic necessities of life will hamper the smooth administration of the body and soul together. Based on the poverty index model proposed by Foster *et al*. (1984) as adopted by Sadiq *et al*. (2015), Sadiq (2015a&b), and Sadiq *et al*. (2019), the expenditure food security index is presented below:

$PCHME = {}^{THME}/_{HHS}$…………………………. (10)

$MPCHME = {}^{TPCHME}/_{TNR}$…………………… (11)

$MPCHDE = {}^{MPCHME}/_{30}$……………………… (12)

$FSL = {}^{2}/_{3} \times MPCHDE$…………………………… (13)

Where: PCHE is per capita household's monthly expenditure; THME is the total household's monthly expenditure; HHS is the household size (adjusted adult equivalent); MPCHME is mean per capita household's monthly expenditure; TNR is the total number of respondents; TPCHME is total per capita household's monthly expenditure; MPCHDE is mean per capita household's daily expenditure; and FSL is food security threshold line.

Food insecurity index (FI):

$FI_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z-Y_i}{Z}\right)^\alpha$ …………………………. (14)

Where *'FI'* stands for food insecurity index; *'n'* stands for the number of households in the population; *'q'* stands for the number of food insecure households; 'Z' stands for the food security threshold value; Y i stands for the actual daily per capita food expenditure; and is the aversion parameter, which takes on a value of 0 to 2 and is used to calculate the food insecurity index in a stepwise manner.

When α = 0, the expression reduces to:

$$FI_0 = \frac{q}{n} \quad \text{…...……………………………………. (15)}$$

This is known as food insecurity incidence, and it refers to the percentage of the population who are food insecure.

When α =1, the expression reduces to:

$$FI_1 = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z-Y_i}{Z}\right)^1 \quad \text{………………………………. (16)}$$

This is called the food insecurity depth/gap.

When α =2, the expression becomes:

$$P_2 = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z-Y_i}{Z}\right)^2 \quad \text{…………………..………. (17)}$$

The severity indicator for food insecurity is named this. The abject food insecure household is given a higher weight in this index than those who are just below the food security threshold. It adds an aspect of unequal distribution of the abjectly food insecure household's intake below the threshold to the depth of food insecurity.

3. Bivariate probit model

The following is a bivariate probit model that takes into account the possibility of contemporaneous correlation in the decision of calorie intake and expenditure food security statuses as part of food security management:

$$Y_{ij} = X_{ij}\beta_j + \varepsilon_{ij} \quad \text{………………………………….. (18)}$$

Where Y_{ij} $(j = 1, \dots \dots, m)$ represents the food security status (m=2) faced by the i^th household (i=1,……, n), X_{ij} is a 1*k vector of observed variables that influence food security status. β_j is a k*1 vector of unknown parameters to be estimated, and ε_{ij} is the stochastic term. In this specification, each Y_j is a binary variable, thus equation 18 is a system of 'm' equations to be estimated:

$$Y_1^* = \alpha_1 + X\beta_1 + \varepsilon_1 \quad \text{……..………………………… (19)}$$

$$Y_2^* = \alpha_2 + X\beta_2 + \varepsilon_2 \quad \text{…...………………………..…… (20)}$$

Where Y_1^* and Y_2^* are two latent variables underlying each of food security management such that $Y_j = 1$ if $Y_j > 0$; otherwise = 0. Y_1^* and Y_2^*respectively, are calorie intake and expenditure food security positions of i^{th} households. The ε_{ij} is likely to experience stochastic dependence. This dependence among the elements can be considered by assuming $\varepsilon_{ij}$is multivariate normally distributed (Ullah *et al*., 2016; Sadiq *et al*., 2021a). Thus, in the bivariate probit model, the stochastic term is assumed to have multivariate normal distributions with a mean that equals zero.

4. Heckit's regression model

Heckit's/Heckman's model is composed of the decision model and the outcome model with the former having the dependent factor being dichotomous while the latter has its predictor variable being continuous (Sadiq *et al*., 2020c). The two-step Heckman's selection model was adopted because of its ability to correct sample selection bias.

The decision stage or first stage is a probit model and it is given below:

$Y_i = f(X_1, X_2, X_3 \dots\dots\dots\dots\dots\dots.. X_n)$ ……………... (21)

$Y_{it} = \beta_0 + \beta X_{it} + \varepsilon_i$………………….………… (22)

In the outcome stage or second stage, the dependent factor of the model is a continuous variable, and it is presented below:

$Y_i^* = \alpha + X\beta + \varepsilon_i$... (23)

$Y_i^* = \alpha + X_1\beta_1 + X_2\beta_2 + X_3\beta_3 + X_4\beta_4 + X_5\beta_5 + \cdots. + X_n\beta_n + \gamma IMR + \varepsilon_i$……… (24)

Where, $Y_{it} = Calorie\ or\ Expenditure\ Food\ security\ (secured = 1, otherwise = 0)$; Y_i^* = latent observation for i[th] household [calorie intake (kcal)/food security gap (₦)]; X_{it} = vector of explanatory variables: X_1= Gender (male =1, otherwise = 0); X_2= Age (year); X_3= Marital status (married =1, otherwise = 0); X_4= Education (years); X_5= Household size (number); X_6= Diversification index (Herfindahl Hirschman index); X_7= Income (₦/month); X_8= Expenditure on non-food items (₦/month); IMR= The Inverse Mill's ratio; β_0 = Intercept; β_{1-n} = Vector of parameters to be estimated; γ= Lambda; and, ε_i = Stochastic term.

Diversification index

Two-dimensional diversification index approach *viz*. Herfindal-Hirschman diversification index (HHDI), Barry's diversification index (BDI), and Ginevičius diversification index (GDI) were subjected to both OLS and Quantile regression (the results not reported here) so as to determine the appropriate index that reflects the income diversification. The HHDI and EDI were found to reflect adequately the calorie and expenditure food diversifications respectively of the respondents as evidenced by their estimated coefficients of the classical normal regression (OLS) and Quantile regression (25[th], 50[th], and 75[th]) that was progressive and plausible at 10% probability level.

5. Oaxaca-Blinder decomposition model

The following are the food security (energy and monetary) index functions (Oaxaca 1973; Blinder, 1973; Marwa, 2014; Revathy *et al*., 2020; Sadiq *et al*., 2020a&b; Sadiq *et al*.,2021b):

$$\bar{Y}_S = \beta_0 + \beta_i \sum_{i=1}^{i} X_i + \varepsilon_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.. (25)$$

$$\bar{Y}_{US} = \beta_0 + \beta_i \sum_{i=1}^{i} X_i + \varepsilon_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (26)$$

Where, $\bar{Y}_S$= average calorie/food security gap of secured; $\bar{Y}_{US}$= average calorie/food security gap of unsecured; $X_{i-n} = explanatory\ variables$; $\beta_0 = intercept$; $\beta_{i-n} = parameter\ estimates$; and, $\varepsilon_i = stochastic\ term$.

The total difference can be explained by,

$\Delta Y = \bar{Y}_S - \bar{Y}_{US}$ …………………………………………….. (27)

The Oaxaca-Blinder decomposition equation is,

$$\Delta Y = \left(\bar{X}_S\hat{\beta}_S - \bar{X}_{US}\hat{\beta}_{US}\right) + \left(\bar{X}_{US}\hat{\beta}_S - \bar{X}_S\hat{\beta}_{US}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (28)$$

If there is only discrimination against the unsecured group, the formula becomes:

$$\Delta Y = (\bar{X}_S - \bar{X}_{US})\hat{\beta}_S + \left(\hat{\beta}_S - \hat{\beta}_{US}\right)\bar{X}_{US} + (\bar{X}_S - \bar{X}_{US})\left(\hat{\beta}_S - \hat{\beta}_{US}\right) \ldots\ldots\ldots (29)$$

If the non-project group has project group's coefficient, then the formula becomes:

$$\Delta Y = (\bar{X}_S - \bar{X}_{US})\hat{\beta}_{US} + \left(\hat{\beta}_S - \hat{\beta}_{US}\right)\bar{X}_{US} + (\bar{X}_S - \bar{X}_{US})\left(\hat{\beta}_S - \hat{\beta}_{US}\right) \ldots\ldots\ldots (30)$$

Thus, equations (29) and (30) have a 'threefold' decomposition, i.e., the outcome difference is divided into three components. The first, second, and third components respectively, are the endowment effect, discrimination effect, and interaction effect.

The assumption that a non-discriminatory coefficient vector should be used to determine the impact of the fluctuations in the predictors leads to a popular decomposition in discrimination research. Let β^* be a non-discriminatory coefficient vector of this type. Following Jan (2008), the outcome difference can then be written as:

$$\Delta Y = (\bar{X}_S - \bar{X}_{US})\beta^* + \left\{(\bar{X}_S)\left(\hat{\beta}_S - \beta^*\right) + (\bar{X}_{US})\left(\beta^* - \hat{\beta}_{US}\right)\right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (31)$$

Therefore, Equations (31) has a 'twofold' decomposition, i.e., the outcome difference is divided into two components. The first and second are quantity effect and unexplained effect respectively. Although the latter is frequently attributed to discrimination, it's important to remember that it also includes all unobserved variables' effects.

RESULTS AND DISCUSSION

Calorie and Expenditure-wise Food Security Status

From the empirical evidence, the average per capita daily calorie intakes of the secured versus unsecured households are 4349.99 and 1154.45 kcal; 4542.00 and 1170.88 kcal; 4477.17 and 1211.72kcal; and 3630.54 and 1089.10kcal for the region, Kano, Bauchi, and Niger states, respectively (Table 3). A cursory review of the pooled results showed 22.73% of the sampled population to be calorie food secured, while 77.27% were calorie food insecure. Besides, the state-wise decomposition details showed the proportions of 21.17, 33.33, and 13.16% of the respectively sampled population from Kano, Bauchi, and Niger states to be calorie food secured. Inversely, the proportions of 78.83, 66.67, and 86.84% of the remaining sampled population from Kano, Bauchi, and Niger states are calorie food unsecured. However, it can be inferred that a large chunk of the regional government workforce fell short of the per capita daily minimum calorie intake recommended by FAO. The possible reason is the poor take-home monthly package which is invariance to the existing cost of living. As a rider, the condition is accelerated due to poor economic activities, a catalyst that hinders additional income earning. Though, the scenario is worse in all the chosen states, but it is more severe in Niger where calorie intake food insecurity trickles by approximately seven-fold times the food secured proportion. The possible reason for the alarming situation in Niger may owe to the fact that the monthly remuneration of the civil servants is abysmal. For Kano and Bauchi, the calorie food insecurity proportions vis-à-vis the food secured are approximately four and two-fold, respectively. However, for the entire region, the proportional disparity between insecure and secured amounts to almost four-fold. Generally, the poor status of the daily per capita calorie intake is a likely *de facto* that hinders the public service labour productivity in the state, by extension calorie malnutrition in their respective households.

Sequel to the FAO recommended daily per capita calorie intake/ energy level per capita of 2260Kcal, approximately ₦447.17, ₦479.85, ₦428.64 and ₦463.48 respectively in the overall region, Kano, Bauchi, and Niger states are the required cost to meet the daily calorie food security line per adult equivalent. Besides, on a weekly cum monthly basis, the foregoing estimates will translate into ₦3130.19 and ₦12520.75; ₦3358.95 and ₦13435.79; ₦3000.45, and ₦12001.80; and ₦ 3244.37, and ₦12977.48 respectively in the region, Kano, Bauchi, and Niger states. Thus, it can be concluded that the cost of living to achieve this minimum recommended daily calorie per capita is high in Kano state and then closely followed by Niger state.

The mean calorie intake index of the calorie secured versus unsecured vis-à-vis the region, Kano, Bauchi, and Niger states respectively were 1.93 and 0.51; 2.01 and 0.52; 1.98 and 0.54; and 1.61 and 0.48. Furthermore, the average calorie intake surplus cum deficit food insecurity indexes of the households in the region, Kano, Bauchi, and Niger states were -0.93 and 0.49; -1.01 and 0.48; -0.98 and 0.46; and -0.61 and 0.52 respectively. Thus, it can be inferred that the average per capita daily calorie intake of an adult equivalent for the secured population in the region, Kano, Bauchi, and Niger states exceed the recommended energy level by 93, 101, 98, and 61% respectively. The excess of both the region and Bauchi state is almost two-fold of the baseline, while that of the Kano state is slightly above two-fold. The excess of Niger state is just barely above one-fold, and thus it is the least in the distribution. On the other hand, the per capita calorie intakes per adult equivalent for the unsecured households were 49, 48, 46, and 52% below the baseline respectively for the region, Kano, Bauchi, and Niger states. In other words, it implies that the secured households in the region, Kano, Bauchi, and Niger states respectively consumed 93, 101, 98, and 61% in excess of the daily per capita calorie requirement. While the unsecured households in the respective order of the foregoing consumed 49, 48, 46, and 52% less than the daily per capita calorie requirement. The surplus of the average daily calorie intake per capita adult equivalent is highest in Kano state and least in Niger state, while the shortfall is the highest in Niger state and the least in Bauchi state.

A detailed analysis of the per capita daily calorie intake diversification status of the secured versus unsecured vis-à-vis the region and the states showed evidence of high diversification among the households in their daily per capita calorie consumption as indicated by the various two-dimensional approach diversification indexes (Table 3). Furthermore, the Gini coefficient index of the diversification index- Herfindahl-Hirschman index showed even distribution or high equality in the diversity of the daily per capita calorie among the secured households against a somewhat moderate equality in the calorie diversity among the unsecured households. Because of the degree of freedom problem which was due to insufficient observations across the states vis-à-vis secured versus unsecured, the state-wise Gini coefficient index was not computed.

Table 3: Summary of calorie intakes in the region

Items	**Secured**			
	Region	**Kano**	**Bauchi**	**Niger**
Calorie/day	4349.882	4542.003	4477.167	3630.536
CI	1.924727	2.009736	1.981047	1.606432
P	-0.92473	-1.00974	-0.98105	-0.60643
H	0.227273	0.211679	0.333333	0.131579
Exp. Calorie/day	623.9874	706.3357	590.0299	557.5982
Exp. Calorie/month	18719.62	21190.07	17700.9	16727.95

Items	**Secured**			
	Region	**Kano**	**Bauchi**	**Niger**
HHD	0.246922(0.176)	0.293839	0.223086	0.221371
BD	0.753078 (0.057)	0.706161	0.776914	0.778629
BDD	0.800145 (0.057)	0.750296	0.825471	0.827293
ED	0.81187 (0.075)	0.732875	0.842941	0.879664
EDD	0.659816 (0.075)	0.595616	0.685068	0.714913
GD	0.903603 (0.012)	0.892246	0.91093	0.905532
	Unsecured			
Calorie/day	1154.454	1170.884	1211.718	1089.1
CI	0.51082	0.51809	0.536158	0.481903
P	0.48918	0.48191	0.463842	0.518097
H	0.772727	0.788321	0.666667	0.868421
Exp. Calorie/day	405.8597	424.3316	340.107	440.1705
Exp. Calorie/month	12175.79	12729.95	10203.21	13205.11
HHD	0.222222 (0.193)	0.262352	0.211131	0.18763
BD	0.777778 (0.055)	0.737648	0.788869	0.81237
BDD	0.826389 (0.055)	0.783751	0.838174	0.863143
ED	0.845998 (0.080)	0.773656	0.852542	0.919497
EDD	0.687553 (0.080)	0.628759	0.69287	0.747286
GD	0.908915 (0.011)	0.899363	0.913783	0.915302
	Cost of minimum calorie intake threshold (S) for unsecured			
Intercept	5.72595	5.74361	5.69037	5.77729
SE	0.028083	0.038305	0.036889	0.066936
t-statistics	203.89***	149.94***	154.25***	86.31***
Slope	0.000167	0.00019	0.000164	0.00016
SE	6.01E-06	8.81E-06	7.20E-06	1.47E-05
t-statistics	2.78E+01***	2.16E+01***	2.28E+01***	1.09E+01***
Daily	447.1698	479.8496	428.6358	463.4815
Weekly	3130.188	3358.947	3000.45	3244.37
Monthly	12520.75	13435.79	12001.8	12977.48

Source: Field survey, 2021

Note: *** means significant at 1%; values in ( ) are Gini coefficients; Exp. = Expenditure; HHD= Herfindahl-Hirschman diversification index; BD = Barry's diversification index; BDD = Barry's diversification degree index; ED= Entropy's diversification index; EDD= Entropy's diversification degree index; and, GD = Ginevičius diversification index

A cursory review of the food insecurity incidence-expenditure dimension showed 47.86, 37.96, 43.09, and 64.91% of the sampled populations in the region, Kano, Bauchi, and Niger states respectively to be food unsecured (Table 4). Besides, the food insecurity gap cum severity was 0.1453 and 0.059; 0.1030 and 0.0379; 0.1413 and 0.0584; and 0.2012 and 0.0856 respectively for the region, Kano, Bauchi, and Niger states. From the dimension of the food insecurity, it is implied that in the region, Kano, Bauchi, and Niger states respectively, the food unsecured households fell short of the daily per capita basic food security line by ₦44.12, ₦31.28, ₦42.91, and ₦61.09. Therefore, for the unsecured households in the region and respective states to attain the basic threshold line (₦303.62), they need to bridge their food insecurity gaps with their given respective monetary variations. Generally, based on the prevailing exchange rate, the basic threshold line is slightly below the food security threshold of $1 per capita/day recommended by the FOA. Given the average food security threshold of N455.43 ($1 = ₦411.52), based on the basic food security threshold of the locality that is not in conformity with the global basic threshold (FAO recommendation), most of the borderline food-secured households are likely to be vulnerable to food insecurity. Thus, it becomes imperative for policymakers to relax some of the income taxes and control the inflationary rate in the economy, thus enhancing the food security of its citizens. Further, in view of the severity dimension, it can be inferred that 5.9, 3.8, 5.8, and 8.6% of the households in the region, Kano, Bauchi, and Niger states respectively are in a state of abject food insecurity. The diversification indexes-two approach showed expenditure on food to be highly diversified across the region and states, thus implying high diversification in the budget dietary consumption of the sampled households. However, the entropy index which reflects the true diversification status in the studied area showed the dietary diversification in Bauchi and Niger States to be perfect. Thus, it can be inferred that the households in the affected areas are health-conscious about dietary consumption.

Overall, across the consumption dimension-calorie and expenditure, the state/situation of food insecurity looks more precarious and devastating in the Niger state, thus there is a need for urgent intervention before the state workforce households degenerate into the destitute zone. Across the region, there is a need to improve the food security status of the household, which is a pre-requisite for labour productivity required for enhancing economic growth and development.

Table 4: Food insecurity index and diversification (general)

Index	Region	Kano	Bauchi	Niger
Incidence	0.47861	0.379562	0.430894	0.649123
Gap	0.145267	0.103017	0.141327	0.201197
Severity	0.059051	0.037861	0.058365	0.085588
HHD	0.141711	0.15898	0.143033	0.130265
BD	0.858289	0.84102	0.856967	0.869735
BDD	0.911932	0.893583	0.910527	0.924093
ED	0.992614	0.931375	1.004199	1.031314
EDD	0.806709	0.756939	0.816124	0.838161
GD	0.923694	0.921611	0.922021	0.925294

Source: Field survey, 2021

Note: HHD= Herfindahl-Hirschman diversification index; BD = Barry's diversification index; BDD = Barry's diversification degree index; ED= Entropy's diversification index; EDD= Entropy's diversification degree index; and GD = Ginevičius diversification index.

Determinants of Calorie intake and Expenditure food securities

The significance of the bivariate probit regression Chi^2 for the test of independence (correlation) being within the plausible margin of a 10% error gap implies that there is a correlation between calorie and expenditure food securities of the respondents (Table 5). In addition, it implies that the chosen model is the best fit for the specified equation. Predictor variables *viz.* household size, dietary diversification, and income have two-way traffic influences vis-à-vis calorie and expenditure food securities as indicated by their respective parameter estimates that are within the acceptable margin of 10% significance level. Educational status and age have one-way traffic influences on calorie and expenditure food securities respectively as indicated by their respective parameter, and they estimate that are within the plausible margin of a 10% probability level.

The negative-significant of the household coefficient for both dimensions implies that large households, large mouths, and the expenditure food security to cater for plummeted require daily per capita calorie intake status. A household with a large number of dependents (vulnerable group) is at risk of being calorie deficient and expenditure food unsecured owing to many mouths to be fed. Thus, the probability of a household being calorie and expenditure food unsecured due to a unit increase in the household size by a person will be 0.32 and 0.40%, respectively. The positive and significant of the dietary diversification index for both dimensions showed that high diversification of household dietary consumption enhances their calorie and expenditure food security simultaneously. As a rider, households with high dietary diversification are food secured, compared to those with low dietary diversification. Besides, it reveals the health consciousness of the households results in a balanced diet in their food basket. Thus, an increase in household dietary diversification by 1% will increase the chances of being calorie and expenditure food secured by 4.23 and 6.34%, respectively. The positive-significant of the estimated income parameter implies that large income enhances both calorie and expenditure food securities. Thus, households with remunerative income are better off in terms of food security status, compared to those with meagre monthly earnings. Therefore, the probability of a household migrating from calorie and expenditure food unsecured to comfort zone for a unit increase in his/her monthly income will be 0.72 and 1.85%, respectively.

The negative-significant of the educational coefficient implies that households with high educational achievement are likely to be calorie food unsecured. The possible reason may be due to individual motives that influence consumption, which is a subjective factor *viz*. the desire to build reserves for unforeseen contingencies to improvise for anticipated future needs, retirement period, sickness, etc; the desire to enjoy a gradually increasing expenditure for enhancement of the standard of living; and the desire to bequeath a fortune. Besides, the need for self-esteem and a pure misery instinct satisfaction cannot be ruled out. Thus, an increase in the educational attainment of a household by a year will increase the tendency of being calorie unsecured by 0.062%. The positive-significant of age coefficient shows that aged people are very keen and conscious of achieving expenditure food to keep the body and the soul together, unlike the youthful population who are materialistic inclined. Therefore, the implication of a unit increase in a household head by a year will increase his/her probability of being expenditure food secured by 0.031%.

Table 5: Bivariate probit model for calorie intake and expenditure food securities

Variable	calorie intake		expenditure food security	
	Coefficient	t-stat	Coefficient	t-stat
Intercept	−5.587(3.027)	1.846*	−15.70(3.020)	5.199***
Gender	0.187(0.277)	0.675^{NS}	0.124(0.271)	0.458^{NS}
Age	−0.019(0.014)	1.312^{NS}	0.030(0.017)	1.810*
Marital status (MS)	0.343(0.314)	1.093^{NS}	0.396(0.314)	1.259^{NS}

Education	-0.061(0.032)	1.893*	−0.004(0.025)	0.185^{NS}
Household size (HS)	−0.315(0.035)	8.933***	−0.402(0.037)	10.70***
HHD	4.228(1.298)	3.255***	6.339(2.019)	3.139***
Income	0.720(0.268)	2.687***	1.847(0.312)	5.907***
ENF			−0.272(0.181)	1.497^{NS}
TI(t-stat:Chi^2)	**2.89[0.089]***			

Source: Field survey, 2020

Note: *** ** * &^{NS} imply significant at 1%, 5%, 10% & non-significant, respectively.

Figures in ( ) and [ ] are standard error and probability level, respectively. ENF = Expenditure on non-food; TI = Test of independence.

In determining the factors that influence calorie intake and food insecurity depth of the deprived households simultaneously with the forgoing dependent variables (calorie and expenditure food security statuses), the two-step Heckman's model was performed (Table 6). The models for both the calorie and expenditure food securities fit the specified equations as indicated by their respective inverse Mill's ratio (IMR) coefficients which are not different from zero at a 10% degree of freedom. The non-plausibility of the IMR coefficients implies that there is no case of selection bias in the use of non-zero calorie intake deficiency and expenditure food insecurity gap. Therefore, the outcome model, the second stage OLS, is useful in explaining the factors that influence both calorie intake deficiency and expenditure food security depth. In addition, the test of multi-collinearity showed no evidence of covariance between the explanatory variables as indicated by their respective variance inflation factors (VIF) which were within the limit of 10.0.

The coefficients of the selection model vis-à-vis the calorie intake and expenditure food insecurity statuses were almost indifferent to the estimates obtained under the bivariate probit model. Thus, the inferences in the bivariate probit were sufficient enough to subsist for the selection model of Heckman's model.

The empirical evidence showed that the household's size has a bidirectional influence on both outcome models, while marital status and gender have a unidirectional influence on food insecurity depth as evidenced by their respective estimated coefficients that are different from zero at a 10% probability level. The positive and significant of the household coefficient implies that large household susceptibility to calorie intake deficiency and food security gap is inelastic. Thus, a unit change in the household composition will lead to an increase in the calorie intake deficiency and food security gap by 0.498 and 0.334%, respectively. The negative significant of the gender coefficient implies that women households are less vulnerable to food security depth, compared to their men counterparts. Literature has reported that men's income does not improve the quality of household food accessibility as they tend to invest their earnings in other personal matters. However, if women earn cash, even if relatively low, it is likely to be expended on households' food (Sadiq *et al.*, 2021). Therefore, the probability of a household being a woman will decrease its chances of a food insecurity gap by 0.76%. The positive-significant of the marital status coefficient implies that married households are vulnerable to a heightened food insecurity gap, compared to their single counterparts. The possible reason may be attributed to too much household responsibility to carter for, thus exacerbating food insecurity depth. This outcome is expected owing to the trend behaviour of large household size on the food insecurity status of households facing this phenomenon. However, this downplays the significance of economic and social security, a twin capital associated with marriage.

Table 6: Heckman's model for calorie intake and expenditure food securities

Variable	Calorie intake				
	Status (decision)		Deficiency/Gap (outcome)		VIF
	Coefficient	t-stat	Coefficient	t-stat	
Intercept	−5.746(3.003)	1.913*	−3.150(1.478)	2.131***	-
Gender	0.128(0.275)	0.467^{NS}	−0.619(0.468)	1.323^{NS}	1.427
Age	−0.020(0.014)	1.406^{NS}	0.024(0.030)	0.803^{NS}	1.180
Marital status	0.369(0.304)	1.215^{NS}	0.582(0.474)	1.228^{NS}	1.462
Education	−0.053(0.029)	1.798*	−0.018(0.052)	0.360^{NS}	1.601
Household size	−0.328(0.036)	8.917***	0.498(0.140)	3.556***	1.128
HHD	3.928(1.360)	2.887***	-	-	-
Income	0.748(0.267)	2.793***	-	-	-
Lambda (IMR)	**-**	**-**	**−1.799(1.737)**	**1.035^{NS}**	**-**
Sigma	**1.799**				
Rho	**−1.000**				
Wald Chi^2	**21.84 [0.0006]*** **				
	Expenditure food security				
Intercept	−15.80(3.095)	5.106***	−3.400(0.701)	4.849***	-
Gender	0.151(0.275)	0.549^{NS}	−0.761(0.273)	2.783***	1.427
Age	0.034(0.017)	1.956*	0.002(0.014)	0.183^{NS}	1.180
Marital status	0.336(0.318)	1.057^{NS}	0.937(0.294)	3.189***	1.462
Education	−0.003(0.025)	0.135^{NS}	−0.038(0.029)	1.268^{NS}	1.601
Household size	−0.395(0.040)	9.877***	0.333(0.039)	8.505***	1.128
HHD	5.839(2.043)	2.857***	-	-	-
Income	1.810(0.319)	5.667***	-	-	-
ENF	−0.228(0.176)	1.296^{NS}	-	-	-
Lambda (IMR)	**-**	**-**	**−1.227(0.805)**	**1.525^{NS}**	
Sigma	**1.516**				
Rho	**−0.809**				
Wald Chi^2	**130.53(0.000)**				

Source: Field survey, 2020

Note: *** ** * &^{NS} imply significant at 1%, 5%, 10% & non-significant, respectively.

Figures in ( ) and [ ] are standard error and probability level, respectively

Gap due to Calorie Intake Differential

Table 7 showed the average per capita daily calorie intake of the secured versus unsecured cum the gap for the region to be 4349.88, 1154.45, and 3195.43kcals, respectively. The threefold decomposition details showed that out of the overall gap, differences in the group covariates- endowment effect accounts for 515.36kcal, coefficient differences-structural effect accounts for -2294.92kcal, while 4974.99kcal is attributed to interaction effect (Table 8). Therefore, it can be inferred that the calorie secured are structurally disadvantaged on one hand, and endowment and interactional advantaged, on the other. Besides, calorie-deficient households are structurally advantaged, and endowment and interactional are disadvantaged. In the endowment component, only household size has a significant influence on the calorie gap as evidenced by its estimated coefficient cum the error bar that is within the acceptable margin of a 10% probability level (Figure 1). Thus, it implies that a significant portion of the secured versus unsecured calorie gap is driven by the group differences in the proportion of individuals with a large household size. Individuals with a large household size tend to be calorie deficient as evidenced by the pooled regression result (Table 7). Furthermore, the value of the household means difference showed that the calorie-deficient group maintained a large household size. Similarly, in the coefficient component, only educational level achieves a clear statistical significance level (Figure 1). As evident from the educational level coefficient difference between the secured versus unsecured, the calorie intake due to an additional one-year educational attainment is greater for the secured household by 178.46kcal/day/head (Table 7). Thus, the differences in the regression coefficient on educational level account for the decisive portion of the calorie intake gap.

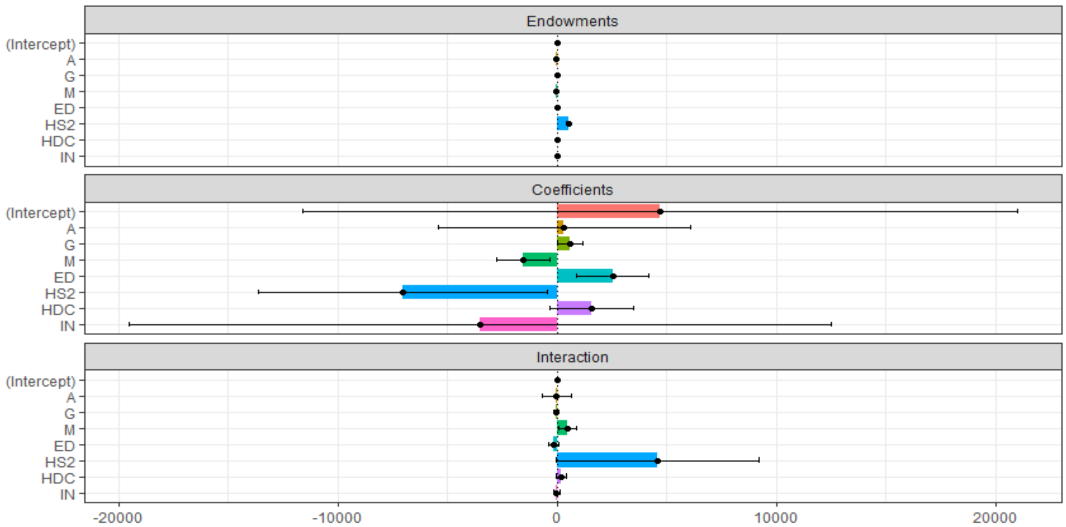

Figure 1: Threefold decomposition of calorie food security

The weight column in the reference coefficient vector for the twofold decomposition results indicates the relative weights of coefficients from the regression on secured and unsecured data, respectively. The two negative weights show that the reference coefficients are derived from pooled regressions without (minus one) or with (minus two) the group indicator variable as a covariate. Following Neumark (1988); Hlavac (2018), the reference coefficient set used was the pooled regression coefficients. The minus one in the weight column denotes Neumark's decomposition (Table 9). The overall twofold decomposition gap of 3195.43kcal can be decomposed into 1877.05kcal-attributed to explained effect and 1318.38kcal-attributed to unexplained effect. Given that the unexplained part of the calorie gap is due to calorie discrimination, and the pooled regression coefficients are non-discriminatory, thus it can be deduced that 1018.75kcal of the unexplained portion originates from the discrimination in favour of calorie-secured households, while 299.63kcal comes from the discrimination against calorie-unsecured households. In the same vein, for the weight (-2), the gap of 1318.38kcal for the overall twofold decomposition can be partitioned into 1027.18kcal *viz*. endowment effect and 2168.25kcal *viz*. discrimination effect. Thus, by holding the pooled regression non-discriminatory and the structural effect discriminatory, it can be deduced that -4.97E-13kcal comes from discrimination in favour of the calorie-secured households, while 2168.25kcal comes from discrimination against the calorie-unsecured households. At weights minus 1 and 2, without discrimination against the unsecured, their per capita daily calorie intake should be 2472.83 and 3322.70kcals respectively.

Gap due to Food Security Differential

With the average per capita daily food expenditures of ₦553.09 and ₦349.43, respectively, for the secured and unsecured, the expenditure gap between them is ₦203.66 (Table 8). The threefold decomposition of the overall gap of ₦203.66; ₦64.91, ₦92.03, and ₦46.72 are attributed to the endowment, discrimination, and interaction effects, respectively. Thus, the unsecured households are disadvantaged in all components, while the secured are advantaged in all components. In the endowment component, except for the household size, all the remaining explanatory variables were non-plausible at a 10% degree of freedom, thus having an insignificant influence (Figure 2). Thus, it can be inferred that a significant portion of the food expenditure gap is governed by group differences in the proportion of households with large household sizes. Further, individuals with large household sizes tend to be food unsecured as evidenced by the pooled regression household estimated coefficient (Table 7). In addition, the value of the household means differences showed that unsecured households have a large family size. Therefore, the differences in the groups' household composition account for the higher portion of secured household food security. In the same vein, only expenditure on non-food items is found to have a significant influence on the discrimination component as indicated by the plausibility of its estimated parameter at a 10% accuracy level (Figure 2). Based on the non-food expenditure coefficient differentials between secured and unsecured, the food security due to a naira increase in the non-food expenditure is higher for food-secure households by ₦135.80 (Table 7).

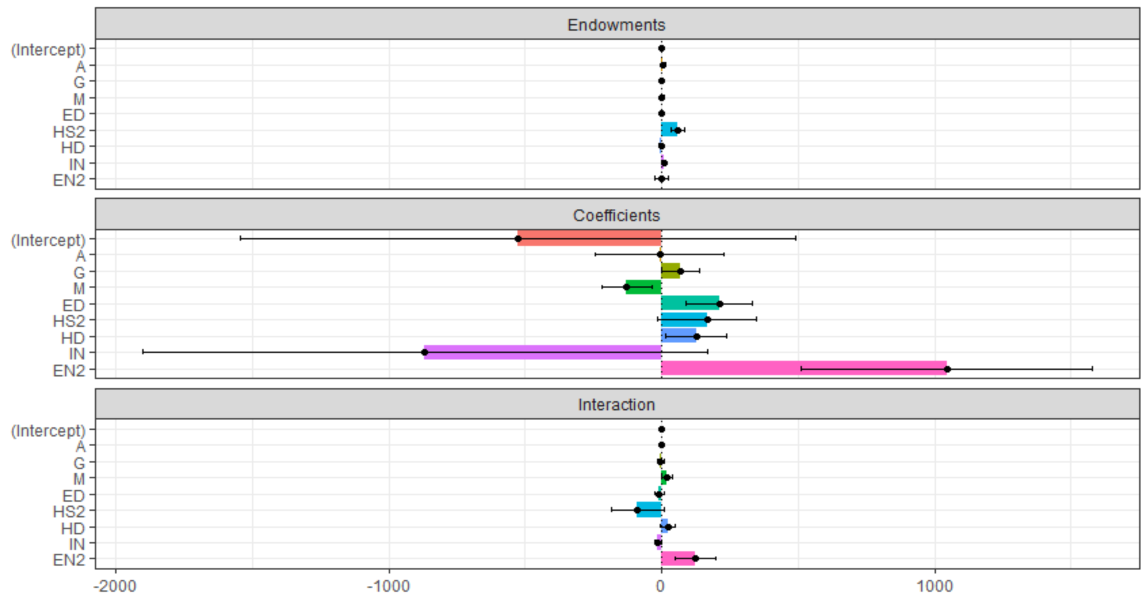

Figure 2: Threefold decomposition of expenditure food security

For the twofold decomposition, at the weight of (-1), the food security gap of ₦203.66 can be decomposed into ₦166.05 which is explained by the differences between the group's idiosyncratic factors and ₦37.61 that is unexplained (Table 9). Given that the unexplained portion of the food security gap owes to food security discrimination while the pooled regression coefficients are non-discriminatory, the empirical evidence showed that ₦18.00 of the unexplained part owes to discrimination in favour of the secured group, while ₦19.61 owes to discrimination against the unsecured category. Besides, at the weight of (-2), the explained and unexplained effects respectively account for ₦120.45 and ₦83.22of the food security gap. *Ceteris paribus* vis-à-vis discrimination and non-discriminatory, -18.11E-13 naira is associated with discrimination in favour of the secured category, while ₦83.22 is associated with discrimination against the unsecured household. In a nutshell, at weights -1 and -2, without discrimination against the unsecured, their food security status should be ₦387.04 and ₦432.65, respectively. Sequel to the foregoing, the unsecured category will fall within the food security threshold borderline. This is a source of concern that needs the immediate attention of policymakers as none of the unsecured households will be within the comfort zone of food security.

Table 7: Continued (Reg. Pool 2) …………

Item	Calorie food security			Expenditure food security		
	Coeff.	SE	t-stat	Coeff.	SE	t-stat
Intercept	191.72	-	-	-156.78	-	-
Age	-6.461	10.610	0.608	-5.985	1.37E+00	4.380***
Gender	527.97	1.89E+02	2.790	130.05	2.46E+01	5.280***
MS	-749.77	1.92E+02	3.910	-113.13	2.51E+01	4.510***
Education	23.39	19.24	1.215	8.511	2.482	3.428***
HHS	-82.59	1.30E+01	6.360	-4.765	2.241	2.126**
HHD	349.46	875.13	0.399	194.23	194.01	1.001^{NS}
Income	396.16	159.15	2.489	22.66	23.44	0.966^{NS}
ENF				66.281	1.30E+01	5.120***
Classification	**-2168.25**			**-83.218**		

Source: Computer print-out, 2021

Table 7: Summary of variables in the Oaxaca-Blinder decomposition model

Items	Calorie food security								
	Beta A	Beta B	Beta Diff.	Reg. A	Reg. B	Reg. Pool 1	Mean A	Mean B	Diff.
Intercept	2912.323	-1788.62	4700.943	2912.32	-1788.62	-2493.83	1	1	0
Age	13.3732	5.523571	7.849631	13.37	5.524	-23.47	36.69412	41.12803	-4.43391
Gender	899.9504	70.53089	829.4195	899.95	70.531	634.58	0.682353	0.730104	-0.04775
MS	-1900.61	51.48574	-1952.09	-1900.61	51.486	-867.5	0.529412	0.778547	-0.24913
Education	176.9044	-1.55144	178.4559	176.9	-1.551	12.17	13.22353	14.21453	-0.991
HHS	-514.56	-52.6093	-461.95	-514.56	-52.609	-154.56	5.275294	15.2083	-9.93301
HHD	7456.398	338.7759	7117.622	7456.4	338.776	556.83	0.246923	0.222222	0.024701

Items	Calorie food security								
	Beta A	**Beta B**	**Beta Diff.**	**Reg. A**	**Reg. B**	**Reg. Pool 1**	**Mean A**	**Mean B**	**Diff.**
Income	-11.2542	300.7394	-311.994	-11.25	300.739	640.46	11.28803	11.20967	0.078366
Calorie							4349.882	1154.454	3195.428
	Expenditure food security								
Intercept	-348.427	177.9295	-526.356	-348.427	177.9295	-408.73	1	1	0
Age	-5.04337	-4.86959	-0.17378	-5.043	-4.8696	-5.585	39.66667	40.61453	-0.94786
Gender	141.2942	46.75278	94.54139	141.294	46.7528	129.657	0.697436	0.743017	-0.04558
MS	-171.522	-6.36095	-165.161	-171.522	-6.361	-105.21	0.671795	0.776536	-0.10474
Education	15.32411	0.518603	14.8055	15.324	0.5186	8.411	13.68205	14.32402	-0.64197
HHS	3.181539	-6.10493	9.286471	3.182	-6.1049	-9.084	8.348718	17.96425	-9.61553
HHD	867.2562	-118.283	985.5393	867.256	-118.283	259.267	0.152793	0.129639	0.023154
Income	-36.0196	41.90595	-77.9256	-36.02	41.9059	43.923	11.31051	11.13702	0.173489
ENF	134.5435	-1.25487	135.7984	134.544	-1.2549	66.285	8.598856	7.692607	0.906249
EF							553.0931	349.4302	203.6629

Source: Computer print-out, 2021

Note: EF = Expenditure of food; Diff. = Difference

Table 8: Gap due to discrimination in food security (Threefold decomposition)

Items	Calorie food security								
	Endowment effect			**Discrimination effect**			**Interaction effect**		
	Coeff.	**SE**	**t-stat**	**Coeff.**	**SE**	**t-stat**	**Coeff.**	**SE**	**t-stat**
Intercept	0.000	0.000	0.000^{NS}	4700.94	8319.39	0.565^{NS}	0.000	0.000	0.000^{NS}
Age	-24.49	16.68	1.468^{NS}	322.83	2932.94	0.110^{NS}	-34.80	339.35	0.102^{NS}
Gender	-3.368	7.830	0.430^{NS}	605.56	304.17	1.990**	-39.61	66.037	0.599^{NS}
MS	-12.83	12.31	1.041^{NS}	-1519.8	615.90	2.467**	486.34	213.94	2.273**
Education	1.537	5.194	0.295^{NS}	2536.66	830.01	3.056***	-176.85	119.86	1.475^{NS}
HHS	522.56	44.26	11.80***	-7025.48	3359.07	2.091**	4588.56	2366.53	1.938*
HHD	8.368	6.866	1.218^{NS}	1581.69	975.47	1.621^{NS}	175.81	123.69	1.421^{NS}
Income	23.57	20.54	1.147^{NS}	-3497.35	8169.67	0.428^{NS}	-24.45	68.277	0.358^{NS}
Effect	515.36	59.72	8.630***	-2294.92	2051.97	1.118^{NS}	4974.99	2178.698	2.283^{NS}
	Expenditure food security								
Intercept	0.000	0.000	0.000^{NS}	-526.35	519.00	1.014^{NS}	0.000	0.000	0.000^{NS}
Age	4.615	3.678	1.254^{NS}	-7.057	120.61	0.058^{NS}	0.165	1.962	0.083^{NS}
Gender	-2.131	2.575	0.827^{NS}	70.24	35.65	1.970**	-4.309	6.476	0.665^{NS}
MS	0.666	3.228	0.206^{NS}	-128.25	47.123	2.721***	17.29	10.483	1.650*
Education	-0.332	1.279	0.260^{NS}	212.07	62.202	3.409***	-9.505	8.346	1.138^{NS}
HHS	58.70	13.55	4.330***	166.82	92.72	1.799*	-89.29	49.397	1.807*

Items	**Calorie food security**								
	Endowment effect			**Discrimination effect**			**Interaction effect**		
	Coeff.	**SE**	**t-stat**	**Coeff.**	**SE**	**t-stat**	**Coeff.**	**SE**	**t-stat**
HHD	-2.738	4.645	0.589^{NS}	127.76	57.11	2.237**	22.82	13.704	1.665*
Income	7.270	3.329	2.183**	-867.86	527.90	1.643^{NS}	-13.52	7.142	1.893*
ENF	-1.137	12.22	0.093^{NS}	1044.64	272.73	3.830***	123.07	38.524	3.194***
Effect	64.91	14.18	4.576***	92.025	46.02	1.999**	46.722	50.908	0.917^{NS}

Source: Computer print-out, 2021

Table 9: Gap due to discrimination in food security (Twofold decomposition)

S/N	**Weight**	**Energy food security**					
		Explained			**Unexplained**		
		Coeff.	**SE**	**t-stat**	**Coeff.**	**SE**	**t-stat**
1	**0**	515.35	59.71	8.630***	2680.07	298.52	8.977***
2	**1**	5490.35	2184.37	2.513**	-2294.92	2051.97	1.118^{NS}
3	**0.5**	3002.85	1095.83	2.740***	192.57	981.41	0.196^{NS}
4	**0.227273**	1646.03	1689.45	0.974^{NS}	1549.39	1562.14	0.991^{NS}
5	**-1**	1877.04	257.49	7.289***	1318.37	153.15	8.608***
6	**-2**	1027.18	189.28	5.426***	2168.24	217.56	9.966***
	WD(-1)	**2472.833^**			**2472.833^^**		
	WD(-2)	**3322.699^**			**3322.699^^**		
		Unexplained A			**Unexplained B**		
1	**0**	2.68E+03	2.99E+02	8.980***	0.000	0.000	0.000^{NS}
2	**1**	0.00E+00	0.00E+00	0.000^{NS}	-2294.92	2051.97	1.118^{NS}
3	**0.5**	1.34E+03	1.49E+02	8.980***	-1147.46	1025.98	1.118^{NS}
4	**0.227273**	2.07E+03	6.78E+01	30.50***	-521.57	1585.61	0.328^{NS}
5	**-1**	1.02E+03	1.33E+02	7.650***	299.63	31.45	9.526***
6	**-2**	-4.97E-13	1.86E-12	0.268^{NS}	2168.24	217.56	9.966***
		Expenditure food security					
		Explained			**Unexplained**		
1	**0**	64.91	14.18	4.576***	138.74	22.05	6.290***
2	**1**	111.63	49.12	2.272**	92.02	46.02	1.999**
3	**0.5**	88.27	25.67	3.438***	115.38	25.58	4.510***
4	**0.52139**	89.27	24.76	3.606***	114.38	24.91	4.591***
5	**-1**	166.04	17.79	9.332***	37.61	10.87	3.457***
6	**-2**	120.44	27.17	4.431***	83.21	23.69	3.512***
	WD(-1)	**387.04^**			**387.04^^**		
	WD(-2)	**432.65^**			**432.65^^**		

S/N	Weight	Energy food security					
		Explained			Unexplained		
		Coeff.	SE	t-stat	Coeff.	SE	t-stat
		Unexplained A			Unexplained B		
1	**0**	1.39E+02	2.21E+01	6.290***	0.000	0.000	0.000^{NS}
2	**1**	0.00E+00	0.00E+00	0.000^{NS}	92.02	46.02	1.999**
3	**0.5**	6.94E+01	1.10E+01	6.290***	46.01	23.01	1.999**
4	**0.52139**	6.64E+01	1.15E+01	5.770***	47.98	22.02	2.178**
5	**-1**	1.80E+01	5.37E+00	3.350***	19.61	5.670	3.458***
6	**-2**	-8.11E-14	1.24E-13	0.653NS	83.21	23.69	3.512***

Source: Computer print-out, 2021

Note: A = secured group; B = unsecured group; WD = without discrimination; ^ = mean calorie/expenditure of secured minus endowment coefficient; ^^ = mean calorie/expenditure of unsecured plus discrimination coefficient

CONCLUSION AND RECOMMENDATIONS

It was established from the empirical findings that more than two-thirds of the sampled households were food unsecured vis-à-vis calorie intake and expenditure food securities in the region and the state-wise. An established correlation exists between the energy and monetary dimensions of food security. In addition, the major *de facto* predictor that influenced the dual dimension was the household size. Furthermore, in the energy dimension of food security, it was established that the average calorie intake differential between the secured and unsecured owes to the interaction effect, while in the monetary dimension, the expenditure food security gap is largely attributed to the discrimination effect termed structural difference. Consequently, this is a clarion call to policymakers to checkmate and improve the macroeconomic policies, especially the multiplier factor that triggered the inflationary trend, thus containing the twin necessary evils affecting the food security of the regional public workforce. An intervention of this kind will enhance the productivity and efficiency of the labour force, thus enhancing the growth and development of the regional economy in particular and that of the country in general.

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