THE CHASM OF PERSISTENT FOOD CALORIE INTAKE DEFICIENCY OF PROLETARIANS IN NIGERIA'S NORTHERN STATES: A PERCEPTION OR A REALITY?

¹Sadiq, M.S., ²Singh, I.P., ³Ahmad, M.M.

¹Department of Agricultural Economics and Extension, FUD, Dutse, Nigeria

²Department of Agricultural Economics, SKRAU, Bikaner, India

³Department of Agricultural Economics and Extension, BUK, Kano, Nigeria

Note: * Indicates corresponding author

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*Corresponding Author

sadiqsanusi30@gmail.com

ABSTRACT

Food calorie deficiency due to poor purchasing power has been a nightmare affecting 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-out the known middle-income class, 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 servants retrogression into the trough-income category is real or a myth. A total of 375 sampled respondents were obtained through a multi-stage sampling procedure and valid data were sequestered via structured questionnaires. Both descriptive and inferential statistics were used to analyze the data. It was established that a large chunk of the regional workforce fell below the recommended food security threshold level both energy and expenditure dimensions. Besides, an 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 interaction effect in the case of calorie intake; and structural effect termed food security discrimination in the dimension of expenditure. Consequently, this is a clarion call on the policymakers to improve on 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 leverage for economic growth and development in both the region and the country in general.

1. Introduction

Nigeria has a lot of natural, human, and material resources, but it hasn't been able to utilize them effectively enough to meet the country's poor people's food demands (Sadiq *et al.*, 2020b). More disturbing is the reality that the majority of the population still lives on less than

\$1 per day, and wealth distribution remains unequal and exclusive (Sadiq *et al.*, 2020c). 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 (FAO, 2017). Despite gains in improving nutrient availability over the previous decade, a considerable share of impoverished households in developing nations 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 nations has improved significantly over the last decade, there are still over 923 million people who are undernourished, and recent food price hikes have also generated an upsurge in hunger worldwide (Adekunle *et al.*, 2020; Eguwama *et al.*, 2019).

Calorie consumption has been discovered to have a substantial relationship with human health and productivity. To maintain normal body metabolic function and engage in activities connected to good health and cleanliness, the human body requires dietary calorie energy. Furthermore, calorie consumption is the primary determinant of people's undernutrition 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, 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.

In spite of the insinuation and narrative of the proletariats' pressure union, none 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 towards the Nigeria's Northern states' government proletariats. The outcome of this research will be very useful to policymakers as it will address 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 determined 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; to determine the nexus between calorie intake and expenditure food securities alongside determinants of food security; and, determine the causes of food security gap due to food security status.

2. 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 been very workaholic in public service since the colonial masters' era. The region prowess in agriculture is unrivaled 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 unity 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 (1970) sampling formula (Equation 1) to the workforce sampling frame (Table 1), a total of 384 representative sample size werre randomly selected for the exercise. Using easy-cost-route approach, a pre-tested questionnaire was administered on a total of 384 respondents for

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data elicitation. However, only 375 retrieved questionnaires were found to be valid, 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 Blinder-Oaxaca decomposition model.

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

States	Popul ation	Sample size
Bauchi	10119 9	118
Kano	15100 0	177
Niger	76000	89
Total	32819 9	384

Source: Agency reports, 2019

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

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

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

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):

$$CI_i = \frac{P_i}{R} \quad \dots \dots \dots (3)$$

Where, CI_i is the calorie intake food security index of the i^{th} household, P is the daily per capita calorie intake of the i^{th} 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):

$$P = \frac{1}{m} \sum_{i=1}^m G_i \quad \dots \dots \dots (4)$$

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

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

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

$$H = \frac{m}{n} \quad \dots \dots \dots (6)$$

Where, 'n' is the total sampled population.

Cost of minimum calorie intake threshold

(S): The cost of calorie intake index as proposed by Foster *et al.*(1984) determine the minimum cost that can afford the minimum calorie required to keep the body and the soul together. Below is the formula (Abdulrahman *et al.*, 2017; Oladimeji *et al.*, 2018):

$$E_i = \alpha + \beta C_i + \varepsilon_i \quad \dots \dots \dots (7)$$

$$S = e^{\alpha + \beta L} \quad \dots \dots \dots (8)$$

Where, E_i is the stochastic food expenditure of i^{th} household per day; C_i is the actual daily per capita calorie intake of the i^{th} 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
Sorghum Flour	316	Sphaggetti	348

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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 takes into account both household size and its composition (Sadiq *et al.*, 2019). The scale is as follows:

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

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 centered 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. Been food unsecured does not unilaterally implies been poor due to some subjective factors *viz.* individual and business motives that affects consumption. However, been poor unilaterally implies been food insecure as inability to meet-up with the basic necessities of life will hamper 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:

$$PCHME = \frac{THME}{HHS} \quad (10)$$

$$MPCHME = \frac{TPCHME}{TNR} \quad (11)$$

$$MPCHDE = \frac{MPCHME}{30} \quad (12)$$

$$FSL = \frac{2}{3} \times MPCHDE \quad (13)$$

Where: PCHE is per capita household's monthly expenditure; THME is total household's monthly expenditure; HHS is household size (adjusted adult equivalent); MPCHME is mean per capita household's monthly expenditure; TNR is 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):

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

Where, ' FI ' is food insecurity index; ' n ' is number of households in the population; ' q ' is the number of food unsecured households; ' Z ' is the food security threshold value; Y_i is the actual daily per capita food expenditure; and, α is the aversion parameter and takes on the value of 0 to 2 used to determine food insecurity index in a step-wise manner.

When $\alpha = 0$, the expression reduces to:

$$FI_0 = \frac{q}{n}$$

(15)

This is called food insecurity incidence, describing the proportion of the population that fall below the food security threshold.

When $\alpha = 1$, the expression reduces to:

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

This is called the food insecurity depth/gap.

When $\alpha = 2$, the expression becomes:

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

This is called food insecurity severity index. This index weighs the food insecurity of the abject food unsecured household more heavily than those just slightly below the food security threshold. It adds to the food insecurity depth an element of unequal distribution of the abject food insecure household's consumption below the threshold.

3. Bivariate probit model

A bivariate probit model considering the possibility of contemporaneous correlation in the decision of calorie intake and expenditure food security statuses as food security management is given below:

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

Where Y_{ij} ($j = 1, \dots, m$) represent the food security status ($m = 2$) faced by the i^{th} household ($i = 1, \dots, n$), X_{ij} is a $1 \times k$ vector of observed variables that influence food security status. β_j is a $k \times 1$ 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 actually a system of ' m ' equations to be estimated:

$$Y_1^* = \alpha_1 + X\beta_1 + \varepsilon_1 \quad (19)$$

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$$Y_2^* = \alpha_2 + X\beta_2 + \varepsilon_2 \quad (20)$$

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 ε_{ij} is multivariate normally distributed (Ullah *et al.*, 2016; Sadiq *et al.*, 2021a). Thus, in the bivariate probit model the stochastic term are assumed to have multivariate normal distributions with mean equal to zero.

4. Heckit's regression model

The Heckit's/Heckman's model is composed of decision model and the outcome model with the former having the dependent factor been dichotomous while the latter has its predict variable been continuous (Sadiq *et al.*, 2020a). 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:

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

$$Y_{it} = \beta_0 + \beta X_{it} + \varepsilon_i$$

(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)

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

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 (N)]; $X_{it} =$ 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 (N/month); $X_8 =$ Expenditure on non-food items (N/month); IMR = The Inverse Mill's ratio; $\beta_0 =$ Intercept; $\beta_{1-n} =$ Vector of parameters to be estimated; $\gamma =$ Lambda; and, $\varepsilon_i =$ 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 evident by their estimated coefficients of the classical normal regression (OLS) and Quantile regression (25th, 50th and 75th) 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.*, 2020b&c; Sadiq *et al.*, 2021b):

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

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

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 explain by,

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

The Oaxaca-Blinder decomposition equation is, $\Delta Y = (\bar{X}_S \hat{\beta}_S - \bar{X}_{US} \hat{\beta}_{US}) + (\bar{X}_{US} \hat{\beta}_S - \bar{X}_S \hat{\beta}_{US})$ (28)

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

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

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

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

Thus, Equations (29) & (20) have a 'threefold' decomposition, i.e. the outcome difference is divided into three components. The first, second and third components respectively, are endowment effect, discrimination effect and interaction effect.

The idea that there is a non-discriminatory coefficient vector that should be utilized to determine the contribution of the variations in

the predictors leads to an alternative decomposition that is popular in the discrimination research. Let β^* be a non-discriminatory coefficient vector of this type. Following Jan (2008), the outcome difference can then be written as:

$$\Delta Y = (\bar{X}_S - \bar{X}_{US})\beta^* + \{(\bar{X}_S)(\beta_S - \beta^*) + (\bar{X}_{US})(\beta^* - \beta_{US})\} \dots \dots \dots (31)$$

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. The latter is frequently attributed to discrimination, but it's vital to remember that it also includes all of the possible effects of unobserved variables.

3. RESULTS AND DISCUSSION

Calorie and Expenditure-wise Food Security Status

From the empirical evidences 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 sampled population from Kano, Bauchi and Niger states respectively 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 respectively, are calorie food unsecured. Therefore, 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 state where calorie intake food insecurity trickles by approximately seven-fold times of the food secured proportion. The possible reason for the alarming situation in Niger state may owe to the fact that the monthly remuneration of the civil servants is abysmal. For Kano and Bauchi states respectively, the calorie food insecurity proportions vis-à-vis the food secured are

approximately four and two-folds. 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 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 base line while that of Kano state is slightly above two-fold. The excess of Niger state is just barely above one-fold, thus 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 base line 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

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state and least in Niger state while the shortfall is highest in Niger state and 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 evidences of high diversification among the households in their daily per capita calorie consumption as indicated by the various two-dimensional approach diversification indexes (Table 2). Furthermore, 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 problem of degree of freedom due to insufficient observations across the states vis-à-vis secured versus unsecured, the state-wise Gini coefficient index was not computed.

Table 2: Summary of calorie intakes in the region
Secured

Items	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.	623.9874	706.3357	590.0299	557.5982
Calorie/day				
Exp.	18719.62	21190.07	17700.9	16727.95
Calorie/month				
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.	405.8597	424.3316	340.107	440.1705
Calorie/day				
Exp.	12175.79	12729.95	10203.21	13205.11
Calorie/month				
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 (\$) 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 3). Besides, the food insecurity gap cum severity were 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 implies 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 FOA. Given the average food security threshold of ₦455.43 (\$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 household are likely to be vulnerable to food insecurity. Thus, it becomes imperative for the policymakers to relax some of the income taxes, control inflationary rate in the economy, thus enhancing the food security of its citizenries. 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 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's 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 Niger state, thus the need for urgent intervention before the state workforce households' degenerate into the destitute zone. Across the region, there is need to improve the food security status of the household; a pre-requisite for labour productivity required for enhance economic growth and development.

Table 3: 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

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EDD	0.806709	0.756939	0.816124	0.838161
GD	0.923694	0.921611	0.922021	0.925294

Source: Field survey, 2021

Note: HDD= 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 χ^2 for the test of independence (correlation) being within the plausible margin of 10% error gap implies that there is correlation between calorie and expenditure food securities of the respondents (Table 4). In addition, it implies that the chosen model is 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. While educational status and age have one-way traffic influences on calorie and expenditure food securities respectively as indicated by their respective parameter estimates that are within the plausible margin of 10% probability level.

The negative-significant of the household coefficient for both dimensions imply that large household, thus large mouths to cater for plummeted required daily per capita calorie intake status, likewise the expenditure food security. A household with a large number of dependents (vulnerable group) are at risk of been calorie deficient and expenditure food unsecured owing to many mouths to be fed. Thus, the probability of a household been 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 towards balance diet in their food basket. Thus, an increase in a household dietary diversification by 1% will increase his chances of been calorie and expenditure food secured by 4.23 and 6.34% respectively. The positive-significant of estimated income parameter implies that large income enhanced 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 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 - 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 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 educational attainment of a household by a year will increase his/her tendency of been calorie unsecured by 0.062%. The positive-significant of age coefficient shows that aged people are very keen and conscious of achieving expenditure food so as 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 4: Bivariate probit model for calorie intake and expenditure food securities

Variable	calorie intake	t-stat	expenditure food security	t-stat
	Coefficient		Coefficient	
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:Chi²)	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 influences calorie intake and food insecurity depth of the deprived households simultaneously with the forgoing dependent variables (calorie and expenditure food security statuses), two-step Heckman's model was performed (Table 5). 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 is not different from zero at 10% degree of freedom. The non-plausibility of the IMR coefficients imply 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 influences 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 with 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 the Heckman's model.

The empirical evidences showed household

size to have bidirectional influence on both the outcome models while marital status and gender had unidirectional influences on food insecurity depth as evidenced by their respective estimated coefficients that are different from zero at 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 gender coefficient implies that women households are less vulnerable to food security depth as 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 for other personal things. But 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 decreases its chances of food insecurity gap by 0.76%. The positive-significant of the marital status coefficient implies that married households are vulnerable to heightened food insecurity gap compared to their counterparts who are single. The possible reason may be attributed to too much household responsibility to carter for, thus exacerbated the food insecurity depth. This outcome is expected owing to the trend behaviour of large household size on 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 4: Heckman's model for calorie intake and expenditure food securities

Variable	Status (decision)		Calorie intake		VIF
	Coefficient	t-stat	Deficiency/Gap (outcome)	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

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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

A perusal of Table 5 showed the average per capita daily calorie intake of secured versus unsecured cum the gap for the region to be 4349.88, 1154.45 and 3195.43kcal 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 6). Therefore, it can be inferred that the calorie secured are structurally disadvantaged on one hand and endowment and interactional advantaged on the other hand. Besides, the calorie deficient households are structurally advantaged; and endowment and interactional disadvantaged. In the endowment component only household size has significant

influence on the calorie gap as evidenced by its estimated coefficient cum the error bar that are within the acceptable margin of 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 large household size. Individuals with large household size tend to be calorie deficient as evident by the pooled regression result (Table 5). Furthermore, the value of the household mean difference showed that calorie deficient group maintained large household size. Similarly, in the coefficient component, only educational level achieves 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 5). 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 7). 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, 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

Faculty of Economics and Business,
Brawijaya University

minus 1 and 2, without discrimination against the unsecured, their per capita daily calorie intake should be 2472.83 and 3322.70kcal 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 6). From the threefold decomposition, of the overall gap of ₦203.66; ₦64.91, ₦92.03 and ₦46.72 are attributed to endowment, discrimination and interaction effects respectively. Thus, the unsecured households are disadvantaged in all the components while the secured are advantaged in all the components. In the endowment component, except household size, all the remaining explanatory variables were non-plausible at 10% degree of freedom, thus have insignificant influence (Figure 2). Thus, it can be inferred that the significant portion of the food expenditure gap is governed by group differences in the proportion of households with large household size. Further, the individuals with large household size tend to be food unsecured as evident by the pooled regression household estimated coefficient (Table 5). In addition, the value of the household mean differences showed that unsecured households have a large family size. Therefore, the differences in the groups' household composition account for the higher portion of the secured household food security. In the same vein, only expenditure on non-food items is found to have significant influence in the discrimination component as indicated by the plausibility of its estimated parameter at 10% accuracy level (Figure 2). Based on the non-food expenditure

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coefficient differentials between secured and unsecured, the food security due to a naira increase in the non-food expenditure is higher

for food secured households by ₦135.80 (Table 5).

Figure 2: Threefold decomposition of expenditure food security

For the twofold decomposition, at weight (-1), the food security gap of ₦203.66 can be decomposed into ₦166.05 that is explained by the differences between the groups idiosyncratic factors and ₦37.61 that is unexplained (Table 7). 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 evidences 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 weight (-2), the explained and unexplained effects respectively, account for ₦120.45 and ₦83.22 of 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.

Commented [AMH3]: Kindly add conversion rate in USD (in the particular year) to make the readers easily understand the monetary values in the figures as well as in the results section

Table 5: 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 5: 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	-514.563	-52.6093	-461.95	-514.56	-52.609	-154.56	5.275294	15.2083	-9.93301
HHD	7456.398	338.7759	7117.622	7456.39	338.776	556.83	0.246923	0.222222	0.024701
Income	-11.2542	300.7394	-311.994	-11.254	300.739	640.46	11.28803	11.20967	0.078366
Calorie							4349.882	1154.454	3195.428
Items	Expenditure food security								
	Beta A	Beta B	Beta Diff.	Reg. A	Reg. B	Reg. Pool 1	Mean A	Mean B	Diff.
Intercept	-348.427	177.9295	-526.35	-348.427	177.9295	408.73	1	1	0
Age	-5.04337	-4.86959	0.17378	-5.04337	-4.86959	-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	15.32411	0.518603	8.41105	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

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ENF	134.54 35	- 1.2548 7	135.79 84	134.5 44	-1.2549	66.28 5	8.5988 56	7.6926 07	0.9062 49
EF							553.09 31	349.43 02	203.66 29

Source: Computer print-out, 2021
Note: EF = Expenditure of food; Diff. = Difference

Table 6: Gap due to discrimination in food security (Threefold decomposition)

Items	Endowment effect			Calorie food security Discrimination effect			Interaction effect		
	Coeff.	SE	t-stat	Coeff.	SE	t-stat	Coeff.	SE	t-stat
Intercept	0.000	0.00	0.000 ^{NS}	4700.9 4	8319.3 9	0.565 ^{NS}	0.000	0.000	0.000 ^{NS}
Age	-24.49 8	16.6	1.468 ^{NS}	322.83 4	2932.9	0.110 ^{NS}	-34.80	339.35	0.102 ^{NS}
Gender	-3.368 0	7.83	0.430 ^{NS}	605.56	304.17	1.990 ^{**}	-39.61	66.037	0.599 ^{NS}
MS	-12.83 1	12.3	1.041 ^{NS}	-1519.8	615.90	2.467 ^{**}	486.34	213.94	2.273 ^{**}
Educatio n	1.537 4	5.19	0.295 ^{NS}	2536.6 6	830.01	3.056 ^{**}	-176.85	119.86	1.475 ^{NS}
HHS	522.5 6	44.2 6	11.80 ^{**} *	- 7025.4 8	3359.0 7	2.091 ^{**}	4588.5 6	2366.53	1.938 [*]
HHD	8.368 6	6.86	1.218 ^{NS}	1581.6 9	975.47	1.621 ^{NS}	175.81	123.69	1.421 ^{NS}
Income	23.57 4	20.5	1.147 ^{NS}	- 3497.3 5	8169.6 7	0.428 ^{NS}	-24.45	68.277	0.358 ^{NS}
Effect	515.3 6	59.7 2	8.630 ^{**} *	- 2294.9 2	2051.9 7	1.118 ^{NS}	4974.9 9	2178.69 8	2.283 ^{NS}
Expenditure food security									
Intercept	0.000	0.00	0.000 ^{NS}	-526.35	519.00	1.014 ^{NS}	0.000	0.000	0.000 ^{NS}
Age	4.615 8	3.67	1.254 ^{NS}	-7.057	120.61	0.058 ^{NS}	0.165	1.962	0.083 ^{NS}
Gender	-2.131 5	2.57	0.827 ^{NS}	70.24	35.65	1.970 ^{**}	-4.309	6.476	0.665 ^{NS}
MS	0.666 8	3.22	0.206 ^{NS}	-128.25	47.123	2.721 ^{**} *	17.29	10.483	1.650 [*]
Educatio n	-0.332 9	1.27	0.260 ^{NS}	212.07	62.202	3.409 ^{**} *	-9.505	8.346	1.138 ^{NS}
HHS	58.70 5	13.5	4.330 ^{**} *	166.82	92.72	1.799 [*]	-89.29	49.397	1.807 [*]
HHD	-2.738 5	4.64	0.589 ^{NS}	127.76	57.11	2.237 ^{**}	22.82	13.704	1.665 [*]
Income	7.270 9	3.32	2.183 ^{**}	-867.86	527.90	1.643 ^{NS}	-13.52	7.142	1.893 [*]
ENF	-1.137 2	12.2	0.093 ^{NS}	1044.6 4	272.73	3.830 ^{**} *	123.07	38.524	3.194 ^{**} *
Effect	64.91 8	14.1	4.576 ^{**} *	92.025	46.02	1.999 ^{**}	46.722	50.908	0.917 ^{NS}

Source: Computer print-out, 2021

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Table 7: 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 ^{^^}		
		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	0.653 ^{NS}	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

4. CONCLUSION AND RECOMMENDATIONS

From the empirical findings it was established that more than two-third of the sampled households were food unsecured vis-à-vis

Faculty of Economics and Business,
Brawijaya University

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 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 interaction effect, while in the monetary dimension, expenditure food security gap is largely attributed to discrimination effect termed structural difference. Consequently, this is a clarion call on policymakers to checkmate and improve the macroeconomic policies, especially the multiplier factor that triggered inflationary trend, thus containing the twin necessary evils affecting 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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