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# Dynamic Food Insecurity and Resilience of Smallholder Households in a Local Food System: The Pandemic Experience in Nigeria

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## Abstract

Research background: In Nigeria's local food system, staple foods, Animal sourced foods, perishable foods such as fruits, and vegetables are important food products that are produced processed stored, transported and traded mostly by smallholder participants in the supply chain. COVID-19 pandemic compounds system's shock through the negative impact on health, employment and income. Food security and nutrition are outcomes of a food system linked to the interrelated interaction of the food supply chain, consumer behaviour and the food environment -Biophysical, Physical, economic, Political, social cultural factors, Opportunities and conditions-.Strengthening the resilience capacity of participants have been ad hoc given the paucity of data necessary for targeted policy intervention. Purpose of the article: The paper examines the pattern of food insecurity of smallholder participants, the dynamics of their food insecurity and the role of resilience capacity. Methods: The paper used the Nigeria COVID-19 National Longitudinal Phone Survey (NLPS) 2020 household data set collected by the National Bureau of Statistics with technical support from the World Bank for the analysis. It used summary statistics; markov matrix and logistic regression to analyse the aforementioned objectives. Findings & Value added: The findings reveal a doubling of food insecurity over the period considered. Poorer households experienced a 0.53 points increase in food insecurity rate over the period. The probability of escape from food insecurity was four times less likely compared to the probability of entering into food insecurity. Farm productive assets reduced the probability of persistent food insecurity while housing quality increased the probability. Safety nets increased the probability of escaping food insecurity while farm inputs and markets access reduced food insecurity persistence. While farm productive assets and farm inputs and market access are important resilience capacity that can promote persistent food security and reduce persistent food insecurity, capacities such as Safety nets can play important role of helping participants in local food systems from escaping food insecurity.

## Keywords

Food Insecurity, Food system resilience, Vulnerability, Pandemic shock, Consumption smoothing

# 1. Introduction

## 1.1. Problem statement

COVID-19 Pandemic interacts with a local food system as a shock when participants or members of their households fall sick or die as a result of the virus and also through loss of employment, income and purchasing power as a consequence of the lockdown and other pre-existing conditions. Nigeria alone accounts for 42% of West Africa's total number of acutely food-insecure people. In terms of absolute numbers, Nigeria ranked among the world's 10 worst food crises in 2019, with 5 million food insecure people [1]. COVID-19 pandemic, no doubt is compounding the problem through a negative impact on health, employment, income and associated purchasing power. However, a major challenge in the assessment of the pandemic on households and individuals is often the time lag between the availability of a micro data and the crisis [2]. Accordingly, several authors have turned to high-frequency phone surveys implemented by National statistical offices to analyze empirically, the problem of food insecurity at the household level since the emergence of the Pandemic [3-8]. While these studies provide timely quantitative evidence of the impact of COVID-19 pandemic on food security rates, such analysis do not permit full understanding of the dynamics. That is how participants in the food system whether as purchasers or sellers have moved most rapidly over food insecurity or entered into food insecurity. That is what is the probability of escaping and entering into food insecurity? What role do the resilience capacities of participants play? This paper contributes to the literature by drawing on the vulnerability and resilience literature and using Nigeria COVID-19 National Longitudinal Phone Survey (NLPS) 2020 household data set collected by the National Bureau of Statistics with technical support from the World Bank for the analysis. It is a high frequency data collected on the same household over quarterly periods. The food insecurity and resilience capacity variables selected are analysed within the hypothesis that a more resilient household is expected to suffer a smaller reduction in food security in the face of a negative shock compared to a less resilient household [9]. The first objective of this paper is to examine the food security status of participants pre- and post-COVID-19 periods and the transition across periods. The second objective estimates the relationship between resilience capacity and food security transitions of participants.

Such information is insightful in understanding conditions driving transitions or mobility decisions of a household food security. Hence the added policy value of understanding how systems resilience influences livelihood outcomes such as food and nutrition security. Furthermore, quantitative analysis of such objectives will bring to light the effectiveness of governmental interventions and the ex ante or ex post responses of household participants and their communities. Furthermore, understanding resilient conditions driving transitions or mobility decisions of smallholder participants in a local food system is insightful for policy formulation. The remainder of this study is organised as follows. Section two provides a review of the literature paying attention to the meaning of a local food system and the research focus, Section three focuses on the methodology paying attention on the nature of the data and empirical estimation. Section four presents the results while section five the results. Section six offers conclusions.

## 1.2. Background

The definition of food security is well established in the literature. It is said to exist when all people, at all times have physical, social and economic access to sufficient, safe and nutritious food, which meets their dietary needs and food preferences for an active and healthy life [10][11][12][13]. On the flip side, food insecurity is generated when individuals, households, communities are unable to have adequate, safe, nutritious and stable food for an active and healthy life. Recent publications on food systems for healthier diets view food security and nutrition as outcomes of a food system. Nigeria's food system is diverse and consists of traditional, modern and mixed systems. Indeed, the interrelated components of the food supply chain, consumer behaviour and the food environment -Biophysical, Physical, economic, Political, social cultural factors, Opportunities and conditions- shape outcomes of food security. The concept of food security is generally regarded as multidimensional and having the components of availability, accessibility, stability and utilization. Availability corresponds to food supply. Access refers to effective demand for food (economic access) and proximity of markets (physical access). Utilization is partly related to dietary quality while stability captures the dynamic aspect since being food secure requires stability in the other three pillars over time [7]. Several indicators have been used in the empirical literature to operationalize food security or food insecurity. Some studies have used food expenditure and the Household Dietary Diversity Score (HDDS) which focuses on diversification of the household diet. These two indicators mainly refer to the availability of food and do not express the other dimensions of food security (utilization and stability). There is also the Household Food Insecurity Access Scale (HFIAS) score which measures the degree of food insecurity in the household in the past weeks before the interview. [14], investigated the nexus between COVID-19 and food security using a cross-sectional data of 1478 low-income adults in the United States and showed that 44% were food insecure, 36% were food secure and 20% experienced marginal food security in the early stages of the pandemic. [15], examined the empirical evidence of the relation between resilience and food security and find that out of the 21 studies with an empirical focus, 13 use cross-sectional data, 6 use panel data while 2 use repeated

cross-sectional data for analysis.

[4], explore the effect of the coronavirus pandemic on households' food insecurity as well as labor market participation using a fixed effects model. The paper combines pre-pandemic face-to-face survey data with follow up phone surveys collected in April-May 2020. The paper finds that households exposed to higher COVID-19 case rates or mobility lockdowns experience a significant increase in measures of food insecurity.[16] used the Household Food Insecurity Access Scale to measure the food insecurity of farmers in Southern Iran during the COVID-19 Pandemic and related it with the Livelihood Assets of households using the sustainable livelihoods framework. The results of the food security situation show highly precarious and food insecure situations among the studied rural households. The regression analysis shows that the most important assets affecting the food security of rural households under COVID-19 are financial, psychological, physical, and human assets, respectively. [8], examined the relationship between Household food security and the COVID19 pandemic in Nigeria using the COVID-19 National Longitudinal Phone Survey (COVID-19 NLPS). The study showed that over two-thirds of households were threatened by food insecurity in Nigeria. The result from the ordered probit regression identified socioeconomic variables (education, income and wealth status) as the main determinants of food security during the pandemic. While the study examined the level of household food security of households and the determinants during the COVID-19 pandemic, they ignored the analysis of food insecurity dynamics.

Secondly studies that have the used the Nigeria's high frequency data have not analysed the relationship between food systems resilience and food security. As noted in [17], "the resilience of food systems is not consistently assessed and hardly synthesized for low- and middle-income countries". Very little is known, therefore, about what strategies/interventions would strengthen the ability of processors, or traders, or street vendors to react (or anticipate) positively to shocks or stressors, especially if those actors are operating in LMICs [18]. The resilience – food security nexus has been conceptualized in several ways. There is the increasing use of the FAO's RIMA framework [10],consisting of the following dimensions: Income and Food Access (IFA), Assets (AST), Social Safety Nets (SSN) and Access to Public Services (APS), Stability (S) and Adaptive Capacity (AC). This perspective of understanding resilience – food security nexus is however limited by the limited attention given to the agency of households to learn and adapt their systems to changing contexts [17]. Another limitation is the lumping of resilience and food security. [17], proposed resilience capacity as distinct from food security. Resilience capacity is defined as the different elements, tangible or less tangible, that actors have at their disposal, which they have accumulated, built, developed and that they may or may not use in response to a crisis/shock. This definition of resilience capacity is closely related to "Social vulnerability" concept in [19] and Sen's concepts of endowments, entilements, and rights. [20], included assets, savings, social safety nets and improved governance, access to markets and women empowerment. [9], included access to basic services, productive and non-productive assets and safety nets, Human capital, diversification of income sources and demographic structure of a household.

## 2. Methods

### 2.1. Data Source

The paper used the Nigeria COVID-19 National Longitudinal Phone Survey (NLPS) 2020 data set, [21] collected by the National Bureau of Statistics with technical support from the World Bank (details of this data set can be found in [3][4]. The paper used round 2 and round 4 of the surveys collected in June and August and together with 2018/2019 WAVE four of the GHS-Panel, able to analysedata sets covering the same households before and during the COVID-19 Pandemic. As noted in the websites of the National Bureau of Statistics and the World Bank, wave 4 of the GHS-Panel conducted in 2018/19 served as the frame for the Nigeria COVID-19 NLPS survey (round 0). 3,000 households were selected from the frame of 4,934 households with contact details and constituted the baseline sample size for the COVID-19 longitudinal phone survey interview. Of this sample size, 2070 households were contacted in the first round of the survey and 1,950 households fully interviewed. This constituted the sample size for round 2 with 1852 contacts, round 3 with 1837 contacts, 4(1819 contacts), 5(1794 contacts), 6(1781 contacts), 7(1740 contacts) and 8(1738 contacts). We used the food insecurity variable in the Pre-COVID-19 data and rounds 2 and 4 as well as the various household characteristic indicators to understudy the food security transition rates of households and the role of household resilience capacity. There are two food insecurity variables in the data set used (downloaded from the World Bank's web site). The moderate and (2) severe food insecurity among adult individuals. We used the moderate food insecurity measure of household food security. [3], detailed how the food insecurity variable was generated using the Food Insecurity Experience Scale(FIES) The .FIES relies on people's direct responses to questions about their experiences with access to adequate food. It consists of eight questions aiming to capture whether the respondent or other adult households members: (1) were worried they would not have enough to eat, (2) were unable to eat healthy and nutritious food, (3) ate only a few kinds of foods, (4) had to skip a meal, (5) ate less than they thought they should, (6) ran out of food, (7) were hungry but did not eat, or (8) went without eating for a whole day. Food insecurity variable is measured as a dummy where 1 is ascribed to food insecurity and 0, otherwise. There are 56 indicators used in the analysis to construct

the various dimensions of a household resilience capacity. The information on participants resilience decision variables captured included household's productive assets in agriculture, household assets, income sources, employment in agriculture, employment in non-farm, household composition, Access to Basic services and safety nets. The data set also includes regional variables that were included. Rainfall data and population density and prices were sourced externally and included at the local government area council.

### 2.2. Empirical Estimation

The first part of the analysis consists of a descriptive analysis of the transition probability of a participants' food insecurity states over time t and t-1 using markov transition matrix. Let $X_{it}$(i=1,..,n) denote the food insecurity status of a participant (i) in a local food system at time (t). The probability of occurrence of food insecurity states were estimated as probabilities and interpreted as percentages (0% to 100%). The following probabilities were generated and analysed: (1) $P_{1,1}$(food insecurity persistent), (2) $P_{1,0}$(escaping food insecurity), (3) $P_{0,1}$(falling into food insecurity) and (4) $P_{0,0}$(persistent food security). In the second part of the analysis, logistic regression of the relation between food insecurity and resilience capacity of participants was estimated. As the dependent variable is binary coded, logistic regression is an appropriate method for estimation. In the logistic model, food insecurity is denoted as Y and takes one of two values (1,0). The probability that participants in the local food system experience any of the food insecurity states is observed as 1. The continuous latent variable $Y^*$ model is expressed in (Eq. 1) as:

$$Y^* = X\beta + \mu \tag{1}$$

Where

$$\mathrm{Y} = \begin{Bmatrix} 1\mathrm{if}\mathrm{Y}^* > 0 \\ 0\mathrm{if}\mathrm{Y}^* \leq 0 \end{Bmatrix} \tag{2}$$

Given the above equations, the probability of Food Insecurity is expressed in (Eq.3) as:

$$\mathrm{P}(\mathrm{Y}=1) = \mathrm{P}(\mathrm{X}\beta + \mu > 0) = P(-\mu < X\beta) = F(X\beta) \tag{3}$$

Where P is the conditional probability of a household experiencing Food Insecurity or the transition outcomes; Y is a dummy variable that indicates the food security status of a household. X is a vector of household resilience capacity and locational control variables. $F(.)$ is the cumulative distribution function of $-\mu$, assumed in this paper to be logistically distributed.Thus a Logistic food insecurity regression model explicitly expressed in (Eq.4) as:

$$\mathrm{Logit}_{\mathrm{Foodinsecurity}} = \beta_0 + \beta_1 \mathrm{RI} + \gamma_i \mathrm{z} + \mu_i \tag{4}$$

Four dummy dependent variables of food insecurity states are defined using the food insecurity variable of participants in periods Q1 (Pre-COVID-19), Q2 (COVID-19, Month of June), Q3 (COVID-19, Month of August). Food insecurity persistence captures participants experiencing food insecurity across all three periods. Escaping food insecurity captures participants that experienced food insecurity in the Q1, Q2 but not in Q3. Falling into food insecurity captures participants who are food secure in Q1, Q2 but not in Q3. Food security persistence captures participants experiencing food security across all three periods, Q1, Q2 and Q3. These categories of food insecurity states are used as dependent variables in the logistic regression in which the resilience capacity of participants is the key explanatory variable**.** RI is a vector of explanatory variables represents the various dimensions of household resilience capacity developed from the original 56 latent indicators of resilience capacity in the data set. The following indicators of resilience capacity were constructed: Housing Quality (HQ), Household Assets (HA) and Household Farm Productive Assets (HFPA), Safety Nets (SN)/Household Composition, Employment Diversification(ED), Access to Farm puts and Markets (TC)). The variables used in constructing the indicators of resilience were normalized to permit adequate aggregation of the variables. The weights used for aggregation were derived from the data in a mathematical function using the Factor Component Analysis (FCA). Z is a vector of control variables that includes local government area population, state level annual rainfall, household exposure to shock, age and education attainment were included. Dummy variables of participants geopolitical zones and states were also included. Data were analysed in STATA at $\propto_{0.05}$. The $\beta$ $and$ $\gamma_i$ are the respective coefficients measures of the variables.

## 3. Results

The mean food insecurity rates of participants and the change over time for various locations and income groups are presented **in Table 1.** In the periods Q1 and Q2 capturing Pre-COVID-19 period and COVID-19, Month of June, food insecurity rates increased by 0.44 points from 0.33 to 0.76 for the whole country (Table 1). This suggests a doubling of food insecurity rates in Q2. It should be noted that Q1 captured Pre-COVID-19 period, Q2 captured COVID-19, Month of June period while Q3 captured COVID-19, Month of August. Food insecurity rate also doubled in Q3 period which captures COVID-19, Month of August. The percentage change in food insecurity rates between Q1 and Q2 was 44% and between Q1 and Q3, the percentage change was 42% for the whole country (Table 1). However, the change in food insecurity rate between Q2 and Q3 was infinitesimal, about 0.017 points for the whole country. This can be ascribed to

some extent to responses by households, communities and governmental agencies reactive actions on palliatives[1] to mitigate the effects of the Pandemic. The variation in mean food insecurity rates across income groups[2] showed that poorer households experienced a 0.53 points increase in food insecurity rate over the period (Table 1).

The Food insecurity transition probabilities for the whole of the country, rural and urban areas are presented in **Table 2.** The probability of food insecurity persistence between periods Q1 and Q2 for the whole country was 84.15% (Table 2). This estimate is consistent with the estimate between periods Q1 and Q3 (80.87%). and periods Q2 and Q3 (85.16%) for the whole country albeit with insignificant difference. This estimate is also consistent across rural and urban areas, albeit with insignificant differences (Table 2). Overall, food insecurity persistence is two times more likely compared to the persistence of food security. The probability of escaping food insecurity was 15.85% for the whole country while the probability of entering food insecurity was 68.22%. The summary statistics of the variables used in the logistic regression are presented in **Table 3**. The average age of participants was 49 years and 81% of the sampled population were males.

**Logistic regression estimates**

Logistic estimates of food insecurity level and food insecurity transitions are presented in **Table 4 and Table 5**. For the logistic food insecurity level, in Pre-COVID period (Q1), participant asset was significant at 10% and reduced food insecurity for rural, urban and pooled households. Farm productive asset (FPA) was significant at 1% and reduced food insecurity only for urban and the pooled sample. Housing quality was significant at 1% and increased food insecurity for urban and pooled. Farm input and market access (TC) reduced food insecurity significantly at 1% for rural, urban and pooled households. Safety nets and household composition (HC) rather increased food insecurity for urban and pooled households. In times of COVID-19 captured by quarters 2 and 3, only household assets (HA) was significant in reducing food insecurity in rural ($p<0.01$), urban ($p<0.1$) and pooled ($p<0.01$). While housing quality (HQ) was helpful in quarter 1 in reducing food insecurity significantly at 10% for urban and pooled households, it reduced food insecurity significantly at 5% for rural households in quarter three. Furthermore, in quarter three, employment and income diversification (ED) reduced food insecurity significantly at 5% for rural households. Household composition/safety nets (HC) increased food insecurity at 10% level of significance in quarter three of the COVID-19 period in 2020. While in the same quarter, access to farm inputs and output markets reduced food security at 10% level of significance. Estimates of food insecurity transition regression are presented in **Table 5**. Housing quality (HC) increased transition into food insecurity for the pooled households at 1% level of significance. While farm productive assets reduced the transition into persistent food insecurity at 5% level of significance, it reduced the escape of from food insecurity and significant at 10% level. In contrast, Safety nets/household composition increased the escape from food insecurity and significant at 10% level. While access to farm inputs and markets (TC) reduced persistent food insecurity at 1% level of significance, the role on food security transition is both negative and positive.

**Table 1. Mean distribution of Household food insecurity rates and changes over time by location and income group**

| | Q1 | Q2 | Δ | Q1 | Q3 | Δ | Q2 | Q3 | Δ |
|---|---|---|---|---|---|---|---|---|---|
| National | 0.325 | 0.763 | 0.438 | 0.325 | 0.746 | 0.421 | 0.763 | 0.746 | -0.017 |
| Rural | 0.419 | 0.789 | 0.369 | 0.419 | 0.731 | 0.312 | 0.789 | 0.731 | -0.058 |
| Urban | 0.282 | 0.751 | 0.469 | 0.282 | 0.753 | 0.471 | 0.751 | 0.753 | 0.002 |
| North Central | 0.088 | 0.775 | 0.688 | 0.088 | 0.701 | 0.613 | 0.775 | 0.701 | -0.075 |
| North East | 0.238 | 0.765 | 0.527 | 0.238 | 0.786 | 0.548 | 0.765 | 0.786 | 0.021 |
| North West | 0.151 | 0.674 | 0.523 | 0.151 | 0.702 | 0.551 | 0.674 | 0.702 | 0.028 |
| South East | 0.522 | 0.769 | 0.247 | 0.522 | 0.810 | 0.288 | 0.769 | 0.810 | 0.041 |
| South South | 0.506 | 0.791 | 0.285 | 0.506 | 0.757 | 0.250 | 0.791 | 0.757 | -0.035 |
| South West | 0.455 | 0.831 | 0.377 | 0.455 | 0.750 | 0.295 | 0.831 | 0.750 | -0.081 |
| POOREST | 0.275 | 0.746 | 0.471 | 0.275 | 0.795 | 0.520 | 0.746 | 0.795 | 0.049 |
| POORER | 0.264 | 0.810 | 0.545 | 0.264 | 0.812 | 0.548 | 0.810 | 0.812 | 0.002 |
| MIDDLE | 0.399 | 0.795 | 0.396 | 0.399 | 0.766 | 0.367 | 0.795 | 0.766 | -0.029 |
| RICHER | 0.325 | 0.723 | 0.398 | 0.325 | 0.705 | 0.379 | 0.723 | 0.705 | -0.019 |
| RICHEST | 0.364 | 0.738 | 0.374 | 0.364 | 0.653 | 0.289 | 0.738 | 0.653 | -0.085 |

Source: Author's estimates

Note: Q1 (Pre-COVID-19), Q2(COVID-19, Month of June), Q3(COVID-19, Month of August),

Δ symbol of change. Estimates are interpreted as proportions.

[1]Examples include temporary subsidies; Loans, Food support programmes; construction of food storage facilities and monitoring of prices.

[2]The income group variable was generated from household annual per capita income variable in the pre-COVID-19 LSMS–ISA survey data set using the quintile function. The function categorizes households into poorest, poor, middle, rich and richest income groups.

**Table 2. Food insecurity transition probabilities**

| | | NATIONAL | | | | | |
|---|---|---|---|---|---|---|---|
| | | Q1-Q2 | | Q1-Q3 | | Q2-Q3 | |
| | | Freq. | % | Freq. | % | Freq. | % |
| Secure | $P_{0,0}$ | 375 | 31.78 | 387 | 32.8 | 304 | 65.8 |
| Entering | $P_{0,1}$ | 805 | 68.22 | 793 | 67.2 | 158 | 34.2 |
| Escape | $P_{1,0}$ | 87 | 15.85 | 105 | 19.13 | 188 | 14.84 |
| Insecure | $P_{1,1}$ | 462 | 84.15 | 444 | 80.87 | 1079 | 85.16 |
| | | | | **RURAL** | | | |
| Secure | $P_{0,0}$ | 156 | 35.86 | 177 | 40.69 | 146 | 74.49 |
| Entering | $P_{0,1}$ | 279 | 64.14 | 258 | 59.31 | 50 | 25.51 |
| Escape | $P_{1,0}$ | 40 | 15.81 | 55 | 21.74 | 86 | 17.48 |
| Insecure | $P_{1,1}$ | 213 | 84.19 | 198 | 78.26 | 406 | 82.52 |
| | | | | **URBAN** | | | |
| Secure | $P_{0,0}$ | 219 | 29.4 | 210 | 28.19 | 158 | 59.4 |
| Entering | $P_{0,1}$ | 526 | 70.6 | 535 | 71.81 | 108 | 40.6 |
| Escape | $P_{1,0}$ | 47 | 15.88 | 50 | 16.89 | 102 | 13.16 |
| Insecure | $P_{1,1}$ | 249 | 84.12 | 246 | 83.11 | 673 | 86.84 |

Source: Author's estimates

Note: $P_{1,1}$, the probability of food insecurity persisting, $P_{1,0}$, the probability of transiting into food security and can be interpreted as the probability of being resilient, $P_{0,1}$ probability of transiting from food security to food insecurity and can also be thought of as the probability of being vulnerable. The probabilities are interpreted as percentages.

**Table 3. Summary Statistics**

| Variables | Observations | Mean | St.Dev | Min | Max |
|---|---|---|---|---|---|
| Food insecurity Q1(X_78) | 1950 | 0.32103 | 0.46699 | 0 | 1 |
| Food insecurity Q2(Y_78) | 1821 | 0.73586 | 0.44100 | 0 | 1 |
| Food insecurity Q3(Z_78) | 1792 | 0.71931 | 0.44946 | 0 | 1 |
| Gender | 1950 | 0.80923 | 0.39301 | 0 | 1 |
| Education attainment in years | 1630 | 10.23006 | 4.06928 | 0 | 17 |
| Housing Quality (HQ) | 1950 | 1.64748 | 0.54462 | 0.015 | 2.775 |
| Assets(HA) | 1950 | 1.71948 | 0.96383 | 0 | 4.51 |
| Farm productive Assets(FPA) | 1950 | 0.93220 | 0.84346 | 0 | 3.842034 |
| Safety net(HC) | 1950 | 0.50300 | 0.32314 | 0.038 | 2.274818 |
| Employment diversification (ED) | 1887 | 0.63748 | 0.31386 | 0 | 1.446667 |
| Access to inputs and markets(TC) | 1279 | 1.42082 | 0.66448 | 0.012609 | 3.240435 |
| Population | 1411 | 309612.40 | 196181.50 | 73160.61 | 1774676 |
| Rainfall | 1927 | 1802.23 | 961.585 | 683.8 | 4772.5 |
| Exposure to shock | 1950 | 0.46256 | 0.49872 | 0 | 1 |
| Age in years | 1950 | 49.40205 | 14.722 | 18 | 99 |

Source: Author's estimates

**Table 4. Indicators of resilience capacity and food insecurity**

| | QUARTER 1 | | | QUARTER 2 | | | QUARTER 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | RURAL | URBAN | POOLED | RURAL | URBAN | POOLED | RURAL | URBAN | POOLED |
| HQ | -0.206 | 0.503*** | 0.442*** | -0.644 | -0.272* | -0.251* | -0.875** | 0.00975 | -0.129 |
| | -0.339 | 0.147 | 0.132 | -0.419 | -0.154 | -0.141 | -0.39 | 0.158 | -0.141 |
| HA | -0.280* | -0.167* | -0.184** | -0.813*** | -0.163* | -0.291*** | -0.527*** | -0.426*** | -0.437*** |
| | -0.157 | -0.0919 | -0.0785 | -0.194 | -0.0956 | -0.083 | -0.175 | -0.098 | -0.0833 |
| FPA | 0.279 | -0.438*** | -0.327*** | 0.0913 | -0.125 | -0.117 | 0.0762 | -0.0369 | -0.0421 |
| | 0.211 | -0.104 | -0.0911 | 0.245 | -0.106 | -0.0955 | 0.23 | -0.108 | -0.0958 |
| HC | 0.0342 | 0.504** | 0.419** | -0.421 | -0.139 | -0.177 | 0.619 | 0.367 | 0.419* |
| | 0.47 | 0.226 | 0.201 | -0.526 | -0.231 | -0.209 | 0.509 | 0.242 | 0.216 |
| ED | 0.000668 | 0.359 | 0.298 | -0.00236 | 0.338 | 0.309 | -1.218** | 0.315 | 0.0223 |
| | -0.454 | 0.228 | 0.202 | -0.531 | 0.231 | 0.21 | -0.508 | 0.236 | 0.21 |
| TC | -0.810*** | -0.648*** | -0.681*** | -0.219 | -0.192 | -0.215* | -0.24 | -0.215 | -0.194* |
| | -0.234 | -0.124 | -0.108 | -0.259 | -0.127 | -0.112 | -0.241 | -0.131 | -0.113 |
| Constant | 1.003 | -0.507 | -0.379 | 4.430*** | 2.105*** | 2.350*** | 4.225*** | 1.759*** | 2.072*** |
| | 0.725 | -0.339 | -0.301 | 0.992 | 0.368 | 0.337 | 0.917 | 0.373 | 0.336 |
| Observations | 252 | 1,000 | 1,252 | 240 | 925 | 1,165 | 239 | 907 | 1,146 |

Source: Author's estimates.

Note: Q1 (Pre-COVID-19), Q2(COVID-19, Month of June), Q3(COVID-19, Month of August),

**Table 5. Food Security Transition regression estimates**

| | Food Security Transition | | | |
|---|---|---|---|---|
| | $P_{1,1}$ | $P_{1,0}$ | $P_{0,1}$ | $P_{0,0}$ |
| Housing Quality(HQ) | 0.597*** | -0.0876 | -0.27 | 0.0272 |
| | 0.163 | -0.473 | -0.67 | 0.532 |
| Household Assets(HA) | -0.133 | 0.0109 | 0.42 | 0.245 |
| | -0.102 | 0.288 | 0.383 | 0.277 |
| Farm Productive Assets(FPA) | -0.283** | -0.813** | 0.165 | 0.455 |
| | -0.117 | -0.35 | 0.398 | 0.333 |
| Safety nets/Household Composition (HC) | 0.329 | 1.585* | 0.367 | -0.558 |
| | 0.261 | 0.846 | 0.821 | -0.654 |
| Employment diversification(ED) | 0.188 | -0.047 | 0.451 | -1.144 |
| | 0.252 | -0.823 | 0.846 | -0.705 |
| farm inputs and output market Access (TC) | -0.574*** | -0.939** | 1.148** | 0.944** |
| | -0.138 | -0.4 | 0.484 | 0.392 |
| Constant | -0.53 | 0.391 | -0.843 | 0.469 |
| Observations | -0.373 | 1.068 | -1.52 | 1.295 |
| | 706 | 120 | 106 | 172 |

Source: Author's estimates .

Note: $P_{1,1}$, the probability of food insecurity persisting, $P_{1,0}$, the probability of transiting into food security and can be interpreted as the probability of being resilient, $P_{0,1}$ probability of transiting from food security to food insecurity and can also be thought of as the probability of being vulnerable. Population, annual rainfall, exposure, age and education attainment, geopolitical zones and states dummy

## 4. Discussion

The findings above reveal the doubling of participants food insecurity over the period considered (Table 2) and the dynamics as a result of the exposure to multiple shocks. For example, measures undertaken by government such as Border closures, quarantines, social distancing, curfews, and trade restrictions to control the pandemic affected livelihoods and food supply chain. [22][16, 23]. These stressors affect the ability of local food systems to operate and earn a living. "Pandemic-related control measures do not act alone, but interact with contextual factors [17]. In Nigeria, such factors include poor infrastructure, climate variability, high transaction cost and poor access to credit and insurance. In Nigeria's local food system, staple foods, Animal sourced foods, perishable foods such as fruits, and vegetables are important food products that are produced processed stored, transported and traded mostly by smallholder participants in the supply chain. The food supply chain for selected countries in Africa including Nigeria, according to [24] accounts for 65% of all rural employment and composed of 40% own-farming, 5% farm-wage-labor, and 20% post farm gate employment. Also, 80% of food consumed (in value terms) is purchased from food supply chains. With recurrent exposure to multiple shocks, the food security of participants in local food systems is affected. From the findings, poorer households experienced a 0.53 points increase in food insecurity rate over the period. These findings corroborate [3] study of the data and showed estimated 76% food insecure adults for Nigeria. They also alluded to the fact that "the significant increase in food insecurity in Nigeria combined with evidence from the European Union and the United States suggests that households have been experiencing a high prevalence of food insecurity since the pandemic began". Estimate of food insecurity levels alone do not permit full understanding of the dynamics between being food insecure and food secure. Hence as part of our contribution to the emerging literature food insecurity dynamics was investigated using the Markov transition probabilities model. By this, the probability of entering and escaping food insecurity across different periods during the pandemic was estimated. Transition probabilities were examined across periods Q1 and Q2; Q2 and Q3; and Q1and Q3 for rural, urban and for the whole country. From Table 3, the probability of escape from food insecurity was four times less likely compared to the probability of entering into food insecurity. Again, persistent food insecurity across participants was most probable, followed by the probability of entering into food insecurity. The least probability was the probability of escape. Participants in Nigeria's local food systems are often faced with conditions that support entering into food insecurity with limited conditions for escape. While farm productive assets and farm inputs and market access are important resilience capacity that can promote persistent food security and reduce persistent food insecurity, capacities such as Safety nets can play important role of helping participants in local food systems from escaping.

Nonetheless, COVID-19 Pandemic does not act alone but also interacts with existing conditions. Thus "understanding the response of household towards a certain external shock such as the COVID-19 pandemic, resilience and vulnerability can be good measures[5]. Our approach to conceptualizing household resilience capacity is rather multidimensional. Like most concepts, that are "multi-faceted measuring resilience in the context of food security include proxies that are thought to reflect indirectly the level of resilience. In this paper we focus on measuring resilience capacity from the perspective that views household resilience as a process that ultimately determines food security outcomes of households.

## 5. Conclusion

The paper investigated the correlated link between resilience capacity and food insecurity of smallholder participants in a local food system during the Pandemic and the dynamics of food insecurity. We applied two-period analysis consisting of a pre-COVID_19 period (data set, the latest wave of the GHS-Panel) and COVID-19 period (rounds 2 and 4 of the COVID-19 National Longitudinal Phone Survey (NLPS) 2020 data set).). From the results, FI increased by 0.40 points from 0.32 to 0.72 points over the period. There was a non-uniform effect across locations and income groups. Poorer households experienced worse food security changes with their FI status increasing by an average of 0.53 points over the period. It becomes imperative to strengthen the resilience of local food systems to both current and future shocks for sustained outcomes of food security and nutrition.

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