



RESEARCH ARTICLE

Effects of Agricultural Commercialization in Food Insecurity Transition among Smallholder Rice Farmers in Ekiti-State, Nigeria

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ABSTRACT

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This study examined the effects of agricultural commercialization on food insecurity transition among smallholder rice farmers in Ekiti state, Nigeria. The study employed a multi-stage sampling procedure to select the sample. A well-structured questionnaire was used to collect data during the on- and off-seasons period in the study area. While descriptive statistics was employed to analyse respondents' socioeconomic variables, Transition Matrix Box and Ordered Probit Regression models were used to analyses food insecurity transition among the smallholder farmers. Result of data analysis showed that 64% of the respondents were commercial rice farmers while others were subsistence rice farmers. The result further revealed respondents that engaged in commercial agriculture were food secured during both surveys unlike their subsistence counterparts who were only food secure during first survey period (on-season). Also, the transition matrix revealed a scenario whereby more of commercial rice farming households are food secure in both surveys and having more of their households exited food insecurity than their subsistence counterparts. Furthermore, the results of the Ordered probit Regression revealed that vulnerability status, asset value, years of formal education, adult equivalence, livestock, agricultural commercialization, incidence of crop loss, membership of agricultural cooperatives, extension contact and challenge of Fulani herdsmen were significant factors influencing respondents' food insecurity transition regardless of their commercialization status. Therefore, the study recommends that government and other stakeholders should formulate relevant policies that have bearings on the key drivers in order to address all forms of food insecurity in the study area.

INTRODUCTION

Smallholder farmers live in environments characterized by shocks such as vagaries of weather, food and non-food items prices volatility, insurgency, political upheaval, terrorism, kidnapping, banditry, fire outbreak, illness, pests and diseases outbreak among others. When households experience one or a combination of these shocks, a large income or consumption variability becomes noticeable over time (Azomahou & Yitbarek, 2014) thereby necessitating appropriate policy prescription. Until recently, food security policies had been formulated based on prescriptions from the viewpoint of static food insecurity analysis resulting in targeting error (Eyob, 2013). For instance, households whose food security challenge stems from low level of food consumption would need a different policy prescription from those faced with high variability in food consumption. However, food insecurity alleviation efforts in Nigeria have been general in approach rather than specific in addressing the immediate cause of household food insecurity.

Not distinguishing between static food insecurity from vulnerability to food insecurity can be linked to the slower than expected progress recorded in the 'war' against food insecurity particularly in the Millenium Development Goals (MDGs) era (Sahn, 2015). Since food insecurity policy interventions (e.g. economic growth enhancing or income- generating policies) have been "one- hat fits all "in their designs, persistence of food insecurity results. Indeed some households need intervention in terms of empowering them to engage in income-generating activities while some need social protection to cushion against shocks (Azeem, 2016). Others need to produce for markets (engage in agricultural commercialization) in order to accumulate assets among others which they can use as insurance in the event of shock (Ojo, 2020).

Arising from this phenomenon of moving into or out of food insecurity, Carter & May (1999) present a typology of transitory and chronic food insecurity consequent upon the nature of the shock that the household faces. Furthermore, they identified two groups of transitory food insecure households. According to them, the transitory food insecure are those that are food insecure due to stochastic shocks that temporarily move their consumption below a pre-determined benchmark and those that are food insecure but are able to build up their asset base so that in the next period they move out of food insecurity. On the other hand, the chronic food insecure are those households having little assets and cannot build up their asset base high enough to enable them exit food insecurity. Oduro (2002) posits that transitory food insecurity occurs due to the inability of households to smoothen consumption as a result of non-existent/poorly functioning credit markets and weak social capital of food insecure households. He posits further that chronic food insecurity on the other hand may be linked to structural characteristics of the household worsened by poorly functioning insurance and credit arrangements.

Shocks in any form when experienced by households without protection or insurance or assets that may be liquidated may push them into food insecurity or make them remain in it if they are already in it. According to Barrientos (2007), uninsured shocks increase incidence of negative welfare outcome such as food insecurity. Therefore, against this background of household food insecurity transition, static welfare outcome analysis has limited explanatory power of the determinants of welfare outcome and can lead policy makers to focus on symptoms of food insecurity rather than the cause (Addison, 2009). Even though the literature on food insecurity is growing, however, exposure to and recovery from shock with or without insurance mechanisms can trigger food insecurity transition.

Several studies including Obayelu and Akpan (2021); Ayantoye, Yusuf, Omonona, and Amao, (2011); Amao and Ayantoye, (2011) have been conducted on food insecurity in Nigeria. However, these studies did not include shock variables and asset-accumulating variable among their explanatory variables. This limits how much is known about factors influencing food insecurity transition among rural households particularly smallholder rice farming households.

Therefore, there is the need to expand the frontier of knowledge in this regard so that food insecurity scourge can be tackled headlong with more robust policies. Consequently, this study examined the effect of agricultural commercialization on food insecurity transition among smallholder rice farmers in Ekiti-State, Nigeria.

METHODOLOGY

The study was carried out in Ekiti State, Nigeria. The state is situated in the Southwestern part of Nigeria. It is located between longitudes 7°45' and 5°45' East of Greenwich and latitudes 7°45' and 8°05' North of equator. It lies South of Kwara and Kogi States as well as East of Osun State. It is bounded in the East by Edo State and in the South by Ondo State.

The state has sixteen Local Government Areas LGAs). It enjoys tropical climate with two distinct seasons: the rainy season (April – October) and dry season (November – March). The temperature ranges between 21°C and 28°C with high humidity. Tropical forest exists in the South and guinea savannah in the North. The state is endowed with water resources like Ero, Osun, Ose and Ogbese rivers. Ekitis are culturally homogenous and they speak a dialect of Yoruba language known as Ekiti.

The major food crops grown in the state include yam, maize, cassava, cocoyam and rice; also the tree crops grown include cocoa, kolanut and oil palm tree. The main livestock species include sheep, goat, pigs and poultry. The people of the state are to a large extent rural dwellers whose poverty is a result of inability to generate enough income from their agricultural and non-agricultural activities to increase production. Ekiti state is an agriculture- based economy with the production of food crops providing employment and income for more than 75% of the population (Oluwatayo, 2004). The people are predominantly farmers while women engage in food processing, trading, in addition to farming activities. The climate favours the state in the cultivation of crops like maize, yam, cassava, millet, rice, plantains, cocoa, palm produce, cashew etc.

Sampling Technique

The study was conducted using cross-sectional data obtained from rice farmers who are the target population in the study area. The study employed multi-stage sampling procedure in selecting the respondents. The first stage involved a purposive sampling of rice producing communities in Ekiti state.

Secondly, twenty-three communities were randomly selected in a manner that ensured representation of the three Agricultural Development Projects zones. The ADPs zones were located in each of the three senatorial districts in the study area. In the third stage, a total of four hundred and forty-six rice farmers were selected from the list of rice farmers obtained from the ADPs office (state headquarters), for the study based on probability proportionate to size. However, out of the 446 questionnaire administered, 420 were correctly completed. Following Yamene, (1967), the following sample size determination was used in this study:

$$n = \frac{N}{1+N(e^2)} \quad (1)$$

Where, N (1556) is the population size and e is the level of precision (4%), n is the sample size. The proportionality factor used in the selection of the sample for equal representation is stated as:

$$x_i = \frac{n}{N} * \text{No of registered rice farmers in } i\text{th community} \quad (2)$$

Where, x_i = sample selected from ith community, n = total sample estimate obtained from Yamene 1967 formula and N= population of registered rice farmers in the study area. The sampling procedure is as shown in table one.

Data Collection

Primary data were obtained through field survey using structured questionnaire and oral interview during the on and off seasons to elicit response from respondents regarding household food consumption, socio-economic attributes of the respondents, physical and financial endowments of the households, households' membership of social network, households' exposure to shock, and agricultural commercialization participation of farm households.

Analytical Techniques

Determination of Household Food Insecurity Status

To achieve household food insecurity status objective, firstly, quantities of the commonly consumed food items at the household level in the study area was calculated and converted to calories based on their composition (Oguntona and Akinyele, 1985; Stefan and Pramila, 1998). Resulting calorie values was divided by the respective adult equivalent (AE) values of the households, in order to obtain numbers that are comparable across households of different sizes. The World Health Organization (WHO) considers 2850kilo calories as the required daily intake for a moderately active adult equivalent. (FAO-WHO-UNN, 1985). Food secure households are those whose daily per capita calorie consumed per Adult Equivalent (AE) is greater than or equal to the minimum recommended daily calorie requirement of 2850kcal/day/AE, otherwise household was considered food insecure for this study. Therefore, household food security status assumed a binary choice of 1 for food insecure household, and 0 otherwise.

Transitional Matrix Box

In order to measure mobility, a two-stage index is used. The two-stage index first allocates individuals to food calories consumption groups (either exogenously food calories consumption groups or endogenously determines ones like quintiles) and then examines mobility between these groups. When two observations in time are available (in a panel or in a cross-section which contains a quasi-panel component), a transition matrix and indices derived from it can be used to map changes i.e. improvement or decline in household welfare (see Dercon, 2001).

Table 1: Transitional Matrix Box

	Food secure	Food insecure	Total
Food secure	f_1	f_2	$f_1 + f_2$
Food insecure	f_3	f_4	$f_3 + f_4$
Total	$f_1 + f_3$	$f_2 + f_4$	Z

Source: Ayantoye and Amao, 2015

Where:

f_1 = numbers of households that were food insecure in the two survey rounds

f_2 = numbers of households that were food insecure in the first round but food secure in the second survey round

f_3 = numbers of households that were food secure in the first round but food insecure in the second survey

f_4 = numbers of households that were food secure in the two survey rounds

Z = total numbers of households ie. $(f_1 + f_2 + f_3 + f_4)$.

Households were grouped based on the measure of poverty as follows:

The probability of being always food insecure defined as being food insecure in the survey rounds

The probability of becoming food insecure defined as being food secure in the first round but food insecure in the second survey.

Ordered probity Regression Model

An ordered probity model assumes that a dependent variable (Transition group) is a linear combination of the independent variables (characteristics).

The central idea is that there is a latent continuous metric underlying the ordinal responses observed. Thresholds partition the real line into a series of regions corresponding to the various ordinal categories. The latent continuous variable, y_i^* is a linear combination of some predictors, X , plus a disturbance term that has a standard Normal distribution:

$$y_i^* = x_i\beta + e_i, e_i \sim (0,1), \forall i = 1, \dots, N. \quad (4)$$

y_i , the observed ordinal variable, takes on values 0 through m according to the following scheme;

$$y_i = j \Leftrightarrow \mu_{j-1} < y_i^* \leq \mu_j, \quad (5)$$

where $j=0, \dots, m$, and by slight abuse of notation in the pursuit of completeness, $\mu_{-1} = -\infty$, and $\mu_m = +\infty$ are defined accordingly.

Like the models for binary data, we are concerned with how changes in the predictors translate into the probability of observing a particular ordinal outcome. Consider the probabilities of each ordinal outcome:

$$[y_i = 0] = [\mu_{-1} < y_i^* \leq \mu_0],$$

$$= [-\infty < y_i^* \leq \mu_0],$$

$$= [x_i\beta + e_i \leq \mu_0], \text{ substituting from (4),}$$

$$[x_i\beta + e_i \leq \mu_0],$$

$$\begin{aligned}
& [\leq \mu_0 - x_i\beta] \\
& = (\mu_0 - x_i\beta); \\
& [y_i = 1] = [\mu_0 < y_i^* \leq \mu_1], \\
& = [\mu_0 < x_i\beta + e_i \leq \mu_1], \\
& = [\mu_0 < x_i\beta < e_i \leq \mu_1 - x_i\beta], = (\mu_1 - x_i\beta) - (\mu_0 - x_i\beta).
\end{aligned} \tag{6}$$

It is straightforward to see that

$$\begin{aligned}
& [y_i = 2] = (\mu_1 - x_i\beta), \text{ and that generally} \\
& [y_i = j] = (\mu_j - x_i\beta) - (\mu_{j-1} - x_i\beta). \text{ for } j = m \text{ (the "highest" category) the generic form reduces to} \\
& [y_i = m] = (\mu_m - x_i\beta) - (\mu_{m-1} - x_i\beta), \\
& = 1 - (\mu_{m-1} - x_i\beta).
\end{aligned} \tag{7}$$

To estimate this model we use MLE, and so first we need a log-likelihood function. This is done by defining an indicator variable Z_{ij} , which equals 1 if $y_i = j$ and 0 otherwise. The loglikelihood is simply

$$\ln \mathcal{L} = \sum_{i=1}^N \sum_{j=0}^m Z_{ij} \ln[\phi_{ij} - \phi_{i,j-1}], \tag{8}$$

$$\text{where } \phi_{ij} = [\mu_j - x_i\beta] \text{ } \phi_{i,-1} = \phi[\mu_{j-1} - x_i\beta]. \tag{9}$$

The ordered probit regression model used in this study follows Asagidigbi (2013);

Definition of variables and measurement

Dependent variable

y_i = Food insecurity transition group (1=never food insecure, 2= exiting food insecurity, 3= entering food insecurity, 4= always food insecure)

Independent variables

X_1 = *Vulnerability status* (1 = vulnerable; 0=otherwise)

X_2 = *Assets value* (Naira)

X_3 = *Years of formal education* (Years)

X_4 = *Adult equivalence* (Number)

X_5 = *Credit value* (Naira)

X_6 = *Livestock value* (Naira)

X_7 = *Agricultural commercialization status* (Participant = 1; 0 otherwise)

X_8 = *Incidence of crop loss* (Yes =1, 0 otherwise)

X_9 = *Age* (Years)

X_{10} = *Membership of agricultural production group* (Yes=1; 0 otherwise)

X_{11} = *Sex* (Male= 1; 0 otherwise)

X_{12} = *Challenge of fulani herdsmen* (Yes= 1; 0 otherwise)

X_{13} = *Mode of rice farm cultivation* (Upland= 1; 0 otherwise)

RESULTS AND DISCUSSION

Respondents' Participation in Commercialization

Table 2 presents distribution of respondents by participation in agricultural commercialization. About 64% of the surveyed respondents commercialized i.e. sold at least some of the rice they had produced on their farms. On the other hand 36% of the sampled respondents did not

commercialize. In other words, about one-third of the sampled respondents practised subsistence farming with respect to rice production. Since there are more participants of commercialization, it is expected that a reasonable proportion of respondents that commercialized should be able to generate marketable surplus that would enable them escape being vulnerable to food insecurity. Muricho (2015) found in his study that 75% of his sampled respondents commercialized.

Table 2: Distribution of Respondents by Commercialization Status

Commercialization Status	Frequency	Percentage
Commercialized Respondent	269	64.0
Non-Commercialized Respondent	151	36.0
Total	420	100

Source: Authors' computation from field survey

Socioeconomic Characteristics of the Respondents

Table 3 presents the distribution of the respondents by age. The result showed that 85.1% of the commercialized respondents were less than or equal to 60years old. The percentage of other commercialization participants that were over 60 years old was 14.1%. However, for non-commercialized respondents, 88.1% were less than or equal to 60 years old while the percentage of other members of the group (non-commercialized respondents) was 11.9%. The average age of the sampled respondents regardless of their commercialization status was 47.2years. This implies that the sampled respondents were in their active and productive age. It is expected that being in their active and productive age would enable them engage in income – generating activities such as agricultural commercialization that has potential to reduce being vulnerable to food insecurity. This result agrees with Ojo (2014) who found that being in productive age has a significant reduction on food insecurity.

With respect to sex of the respondents, the distribution shows that 68.4% of the respondents that commercialized were male while the remaining commercialized respondents were female. On the other hand 67.5% of non-commercialized respondents were male while the rest were female. This implies there were more male rice farmers than female rice farmers in the sampled respondents. This finding could be associated with the possibility that rice farming is a labour and resource-intensive enterprise (requires much productive resources that men are usually more endowed with than women especially in African setting). The usual practice in farming enterprise is that women tend to support their husbands in the processing aspect of rice production activities. This result corroborates Babatunde, Omotesho, Olorunsanya, & Owotoki (2008) who found that male farmers are more likely to engage labour intensive farming activities than female farmers.

For respondents' acquisition of formal education, the result showed that all the commercialized respondents acquired formal education as they reflected varying levels of acquisition. Majority of (about 41%) of the commercialized respondents completed secondary school education. In the case of the non-commercialized respondents, 8.6% of them did not have formal education while 28.5% of them completed primary school education. Some of the remaining population of the non-commercialized respondent either attempted primary or secondary school education or completed secondary school education. The rest of them either attempted tertiary institution or completed it. The average number of years that commercialized and non-commercialized respondents spent to acquire formal education were about 10.5years and 9.3 years respectively. This implies that commercialized respondents were more educated than their non-commercialized counterparts. The level of education acquired by respondents could determine the range of opportunities available to improve livelihood strategies, access to market and enhance food security (Ukpe, 2016).

Also, the distribution by membership of agricultural production network group, revealed that commercialized respondents had more percentage of their (about 69%) members in association than non-commercialized respondents that had 40.4% of their members belonging to one association or another. Respondents that belonged to associations would be more probable to participate in agricultural commercialization and invariably have less tendency to be vulnerable

to food insecurity. Belonging to association enables member respondents to have access to important production and marketing information and reciprocity. These benefits enhance respondents' participation in agricultural commercialization which has the potential of reducing vulnerability to food insecurity. This finding agrees with Balogun (2011), who finds that respondents who are membership of a social network are less poor.

The distribution by value of asset owned by both type of respondents showed that they possessed assets of varying monetary worth. The modal class with respect to naira worth of asset owned by sampled respondents regardless of their commercialization status is ₦5,000 – ₦34,999. Specifically, 68.1% and 49% of commercialized and non-commercialized respondents were in this class. The average monetary worth of assets owned by commercialized and non-commercialized respondents were ₦22,166.10 and ₦22,654.11 respectively. Assets owned by respondents could be sold off during emergency to serve as insurance mechanism against vulnerability to food insecurity.

Table 3: Distribution of Respondents by Socio Economic Characteristics

Age	Commercialized		Non-commercialized	
	Frequen cy	Percentag e	Frequen cy	Percentage
≤30	27	10.0	15	9.9
31-40	47	17.5	27	
40-50	85	31.6	48	31.8
51-60	72	26.8	43	31
>60	38	14.1	18	11.9
Total	269	100.0	151	100.0
Mean	47.2		47.2	
SEX				
Male	184	68.4	102	67.5
Female	85	31.6	49	32.5
Total	296	100.0	151	100.0
Years of Formal Education				
0	-	-	13	8.6
1-6	24	8.9	72	47.7
7-12	167	62.1	45	29.8
13-18	78	29	21	13.9
Total	269	100.0	151	100.0
Mean	10.5		9.3	
Membership of Agricultural Production Network Group				
Yes	84	31.2	9	6.0
No	185	68.8	142	94.0
Total	269	100.0	151	100.0
Value of Assets possessed (Naira)				
< 5,000	35	13	25	16.6
5,000 – 34,999	183	68.1	74	49
35,000 – 64,999	43	15.9	47	31.1
≥ 65,000	8	3.0	5	3.3
Total	269	100.0	151	100.0
Mean	22,166.1		22,654.1	

Source: Authors' computation from field survey

Households Food Security Status

Table 4 presents the household distribution by amount of calories consumed during the two survey period. The study used calorie threshold of daily intake of 2850 kilo calories for moderately active adult equivalent as set by World Health Organisation (FAO-WHO-UNU, 1985) and used by Azeem (2016) to categorise households calorie consumption. The distribution showed that more non-commercialized households (49%) consumed less than the calorie threshold value compared with commercialized households (27.5%) in the first period of the survey. However, more commercialized households (72.5%) consumed calorie above the threshold compared with non-commercialized household (51%) also in the first period of the survey. Again, in the second period of the survey similar results were observed as in the period of the survey. More non-commercialized households (57%) consumed calorie below the threshold value compared with commercialized households (36.1%). However, in the same survey period more commercialized households consumed calorie above the threshold value compared with non-commercialized households (43%). This implies that in the survey periods commercialized households are more food secure compared with non-commercialized households. The average calorie consumed per adult equivalent by commercialized and non-commercialized households were 3274.2 and 3033.0 kilo calories respectively in the first survey period. Also, the average calorie consumed per adult equivalent by commercialized and non-commercialized households were 3144.1 and 2816.0 kilo calories respectively in the second survey period. This finding could be linked to seasonal effect/variation in food availability and prices.

Table 4: Distribution of Households by Calories Consumed During the Two Survey Periods.

Calorie consumed	Commercialized				Non-commercialized			
	Freq ₁	Freq ₂	% ₁	% ₂	Freq ₁	Freq ₂	% ₁	% ₂
1850 – 2849	74	97	27.5	36.1	74	86	49.0	57.0
> 2849	195	172	72.5	63.9	77	65	51.0	43.0
Total	269	269	100.0	100.0	151	151	100.0	100.0
Mean	3274.2	3144.4			3033.0	2816.0		

Source: Authors' computation from field survey

Note: Freq₁ = Frequency of households in period one of the survey

Freq₂ = Frequency of households in period two of the survey

%₁ = Percentage of households in period one of the survey

%₂ = Percentage of households in period two of the survey

Households' Food Insecurity/Food Security Transition Matrix

Table 5 presents households' food security transition matrix in both survey periods. The table presents four food (in) security scenarios consequent upon analysis of data collected during the two rounds of survey viz: 'always food secure'; 'entering food insecurity'; 'exiting food insecurity'; and 'always staying in food insecurity'. The first scenario shows a scenario where over one-third (35.9%) of the sampled respondents who were commercial farmers were always food secure even in the face of shock. Also, the second scenario reveals a situation whereby more (5%) of respondents that were engaged in commercial agriculture exited food insecurity. This underscores the important role that agricultural commercialization plays in household food security. Agricultural commercialization enables households to earn income to purchase food not produced by the farmer as well as accumulate assets which may be sold in the event of shock to purchase food.

In the third scenario, however, more (10.50%) of the sampled respondents who entered food insecurity were respondents who practiced agricultural commercialization. For the fourth scenario, more (14.8%) of the subsistence farmers were always food insecure. This results points to the fact different households need peculiar policy intervention because "one hat fits all" policy would not address the peculiar food security needs of households. Some households may be

suffering from a low level of food consumption while others challenge may be high consumption variability (Azeem, 2016).

Table 5: Households' Distribution by Food Insecurity/Food Security Transition Matrix

		2nd period		Total
		Food Secure	Food Insecure	
	Food Secure	NC = (12.6%) C = (35.9%)	NC = (5.9%) C = (10.5%)	NC = (18.6%) C = (46.4%) Subtotal = (65%)
		1st period		
	Food Insecure	NC = (2.9%) C = (5%)	NC = (14.8%) C = (12.4%)	NC = (17.4%) C = (17.6%) Subtotal = (35%)
	Sub-Total 1	NC = (15.5%)	NC = (20.5%)	NC = (36.0%)
	Sub-Total 2	C = (40.9%)	C = (23.1%)	C = (64.0%)
	Grand Total	All = (56.4%)	All = (43.6%)	All = (100%)

Note: N C= Non-commercialized Households

C = Commercialized Households

Source: Authors' computation from field survey

Factors Influencing Food Insecurity Transition among Sampled Households

Table 6 showed the results of food insecurity transition among the sampled rice farming households. The results of the model of factors influencing food insecurity transition estimated using ordered probit regression. In general the model performs well. The goodness of fit measure, R^2 , is 0.71 which is sufficiently high for model using cross-sectional data. Also, log likelihood is significant at 1%.

The table depicted four food insecurity transition groups namely: never food insecure; exiting food insecurity, falling into food insecurity and always staying or remaining in food insecurity.

From the table, columns 2 and 5 which present the results of factors influencing never food insecure and always food insecure conditions respectively indicate that same variables influence never food insecure and always food insecure conditions respectively but with coefficients having opposite signs. In other words, vulnerability status is significant and negatively affected being in the condition of remaining never food insecure at 5% level of significance. This implies that households that were not vulnerable to food insecurity were more likely to stay never food insecure than similar households that were vulnerable. The non-vulnerable status of the never food insecure household may be linked to regular access to food throughout the year. Household that is not exposed to shock or whose resources are above what is required to neutralize the effect of shock will remain never food insecure. Households that are endowed with assets of different kinds will not be vulnerable and stay never food insecure. However, vulnerability status is significant and positively affected the condition of being always food insecure at 10% level of significance. This implies that they were vulnerable to food insecurity and were prone to always remain food insecure probably because they lack insurance mechanism. This result is in line with Azeem (2016).

Value of asset possessed is significant at 1% and positively influenced the condition of being never food insecure. This implies that households having more valuable assets were more likely to stay never food insecure than similar households having less asset value. Assets possessed by households can be converted to cash through sale if it experiences difficulty in purchasing food as a result of running out of cash so that it can purchase food with income realised from such sale pending the time that household's cash less condition improves. This is a short-term food insecurity coping strategy. However, non-possession of assets that can be sold is significant at 1% and positively influence the condition of always being food insecure. This is in line with Deaton (1992).

Years of formal education is significant at 1% and positively influenced the condition of being never food insecure. This implies that households that acquired more years of formal education

were more likely to stay never food insecure than similar households that acquired less years of formal education. The number of years that household spent in school to acquire formal education can make it remain food secure at all time. They have better skills and better access to information which enable them to process information accurately. The result is in line with Azomahou and Yitbarek (2014). However, the number of years spent to acquire formal education by households significantly and negatively influenced staying food insecure at 1% level of significance. This implies that households that did not acquire formal education were more likely to stay food insecure than households that acquired formal education. This may be linked to the deprivation of educational opportunities by households that did not acquire formal education. The level of education determines the level of opportunities available to improve livelihood strategies and enhance food security. Education status of households enables them to acquire skills and knowledge for budgeting, savings, adoption of innovation and efficient use of resources (Esturk and Oren, 2014). The result is in line with Azomahou and Yitbarek (2014).

Adult equivalent size is significant at 1% and positively affected staying food insecure. This implies that large-size adult equivalent households were more likely to stay in food insecurity than small-size adult equivalent households. This may be because large-size adult equivalent households lacked the ability (resources) to supply the food demand of their households on a sustainable basis. This could be true especially when such households did not commercialize to earn income from marketable surplus that could be used to buy food not produced by them that they need to supplement own-produced food. However, adult equivalence is significant at 1% and negatively related to the condition of being never food insecure. This implies that households having small-size adult equivalence were more likely to stay never being food insecure than similar households having large-size adult equivalence. Adult equivalence is derived from household size and it is a function of how many mouths to be fed in a household. If the number of mouths to be fed are too many relative to the hand(s) that is (are) to feed the mouths, there will be pressure on household's available food resources. The pressure will result in reduced per capita household food intake and faster depletion of household food stock than it is replenished. The result conforms to Juhar (2012).

Value of livestock is significant at 5% and positively influenced the condition of being never food insecure. This implies that households that have higher livestock value were more likely to stay being never food insecure than similar households that have lower livestock value. Livestock can be sold to earn income which in turn can be spent on purchase of food items for household consumption. Better still, livestock can be slaughtered and consumed as meat (protein) component of household food. So, the higher the value of livestock owned by household, the more the chance of being never food insecure. This result is in line with Muche and Tadele (2015) who found that livestock contributes significantly to improved food and nutrition through increasing the quality of highly nutritious animal source food and through income (when sold) that enables the poor to purchase food as well as paying bank or safety net role.

However, value of livestock possessed significantly at 5% and negatively affected staying in food insecure. This implies that households that did not have livestock were more likely to stay in food insecurity condition than households that had livestock. This may be attributed to the fact that possession of valuable number of livestock is crucial to smoothening food consumption and investment. Livestock asset is easily convertible to money through sale to bring about positive welfare outcome for household and to prevent, mitigate and cope with shock. This finding is in line with Tolla *et al.* (2016).

Agricultural commercialization is significant at 1% and positively influenced the condition of being never food insecure. This implies that households that commercialized were more likely to stay never food insecure than similar households that did not commercialize. This is because participating in agricultural commercialization enables households to generate marketable surplus. The marketable surplus so generated can be sold to earn income to buy food items required for household consumption. This result is in line with Ochieng (2015). However, agricultural commercialization is significant at 1% and negatively affected staying in food insecure. This implies that households that did not commercialize were more likely to stay food insecure than households that commercialized. This may be related to inability of subsistence

farmers to realize income high enough to improve their standard of living. Gabre-madhin *et al.*, (2009) considered commercialization of agriculture as an important means of enhancing income, food security and nutrition particularly when market access barriers are reduced. Therefore, households that did not commercialize need to do so for them to escape being at risk of staying in food insecurity. The finding is in line with Ahmed (2017).

Loss of crops is significant at 1% and negatively influenced the condition of being never food insecure. This implies that households that did not experience the incidence of loss of crop were more likely to stay never food insecure than similar households that had the experience. Loss of crops result in reduced yield and invariably reduced income which in turn affects purchasing power of affected households and consequently their access to food. This finding is consistent with Namkunda, Nyomora & Lyimo (2020) who found that presence of losses of food crops both before harvest and after harvest reduces the probability of attaining household food security. Because this causes reduced food availability, access to food, increased food prices and reduced power to purchase enough food households need to be food secure. However, loss of crop is significant at 5% and positively influenced staying in food insecure. This implies that household that lost crops were more likely to stay in food insecurity than household that did not lose crops. This may be due to the fact that such loss was colossal as such it would have serious adverse economic implication on such households, particularly when such households lacked insurance mechanisms. The magnitude of such loss is a function of the size of income that households could have realized from sale of the crop. Since income is one of the determinants of food security status, households that suffered high level of loss of crop tend to have inadequate own-produced food to consume as well as little or no output to sell to earn income. Hence, such households tend to move into food insecurity condition. The result is in line with Mesfin (2016).

Membership of agricultural production group (e.g. rice producer, cooperative society) is significant at 1% and positively influenced the condition of being never food insecure. This implies that households that are members of agricultural production group were more likely to stay food insecure than similar households that were not members of group. This may be linked to the numerous benefits / opportunities inherent in group, which members can exploit to achieve positive welfare outcomes such as food security and poverty reduction. Among the opportunities inherent in belonging to group are access to credit/farm inputs, lower transaction cost, access to agricultural extension training, market / improved technology information sharing, solidarity during unfavorable experience etc. This result is in line with Kausar (2013). However, membership of agricultural production group is significant at 1% and negatively influenced staying in food insecure. This implies that households that were not member of agricultural production group were more likely to stay in food insecurity than households that were member of group. This may be ascribed to deprivation of benefits inherent in being member of group. Households that were members of group may be in better position to reduce transaction costs of accessing inputs and outputs, obtaining market information, secure access to new technologies, and tap into high value markets (Mmbado, 2015). Through group, households obtain important market information about the market prices and potential buyers and the use of yield-enhancing farm inputs (such as fertilizers, improved varieties) and where they are available which eventually lead to improved welfare outcome (Ochieng *et al.*, 2015). This finding corroborates Ukpe (2016).

Contact with extension agents is significant at 1% and positively influenced remaining never food insecure. This implies that households that have contact with extension agents were more likely to stay never food insecure than similar households that have no contact with extension agents. This may be linked to the fact that access to extension contact enabled such households to adopt improved technology package such as high-yielding crop variety, climate change adaptation strategies, good market linkage, gaining access to farm input at competitive price and so on. The consequences of these benefits will enable household to generate improved output which in turn can be sold to earn improved income. The improved income can now be used to purchase food capable of sustaining the household throughout the year. This result is in line with Chege, Lemba & Semanya (2018) who reported that agricultural extension agent's visit to farmers on an individual basis is essential for improvement of households food security. However, contact with

agricultural extension workers is significant at 1% and negatively affected staying food insecure. This implies that household that did not have contact with agricultural extension workers were more likely to stay in food insecurity than households that had contact with agricultural extension workers. This may be because households without extension contacts missed training opportunities offered by extension workers in terms of technology of improved crop variety production, marketing strategies, sourcing of farm inputs, post-harvest technology for sustainability and general support services Ladele *et al* (2012). These extension trainings have potentials of bringing about favorable welfare outcome (food security) for households that attended such trainings. The finding is in line with Mmbado (2014).

Fulani herdsmen challenge is significant at 5% and negatively influenced the condition of being never food insecure. This implies that households not threatened with Fulani herdsmen challenge were more likely to stay never being food insecure than households threatened with Fulani herdsmen challenge. Fulani herdsmen challenge is another counter-productive phenomenon because their nefarious activities (maiming, kidnapping, killing and destruction of crops) in the recent is worrisome. As a response, regular farmers have become occasional farmers to the extent that even while on the farm, they are on red alert so that they can run for their dear lives in case the Fulani herdsmen appear. This scenario has made farmers to produce at sub-optimal level and this has affected general food supply and prices adversely such that people's (including the farmers) access to food is threatened. This is in line with FEWS NET (2019; 2020) that reported that farmers/herders clash distributed/prevented livelihood activities such as farming access to market and other economic engagements leading to (money-generating activities via death or displacement) reduced household income and access to food (USAID, 2017; Udo 2021). However, Fulani herdsmen challenge is significant at 5% and positively influenced staying food insecure. This implies that households threatened by Fulani herdsmen nefarious activities are more likely to stay in food insecurity. This may be due to loss of their crops occasioned by the indiscriminate grazing of Fulani cattle on such households' farms. Also, households threatened by Fulani herdsmen's dangerous activities entertain fear of insecurity rooted in the reports that some farmers has been maimed, kidnapped, killed and molested. This fear of insecurity resulted in "coping strategy" such as going to farm occasionally especially when they receive signals that Fulani herdsmen are not around their farms. Some household dared the Fulani herdsmen by going to farm regularly. However, they are always on red alert on the farm in case the Fulani herdsmen appear so that they may escape their unimaginable attack. These "coping strategies" adopted by Fulani-ravaged households are counter-productive and a threat to food insecurity. This explains why households threatened by Fulani herdsmen stay in food security. This result is in line with Olagunju *et al.*, (2012).

Column 3 and 4 of table 6 presents the cases of exiting and entering food insecurity. The following variables significantly and positively influenced coming out of food insecurity: agricultural commercialization membership of association and agricultural extension contact.

Agricultural commercialization is significant at 1% and positively influenced exiting food insecurity. This implies that households that are participating in agricultural commercialization are more likely to exit food insecurity than households that are not participating in agricultural commercialization this may be linked to the possibility that households that commercialized generate more income (that raise their purchasing power which could be used to improve their access to diverse types of food. IFAD (2003), posits that commercialization enables small holder farmers to increase their incomes and enhance their food security. This result is in line with Ahmed (2017). Agricultural commercialization raises income of the vulnerable and even provides basis of savings, insurance and credit for improving the financial status of the vulnerable households. Also agricultural commercialization exposes households to training opportunities that assist in acquiring skills for more effective use of their resources and enhancement of human capital. (Balogun, 2011). This result is supported by Ahmed (2017).

Membership of association is significant at 10% and positively influenced exiting food insecurity. This implies that households that are members of associations are more probable to exit food insecurity than households that are not members of associations. This may be because membership of informal institutions plays important role in addressing widespread food

insecurity among rural farming households. Past empirical studies has demonstrated that these types of informal rural institutions play important roles in easing households' ability to access markets and other important services like credit and improved technologies (Shiferaw et al., 2008; Govereh and 2003). The result agrees with Mwangi and Ouma (2012).

Contact with agricultural extension agents is significant and positively influenced exiting food insecurity at 5% level of significance. This implies that households that have contact with agricultural extension agents were more likely to exit food insecurity than households that have no contact with agricultural extension agents. Having contact with agricultural extension agents has a number of merits which include improved production technology, access to improved production inputs and market linkages among others. This finding corroborates Mmbado (2014).

Table 1: Maximum Likelihood Estimates of Ordered probity Regression for Examining Factors Influencing Food Insecurity Transition

Variable	Never Food Insecure	Exiting Food Insecurity	Entering Food Insecurity	Always Food Insecure
Vulnerability Status	-0.179** (0.084)	-0.022 (0.026)	0.007 (0.007)	0.150* (0.766)
Asset Value	5.76e-05*** (1.00e-5)	9.75e-06 (1.00e-5)	-1.86e-06 (0.000)	-4.60e-05*** (1.00e-5)
Years of Formal Edu.	0.058*** (0.017)	0.010 (0.008)	-0.002 (0.001)	-0.046*** (0.015)
Adult Equivalence	-0.073*** (0.020)	-0.012 (0.011)	0.002 (0.002)	0.058*** (0.017)
Sex	-2.82e-06 (0.000)	4.77e-07 (0.000)	-9.12e-08 (0.000)	-2.25e-06 (0.000)
Livestock	3.12e-06** (0.000)	5.29e-07 (0.000)	-1.01e-07 (0.000)	-2.49e-06** (0.000)
Agric Commercialization	0.952*** (0.024)	0.137** (0.046)	-0.138** (0.057)	-0.677*** (0.056)
Incidence of Crop loss	-0.251*** (0.086)	-0.027 (0.035)	0.011 (0.009)	0.212** (0.083)
Age	0.006 (0.006)	9.72e-04 (0.002)	-1.86e-04 (2.30e-04)	-0.005 (0.005)
Membership of Agri Production Group	0.411*** (0.109)	0.134* (0.071)	-0.008 (0.006)	-0.269*** (0.067)
Extension Contact	0.477*** (0.078)	0.180** (0.090)	-0.176 (0.126)	-0.481*** (0.741)
Challenge of Fulani Herdsmen	-0.174** (0.079)	-0.026 (0.027)	0.006 (0.005)	0.142** (0.066)
Mode of Rice Farm Cultivated	-0.152 (0.093)	-0.015 (0.022)	0.007 (0.007)	0.131 (0.086)
Number of Observations	420			
Prob > χ^2	0.000			
Log likelihood	-166.052			
<i>pseudo R</i> ²	0.71			

Note: Coefficients followed by *, **, and *** indicate significance at the 10%, 5% and 1% levels respectively

Source: Authors' computation from field survey

Figures in parenthesis are standard error

CONCLUSION AND RECOMMENDATIONS

This study examined the effects of agricultural commercialization on food insecurity transition among smallholder rice farmers in Ekiti-state, Nigeria. In the study, four food insecurity transition groups (never food insecure; exiting food insecurity; falling into food insecurity and staying in food insecurity) were identified among the sampled respondents while examining factors influencing out of these food insecurity transition, two central policy implications emerge from this study.

First, agricultural commercialization is beneficial because it has a potential to improve household income, savings and accumulate assets. These benefits that are associated with agricultural commercialization should be exploited so that households can be prevented from slipping into food insecurity; lifted from food insecurity and helped to stay food secure always. This can be achieved if Nigerian government promotes agricultural commercialization via its agricultural promotion policy (APP) that has as its policy thrust running agriculture as business.

Second, “one-hat fits all” policy intervention cannot tackle food insecurity headlong because the cause of food insecurity in each household is unique. This is obvious on table 6. As such this study prescribes a blend (mix) of evidence-based and unique food security policy for different households. For instance a combination of two or, more of the following suggestions will cater for the unique needs of households in one food insecurity transition group or another.

Government and Non-governmental organization must ensure that transitory and chronic food insecure households are protected from shock, assisted to build assets, provided with education, persuaded not to have large families, provided with insurance mechanisms and encouraged to form production group through group agricultural credit lending. Also, transitory and chronic food insecure households must be made to benefit from extension services by motivating extension workers to discharge their duties effectively while government should enact law to establish cattle ranch to address the Fulani herdsmen challenge.

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APPENDIX

Table 1. Nutrition (calorie) based equivalent scales

Years of age	Men	Women
0-1	0.33	0.33
1-2	0.46	0.46
2-3	0.54	0.54
3-5	0.62	0.62
5-7	0.74	0.70
7-10	0.84	0.72
10-12	0.88	0.78
12-14	0.96	0.84
14-16	1.06	0.86
16-18	1.14	0.86
18-30	1.04	0.80
30-60	1.00	0.82
60 above	0.84	0.74

Source: Calculated from world health organization data (Stefan and Pramila, 1998).

Table 2. Nutrients composition of commonly eaten foods in Nigeria (Raw, processed and prepared)

Food item	Kcal/kg
Gari	3840
Cowpea	5920
Rice	1230
Soybean	4050
Melons (shelled)	5670
Groundnut	5950
Bread	2330
Sugar	3750
Orange	440
Mango	590
Powdered milk	4900
Agric egg	1400
Fish	2230
Meat	2370
Maize	4120
Okra	4550
Pepper	3930
Tomatoes	880
Plantain	770
Yam	3810
Cocoyam	3830
Cassava flour	3870

Source: Oguntola. E.B. and Akinyele. I.O. (1995).