

Agricultural Diversification And Food Security: A Case Of Smallholder Farmer In Kano State, Nigeria

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Abstract: *The study examined the relationship between agricultural diversification and sustainable food security in Kano State, Nigeria. Data was collected from a sample of 378 respondents through questionnaire administration, interview and focus group discussions. Using correlation and multiple regression analysis, the paper established that mixed cropping and mixed farming were positive correlates of food security. At preliminary level, there was relationship between mixed cropping and food security ($r = 0.364, p < 0.05$) and also between mixed farming and food security ($r = 0.481, p < 0.05$). However, mixed farming had a more positive significant relationship than mixed cropping. At confirmatory level, the two enterprise diversification methods explained 26.7% of the variation in food security (adjusted $R^2 = 0.267$), while the remaining 73.3 was explained by other factors not considered by this paper. The regression model was significant ($F = 64.510, p < 0.05$). This also suggested that there is relationship between mixed cropping and food security ($\beta = 0.215, p = 0.000$) and between mixed farming and food security ($\beta = 0.402, p = 0.000$). However, the magnitudes of the respective betas suggested that mixed farming was the most significant predictor of food security followed by mixed cropping.*

Keyword: *Agricultural Diversification, Mixed Cropping, Mixed Farming, sustainable food security.*

I. INTRODUCTION

Kano State was estimated to have a total of 13,076,900 people according to 2016 forecast by National Population Commission of Nigeria and National Bureau of Statistics (2018). It is the most populated state in Nigeria. Agriculture is the major economic activity engaging over 65% of the population majority of who were producing at subsistence levels (Abdulrahman, 2013). The study was premised on the assertion that, in spite of executing several agricultural projects, spending huge sums of money annually to boost agriculture in order to make Nigeria self-sufficient in food production, the situation remained the same affecting many families (Ephraim, & Arene, 2015). Various authors have discussed of the eminent food and nutrition insecurity in Nigeria (Olayide, 1982; Famoriyo, 1998; Okuneye, 2000, 2002) in Adebayo, (2010). And this was argued to be the main

reason behind the deregulation policy measures in the food sub-sector in 1986. Food insecurity is conceived to mean food supply and demand imbalance. Base on nutrition and food security survey, Adebayo (2010) observed this to have reach unprecedented level. Children under the age of five years were mostly stunted (42 %), malnourished (9%) and underweight (25%). In addition, about 9% of adults suffered from mineral deficiency, and 11.6% of child bearing age women were under-nourished. In Kano State, the focus of the study, it was reported by Irohigbe and Agwu (2014) that many families cannot access or afford the required amount of food they needed on a sustainable basis. The fact that the State had executed a number of agricultural projects like the Fadama Irrigation Scheme which targeted over 760,000 smallholder farmers and the Agricultural Intensification Program under the National Special Program on Food Security (NSPFS) targeting over 6,000 smallholder farmers, however, achieving sustainable

food security remained a major challenge. The paper therefore, examined the relationship between agricultural diversification and sustainable food security among smallholder farmers in the State.

Boserup (1975), posit that population pressure when managed properly could induces some positive changes in the agricultural production process by encouraging intensification (Diversification). Thus, intensification can be used to overcome any shortfall in the production due to land degradation and at the same time cater for the additional mouths that need to be fed in a populated state like Kano. In this regard, large population size is seen to have a positive impact on agricultural production, particularly being the major stimulus (Labour) for agricultural production (Boserup, 1975; Carswell, 1997). The theory of agricultural intensification by Boserup therefore, is a factor to achieving sustainable food security. Sustainable food security is defined as, “when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preference for a healthy and active life” (Sunderland, 2011). Whereas, smallholder farmers are small-scale farmers, pastoralists, forest keepers or fishers who manage areas varying from less than one hectare to 7 hectares characterized by family motives, using mainly family labour for production and using most of the produce for family consumption (FAO, 2009). Agricultural diversification on the other hand, is the development of multiple production ventures within the farm business unit resulting in additional distinct marketed outputs (Hansson, Ferguson & Olofsson, 2010). Aneani, Anchirinah, Owusu-Ansah, and Asamoah (2011) observed that there are two main forms of diversification: horizontal and vertical diversification. Horizontal diversification involves the cultivation of additional crops/ livestock as opposed to one or two major crops/livestock while vertical diversification refers to the upstream and downstream activities of a particular crop or crops/livestock. However, this study is limited to horizontal diversification which involves the cultivation of additional crops/ livestock as opposed to one or two major crops/livestock, hence, mixed cropping and mixed farming were considered in this investigation.

Mixed cropping is a simple and inexpensive strategy and has been recognized as a potentially befitted technology to increase crop production due to its substantial yield advantage than sole cropping (Talukder, Rahman, Nahar, Rahman, and Kaiser 2015). The purpose of intercropping is to generate beneficial biological interactions between the crops. The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources that would otherwise not be utilised by a single crop. Studies by (Amujoyegbe, Torimiro, Tselaesele and Balole 2013; Dhakal, Regmi, Thapa, Sah, and Khatri-Chhetri, 2015; Legwaila, Marokane, and Mojeremane 2012; Maheswarappa, Hegde, Dhanapal, Sairam, and Vidhan Singh, 2001; Guvenc and Yildirim, 2006; Mousavi and Eskandari, 2011; Negash and Mulualem, 2014; Pypers, Sanginga, Kasereka, Walangululu and Vanlauwe 2011; Yadollahi, Abad, Khaje, Asgharipour, and Amiri 2014) pointed to the relationship between mixed cropping and food security. However, gaps emerged at contextual, conceptual, methodological and empirical levels. For instance, at contextual level only one study by

Amujoyegbe et al. (2013) was carried out in Nigeria. At conceptual level, no study considered food security but instead they were impliedly on increased agricultural production. At methodological level, studies by Mousavi and Eskandari (2011) and Yadollahi et al. (2014) were critical reviews. These gaps made it reasonable for this empirical study in the context of Kano State, Nigeria to investigate the relationship between mixed cropping and sustainable food security.

In the same token, mixed farming is a system where by livestock are kept on a farm where crops are grown simultaneously by the farmer. A mixed crop/ livestock farming system consists of integrated crop and livestock activities. A number of scholars (Błażejczyk-Majka, Kala and Maciejewski, 2011; Funes-Monzote, 2008; Gupta, Rai, and Risam, 2012; Moraes, Carvalho, Lustosa, Lang, and Deiss 2014; Obasi et Obasi, Nwaiwu, Korie, and Tim-Ashama, 2016; Obasi and Tim-Ashama, 2016; Peyrauda, Taboadac and Delabya, 2014; Sujatha and Bhat, 2015) conducted studies that relate mixed farming to food security. The findings revealed that the contribution of livestock to total crop outflows was very high. Mixed farming therefore increases agricultural production hence food security. However, gaps arised at contextual and methodological level. For instance at contextual level, only two studies (e.g. Obasi et al., 2016; Obasi and Tim-Ashama, 2016) were carried out in Nigeria. At methodological levels, studies by Gupta *et al.* (2012) and Peyrauda *et al.* (2014) were critical reviews. These gaps made it imperative for this empirical study in the context of Kano State, Nigeria, to the effect if there is relationship between mixed farming and food security.

II. METHOD

A total of 378 respondents were selected using multi-stage random sampling techniques for the questionnaire. Interview and focus group discussions were conducted using participants who were purposively selected from 9 program sites.

SURVEY METHOD: Questionnaire was administered on a total of 378 respondents from 9 program sites across the state. The questionnaire demanded respondents to answer questions covering: background information and agricultural diversification. Section A has a total of 7 items, while section B, has 10 questions. Questionnaire survey was chosen for the simple reason, it allowed for gathering of a lot of information from large number of respondents within a short period of time (Oso and Onen, 2009).

INTERVIEW: The study used unstructured interview because it allowed great freedom and flexibility of questions and responses which relied on social interaction between the researcher and the informant. Interview was conducted in all the 9 sites where 2 farmers and site manager (extension officer) were purposively selected making a total of 3 participants. Interview was also conducted with Kano State coordinator National Special Program on Food Security (NSPFS)

FOCUS GROUP DISCUSSION: Focus Group Discussions was also conducted to obtain more detailed information not necessarily provided by the questionnaire or

under the interview. This comprised two groups of 17 participants who were purposively selected. The first group consisted of 4 extension managers from each of the program site, 4 farmers and 1 representative of the Local Government Authority making a total of 9 participants. The second group also had 5 site managers 5 farmers representing each program site, and 1 representative of the Local Government Authority, making a total of 11 participants. The discussion was guided by the questions used in the interview, though, not restricted to that. Vital information was obtained particularly on the counterpart funding, sustainability of the program and general benefits of the program to the farmers and the state.

To establish whether there was a relationship between agricultural diversification and food, security, of each of the two constructs on agricultural diversification (mixed cropping and mixed farming), the results were presented at bivariate which include linear correlation of the independent variable on the dependent variable and at multivariate level the pertinent hypotheses derived from agricultural diversification are tested using multiple regression modelling. In the interpretation of the results basing on the five-point Likert scale that was used, a mean close to one is considered to imply strongly disagreed; a mean close to two is considered to indicate disagreed; a mean close to three is considered not sure (average or moderate); a mean close to four suggests agreed while a mean close to five is considered to indicate strongly agreed. To establish how mixed cropping was carried out in the areas under agricultural diversification, respondents were required to specify whether they grew more than one crop on their farms, grew several crop varieties on the same farm, had been introduced to improved mixed cropping techniques, grow cash crops mixed with other food crops and whether they can easy access capital to enabled them grow cash crops in a mixed cropping system. The results of farmers access to mixed cropping methods were presented in table 1:

	Descriptive	Statistic	Std. Error
Mixed cropping	Mean	3.67	0.02
	95% Confidence Interval for Mean	Lower Bound	3.63
		Upper Bound	3.71
	5% Trimmed Mean	3.69	
	Median	3.60	
	Variance	0.15	
	Std. Deviation	0.39	
	Minimum	2.60	
	Maximum	4.20	
	Range	1.60	
	Interquartile Range	0.60	
	Skewness	-0.17	0.13
	Kurtosis	-0.70	0.25

Source: Primary Data (2016)

Table 1: Summary statistics on Farmers Access to Mixed Cropping

Table 1 shows that the mean = 3.67 was almost equal to the median = 3.60. Therefore, despite the negative skew (skew = -0.70), the results were normally distributed. The mean and median close to four suggested that mixed cropping was high basing on the scale used; four represented agreed (good). The low standard deviation = 0.39 suggested low dispersion in the responses.

To establish how mixed farming was carried out in the areas under the agricultural diversification program, the respondents were required to indicate whether they reared animals and grew crops at the same time, animal farming was their major source of income, animal farming catered for their different family needs, sold animals to buy other food items needed by the family and whether they preferred growing crops than keeping animals. The results of farmers access to mixed farming methods were presented in table 2.

	Descriptive	Statistic	Std. Error
Mixed farming	Mean	3.71	0.03
	95% Confidence Interval for Mean	Lower Bound	3.65
		Upper Bound	3.77
	5% Trimmed Mean	3.72	
	Median	3.80	
	Variance	0.28	
	Std. Deviation	0.54	
	Minimum	2.00	
	Maximum	5.00	
	Range	3.00	
	Interquartile Range	0.80	
	Skewness	-0.46	0.13
	Kurtosis	0.05	0.25

Source: Primary Data (2016)

Table 2: Summary statistics on Farmers Access to Mixed Farming

Table 2 shows that the mean = 3.71 was almost equal to the median = 3.80. Therefore, despite the negative skew (skew = -0.46), the results were normally distributed. The mean and median close to four suggested that mixed farming was high basing on the scale used, four represented agreed (good). The low standard deviation = 0.54 suggested low dispersion in the responses.

To establish whether there was a relationship between agricultural diversification and food security, linear correlation analysis was carried out. The two agricultural diversification methods considered were mixed cropping and mixed farming.

Constructs	Food security	Mixed cropping	Mixed farming
Food security	1		
Mixed cropping	0.364**	1	
Mixed farming	0.481**	0.388**	1

** Correlation is significant at the 0.01 level (2-tailed).

Table 3: Correlation between Enterprise Diversification and Food Security

The results in Table 3 suggested that both methods of agricultural diversification namely mixed cropping and mixed farming were positive significant correlates of food security ($p < 0.05$). Thus, at the preliminary level, hypotheses H1 to the effect that there is a relationship between mixed cropping and food security ($r = 0.364, p < 0.05$) and H2 to the effect that there is a relationship between mixed farming and food security ($r = 0.481, p < 0.05$) were supported. That means there was significant positive relationship between enterprise diversification and food security. However, mixed farming had a more positive significant relationship than mixed cropping.

To confirm whether agricultural diversification predicted food security, agricultural diversification (the independent variable) was regressed on the dependent variable (food security). The agricultural diversification methods were mixed cropping and mixed farming and the result was presented in table 4.

Constructs	Standardised Coefficients Beta (β)	Significance P
Mixed cropping	0.215	0.000
Mixed farming	0.402	0.000

Adjusted $R^2 = 0.267$
F = 64.510, p = 0.000

Source: Primary Data (2016)

Table 4: Regression of Enterprise Diversification and Food Security

The results in Table 4 shows that, the two agricultural diversification methods explained 26.7% of the variation in food security (adjusted $R^2 = 0.267$). This means that 73.3% of the variation was accounted for by other factors not considered in this study. The regression model was significant (F = 64.510, $p < 0.05$). Therefore, the hypotheses to the effect that; H1 stating that there is a relationship between mixed cropping and food security ($\beta = 0.215$, $p = 0.000$) and H2 stating that there is a relationship between mixed farming and food security ($\beta = 0.402$, $p = 0.000$), therefore the study hypothesis is accepted. The magnitudes of the respective betas suggested that mixed farming was the most significant predictor of food security and mixed cropping followed respectively.

III. SUMMARY

Enterprise diversification was found to be the dominant methods used for achieving food security in Kano State. It was also indicated that farmers now grow cash crops mixed with other food crops simultaneously. Some degree of specialisation had also been achieved where farmers grew crops that have been identified to do well in their respective areas. With regards to mixed farming, farmers who reared animals and grew crops at a go were more food secured than those who do not. Therefore, the two enterprise diversification methods namely mixed cropping and mixed farming were positive correlates of food security. This means that there is a significant positive relationship between enterprise diversification and food security

IV. DISCUSSION OF FINDINGS

The dependent variable was food security, and the results of the study revealed that there was food security. This finding therefore was inconsistent with the premise on which this study was developed, that despite designing and executing several agricultural projects to boost agricultural production, smallholder farmers in Kano State were food insecure and increasing number of households in the State could not access or afford the required amount of food on a sustainable basis (Irohibe, 2014). The findings is however consistent with

earlier studies conducted by different authors using the same variables to determine the role of agricultural intensification program on food security as indicated by the related literature reviewed and the summary was presented here under.

The study revealed that the two agricultural diversification methods namely mixed cropping and mixed farming had a positive significant relationship with food security. This finding is consistent with the findings of previous scholars. For instance, Amujoyegbe *et al.* (2013) found that the combine land equivalent ratios (LER) for intercropping were above 200% better than sole cropping at all the sampled locations. Dhakal *et al.* (2015) showed that maize-pumpkin mix cropping was profitable with higher productivity per ha on maize main product equivalent basis. Maheswarappa *et al.* (2001) showed that with mixed cropping, there was an increase in the coconut nut yield over the years. Guvenc and Yildirim (2006) established no significant effect of different intercropping systems on growth characteristics and yield of cabbage compared with sole cabbage cropping. Farm productivity increased significantly when cabbage was intercropped with cos lettuce, bean, leaf lettuce or onion. LER was greater under intercropping systems increasing total yield, productivity and profitability.

Mousavi and Eskandari (2011) showed that row-intercropping, mixed- intercropping, strip-intercropping and relay intercropping were the most important types of intercropping. Crops yield increases with intercropping were due to higher growth rate, reduction of weeds, pests and diseases and more effective use of resources. Pest and disease damage in intercropping was less than in pure cropping, due to pest or pathogen attract by the second crop species, also when crops in intercropping system have a complementary effect together. Soil fertility increases by using plants of leguminosae family in intercropping, due to the increasing amount of biological nitrogen fixation activity. Negash and Muluaem (2014) found out that growing maize with different arrangements between rows of cassava did not cause significant difference on cassava tuber yield and yield components. However, there was a significant grain yield and yield components for maize with yield advantages ranging from 26 to 71%. Pypers *et al.* (2011) revealed that planting cassava at 2m between rows and 0.5m within the row, intercropped with four legume lines, increased bean yields during the first season and permitted a second bean intercrop increasing total legume production. Wang *et al.* (2014) indicated that intercropping led to high yield and nutrient acquisition, with soil fertility maintained over a period of at least 3–4 years. Yadollahi *et al.* (2014) revealed that mixed cropping was an important weed control because mixed crop systems use resources more effectively than with monoculture leading to decrease in the weeds. In general, from the available literature so far reviewed, it can be concluded by saying, there is a positive significant relationship between mixed cropping and food security.

Mixed farming also has significant relationship with food security which concurs with previous scholars. For instance, Błażejczyk-Majka *et al.* (2012) showed that mixed farms had greater scale of production very close to the optimal scale for medium-sized, big and very big farms. Funes-Monzote (2008) indicated that when comparing specialised and mixed farming

systems, the latter achieved higher levels of food production as a result of more efficient use of natural resources available on farm (or locally). Gupta *et al.* (2012) reported that in an integrated system, crops and livestock interacted to create a synergy, with recycling allowing the maximum use of available resources. Crop residues were used for animal feed, while livestock and livestock by-product production and processing enhanced agricultural productivity by intensifying nutrients that improved soil fertility, reducing the use of chemical fertilisers. Obasi and Tim-Ashama (2016) indicated that mixed farming had a positive significant effect on productivity, boosting food production. Peyrauda *et al.* (2014) found out that integrated crop and livestock systems contributed to increasing resilience of the agricultural sector against climatic and economic constraints. Closer integration of arable and livestock farming, and the development of legume cropping reduced the dependence of the agricultural sector on external inputs (mineral fertilisers, protein feeds and pesticides) and careful recycling within agro-ecosystems minimised nutrient losses. Sujatha and Bhat (2015) established that the contribution of livestock to total outflows was high from 2008 to 2014 except in establishment year of dairy unit. With the finding of the study supported by all the previous scholars so far reviewed, this means that there was a positive significant relationship between mixed farming and food security.

V. CONCLUSION

The two enterprise diversification methods namely mixed cropping and mixed farming were positive correlates of food security. At the preliminary level, the hypotheses to the effect that there is a relationship between mixed cropping and food security ($r = 0.364$, $p < 0.05$) and to the effect that there is a relationship between mixed farming and food security ($r = 0.481$, $p < 0.05$). This means that there is a significant positive relationship between agricultural diversification using mixed cropping, mixed farming and food security. However, mixed farming had a more positive significant relationship than mixed cropping. At the confirmatory level, the two enterprise diversification methods explained 26.7% of the variation in food security (adjusted $R^2 = 0.267$). The regression model was significant at ($F = 64.510$, $p < 0.05$). Therefore, stating that there is a relationship between mixed cropping and food security ($\beta = 0.215$, $p = 0.000$) and that there is a relationship between mixed farming and food security ($\beta = 0.402$, $p = 0.000$) were. However, the magnitudes of the respective betas suggested that mixed farming was the most significant predictor of food security and mixed cropping followed respectively.

VI. RECOMMENDATION

- ✓ Smallholder farmers to be encouraged to use the two agricultural diversification methods to enhance their food production capacity to achieve sustainable household food security in Kano State, Nigeria

- ✓ Results from the findings showed that the combine land equivalent ratios (LER) for intercropping were above 200% better than sole cropping. It is therefore recommended that farmers be properly trained on effective farm management under the system.
- ✓ Kano State Government to provide all the necessary inputs and services needed at subsidized rate to make the initiative attractive to farmers for easy adoption.

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