

Off-Farm Diversification among Small-Scale Farmers in North Central Nigeria

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Abstract

The study examined off-farm diversification among small-scale farmers in North Central Nigeria. Multistage sampling technique was used to select 180 respondents. Data for the study were obtained with the aid of standard questionnaire and analysed using entropy index of diversification and multiple regression analysis. Findings showed that the degree of off-farm diversification among small-scale farmers in North Central Nigeria was high, and that the farmers were neither specialised nor completely diversified. Socioeconomic characteristics of the farmers that significantly increased the degree of diversification in the study area were farming as primary occupation, formal education, off-farm work experience, and off-farm work. Conversely, age, farm size, on-farm work hours, leisure, hours, farm asset current value, and crop income decreased off-farm diversification. It was recommended that farmers endeavour to reduce the degree of off-farm diversification so that they could have more time for farm work. Increase in allocation of time to off-farm work would enable the farmers to more efficiently manage large farm size. Government should ensure that farm assets do not depreciate drastically or that replacement of farm asset should be guaranteed. Policy measures should enable farmers obtain more income from their crops.

Keywords: Off-farm work, diversification, entropy index, multiple regression, small-scale farmers, socioeconomic characteristics, functional forms.

Introduction

Formal credit facilities have become unreliable (Ajayi & Ojo, 1986; Folawewo & Osinubi, 2006; International Food Policy Research Institute, 2007; Ogunmuyiwa & Ekone, 2010). Hence, farmers have resorted to alternative measures to raise capital for farm investment. The two major alternative sources of farm income for small-scale farmers were the numerous local savings' schemes and involvement in off-farm activities (Adam & Agba, 2006; Alade, 2006; Ibekwe *et al.*, 2010). In some contexts, rural off-farm activities are important sources of local economic growth (e.g. tourism, mining, and timber processing). Off-farm sector is of importance to the rural economy because of its production linkages and employment effects, while the income it provided to rural households could represent a substantial and sometimes growing share of farm capital (Davis, 2003; Zeller, 2010).

It has become widely accepted in academic and policy research that rural off-farm activities make up a significant component of rural livelihoods in developing countries (Chikwama, 2004; Bezabih, Gebreegziagher, GebreMedhin & Köhlin, 2010). Coupled with the increasing share of off-farm incomes, off-farm activities could no longer be considered as marginal. Reardon (1997) observed that households were pulled into the off-farm activities when returns to off-farm employment were higher and less risky than in agriculture. Also, when farming became less profitable and more risky due to population growth and market failures, many households were pushed into non-farm activities. Nevertheless, many farm households in developing economies are yet to adopt market-oriented agricultural practices and, hence, are unable to enjoy the benefits of the market economy. As a supplementary measure, activities in the off-farm sector have witnessed a boom in the manufacturing, agro-based and service sectors (Ibekwe *et al.*, 2010).

In addition to providing the much needed investment capital for the farm, off-farm occupation has been seen by some researchers as a risk minimising strategy which is important, especially, to the small-scale farmers. This is, indeed, a sound safeguard against crop failure and market failure (Ellis & Freeman, 2004; Babatunde, Olagunju, Fakayode & Adejobi, 2010). De Janvry and Sadoulet (2001) and Ruben and Van den Berg (2001) have shown that farmers resorted to these sources to boost farm capital and investment.

Myyra, Pietola and Heikkila (2011) affirmed that besides generating annual income, a farm family might have a goal to accumulate wealth through capital gains from off-farm activities. This is especially relevant for the about 900 million extremely poor people who lived in rural areas of developing countries. McNamara and Weiss (2005) maintained that farmers faced a number of uncertain factors such as weather and market conditions that affected their household income. Since small-scale farmers are risk-averse, farm diversification is an efficient risk management mechanism which stabilises expected returns in an uncertain environment or enterprise such as agricultural production.

Small-scale farmers belonged to the poorest segment of Nigeria's population and therefore could not make meaningful investment in farming (Asogwa, Umeh & Ater, 2007). In furtherance to this position, Onuk, Ibrahim, Bello and Patrick (2009) maintained that incidences of poverty and poor agricultural production were closely interwoven. Lack of income and poverty among small-scale farmers were consequences of lack of adequate finance. According to Oyeyinka, Arowolo & Ayinde (2012), lack of capital inhibited the purchase of improved seeds and agrochemicals as well as constrained the acquisition of appropriate production technologies for enhanced productivity.

Poor access to formal financial services is due to inherent difficulties associated with such characteristics as low population density in rural areas where farmers reside, isolated markets, seasonality of products, and highly covariant risks such as widespread crop failures, commodity price fluctuations, and high post harvest losses (Yaron, 2004). Also, inadequate infrastructure in rural areas often dissuades profit-oriented formal financial institutions from entering this market, thereby affecting the profitability of agricultural production (IFAD, 2004). Coupled with inadequate policies to attract formal financial intermediaries, small-scale farmers have become vulnerable to money lenders known for cut-throat loan terms.

Studies have reported the inadequacy of farm income and high prevalence of poverty among small-scale farmers resulting in their inability to meaningfully invest in farm business (Lambert & Bayda, 2005; Kwon, Orazem & Otto, 2006). Another group of literature has shown that farmers' resort to sourcing credit from financial intermediaries has not brought the much anticipated farm capital relief (Musser, White & McKissick, 1977; Bagachawa, 2000; Obike, Ukoha & Nwajiuba, 2007). Consequently, current research in agricultural finance has beamed its searchlight on off-farm activities embarked upon by farmers as an alternative and sustainable source of farm capital. It is, thus, expedient to provide empirical content on the degree of off-farm diversification. The specific objectives of this paper are to determine the degree of off-farm diversification and the socioeconomic characteristics affecting off-farm diversification among small-scale farmers in North Central Nigeria. It was hypothesised that socioeconomic characteristics have no significant effect on off-farm diversification among the small-scale arable farmers.

Entropy measure of diversification

According to Zunckel (2011), entropy is known as a measure of dispersion in a distribution or degree of diversification. Computed as complement of the sum of the squared turnover portions (in %) of all independent ranges of an enterprise, it is assumed that entropy of the probability distribution of the final value of the portfolio is a natural measure of diversification known as weighted entropy (E_i). One way to interpret portfolio weights is to see them as the probability of a randomly chosen currency unit to be invested in a certain asset. One could then argue that the entropy difference between these probabilities and the uniform distribution is a measure of information content and diversification. The corresponding measure is the weighted entropy

$$-\sum_{i=1}^N w_i \log(w_i)$$

This measure also has an intriguing sub-division property, which relates the overall entropy to the entropy of sub-portfolios and the weights of the sub-portfolios.

$$E = -w_i \log(w_i) + \sum w_i E_i$$

where w_i are the portfolio weights and E_i are the entropies of the sub-portfolios.

Entropy of diversification is also measured as:

$$E_i = \sum_{i=1}^n z_i \ln \left(\frac{1}{z_i} \right)$$

Where:

Z_i = proportion of firm's total sales in line of business i

If the firm is exclusively in one line of business, $E = 0$; the more E_i tends to 1, the more diversified is the total enterprise (Sambharya, 2000; Lindgren, Persson & Greeve, 2005; PonArul, 2012).

Methodology

The study was conducted in the North Central geo-political region of Nigeria. The region comprised six states, namely, Benue, Kogi, Nasarawa, Plateau, Kwara and Niger, with a total land mass of 296,898 km² and total population of 20.36 million people. Situated between latitudes 6^o30" N and 11^o20" N and longitudes 7^oE and 10^o E, the region has average annual rainfall that ranges from 1,500 mm to 1,800 mm, with average annual temperature varying between 20^oC and 35^oC. North Central Nigeria has 6.6 million hectares of land under cultivation with rain-fed agriculture accounting for about 90 percent of the production systems (Food and Agriculture Organisation (FAO), 2002; National Bureau of Statistics, 2007). Majority of the populace is in agriculture, with farm size ranging from 0.4 to 4.0 ha (FAO, 2002; National Food Reserve Agency, 2008)

Multistage sampling technique was used to select respondents for the study. In the first stage, three states namely, Benue, Kogi and Niger, were selected randomly from the region. In the second stage, two agricultural zones were randomly selected from each state, making a total of six agricultural zones. In the third stage, two Local Government Areas (LGAs) were randomly selected from each agricultural zone, amounting to 12 LGAs. In the fourth stage, three farming communities were randomly selected from each LGA, amounting to 36 farming communities. Finally, five small-scale farmers in off-farm work were randomly selected from each farming community. Thus, the sample size for the study was 180. Data for the study were collected from primary source with the aid of structured and pretested questionnaire.

Degree of diversification was determined with the aid of entropy index of diversification (D_E) as indicated by Mishra and El-Osta (2002), Weiss and Briglauer (2002) and McNamara and Weiss (2005). The model is specified as follows:

$$D_E = \sum_{j=1}^n S_j \log \left(\frac{1}{S_j} \right)$$

Where:

D_E = entropy index of diversification, the value of which ranges from 0 to 1,

S_j = proportion of firm's income, and

n = total number of off-farm firms.

The hypothesis for the study was tested with the F-statistic of different functional forms of multiple regression analysis such as linear, quadratic, and double logarithm functional forms. The explicit forms were specified as follows:

Linear function

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + b_{12}X_{12} + b_{13}X_{13} + b_{14}X_{14} + b_{15}X_{15} + b_{16}X_{16} + b_{17}X_{17} + b_{18}X_{18} + b_{19}X_{19} + b_{20}X_{20} + e_i$$

Quadratic function

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + b_{12}X_{12} + b_{13}X_{13} + b_{14}X_{14} + b_{15}X_{15} + b_{16}X_{16} + b_{17}X_{17} + b_{18}X_{18} + b_{19}X_{19} + b_{20}X_{20} + b_{21}X_1^2 + b_{22}X_2^2 + b_{23}X_3^2 + b_{24}X_4^2 + b_{25}X_5^2 + b_{26}X_6^2 + b_{27}X_7^2 + b_{28}X_8^2 + b_{29}X_9^2 + b_{30}X_{10}^2 + b_{31}X_{11}^2 + b_{32}X_{12}^2 + b_{33}X_{13}^2 + b_{34}X_{14}^2 + b_{35}X_{15}^2 + b_{36}X_{16}^2 + b_{37}X_{17}^2 + b_{38}X_{18}^2 + b_{39}X_{19}^2 + b_{40}X_{20}^2 + e_i$$

Double-log function

$$\log y = b_0 + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 + b_6 \log x_6 + b_7 \log x_7 + b_8 \log x_8 + b_9 \log x_9 + b_{10} \log x_{10} + b_{11} \log x_{11} + b_{12} \log x_{12} + b_{13} \log x_{13} + b_{14} \log x_{14} + b_{15} \log x_{15} + b_{16} \log x_{16} + b_{17} \log x_{17} + b_{18} \log x_{18} + b_{19} \log x_{19} + b_{20} \log x_{20} + e_i$$

Where:

Y = off-farm diversification (D_E),

X_1 = age (years),

X_2 = sex (1 = male, 0 otherwise),

X_3 = primary occupation (1 = farming, 0 otherwise),

X_4 = farmer association,

X_5 = (number of years of formal education),

X_6 = number of male adults in the household,

X_7 = number of female adults in the household,

X_8 = number of children in the household,

X_9 = farm size (ha),

X_{10} = farming experience (years),

X_{11} = off-farm work experience (years),

X_{12} = distance to market (km),

X_{13} = credit market (amount of credit obtained for farming in ₦),

X_{14} = off-farm work hours,
 X_{15} = on-farm work hours,
 X_{16} = leisure hours,
 X_{17} = farmland ownership (1 = own farmland, 0 otherwise),
 X_{18} = number of available infrastructures,
 X_{19} = farm asset current value (₦),
 X_{20} = Crop income (₦), and
 β = coefficient of explanatory variables.

Results and Discussion

Degree of Off-farm Diversification

The degree of off-farm diversification was determined using entropy measure of diversification (D_E). In table 1, the entropy of diversification ranged from 0.009 to 0.677, with 0.669 as the overall average entropy measure of diversification. This is in line with *a priori* expectation since the population of study comprised small-scale farmers. This finding confirmed that all the participants had, at least, an off-farm enterprise. The mean index of diversification of 66.9%, indicated that no farm household was completely specialised, neither was any completely diversified. This is a further proof of off-farm income reliance. Off-farm employment is an important strategy in dealing with income fluctuation and risk associated with agriculture. The average index of diversification in this study was higher than the indexes for Upper Austria's part-time farmers (0.374) and full-time farmers (0.526) in McNamara and Weiss (2005). It was also higher than that of U.S. farms (0.17) in Mishra and El-Osta (2002). These differences could be attributed to the axiom that diversification was more crucial to developing economies with inherent imperfect input market, near absence agricultural subsidy and prevalent poverty (McNamara & Weiss, 2005; Ibekwe *et al.*, 2010; Myyra *et al.*, 2011).

Table 1: Degree of off-farm diversification

Parameters	Index
Mean	0.669
Minimum	0.009
Maximum	0.677
Standard Deviation	0.139
Kurtosis	0.215

Source: Computed from field survey data, 2013

Effect of Socioeconomic Characteristics on Off-farm Diversification

In table 2, three functional forms – linear, quadratic and double-log – were fitted to the regression model to test hypothesis two in which the dependent variable was off-farm diversification index. Considering the number of significant independent variables, the linear functional form was adopted as the lead equation. The coefficient of determination of the model implied that the independent variables accounted for 98.8% of the variations in off-farm diversification. The F-statistic (649.278) was statistically different from zero. Consequently, the null hypothesis was rejected in favour of the alternative hypothesis, implying that socioeconomic characteristics of farmers had significant effect on farm diversification.

The result showed that age (-0.001) significantly reduced off-farm diversification at 1% probability level. A 1% increase in age, bearing in mind the average age of participants in this study, would reduce farm diversification by 0.001%. This implied that as a participant aged, his entropy of diversification waned. With the low prevailing life expectancy in the country, a farmer who is close to 50 years old could no longer effectively share his active time among different enterprises, regardless of the benefits. Such a farmer was likely to spend more time on leisure. This result was consistent with McNamara and Weiss (2005) and Mishra and El-Osta (2002) that age was significant and inversely related to farm diversification.

Primary occupation (0.03) was positively associated with diversification at 1% probability level, implying that a one percent increase in the choice of farming as the main occupation increased diversification by 0.03%. The implication was that due to the capital constraint inherent in small-scale farming in Nigeria, a sole farmer would increase diversification, albeit at the early stage and age, to raise fund necessary for the rapid growth of his farm. This was because farm diversification is a strategy used to curb declining farm and household incomes and insuring farms against agricultural production and marketing risks (Reardon, 1997; Kijima *et al.*, 2006).

The number of adult females (-0.013) in a farm household significantly decreased farm diversification at 1% probability level. This implied that a 1% increase in the number of adult females reduced farm diversification by 0.013%. Off-farm work required the ability to share naturally endowed time between mutually exclusive

enterprises. This constrained the number of off-farm enterprises females could engage in, while retaining farm work and household chores.

The result also showed that farm size (-0.089) significantly imposed restriction on diversification at 1% probability, implying that 1% increase in farm size reduced diversification by 0.089%. With the tradeoff in labour allocation observed in this study, the increased cost outlay associated with larger farm size could completely offset the income from off-farm sources. Hence, the greater the farm size a farm household had, the less the amount of time it had left to participate in several off-farm enterprises. In like manner, participation intensity could decline. This result validated Weiss and Briglauer (2002) that smaller family farms had little capacity for risk reduction through diversification given that a large proportion of the household's wealth and labour capacity was allocated to own farm business.

Off-farm work experience (0.007) significantly increased diversification at 1% probability level, implying that a 1% increase in the number of years of off-farm work increased diversification by 0.007%. The more years a farmer spent in off-farm work, the closer his entropy of diversification got to unity. The reason is that, apart from financial benefits, off-farm work is less rigorous than farm work. This result validated the true state dependency of Ahituv and Kimhi (2006) that those who have worked off-farm before were most likely to continue and that the probability of part-time farmers transiting into full-time farming was high. The dangerous trend, however, is that participation in off-farm work is the first step out of farming as noted by Harris *et al.* (2010). Their continuity in farm enterprise was unlikely (Glauben *et al.*, 2004) because increased diversification implies decreasing time for farm work.

Off-farm hours (0.00079) significantly increased diversification at 1% probability level. Time is an important growth factor in most business ventures. Besides, better time management strategies could be learnt with more hours of off-farm work. Hence, more hours of off-farm work increased diversification. This result contradicted McNamara and Weiss (2001) that the degree of diversification was significantly lower for farms where the operator was working off the farm in the previous period. Conversely, on-farm (0.00076) and leisure hours (0.00058) significantly reduced diversification at 1% and 5% respectively. Obviously, a farmer cannot be on his farm or resting place and in his off-farm business simultaneously. Where he cannot efficiently manage time allocation between farm and off-farm sectors, diversification moved backward towards zero. This finding showed that the emerging dual farm structure in a labour-intensive farm production was counterproductive.

Farm asset current value (-0.000048) significantly reduced diversification at 1% probability level. Growth in farm asset, or gradual depreciation of farm assets, or greater ease of asset replacement, had the tendency to retain farmers' interest in farming. In the presence of efficient machineries, farmers could execute farm operations with ease and even accomplish more work per unit time. Consequently, farm diversification could potentially be on the decline.

Education (0.003) was found to have significantly increased diversification at 5% probability level. With more formal education, preference for white collar jobs would be heightened. In addition, the flexibility to effectively switch between farm and off-farm enterprises was higher. Finally, the capacity to manage two competing enterprises was greater among educated farmers. This result was in line with Huffman (1980) that increasing farmers' education directly increased the odd of diversification. Kurosaki (2001) also found that education positively affected off-farm wage level via diversification. This result was, however, inconsistent with McNamara and Weiss (2001).

Crop income (-0.0000034) significantly decreased diversification at 5% probability level. The more income a farmer realised from his farm enterprise, the less attention he might pay to diversification. Besides, more income from crop enterprises would have taken a toll on the farmer's time endowment, leaving so little time left for off-farm work. Crop income is largely a measure of wealth for a small-scale farm household. This result indicated that wealthier farms are less risk averse and less diversified, which is consistent with Pope and Prescott (1980) who found a negative and significant relationship between wealth and farm diversification. McNamara and Weiss (2001) also confirmed that larger farmers (measured by farm income) tended to be more specialised and required more operator's labour time.

Table 2: Effect of socioeconomic characteristics on farm diversification (n=180)

Parameters	Linear		Quadratic		Double-log	
	β	t-ratio	β	t-ratio	β	t-ratio
Constant	0.573	12.435*	0.562	6.148*	-4.005	-2.143**
Age	-0.001	-7.008*	5.13E-08	-0.004	-0.003	-0.020
Sex	-0.004	-0.333	0.005	-0.524	-	-
Primary occupation	0.03	5.107*	0.014	2.454**	-	-
Farmer association	0.001	-0.12)	-0.004	-0.449	-	-
Education	0.003	2.691**	0.001	3.531*	-0.062	-3.171*
Adult male	0.001	-1.355	0.001	-0.975	0.031	-1.156
Adult female	-0.013	-4.299*	0.001	-1.652	0.395	7.336*
Children	0.001	-0.722	-1.58E-05	-0.636	-0.028	-1.549
Farm size	-0.089	-7.809*	-0.004	-1.434	0.631	1.813
Farming experience	-9.22E-05	-0.073	2.26E-05	-0.391	0.224	-1.502
Off-farm work experience	0.007	5.502*	3.20E-06	-0.043	1.733	6.148*
Distance to market	0.001	-0.447	0.001	-1.272	0.084	2.174**
Credit market	2.51E-06	-1.433	1.81E-09	5.512*	0.055	3.557*
Off-farm work hours	7.93E-05	4.138*	9.52E-09	-0.62	0.006	-0.182
On-farm work hours	-1.76E-05	-6.753*	-2.92E-10	-0.133	-0.664	-7.673*
Leisure hours	-5.76E-06	-2.400**	1.16E-09	-0.984	-0.031	-1.829**
Farmland ownership	0.009	-1.451	0.002	-0.475	-	-
Infrastructures	0.002	1.843	5.25E-05	-0.134	0.009	-0.615
Farm asset current value	-1.48E-06	-8.179*	2.97E-11	4.262*	-0.303	-1.688**
Crop income	-3.39E-08	-2.424**	7.42E-14	4.829*	0.733	2.395**
R ²	0.988		0.994		0.902	
F-statistic	649.278*		686.210*		94.282*	

*, ** significant at 1% and 5% probability levels, respectively.

Source: Computed from field survey, 2013

Conclusion and Recommendations

The degree of off-farm diversification among small-scale farmers in North Central Nigeria is high. The farmers are neither specialised nor completely diversified. Socioeconomic characteristics of the farmers significantly affected the degree of diversification in the study area. Notably, farming as primary occupation, formal education, off-farm work experience, and off-farm work hours increased the degree of off-farm diversification. Conversely, age, farm size, on-farm work hours, leisure, hours, farm asset current value, and crop income decreased off-farm diversification.

It was recommended that farmers endeavour to reduce the degree of off-farm diversification so that they could have more time for farm work. Increase in allocation of time to off-farm work would enable the farmers to more efficiently manage large farm size. Government should ensure that farm assets do not depreciate drastically or that replacement of farm asset should guaranteed. Policy measures should enable farmers obtain more income from their crops.

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