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DETERMINANTS OF THE NEGLECTED AND UNDERUTILIZED SPECIES' CULTIVATION BY SMALL-SCALE FARMERS IN NIGERIAN GUINEA SAVANNAH

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Abstract. There is an increasing consensus that diversifying into the cultivation of 'Neglected and Underutilized Species' (NUS), in addition to growing conventional crops, offers a plethora of livelihood-enhancing benefits to small-scale agricultural households. Therefore this study examined the factors that influence small-scale farmers' diversification into the cultivation of the cashew nut plant (*Anarcadium occidentale*, *Moringa oleifera* and *Jatropha curcas*) in the guinea savannah region of Nigeria. We employed farm household-level survey data of the phenomenon in Kwara State. The data were analyzed using the Simson Index of Diversity (SID) and Tobit censored regression. Findings indicate that respondents diversified most into the cultivation of cashews (70.9%), followed by moringa (38.4%), and jatropha (11.3%). The extent of diversification was positively influenced by the farm size ($p < 0.01$), household head's education level ($p < 0.01$), membership in a cooperative ($p < 0.01$), and farm income ($p < 0.1$). It was negatively influenced by the land tenure system practiced ($p < 0.05$). Findings imply, *inter alia*, that small-scale farmers may avoid diversification into these crops if they have a limited access to cultivated land. This study therefore advocates ensuring equitable access to farmland through a structural and legislative land tenure reform policy.

Key words: NUS cultivation, small-scale farmers, diversification, land tenure system

INTRODUCTION

The rural community is home to a broad range of indigenous animal and plant resources, the use of which portends tremendous opportunities for sustainable livelihoods. Of recent, the cultivation of a broad portfolio of these indigenous and otherwise referred to as 'minor plants' has been identified as strategic options for achieving sustainable rural livelihoods in sub Saharan Africa (IPGRI, 2000). Diversification into the cultivation of these crops by farmers has been shown to enable them minimize the risk of crop failure that might result from the vagaries of the climate and also helps them increase their incomes (ICRISAT, 2009). Apart from bringing in more cash, crop diversification systems create a more nutritious household diet and provide remunerative labour opportunities, as well as valuable by-products such as firewood, fibre and fodder for livestock.

Several crops have recently been identified to possess values qualifing them as being minor and/or Neglected and Underutilized. Specifically, cashew plant, *Moringa oleifera* and *Jatropha curcas* plants have been identified as belonging to this category. Empirical evidence suggests that diversifying into the cultivation of *Jatropha curcas* not only ensures energy and additional income for farmers, but it also reduces the use of fossil fuels, which in turn can help in mitigating climate

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change (ICRISAT, 2009). Similarly, the cultivation of Nutraceutical and ethno-medicinal *Moringa oleifera* may alleviate the nutritional insecurity by small-scale farmers and can also significantly improve profitability of rural households (Animashaun and Toye, 2013; Animashaun et al., 2013; Nadeau and Zakaria, 2012). Furthermore, in countries where due recognition has been given to the cashew (*Anarcadium occidentale*) processing industry, it is a valuable source of foreign exchange, and provides employment for the population at the various value chain nodes. In Mozambique for instance, it is the second largest provider of hard currency to the country's national budget and the leading agro-export in India (Quenum, 2001).

Critical to the cultivation of these crops for sustainable development and biodiversity conservation is understanding of the households' socio-economic and farm specific parameters that influence their cultivation by famers. This knowledge, which is currently limited, could be as a result of the relatively diminutive interest in these crops as against the more conventionally grown crops (Padulosi et al., 1999). This paper therefore seeks to bridge these gaps in knowledge and explore socio-economic and farm specific factors that influence households' extent of cultivation of cashew plant, moringa and jatropha plants with the aim of exposing current households' practices towards NUS cultivation before proposing a blanket and personalized recommendations.

MATERIALS AND METHOD

The study was carried out in the guinea savannah region of Nigeria. Over 90 per cent of the rural populace is involved in farming. Varieties of cash and food crops produced include cereals, tubers, cocoa, kola-nut and livestock. A three-stage random sampling technique was adopted for this study. In the first stage, Kwara State of Nigeria was purposively selected, the second stage involved the random sampling of two Agricultural Development Project (ADP) zones out of the four ADP zones in the study area were sampled. The third stage involved the random selection of 80 rural households in each of the ADP zones. In all, 160 farming households were randomly sampled for this study out of which only 150 provided useful information.

Data were collected through the use of a well-structured, pre-tested and pre-evaluated questionnaire and the data generated were on socio-economic characteristics, the cultivation of the crops of interest by respondents *viz* cashew, moringa and jatropha plants. The Tobit regression model was used to identify the factors that influence the extent of intensification into the cultivation of jatropha, moringa and cashew plants. The Tobit model is a statistical model and non-negative, metric dependent variable which could be only observed if it is above or below some cut off level (Tobin, 1958). It assumes that there is a latent unobservable variable underlying the observed dependent variable. The two are equal when the latent variable is greater than zero, but the observed variable is zero when the latent variable is negative or zero. For this study, the dependent variable was the extent of these crops' cultivation and it was measured by identifying how many of these crops were cultivated by respondents. Respondents who cultivated at least one of these crops were considered as meeting the required threshold for inclusion in the group. Basically, the model takes the form:

$$y_i^* = X_i\beta + e_i \quad (1)$$
$$y_i = 0 \text{ if } y_i^* \leq 0$$
$$y_i = y_i^* \text{ if } y_i^* > 0$$

Where:

$1, y_i^*$ – is an index that captures the extent of cultivation of these crops by the i-th respondent and it is 0 if the i-th respondent cultivates all three NUS crops and greater than zero at least one or two of the crops are cultivated

X_i – represents the explanatory variables that are hypothesized to influence the extent of cultivation and it ranges from (X_1 – age, X_2 – sex, X_3 – education attainment of household head, X_4 – annual farming income, X_5 – household size, X_6 – farming experience of household head, X_7 – farm size, d_1 – membership of cooperative society, takes value of yes or no, d_2 – land ownership, takes value from personal, rent, lease, family, community)

e_i – is the error term that is randomly distributed with mean zero and variance as described by Greene (2003).

The Simpson index of diversity (SID) is widely used to measure the biodiversity of an ecosystem and is expressed as follows:

$$\text{SID} = 1 - \sum p_i^2 \quad (2)$$

Where:

p_i – proportion of organisms classified in a species

$\sum$ – summation sign.

As shown in equation 2, SID can also be interpreted as the probability that two randomly selected organisms will be from the same species. Joshi et al. (2003) adopted the SID to compare crop diversification in South Asia. In this study, it was used to measure NUS crops diversity, interpreting p_i as the proportion of crop *i*. If p_i = n/K, then respondents with one NUS crop (n) = 1 and K = 3. As the number of crops increases, the share p_i increases as does the sum of the squared share, so that SID approaches 1. If there are K NUS crops then SID falls between zero and 1-n/K. The closer SID is to one, the more the specialization, and the further it is from one, implies the more diversification.

RESULTS AND DISCUSSION

Socio-economic distribution of respondents

The socio-economic distribution of the respondents is presented in Table 1.

As revealed in Table 1, our respondents are predominantly male, married with modal household members of 6 to 10 members and fall within the active age bracket (26–55) years. The predominance of male in our sampled respondent may be due to the observation that most rural communities in the study area being male headed. Since farming activities is energy intensive and mainly practiced by adults who possess energy, the predominance of the 26–55 years age group may be understandable as this falls within the age group of adult who possess the requisite energy required for the farming tasks. The study shows that majority of the respondents are married. Farming activities require the use of labour which is usually supplied by the household members; hence, having a marital status as against being single will provide the household with more hands for farming activities.

Furthermore, Table 1 shows that majority of the respondents are with a type of formal education, with an average annual income of N 96,000 (USD 600/annum), and possess more than 20 years of farming experience. About 10% of the respondents belong to a cooperative society. As revealed, about 80% cultivate less than 3 ha of farm land and about 75% either use rented or leased plots of land for farming activities.

Table 1. Socio-economic distribution of respondents
Tabela 1. Socjoekonomiczny rozkład respondentów

Socio-economic characteristics Cecha socjoekonomiczna	Frequency Częstotliwość występowania	Percent Udział procentowy
1	2	3
Sex – Płeć		
male – mężczyzna	140	93.3
female – kobieta	10	6.7
Marital status – Stan cywilny		
single – wolny	6	4.0
married – w związku małżeńskim	144	96.0
Education – Wykształcenie		
no formal – brak oficjalnej edukacji	51	34.0
quranic – szkoła koraniczna	30	20.0
pry – podstawowe	29	19.3
sec – średnie	25	16.7
tertiary – wyższe	12	8.0
adult – edukacja dorosłych	3	2.0

Table 1 cont. – Tabela 1 cd.

1	2	3
Average annual farming income (₦) Przeciętny roczny dochód z działalności rolniczej (₦)	94,386	
Belong to cooperative – Przynależność do spółdzielni		
no – nie	134	89.3
yes – tak	16	10.7
Farm size (ha) – Wielkość gospodarstwa (ha)		
<1	98	65.3
1–3	36	24.0
4–7	13	8.6
8–12	3	2.1
Land tenure practice – Własność ziemi		
family – rodzinna	10	6.7
personal – własna	5	3.3
rent – najem	90	59.6
communal – spółdzielcza	10	6.6
lease – leasing	35	23.2
Total household – Liczba osób w gospodarstwie domowym		
<5	38	25.3
6–10	106	70.7
11–15	6	4.0

Source: field survey, 2016.
Źródło: badania terenowe, 2016.

Distribution of diversification into moringa, jatropha and cashew crops by respondents

The results for ascertaining the proportional distribution of the cultivation of cashew, moringa and jatropha by respondents are presented in Table 2.

As shown in Table 2, respondents diversified more into the cultivation of cashew plant followed by moringa and finally into jatropha. Cashew nut is one of the most traded nuts in the world and this may account for it being more cultivated in the study area. Moringa is equally seen to hold prospects for cultivation because it could also serve as food and feed and could be traded as a source of income (Animashaun and Toye, 2013; Nadeau and Zakaria, 2012). The relatively low proportion of respondents going for jatropha cultivation may be due to the scant knowledge they have on the potential benefits of the crop and or because of the relatively little

Table 2. Distribution of the respondents based on moringa, jatropha and cashew plants cultivation
Tabela 2. Rozkład respondentów ze względu na uprawę moringi, jetrofy i nanercza

NUS Cultivated by respondents Uprawy NUS respondentów	Yes – Tak		No – Nie	
	frequently częstotliwość	%	frequently częstotliwość	%
Grow moringa Uprawia moringę	56	37.1	93	62.9
Grow jatropha Uprawia jatrofę	17	11.3	133	88.1
Grow cashew Uprawia nanercz	107	71.3	43	28.7

Source: field survey, 2016.
Źródło: badania terenowe, 2016.

Table 3. Factors influencing the extent of diversification into selected NUS crops
Tabela 3. Czynniki wpływające na zwiększenie różnorodności o wybrane uprawy NUS

Independent variables Zmienne niezależne	Coefficient Współczynnik	Standard error Błąd standardowy	t	P > /t/
Educational attainment Wykształcenie	0.067***	0.0192	3.54	0.001
Annual farming income Roczny dochód z rolnictwa	5.73e-07*	3.05e-07	1.88	0.062
Membership of cooperative Członkostwo w spółdzielni	0.093***	0.029	3.16	0.002
Farm size Wielkość gospodarstwa	0.034***	0.014	2.37	0.01
Land tenure (rent and lease) Własność ziemi (najem i leasing)	–0.029**	0.013	–2.18	0.03
Constant Stała	–0.063	0.282	–0.23	0.82
Sigma Odchylenie standardowe	0.252***	0.017	14.5	0.001

Source: field survey, 2016.
Źródło: badania terenowe, 2016.

infrastructure with which they can process jatropha seed into oil or low market facilities where exchange jatropha seed into cash can be made in relation to the moringa and cashew plants.

Socio-economic and farm specific factors influencing the extent of diversification into the cultivation of cashew, moringa and jatropha plants

The results of the Tobit regression model for the extent of households' diversification into the cultivation of the selected NUS crops are presented in Table 3.

Model parameters

Log likelihood = –36.51
LR $chi^2(11) = 35.8$, Prob > $chi^2 = 0.0002$
Observation summary 32: left-censored observation at difference ≤ 0
118 uncensored observations
0 right censored observations

The model was fit with 11 variables out of which 5 significantly explained the variations in the diversification index. The significance of the model chi square indicates the significance of the variation of the independent variables. 32 observations have zero value and more specifically indicated that 32 respondents might have cultivated all the three crops.

As revealed in the Table, diversification index was positively influenced by farm size ($p < 0.01$), level of education of household head ($p < 0.01$), membership of cooperative ($p < 0.01$), income from farming ($p < 0.1$), and was negatively influenced by the land tenure system practiced ($p < 0.05$).

As shown in Table 3, the selected NUS crops as used in the study area were permanent crops (although moringa could be classified as a vegetable crop depending on the purpose of cultivation). In addition to growing the normal arable and conventional crops, the cultivation of these crops requires additional farm plots, the absence of which may negatively influence their cultivation by farmers. Furthermore, the possession of formal education in addition to indigenous and informal education by the household head will bring an appreciation of the potentials of these crops for enhancing income, food and nutritional security which ultimately lead to enhance and better livelihood strategies for the households. Ibrahim et al. (2009) found that, high level of education will lead farmers to cultivate a higher valued

crops and involve in more commercially oriented agriculture with greater participation in off-farm works. Given the relatively limited interest in NUS crops by governmental and research agencies, membership of cooperative societies will allow farmers to have access to information to improved farming activities, market potentials and social capital which are basic and essential for the cultivation and diversification into these NUS crops. In addition, a higher income from farming may be as a result of diversification and which may further motivate farmers into embarking more into diversification of NUS crops. Remote households will have more diverse cropping pattern to meet diverse needs of household consumption and promote their disposable income (Ibrahim et al., 2009; Joshi et al., 2003).

Finally, the negative relationship between land tenure (rent and lease) and the extent of diversification implies that the additional cost of land rent and lease may discourage farmers from diversifying too deep into these crops. Both Joshi et al. (2003) and Ibrahim et al. (2009) on their studies, land tenure was not fitted into the regressions model but farm size was fitted whose result was not even significant to explain crop diversification index. So, the land tenure practice in this study was negatively significant which may equally hold that since most of these crops are classified as permanent in the study area, lack of land tenure security and tenure right may discourage farmers from cultivating these crops as the timing of their yields may coincide with when the owner of the plots may request the farmers to evacuate from the land and hence deny them the right of benefiting from it.

CONCLUSION AND RECOMMENDATIONS

This study examined the relative extent of diversifying into the cultivation of cashew plant (*Anarcadium occidentale*), moringa plant (*Moringa oleifera*) and jatropha plant (*Jatropha curcas*) by small scale rural farmers in the Nigerian guinea savanna. Respondents were randomly drawn from Kwara state of Nigeria. The results imply that respondents diversified more into the cultivation of cashew (70.9%), followed by moringa (38.4%), and jatropha (11.3%) respectively. The extent of diversification was positively influenced by the farm size ($p < 0.01$), level of education of household head ($p < 0.01$), membership of cooperative ($p < 0.01$), income from farming ($p < 0.1$), and was negatively influenced by the land tenure system practised ($p < 0.05$).

In view of these findings, this study advances the following recommendations:

1. Empowerment and training of farmers through cooperative societies on the benefits of the cultivation of these crops and the provision of sound marketing facilities that will prevent market glut and facilitate exchange of these crops to cash.
2. A thorough structural and legislative reform on current land tenure practices that will ensure an equitable and secured access to farmland by farmers.

Due to the time constraints, the possibility of going through the structure of the production and the role of NUS plants on farm income generation was very low, therefore, this is left open for further research.

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DETERMINANTY UPRAWY MARGINALNYCH I NIEDOCENIANYCH GATUNKÓW ROŚLIN PRZEZ WŁAŚCICIELI MAŁYCH GOSPODARSTW ROLNYCH W REGIONIE NIGERIAN GUINEA SAVANNAH

Streszczenie. Coraz powszechniej uznaje się, że poszerzanie konwencjonalnych upraw o gatunki marginalne i niedoceniane (Neglected and Underutilized Species, NUS) zapewnia małym gospodarstwom rolnym wiele korzyści, uzupełniając źródła utrzymania. W niniejszym artykule przeanalizowano czynniki, które wpływają na poszerzanie upraw przez właścicieli małych gospodarstw rolnych o nanercz zachodni (*Anarcadium occidentale*), moringę olejodajną (*Moringa oleifera*) oraz jatrofę przeczyszczającą (*Jatropha curcas*) w regionie Nigerian Guinea Savannah. Na potrzeby badania wykorzystano dane z ankiety przeprowadzonej w gospodarstwach rolnych stanu Kwara. Dane poddano analizie za pomocą wskaźnika różnorodności Simpsona (Simpson Index of Diversity, SID) oraz modelu tobitowego regresji cenzurowanej. Wyniki wskazują, że respondenci najczęściej poszerzali uprawy o nanercz (70,9%), a dopiero w dalszej kolejności o moringę (38,4%) i jatrofę (11,3%). Na stopień różnorodności upraw pozytywnie wpływały: wielkość gospodarstwa ($p < 0,01$), wykształcenie głowy rodziny ($p < 0,01$), członkostwo w spółdzielni ($p < 0,01$) oraz dochód gospodarstwa ($p < 0,1$), natomiast negatywny wpływ miał typ własności ziemi ($p < 0,05$). Wyniki wskazują, że właściciele małych gospodarstw rolnych mogą unikać poszerzania upraw o wymienione gatunki, jeśli mają ograniczony dostęp do uprawianej ziemi. Autorzy opowiadają się za zapewnieniem sprawiedliwego dostępu do ziemi przez przeprowadzenie prawnych oraz strukturalnych reform zasad najmu ziemi na omawianym obszarze.

Słowa kluczowe: uprawa gatunków marginalnych i niedocenianych, właściciele małych gospodarstw rolnych, różnorodność, własność ziemi

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