

An Assessment of the Determinants of Moringa Cultivation among Small-Scale Famers in Kwara State, Nigeria

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Abstract

The current rate of micronutrient malnutrition which afflicts over two billion people worldwide calls for a paradigm shift to approaches aimed at linking agricultural production to improved human health, and livelihood. Recent findings indicate the potentials of Moringa tree value-chain development in achieving a sustainable agriculture-agriculture not only aimed at economic prosperity, but equally at nutritional security of small-scale farming households. However, an understanding of factors that influence the cultivation of this crop is important. This study examined the determinants of cultivation of Moringa crop by small-scale farmers in Kwara State, Nigeria. It also highlighted the level of awareness of the benefits of the crop among respondents. The study utilized questionnaire to collect data from 150 arable crop farmers through a 3-stage sampling technique. Binary logistic regression model was used in analyzing the data. Results indicate that 47% of the respondents are aware of the nutritional benefits of the crop and 37.3% grow Moringa on their farms. Furthermore, awareness of crop benefits (p=0.021), farming experience (p=0.063), membership of cooperative society (p=0.07) and the growing of other permanent crops (p=0.001); are the significant factors affecting the cultivation of Moringa crop in the study area. The study recommends the promotion of adequate enlightenment as regards the benefits of Moringa. It also encouraged the utilization of cooperative societies in enhancing value-addition to the Moringa crop.

Keywords: sustainable agriculture, micronutrient malnutrition, cultivation, Moringa

1. Introduction

Modern agricultural systems, at the expense of immense agricultural research, are adept at providing food calories, but in the process, they have increased `Hidden Hunger' among the world's poor by displacing farm land allotted to traditional micronutrient-rich plant foods thereby making such crops less available and more expensive to low-income families (Combs et al., 1996). Cereals production in particular have displaced traditional micronutrient-rich crops like pulses, vegetables and fruits which contain inherently higher amounts of micronutrients Wolnik *et al*. (1985); Augustin *et al.* (1981). Whole cereal grains are noted to contain a relatively high level of antinutrients (substances that reduce the absorption and/or utilization, i.e. bioavailability of micronutrient metals to humans) and lower levels of substances that promote the bioavailability of these nutrients, further reducing the nutritional value of cereal products with respect to micronutrients (Graham and Welch, 1996).

Food and micronutrient insecurities are considered causally related to human health, general well being, productivity, and livelihood; and are strong contributor to stagnating national development efforts in many developing nations (Welch and Graham, 1998). Consequently, the stakes are high in any attempt at eliminating these deficiencies. Food systems approaches which are directed at empowering people and ensuring balanced and adequate nutrition and improved health in sustainable ways hold much promise in providing the methods needed for agricultural research to ensure sustainable agricultural systems. To do so would be to support a new paradigm for agriculture, the food systems paradigm which aims not only at productivity, but equally at sustainable development and better nutrition. These are without any doubts, compelling objectives of the entire human race (Welch and Graham, 1998).

However, to be sustainable requires that this food system approach must meet economic, social and ecological challenges; hallmarks of sustainable development (World summit Outcome, 2005). All these challenges are closely related (Dréo, 2006). It is recommended that these features of sustainable agriculture be considered as a package, and no single feature should predominate over the others. Sustainable agriculture needs to protect the natural resource base, prevent the degradation of soil and water; conserve biodiversity; contribute to the economic and social well-being of all; ensure a safe and high-quality supply of agricultural products; and safeguard the livelihood and well-being of agricultural households (United Nations, 1987).

Meanwhile, cultivating the Moringa crop in an agro forestry practice as a perennial crop by small-scale farmers holds the promise of sustainable development. This is because, Moringa, like any other perennial crop will continue to produce for a number of years and it has the added advantage of not requiring that new sections of forest lands will be cleared every year. Perennial crop can also help restore nutrients to degraded soils by remaining productive for decades, bringing a steady stream of cash to needy farmers. A mixture of perennials and annuals can also work excellently well for small agricultural plots because such polycultural fields provide a diversified income (prices of many cash crops are notoriously volatile), as well as insurance if one crop fails (http://rainforests.mongabay.com). An added bonus of such agroforestry systems is that they maintain forest systems, soils, and biological diversity at a far higher level than do industrial agricultural techniques.

Studies have equally shown that *Moringa oleifera*, a widely cultivated of the 13 different species of the family *Moringaceae* or Horseradish tree (Fahey, 2005), has a well-documented nutritional and medicinal properties that also provides excellent economic opportunities for agricultural producers, traders and processors thereby making it effective in tackling micronutrient insecurity while equally holding the promise of sustainable economic returns to the farmers (Nadeau and Zakaria, 2012). The tree crop of whose leave, seed, bark, pods are of economic importance could be grown as a relatively cheap, all year round, high quality food for both humans and animals. It is also rich in health promoting phytochemicals such as carotenoids, phenolics (chlorogenic acids), flavonoids (quercitin and kaempherol glycosides), various vitamins and minerals (Foidl, *et. al.*, 2001).

This potential of Moringa tree crop for sustainable agriculture has sparked interest among national and international agricultural development stakeholders. This can facilitate the introduction of the Moringa crop to rural areas in Africa. However, the success of the cultivation of this crop by small-scale farmers is expectedly hinged on various socio-economic factors. These conditions need to be well researched, identified and documented so as to facilitate a successful adoption of the crop for cultivation by small-scale farmers.

Against this background, this study examined the determinants of cultivation of the Moringa crop among small-scale farming households in Kwara State, Nigeria.

2. Theoretical Framework

In this study, it is assumed that farmers rationally revealed their choice of cultivation of Moringa or not in line with the objective of improving their welfare. This decision can be represented by a utility function and the decision problem can, therefore, be modeled as a utility maximization problem.

Following the stated choice method (Adamowicz, 1998), the econometric model used to investigate the determinants of farmer's choice in this study is a Random Utility Model (RUM). Suppose that a farmer drives utility from cultivating Moringa given his resource endowment and that the decision to cultivate is represented by j, where $j = 1$ if the farmer is willing to cultivate Moringa and $j = 0$ otherwise. Resource endowment of the farm household is represented by w, and the vector x represents other observable attributes of the farm household that might potentially affect this decision.

If the farmer prefers to cultivate, his utility is given by $U_1 = U(1,w,x)$ and, if he does not $U_0 = U(0,w,x)$. As in a standard economic theory, farmers should try to adopt the technology offering to maximize their utility, subject to their constraints. As a common practice in the specification of utility function, additively separable utility function in the deterministic and stochastic components where the deterministic component is assumed to be linear in the explanatory variables. That is,

$$U_1 = U(1,w;x) = V(1,w;x) + ei, \quad \ldots\ldots 1$$

and,

$$U_0 = U(0,w;x) = V(0,w;x) + e_0 \quad \ldots\ldots 2$$

where *Uj(.)* is the utility from resulting from the decision to cultivate, *Vj(.)* is the deterministic part of the utility, and *ej* is the stochastic component representing the component of utility known to the farmers but unobservable to the economic investigator.

Farmers are assumed to know their resource endowment, *w,* and implicit cost of cultivation resulting from engagement of their resources and can make a decision whether to cultivate or not. Let the farmer's implicit cost of cultivation be represented by *A*. Therefore, the farmer will prefer the cultivation of Moringa if,

U1> U0; that is,

$V(1, w\text{-}A;x)+e_i \geq V(0,w,x)+e_0$ ………………………………………………… 3

The presence of the random component permits to make probabilistic statements about decision maker's behavior. If the farmer is willing to cultivate the crop, the probability distribution is given by

$P_1 = \Pr(\textit{willing}) = \Pr(V(1,w - A; x) + e\ ³\ V(0, w; x) + e_0$ ………………………………….4

and if the farmer was not willing,

$P_0 = \Pr(\textit{not willing}) = \Pr(V(0,w; x) + e\ ³\ \Pr(V(1,w - A; x) + e_0$ ……………………….5

With the assumption that the deterministic component of the utility function is linear in the explanatory variables, the utility functions in (1) an (2) can be expressed as;

$U_1 = b_1'X_i + e_1$, and $U0 = b_0'X_i + e_0$ respectively, and the probabilities in equation 4 and 5 can be given as

Pr (willing to cultivate) = Pr ($U_i \geq U_o$)

Pr ($\beta_i'X_i+e_i \geq \beta_o'X_i+e_0$)

$\Pr(\beta_i'X_i-e_i \geq \beta_o'X_i- e_0)$…………………………………………… ……………6

3. Materials and Method

The study was carried out in Kwara State, Nigeria. The state has two main climatic seasons; the dry and wet season. The natural vegetation comprises of wooded and rainforest savanna, with annual rainfall ranging between 1000 to 1500mm while the average temperature lies between 30^0c and 35^0c. Over 90 per cent of the rural populace is involved in farming. Agriculture is the mainstay of the economy in Kwara State. Varieties of cash and food crops produced include cereals, tubers, cocoa, kolanut and livestock.

A three-stage random sampling technique was adopted for this study. Kwara State is classified into four agricultural zones namely; Zones A, B, C, and Zone D, by the State Agricultural Development Project. The first sampling stage for this study involved the random sampling of two Agricultural zones using the Kwara state Agricultural Development Project zoning arrangement of the state. Specifically, zones C and D were sampled out of the four zones that make up Kwara state. The second stage involved the random selection of two local governments each in the agricultural zones, and the third stage involved the random sampling of 40 farming households in each of the sampled local governments. In all, 160 farming households were randomly sampled for this study out of which only 150 provided useful information. Data were generated from the respondents through the use of well-structured, pre-tested and pre-evaluated questionnaires.

3.1 Analytical Framework

Data were analyzed with the aid of descriptive and inferential statistics such as the Binary Logistic Model (BLR). Farmers were asked whether they cultivate the Moringa crop or not. The response was analyzed with a dichotomous (binary) choice variable of "Yes" or "No" type indicating *cultivate* or *not cultivate* by the household, respectively. In this case, a BLR can be used to examine the impacts of a set of independent variables ($X_1, X_2, \ldots, X_n$) on the logistic function of the probability (P) for Y=1 (*i.e.*, P is the probability for Y=1). Estimation results of a logistic model can be used to identify factors that significantly contribute to the probability for Y=1 and examine the marginal impact of each significant independent variable on the odds ratio for Y=1. Following Maddala (2001), the probability, *p*, that a household embark on the cultivation of Moringa is given by:

$$P = \frac{e^{x'\beta}}{1+e^{x'\beta}} \ldots\ldots 7$$

Central to the use of logistic regression is the Logit transformation of p given by Y

Y= l*n* (p/1-p)………………………………………………………………………………8

With Y being the latent variable representing 1 if the household cultivates Moringa and 0 otherwise, and x being the variables of interest that could influence the decision. The empirical implicit functional form estimated to assess the drivers of moringa for cultivation by a household is given by:

$Y=f(X_1+ X_2 + X_3 +d_1 +d_2 +d_3 +d_4+ d_5 +d_6+d_7 +e)$.

Y= cultivation of Moringa crop, (Yes=1, No=0)

X_1 *=age of household head in years*

X_2 *=household size in numbers*

X_3*=highest educational attainment of household head,*

d_1 *=knowledge of moringa benefit (yes=1, no=0)*

d_2 *=access to farmland, (yes=if there is access, no= otherwise)*

d_3 *=affordability of cost of additional input requirement, (yes =if farmer could afford to bear additional cost, no=otherwise)*

d_4 *=knowledge of available markets for product, (yes=if farmer is aware of available market for moringa output, no=otherwise)*

d_5 *=gender of household head (male=1, female=2)*

d_6*=ethnicity of household head (1=Yoruba, 2=otherwise)*

d_7 *=grow other permanent crop (yes=1, no=otherwise)*

e= error term

4. Results and Discussion

4.1 Socio-economic Distribution of Respondents

The socio-economic distribution of the respondents with respect to gender, marital status, age, annual farm income, membership of cooperatives, educational attainment, experience, average farm size and household membership is presented in Table 1. The Table reveals that a relatively higher proportion of the respondents are male (99.3%) and are married (96%). The average household size of the respondents is 7 members (Table 1). While the majority of the respondents fall within the 26-55 years age category (53.6%), the minimum and maximum ages of the respondents are 24 and 89 years respectively. The average age of the respondents was estimated at 49 years (Table 1). Similarly, it is revealed that 34% of the respondents are without any formal education with 66% of them possessing one form of formal education or the other including quranic, primary, secondary, adult and tertiary education. Respondents' mean experience in years is 30 years and the minimum and maximum years of farming experience are 1 and 75 years while about 89% of the respondents do not belong to any cooperative society (Table 1).

Respondents' farm size cultivated ranges between 0.5 and 12 ha with an average farm size of 1.4 ha (Table 1). As shown in the Table, the average annual farm income in the study is N94,386 (N88,166 standard deviation), the distribution however indicates that majority of the respondents (58%) belong to category earning between N51,000-N150,000 annual farm income (Table 1)

4.2 Distribution of Respondents Based on Moringa Cultivation, Awareness of Benefits and Market Opportunity for Moringa Tree Product

The result of distribution of respondents based on Moringa cultivation, awareness of benefits for man and livestock and the awareness of market opportunity through demand for Moringa products in the market is presented in Table 2.

The result of awareness indicates that 47.3% of the respondents are aware of the benefits of Moringa (Table 2). The benefits described by respondents include those of health and nutritional benefits for both man and livestock.

The proportion of respondents who cultivate Moringa by intercropping it with other crop is 37.3% of the total sample. This indicates the relative non-cultivation of the crop among the farmers in the study area. It however appears that proportion of respondents, relative to the sample population, who are aware of the market potentials of the crop, is higher (46.7%) when compared with those who actually cultivate the crop (37.3%) (Table 2). This may be due to the non-availability of inputs, Moringa seedlings and extension service that may be required for successful utilization of the market potential of the crop.

4.3 Determinants of Moringa Cultivation among Respondents

The result of the determinants of respondents' cultivation of the Moringa crop is presented in Table 3

As revealed in Table 3, a test of the full model against a constant only model was statistically significant, indicating that the predictors as a set reliably distinguished between Moringa cultivators and non-cultivators(chi square = 57.75, $p < .000$ with df = 12). Accordingly, respondents who cultivate Moringa are more likely to those who are aware of the benefits it has ($p= 0.02$), who possess a relatively higher farming experience ($p=0.06$), cultivate other permanent crops like cashew, orange, plantain, Jatropha ($p=0.01$), with a relatively higher educational qualification ($p=0.09$) and are members of cooperative society ($p=0.07$).

As seen from Table 3, the variables which are statistically significant would equally increase the probability of respondents cultivating Moringa. Essentially, awareness of benefits has been recognized as a portent driving factor to adoption in addition to membership in cooperative society. This could be as a result of cooperative societies facilitating access to inputs, credit and markets for agricultural commodities. Equally important are the roles played by experience and education. With experience comes accumulated knowledge which would assist farmers in making well-informed decision on what to grow and what not to grow on their farms. Education could also assist the farmers by enabling him/her to be aware of the benefits of the Moringa crop, thereby enhancing willingness to cultivate the crop.

5. Conclusion

The cultivation of Moringa by small-scale farmers as components of agro-forestry and food security crop is expected to bring about gains in sustainable agricultural development. Premised on this, this study examined issues that could be of influence to Moringa cultivation. Specifically, this study examined the awareness of Moringa plant's economic and nutritional benefits by respondents, awareness of availability of markets and factors which could induce their willingness to cultivate Moringa. This is done with the view to equipping food security interventionist strategist with an understanding of the predisposing socio-economic factors that could make farmers more willing to cultivate the crop. A binary logistic regression (BLR) model was used to estimate these predisposing socio-economic factors.

Based on our findings, about 47% of respondents indicated awareness of Moringa's benefits for health, nutritional and livestock feeding. But when compared to the proportion who cultivates the crop, a relatively lower proportion (37%) has the plant on their farms. The BLR estimates indicate that awareness of Moringa's benefits, presence of other permanent crops like Jatropha, orange, cashew and plantain, membership of cooperative society, possession of a formal education and experience alls significantly influenced the likelihood of respondents cultivating the crop on their farms.

This study concludes based on the findings of this study that respondents' awareness of Moringa's benefits, the cultivation of other permanent crops like Jatropha, orange, cashew and plantain, respondents' membership of cooperative society and possession of a formal education and experience could significantly influenced the likelihood of cultivating the crop on their farms.

Based on these findings, this study recommends that extension agents be trained and empowered to inform and educate farmers on the importance of the crop and encourage them on the need to cultivate the crop. In the same direction, agricultural interventionist strategies should employ the services of farmers' cooperatives and further empowering them with skills and training necessary for Moringa value addition development and marketing.

More focus of research on moringa cultivation and consumption by rural farming households should be conducted to examine other variables that could possibly explain the variation in respondents' willingness to cultivate the crop so as to be more specific exact on the factors and help in making policy that would aptly address the issues of cultivation and consumption of moringa among the small scale farmers.

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Table 1. Socio-economic Distribution of Respondents

Socio-Economic Characteristics		**Frequency**	**Percent**
	MALE		
GENDER:		149	99.3
	FEMALE	1	.7
MARITAL STATUS:	SINGLE	6	4.0
	MARRIED	144	96.0
AGE:	< 25	11	5.3
	26-55	79	53.6
	56-75	54	36.0
	>76	6	4
EDUCATION	NON FORMAL	51	34.0
	QURANIC	30	20.0
	PRY	29	19.3
	SEC	25	16.7
	TERTAIRY	12	8.0
	ADULT	3	2.0
FARMING INCOME (N)	< 50,000	47	31.3
	51,000-150,000	87	58
	151,000-250,000	16	10.7
AVERAGE ANNUAL FARMING INCOME (N)	94,386		
STD DEVIATION	88,166		
EXPERIENCE (years)	<5	6	4.0
	6 – 20	59	39.3
	21-35	28	18.7
	36 – 50	43	28.7
	51-65	12	8.0
	>66		
		10	6.7
BELONG TO COOP	NO	134	89.3
	YES	16	10.7
FARM SIZE (ha)	<1	98	65.3
	1- 3	36	24.0
	4 -7	13	8.6
	8 -12	3	2.1

TOTAL HOUSEHOLD	<5	38	25.3
	6 -10	106	70.7
	11-15	6	4.0

Source: field survey, 2012

Table 2: Distribution of Respondents based on Moringa Cultivation, Awareness of benefits and market potential of Moringa plant

	Yes		**No**	
	Frequency	**%**	**Frequency**	**%**
Small-scale Cultivation of Moringa	56	37.3	95	62.7
Awareness of health and nutritional benefits	71	47.3	79	52.3
Aware of Market opportunity	70	46.7	80	53.3

Source: Field Survey, 2012

Table 3: Result of the Binary Logistic Estimates of Socio Economic Determinants of Moringa Cultivation among Respondents

PREDICTOR VARIABLES	COEFICIENT	STD ERROR	P value
Constant	-3.261	2.760	0.23
Grow Other Permanent Crop	2.299	0.666	0.01***
Awareness of Market for Moringa	0.4692	0.657	0.47
Awareness of Nutraceutical Benefits	1.486	0.6444	0.02**
Farmsize	-0.0167	0.148	0.91
Belong to Cooperative	1.784	1.016	0.07*
Farming Experience	0.069	0.0375	0.06*
Educational Attainment (Formal)	0.3757	0.2230	0.09*
Average Annual Farming Income	-2.69e-06	3.84e-06	0.48
LR (12) 57.75			
Log Likelihood (-69.2)			
P >CHI^2= (0.01)			
Pseudo R^2 (0.30)			

Source: Field Survey, 2012

Note: Single, double and triple asterisks (*) denote the significance of the p value at 1%, 5% and 10% respectively.