Effects of Agricultural Extension Services on Leaf Vegetables Farmers Use of Agro-Chemicals in Imo State, Nigeria

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ABSTRACT---- *This study was designed to analyze the effects of agricultural extension services on leaf vegetables farmers' use of agro-chemicals in Imo State, Nigeria. The study described socioeconomic characteristics of leaf vegetables farmers that use agro-chemicals, ascertained the role of extension services on use of agro-chemicals by leaf vegetable farmers, ascertained the sources of information on the use of agro-chemicals among leaf vegetable farmers, determined the influence of extension services on agro-chemicals use by leaf vegetable farmers and determined the extension variables influencing use of agro-chemicals by leaf vegetables farmers. Data were collected in 2021 with structured and validated questionnaire from 128 proportionately and randomly selected leaf vegetables farmers that use agro-chemicals in Imo State. Data were analyzed using descriptive statistics such as mean, frequency distribution and percentages as well as econometric tools of bivariate and logit regression models. Major roles of extension services in farmers' use of agro-chemicals for leaf vegetables production were acting as catalyst to speed up adoption rate, technology transfer and source of information. The major sources of information to the leaf vegetables farmers on agro-chemicals use were fellow farmers association and traders on vegetables. Extension services positively and significantly influenced leaf vegetables farmers' use of agro-chemicals. The agricultural extension variables influencing use of agro-chemicals by leaf vegetables farmers were availability of certain communication media, extension agents familiarity, relevance of subject matter, size of extension staff, size of audience, frequency of use of familiar teaching methods, farmers' satisfaction with extension information, perceived usefulness of extension information, perceived quality of extension staff and relative cost of the extension teaching methods. There is need for extension services to intensify efforts at visiting and training leaf vegetable farmers on the appropriate application techniques of agro-chemicals to their vegetables to minimize the hazardous effects of the agro-chemicals on farmers' health and the environment and consequently increase productivity and farm income.*

Keywords--- Extension services, leaf vegetables, farmers, agro-chemicals, Imo State.
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1. INTRODUCTION

Nigeria's agricultural development policies and programmes aim at the provision of adequate food for the rapidly increasing population, raw materials for the growing industries and gainful employment for the large turn-out of young school leavers (Ohajianya and Onu, 2004). Vegetable production, due to its numerous products, varied by-products and economic importance has assumed great significance towards the achievement of these policy objectives. Vegetables are the most important ingredients of human diets for the maintenance of good health and prevention of diseases (Funmilayo *et al.,* 2016). Cultivation of vegetables is an excellent source of employment for both rural and urban dwellers as it takes place in many rural areas and outskirts of towns and cities in the form of market and backyard gardening to supply fresh produce to urban markets (Mustapha, 2020; Afari-sela *et al.,* 2015). It plays an important socioeconomic role as well as in diversifying diets for improved nutrition (Ntow *et al.,* 2006; Mathews, 2008).

Labuza (1976) classified vegetables based on the part of the plant that is consumed into leaf or stem vegetables (spinach, lettuce, water leaf, bitter leaf, cabbage, and fluted pumpkin), root vegetables (carrot, beets, turnips, sweet potato and onions), seed bearing fruit vegetables(tomatoes, cucumber, pepper and water melon), legume vegetables (pears and beans). Leaf vegetables which have softer tissues and easily deteriorate due to their high water content are the focus of this study. Leaf vegetables are generally susceptible to a wide range of pests and diseases and these are major constrains to the leaf vegetable production in Imo State in particular and Nigeria generally and therefore require intensive effort in their management (Maisamari, 2001). The increased demand for food, particularly to feed the growing population in Nigeria has necessitated an expansion and intensification of agriculture and horticulture and a concomitant increase in the use of synthetic agro-chemicals for food production, particularly for the production of high value cash crops and vegetables (Jamata *et al.,* 2013). However, these agro-chemicals are often applied indiscriminately and inappropriately, resulting in adverse environmental and health effects. Agro-chemicals refers to the broad range of pesticides and insecticides including fertilizers, hormones, herbicides, fungicides and other growth chemicals and concentrate stores of raw animal manure (Ngowil *et al.,* 2007). Despite the health hazards and environmental issues associated with the use of agro-chemicals, government promotes the use of agro-chemicals in order to achieve national food security and improve the production of export crops.

The government achieves this promotion through the agricultural extension services charged with disseminating appropriate knowledge and technologies on application of agro-chemicals to farmers. Leaf vegetables farmers in Imo State have been provided with extension services by the state Agricultural Development Programme (ADP) through their resident extension agents and there is dearth of information on the effects of the extension services on leaf vegetables farmers' use of the agro-chemicals. The few previous studies on agro-chemicals use on vegetables production (Mustapha, 2020; Afari-seta *et al.,* 2015; Ngowil *et al.,* 2007; Ntow *et al.,* 2006) did not consider the effects of agricultural extension services on the use of the agro-chemicals and none of those studies was conducted in Imo State, Nigeria, thereby leaving a gap in knowledge which this study intends to fill. The broad objective of this study is to analyze the effects of agricultural extension services on leaf vegetables farmers' use of agro-chemicals in Imo State, Nigeria. The specific objectives of the study were; describe the socioeconomic characteristics of leaf vegetable farmers that use agro-chemicals in the study area, ascertain the role of extension services on use of agro-chemicals by leaf vegetable farmers, ascertain the sources of information on the use of agro-chemicals among leaf vegetable farmers, determine the influence of extension services on agro-chemicals use by leaf vegetable farmers and determine the extension variables influencing use of agro-chemicals by leaf vegetables farmers in the study area.

2. MATERIALS AND METHODS

Study area
The study was conducted in Imo State. The state is bounded in the North by Anambra State, in the East by Abia State and in the south by Rivers state. The state Lies between latitudes 5° 10' and 6° 35' North of the equator, and between longitudes 6° 35' and 7° 35' East of the Greenwich meridian (NAERLS, 2015). The state comprises three agricultural zones namely; Owerri, Orlu and Okigwe. The three agricultural zones were sub-divided into 27 Local Government Areas (LGAs) with various communities and villages. Imo state covers an area of 5100 sq.km with a population of about 3934 million people (NPC, 2006). Agriculture is the major occupation of the people of the state. The ecological zone favours the growing of vegetables, roots, tubers, cereals and nuts which are majorly cultivated by small scale farmers. The extension services in the state disseminate information on use and benefits of agro-chemicals as well as the health hazards and environmental issues associated with agro-chemicals to the leaf vegetable farmers.

Sampling and data collection
A multi-stage sampling technique was employed for this study. In the first stage, two LGAs were purposively selected from each agricultural zone to make a total of six LGAs. The LGAs selected were Owerri North and Owerri west from owerri agricultural zone, Ihitte uboma and obowo LGAs from Okigwe agricultural zone, and orlu and Njaba LGAs from Orlu agricultural zone. These LGAs were purposively selected based on leaf vegetables production performance and use of agro-chemicals by leaf vegetable farmers as recorded by the state extension services. In the second stage, two communities were randomly selected from each LGA making a total of 12 communities sampled. In the third stage, the list of 189 registered leaf vegetable farmers that use the agro-chemicals were selected from the resident Agricultural Extension Agents to obtain the sample size of 128 for the study. The sample size model is stated as follows;

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

Where;

n=Sample size of the study, N= total sampling frame, e= tolerable error level (0.05)

From this sampling frame, proportionate and simple random sampling techniques were employed to obtain the sample size of 128 leaf vegetable farmers. Extension agents were recruited and trained to serve as field enumerators and assist in data collection. Data collected were through primary sources, using well-structured questionnaire alongside personal observations. The questionnaires were administered to the farmers for the year 2021 cropping season. Data were collected on variables such as age, sex, marital status, level of education, farming experience, household size, access to credit, membership of co-operative, farm income, off-farm income, use of agro-chemicals, role of extension services, distance of extension office to farmers' home, etc.

Analytical procedure
Descriptive statistics such as mean, frequency distribution and percentages as well as econometric models of bivariate regression analysis and logistic regression analysis were used to analyze data. The description of socioeconomic characteristics of farmers, ascertaining the role of extension services on use of agro-chemicals and ascertaining the sources of information on the use of agro-chemicals were realized using descriptive statistics. The influence of extension services on agro-chemicals use by leaf vegetables farmers was determined using bivariate regression analysis.

The bivariate regression model is implicitly specified as;

$Y=f(x, e)$ . . . (2)

Where, Y= Level of use of agro-chemicals by leaf vegetable farmers measured on a 3-point likert type scale of low level of use =1, moderate level of use=2 and high level of use=3), X= Extension contact (number of visits per annum), e= Error term.

Four functional forms of the Ordinary Least Squares (OLS) bivariate regression models were fitted to determine the lead equation based on having the highest value of coefficient of determination (r^2), F-value and level of significance of variable coefficient. The agricultural extension variables influencing use of ago-chemicals by leaf vegetable farmers were determined with a multivariate logistic regression analysis. The logistic regression model which derives its name from the logistic probability function (Gujarati, 1998) expresses the qualitative dependent variable which in this study is dichotomous as a function of several independent variables, both qualitative and quantitative (Fox, 1984). Te logistic regression model employed in the analysis is specified as follows;

$$\text{Ln } Y = \text{Ln } \left(\frac{P}{(1-P)}\right)$$

$$\text{Ln } \left(\frac{P}{(1-P)}\right) = bo + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8x_8 + b_9X_9 + b1_0X_{10} + e . \quad . \qquad .(4)$$

Where, Y= use of Agro-chemicals (Dummy variable; high level of use of agro-chemicals =1, low level of use of agro-chemicals =0, P= Probability of use of agro-chemicals, Ln=natural logarithm function,bo= constant term, b_1-b_{10}= logistic regression coefficients, X_1= Availability of certain communication media (Dummy variable; 1 if certain communication media are available, 0 if otherwise), X_2= Extension Agent's familiarity (Dummy variable; 1 if the extension agents are familiar with the area, 0 if otherwise), X_3= Relevance of subject matter (Dummy variable, 1 if subject matter is relevant, 0 if otherwise), X_4= Size of extension staff (Number of extension staff), X_5=Size of audience (number of audience), X_6= Frequency of use of familiar extension teaching methods (number of times familiar extension methods are used per month), X_7= Farmers' satisfaction with extension information (Dummy variable, 1 if the farmers are satisfied, 0 if otherwise), X_8= Perceived usefulness of extension information (Dummy variable, 1 if perceived useful, 0 if otherwise), X_9= Perceived quality of extension staff (Dummy variable, 1 if perceived quality is high, 0 if otherwise), X_{10} = Relative cost of the extension teaching method (₦),e= stochastic error term. Since P is the probability of high level of use of agro-chemicals by leaf vegetables farmers and (1-P) is the probability of low-use of agro-chemicals by leaf vegetables farmers, the ratio $\left(\frac{P}{(1-P)}\right)$, known as the odds ratio is the odds in favor of high level of use of agro-chemicals by leaf vegetables farmers. The natural log of the odds ratio is called the logit and therefore, the model is called the logit model which is estimated through the method of maximum likelihood since we have data on individual observations (Gujarati, 1998). For this model, the usual R-squared (R^2) is not a reliable measure of

goodness of fit and it is not suited for the dichotomous dependent variable models, but rather the model gives a chi-square value in place of R^2 (Gujarati, 1998; Ohajianya, 2004).

3. RESULTS AND DISCUSION

A. Socioeconomic Characteristics of Respondents

The mean statistics of leaf vegetables farmers that use agro-chemicals in the study area are presented in Table 1. The table shows that on the average, typical leaf vegetable farmers that use agro-chemicals is 42.36 years old with 9.15 years of education. 15.22 years of leaf vegetables farming experience and average farm size of 0.79 hectare. The mean household size was 9 persons with an average annual farm income of ₦ 616, 339, annual off- farm income of ₦ 153, 106, extension contact of 0.92 visit and mean output value of ₦ 419, 827 per annum.

B. Role of Extension Services In Leaf Vegetables Farmers Use Of Agro-chemicals

The distribution of leaf vegetables farmers using agro-chemicals by their perceived role of extension services in the study area is presented in table 2.

Table 1: Mean Socioeconomic Characteristics of Leaf Vegetables Farmers using Agro-chemicals in Imo state, Nigeria

Socioeconomic characteristic	Mean value
Age (years)	42.36
Level of education (years)	9.15
Farming experience (years)	15.22
Farm size (Ha)	0.79
Household size (Number of persons)	9
Annual farm income (₦)	616,339
Annual off-farm income (₦)	153,106
Extension contacts (Number of visits per annum)	0.92
Value of Output (₦)	419,827

Source: Field Data, 2021

The table indicates that majority (79.7%, 75%, 71.1%, 65.6%, and 64.8%) of the leaf vegetables farmers perceived the role of extension services in the study area as acts as catalyst to speed up adoption rate, technology transfer, provides sources of information, demonstrates technologies to farmers and organizes farmers groups respectively.

Table 2: Distribution of leaf vegetables farmers using agro-chemicals by their perceived role of extension services (n=128)

Perceived role of Extension Services	Frequency	Percentage
Organizes farmers groups	83	64.8
Provides sources of information	91	71.1
Acts as catalyst to speed up adoption rate	102	79.7
Demonstrates technologies to farmers	84	65.6
Identifies farmers problems	39	30.5
Technology transfer	96	75.0
Community development	45	35.2
Improves skills and knowledge	50	39.1
Facilitates access to markets	38	29.7
Discourages farmers from discontinuing the diffusion process	25	19.5

*Multiple response were recorded.

Source: Field Data, 2021.

Also, other perceived roles of extension services were improved skills and knowledge, community development, identifies farmers problems, facilitates access to markets and discourages farmers from discontinuing the diffusion process as reported by 39.1%, 35.2%, 30.5%, 29.7% and 19.5% of the leaf vegetables farmers respectively. This finding agrees with those of Gideon *et al.,* (2018) on Agricultural extension and its effects on farm productivity and income in Northern Ghana.

C. Sources of Information on Use of Agro-chemicals by Leaf Vegetables Farmers

The distribution of leaf vegetables farmers using agro-chemicals by sources of information on use of agro-chemicals is presented in Table 3.

Table 3: Distribution of leaf vegetable farmers using agro-chemicals by sources of information on use of agro-chemicals in Imo state, Nigeria (n=128)

Sources of information	Frequency*	Percentage
Agricultural extension agents	81	63.3
Co-operative society	53	41.4
Fellow farmers	128	100
Vegetables farmers association	103	80.5
Ministry of Agriculture	46	35.9
Extension Bulletin	37	28.9
Radio programme	51	39.8
Television Programme	43	33.6
Traders on vegetables	96	75.0
Relatives and Friends	84	65.6
Extension newsletters	33	25.8

*Multiple response were recorded.

Source: Field Data, 2021.

The table shows that the major sources of information to the leaf vegetable farmers using agro-chemicals as reported by 100%, 80.5%, 75%, 65.6% and 63.3% of the respondents were fellow farmers, vegetables farmers association, traders on vegetables, relatives and friends and agricultural extension agents respectively. Other sources of information available to the leaf vegetables farmers as reported by 41.4%, 39.8%, 35.9%, 33.6%, 28.9% and 25.8% of the leaf vegetables farmers were co-operative society, radio programme, ministry of agriculture, television programme, extension bulletin and newsletters respectively. This result implies that the contribution of extension services as a source of information to leaf vegetables farmers using agro-chemicals was very poor in the study area. The informal information sources performed better than the formal sources of information in the study area. This finding is consistent with those of Oluwalana *et al.,* (2019) on effects of agricultural extension services on vegetables farmers in Osun State and Odebode (2008) on appropriate technology for cassava processing in Nigeria.

D. Influence of Extension Services on Agro-chemicals Use by Leaf Vegetables Farmers

To determine the influence of extension services on use of agro-chemicals by leaf vegetable farmers, the ordinary least squares (OLS) bivariate regression model was used. Results of the functional forms of the model, linear, semi-log, double-log and exponential are presented in table 4.

The table shows that the double-log function produced the highest value of r^2, highest F-value and highest variable significance. Therefore the double-log function was selected as the lead equation and its results were used for discussion. The value of r^2 was 0.8526, indicating that about 85% of the variation in level of use of agro-chemicals by leaf vegetable farmers was accounted for by the extension services. The F-value was 728.718 which was significant at 1% level, indicating that the double-log function gave a good fit to the data fitted to the double-log function. The co-efficient of extension service was positive and significant at 1% level, which implies that extension service directly influenced level of use of agro-chemicals by leaf vegetables farmers in the study area. This result further implies that as the activities on roles of extension services increase, the level of use of agro-chemicals by leaf vegetable farmers equally increases.

E. Agricultural Extension Variables Influencing Use of Agro-chemicals by Leaf Vegetables Farmers in Imo State, Nigeria.

Table 4: Results of four functional forms of bivariate regression on influence of extension services on agro-chemicals use by leaf vegetables farmers in Imo State, Nigeria

Explanatory Variable	Linear function	Semi-log function	Double-Log function	Exponential Function
Constant term	153.042	139.116	106.327	95.098
Extension Contact(X)	13.539 (2.465)**	4.307 (1.843)	0.084 (4.559)*	0.007 (3.158)*
r^2	0.4833	0.3926	0.8526	0.7134
F-value	117.878*	81.452*	728.718*	259.418*
Sample Size (n)	128	128	128	128

Figures in parenthesis are t-ratios
**Significant at 5% level
*Significant at 1% level
Source: Field Data, 2021.

Firstly, tests were carried out to check the presence of any multicollinearity between the independent explanatory variables. Results of the tests showed no such presence of multicollinearity. Consequently, all the explanatory variables were entered and the equation fitting the logit regression equation was estimated. The results are presented in Table 5.

The table shows that the variables related to extension agents familiarity (X_2), size of extension staff (X_4), size of audience (X_5), frequency of use of familiar teaching methods (X_6), farmers' satisfaction with extension information (X_7), perceived usefulness of extension information (X_8) and relative cost of the extension teaching method (X_{10}) were found to be significant at 0.01 level, while the coefficients of availability of certain communication media (X_1) and perceived quality of extension staff (X_9) were found to be significant at 0.05 level, implying that these variables are agricultural extension variables influencing use of agro-chemicals by leaf vegetable farmers in Imo State Nigeria. The coefficient of availability of certain communication media was positive and significant. This direct relationship with use of agro-chemicals imply that increases in the probability of availability of certain communication media would lead to probability of increased use of agro chemicals by leaf vegetable farmers.

Coefficient of extension agents' familiarity was positive and significant, implying that increases in the probability of extension agents' familiarity would lead to probability of increases in use of agro-chemicals by leaf vegetable farmers. Relevance of subject matter was positive and significant suggesting that the higher the probability of relevance of subject matter the higher would be the probability of use of agro-chemicals by leaf vegetable farmers.

Size of extension staff emerged with positive and significant coefficient, which implies that increases in the probability of having more extension staff would lead to probability of increases in use of agro-chemicals by leaf vegetables farmers. The coefficient of size of audience was negative and significant, implying that increases in the probability of having more audience would lead to decrease in the probability of use of agro-chemicals by leaf vegetable farmers.
Frequency of use of familiar teaching methods was positive and significant, implying that increases in the probability of use of familiar teaching methods would lead to increases in the probability of use of agro-chemicals by leaf vegetable farmers. Farmers' satisfaction with extension information was positive and significant, which implies that increases in probability of farmers' satisfaction with extension information would lead to increases in probability of use of agro-chemicals by leaf vegetable farmers. The coefficient of perceived usefulness of extension information was positive and significant, implying that the higher the probability of perceived usefulness of extension information would lead to increases in probability of higher use of agro-chemicals by leaf vegetable farmers. Perceived quality of extension staff was positive and significant, suggesting that

the higher the probability of perceived quality of extension staff would lead to higher probability of use of agro-chemicals by leaf vegetable farmers. The coefficient of relative cost of the extension teaching methods was negative and significant; indicating that increases in the relative cost of the extension teaching methods would lead to decreases in the probability of use of agro-chemicals by leaf vegetables farmers in the study area.

Table 5. Estimate of the influence of agricultural extension variables on use of agro-chemicals by leaf vegetable farmers in Imo State, Nigeria.

Explanatory Variables and important statistics	Logit Regression Coefficients	t-ratio
Constant term	-16.039	-4.103*
Availability of certain communication media (X_1)	0.074	2.555**
Extension agents familiarity (X_2)	0.066	2.814*
Relevance of subject matter(X_3)	0.042	3.115**
Size of extension staff (X_4)	0.268	3.483*
Size of audience (X_5)	-0.312	-3.188*
Frequency of use of familiar teaching methods (X_6)	0.374	4.091*
Farmers' satisfaction with extension information (X_7)	0.053	3.044*
Perceived usefulness of extension information (X_8)	0.049	3.106*
Perceived quality of extension staff (X_9)	0.078	2.513**
Relative cost of the extension teaching methods (X_{10})	-0.063	-3.192*
Chi-square	103.294	4.264*
Sample size (n)	128	

** Significant at 0.05 level
*significant at 0.01 level
Source: computed from field data, 2021

The Chi-square value of 103.294 was significant at 0.01 level, implying that the logit model gave a good fit to the data fitted to the model.
The findings of this study are similar to those of Amanze *et al.,* (2010) on factors influencing the use of fertilizers in arable crop production among small holder farmers in Imo State.

4. CONCLUSION AND RECOMMENDATIONS

This study was designed to analyze the effects of agricultural extension services on leaf vegetable farmers in Imo State, Nigeria. The findings of the study show that the major roles of extension services in farmers' use of agro-chemicals for leaf vegetables production were acting as catalyst to speed up adoption rate, technology transfer and source of information. The major sources of information to the leaf vegetable farmers on agro-chemicals use were fellow farmers, vegetables farmers association and traders on vegetables. The informal information sources performed better than the formal sources of information. Extension services positively and significantly influenced leaf vegetables farmers use of agro-chemicals. The agricultural extension variables influencing use of agro-chemicals by leaf vegetable farmers were availability of certain communication media, extension agents familiarity, relevance of subject matter, size of extension staff, size of audience, frequency of use of familiar teaching methods, farmers' satisfaction with extension information, perceived usefulness of extension information, perceived quality of extension information, perceived quality of extension staff and relative cost of the extension teaching methods.
There is need for extension services to intensify efforts at visiting and training leaf vegetables farmers' on the appropriate application techniques of agro-chemicals to their vegetables to minimize the hazardous effects of the agro-chemicals on farmers' health and the environment and consequently increase productivity and farm income. This can be achieved through making the formal information sources such as extension bulletin, newsletters and extension more effective. The extension variables influencing leaf vegetables farmers' use of agro-chemicals should be given adequate consideration in making policies and planning programmes aimed at increasing the production of leaf vegetables with use of agro-chemicals.

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