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AN ASSESSMENT OF INDIGENOUS KNOWLEDGE SYSTEM OF PEST CONTROL AND TECHNICAL EFFICIENCY OF VEGETABLE PRODUCTION IN OSUN STATE, NIGERIA

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Abstract

Indigenous Knowledge System (IKS) of Pest Control is an eco-friendly, cost effective and culturally accepted method of controlling pests and diseases. The study assessed the Indigenous Knowledge System (IKS) of Pest Control on Technical Efficiency of Vegetable Production in Osun State, Nigeria. A structured questionnaire was used to elicit information from 240 farmers across the state. The data collected were analyzed using Descriptive Statistics, Stochastic Frontier Analysis and Ordinary Least Square Regression Analysis. Result of analysis revealed the major indigenous knowledge used for pests and diseases control by the vegetable farmers were early harvesting (71.32%), removal of affected plants (62.80%), use of ash and water mixture (60.74%) and mixture of red pepper with water (41.09%). The average technical efficiency of farms using only IKS for pest and disease control was 0.78 while farms using a combination of IKS and pesticide had the highest average technical efficiency of 0.94. The technical efficiency of vegetable production in the study area is significantly affected by farm experience, usage of IKS, level of farmer's education and access to extension agent. The study concluded that the usage of Indigenous Knowledge System for pest control in vegetable production increased the technical efficiency of the farmers in the study area. The study however, recommends that there should be increase in the sensitization of farmers by government and non-governmental agencies on the economic benefits of indigenous knowledge system on pest control in order to boost productivity and efficiency of food production.

Key words**:** *efficiency, education, vegetable, farmers*

INTRODUCTION

Vegetable production is a major means of sustenance to the rural poor and even the people in the urban and peri-urban areas of Nigeria especially those who are unemployed [2]; but the production has been constrained by various forms of pests and diseases that includes insect pest and pathogens resulting to crop losses. Currently, the use of pesticides for the management and control of pests and pathogens is becoming more rampant.

Conversely, challenges encountered include resistance of insect pest and pathogen to the pesticides, requirement of repeated applications, increase in the cost of chemicals have given the drive to other methods for managing insect-pests and plant diseases. The use of chemicals for pest control usually leads to food poisoning, soil, water and environmental pollution as they create environmental imbalance and let insect-pest build up resistance, also emergence of new pests that were either non-existent or present as minor pest, degradation of arable land to the extent of unfit for cultivation and overall ill effects to human health as well as declining productivity due to barren and infertile lands caused by excessive use of chemicals [4]. It is as a result of the challenges faced in the use of chemicals for controlling pests in vegetable production that indigenous knowledge system (IKS) associated with plant protection in agriculture becomes important.

Indigenous knowledge system (IKS) are the local knowledge that is exclusive to a given culture or society, it is the basis for local-level decision-making in agriculture, natural resource management, health care, food preparation and several other activities in rural communities [1, 8]. The knowledge system are generally not established in written form and is passed on from generation to generation through word of mouth and have been well employed for enhancing and conservation of natural resources [5]. It involves the use of no or little use of chemicals because of the farmer's eco-friendly attitude; it has cost effectiveness, additional advantages, results in reduced insect pest and disease occurrence in crops, and leads to long-term sustainability of soil and crop productivity [9].

Although, owing to the usage of pesticides, vegetable farmers have been able to increase their productivity to a large extent. Nevertheless, the use of chemical methods in the management of pests and diseases especially the excessive usage have led to severe dangers such as environmental pollution, adverse effects on the health of consumers and causing the death of non-target organisms. Towards reducing and prevailing over these adverse effects, the vegetable farmers are moving back to applying indigenous knowledge system to manage pests and diseases. As a result, this study seeks to assess indigenous knowledge system of pest control and technical efficiency in vegetable production in Osun State, Nigeria. The specific objectives of the study are to:

(i) identify the socio-economic characteristics of respondents;

(ii)identify the indigenous knowledge system practiced by farmers in controlling pests and diseases;

(iii)determine the technical efficiency of vegetable production;

(iv)examine the effect of indigenous knowledge system on technical efficiency of vegetable production.

MATERIALS AND METHODS

Study Area

The study was carried out in Osun State, Nigeria. It has thirty (30) local government areas (LGA) which was further divided into three agricultural zones and the capital of the state is in Osogbo. It lies on latitude 8° and longitude 6° to the North and South respectively; also it is marked by longitude 4° to the west and longitude 5° to the east [6]. It has tropical climate with distinct wet and dry seasons; and rich soil that supports crops and livestock production. The rainy season is usually between April and October, while the dry season is between November and March. The annual average temperature ranges between 21.1 and 31.1°C and the annual rainfall is within the range of 1,000mm and 1,200mm in the derived savannah and rainforest belt respectively [7]. The major economic activities of the people is centered around crop and livestock farming, trading, and artisanship while the main crops produced are palm oil and kernels, yam, cassava, maize, vegetables, plantain, banana and kola nuts [6].

Data and Sampling procedure

Primary data which was used for the study was collected using a structured questionnaire. The population for the study was the vegetable farmers in the state. A two staged sampling technique was employed in selecting the respondents. The first stage was the random selection of four communities from each zone making a total of twelve communities from all the zones using the Agricultural Development Project (ADP) communities listing in the state. The second stage was the random selection of twenty vegetable farmers in each community selected to make a total of 240 respondents which were sampled for the study but only 232 responses were found useful for the study.

Analytical Techniques

Data collected were analyzed using descriptive statistics, stochastic production frontier and ordinary least square regression model.

Descriptive statistics

Descriptive statistics which includes frequency, percentage and tabulation, use of central tendency and dispersion was used to capture the socio-economic characteristics of the vegetable farmers and identify the indigenous knowledge system practices in controlling pests and diseases.

Stochastic production frontier

Stochastic production frontier was used to estimate the technical efficiency indices of vegetable production and was specified using Cobb-Douglas production function following the study by [10]. The model implicit form is given as:

$$TEi = Yi/Yi^* = f(Xi;\beta) \exp(Vi - \mu i)/f(Xi;\beta)$$
$$\exp V = \exp(-\mu i)$$

where:
Yi: Observed output;
Yi*: Frontier output;
TE: Ranges between 0 and 1
while, the explicit form is specified as:

$$\ln Y = \beta_o + \beta_I \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + (V_i - U_i)$$

where:
ln = Natural logarithms;
Y = Output of vegetable farms (kilogram);
Y = Output of vegetable farm (kilogram grain equivalent);
X_1 = farm size (hectares);
X_2 = labour (mandays);
X_3 = quantity of fertilizer (kilograms);
X_4 = quantity of pesticides (litres);
X_5 = quantity of seeds (kilograms);
X_6 = quantity of water used for irrigation ($HaCm^3$);
β_I- β_6 = Production function parameters to be estimated;
B_0 = intercept, U_i = negative random error assumed to account for errors in technical efficiency, it is assumed to be half normally distributed $U_i \sim N(0, \delta^2 u)$ and ranges between zero and one;
V_i = stochastic error term which has zero mean and accounts for measurement errors and random factors beyond the farmers control, it is assumed to be a normally distributed random variable $N \sim (0,\delta^2 v)$.
U_i and V_i are assumed to be independent of each other. The technical efficiency indices were obtained using the FRONTIER 4.1 programme.

Ordinary least square (OLS) regression model

OLS regression model was used to examine the effect of indigenous knowledge system on technical efficiency of vegetable production. It was used due to it normality assumption for error term (ei), and its estimator is said to be normally distributed, best, and unbiased linear estimator [3]. The model is specified implicitly as:

$$Y = f(X_7, X_8, X_9 \ldots\ldots X_{15} + ei)$$

and explicitly as:

$$Y = \alpha + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \ldots\ldots + \beta_{15} X_{15} + ei$$

where:
α = intercept;
Y = Technical efficiency of vegetable farms;
β_7-β_{15} = regression coefficient;
ei =error term designed to capture the effects of unspecified variables in the model;
X_7 = gender of farmer (binary variable: 1 = male, 0 = female);
X_8 = Age (years);
X_9 = household size (adult equivalent);
X_{10} = farm income (Naira);
X_{11} = farming experience (years);
X_{12} = educational level;
X_{13} = access to extension services (binary variable: yes = 1, no = 0);
X_{14} = access to credit (binary variable: yes =1, no = 0);
X_{15} = IKS usage (binary variable: yes = 1, no = 0).

RESULTS AND DISCUSSIONS

Socio-Economic Characteristics of Farmers

Table 1 shows that about 95 percent of the farmers were female and most (90%) of them were married.

The modal age range is 41- 49 years while the average age of the household heads was 44 years. This is an indication that majority of the farmers in the study area are in their middle age and still active.

About 70% of the farmers have no formal education. The average farming experience of the farmers in vegetable production is

12years. This shows that the farmers were well experienced in vegetable production. The average farm size of the farmers in the study area was 1.4 ha with the modal class of farm size being (<2.0) ha.

This suggests that majority of the vegetable farmers in the study area are small scale farmers with farm size less than 2ha. The table also revealed that 55.60% employed indigenous knowledge practices in the control of pests and diseases of vegetable while the remaining 44.40% do not.

Table 1. Socio-Economic Characteristics of the Farmers (n=232)

Characteristics	Frequency	Percentage
Sex		
Male	11	04.74
Female	221	95.26
Age		
< 30	19	08.19
30-39	65	28.02
40-49	101	43.54
50-59	31	13.36
>60	16	06.89
Educational Level		
No Formal	164	70.69
Primary	38	16.38
Secondary	30	12.93
Tertiary	00	00.00
Marital Status		
Single	21	9.05
Married	132	56.89
Widowed	79	34.06
Farm Size		
<2.0 hectare	196	84.48
2.0-4.0	35	15.09
>4.0	01	0.43
Farming		
Experience	38	16.38
<5	78	33.62
5-10	49	21.12
11-16	64	27.59
16-21	03	1.29
>22		
Usage of IKS		
Yes	129	55.60
No	103	44.40
Extension Visits		
Yes	56	24.14
No	176	75.86

Source: Field Survey, 2020.

Indigenous Knowledge System Practiced in Controlling Pest and Diseases in Vegetable Production

Table 2 shows that the major indigenous knowledge used for pests and diseases control by the vegetable farmers were early harvesting (71.32%), removal of affected plants (62.80%), use of ash and water mixture (60.74%), mixture of red pepper with water (41.09%) etc.

Table 2. Distribution of Vegetable Farmers according to the Indigenous Knowledge System Practices used

Indigenous Materials used for field pest	Frequency (n=129)	Percentage
Mixture of Wood Ash and water	78	60.47
Mixture of Red Pepper with water	53	41.09
Mixture of Ginger with water	50	38.76
Crop Rotation	46	35.66
Neem seed	43	30.01
Cassava Slurry	32	24.81
Early harvesting	92	71.32
Removal of affected plants	81	62.80
Locust Bean soaked in water	41	31.78

Source: Field Survey, 2020.

Technical Efficiency of Vegetable Production under Orthodox and Indigenous Knowledge System (IKS) of Pests and Diseases Control Methods

Table 3 shows the summary of technical efficiency indices of vegetable farms in the study area.

The technical efficiency of farms that solely use IKS ranged from 0.30 to 0.99 with an average technical efficiency of 0.78.

Meanwhile the technical efficiency of farms that use only pesticide for the control of pest ranged from 0.60 to 0.99 with an average of 0.88.

The technical efficiency of farms using a combination of IKS and pesticide had the highest average technical efficiency of 0.94.

Table 3. Distribution of Vegetable Farmers by Level of Technical Efficiency

Efficiency Level	IKS Sole Users		Pesticides Sole Users		Users of both IKS and Pesticide	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0.10-0.19	00	0.00	00	0.00	01	1.49
0.20-029	00	0.00	00	0.00	00	0.00
0.30-0.39	06	9.68	00	0.00	00	0.00
0.40-0.49	01	1.61	00	0.00	00	0.00
0.50-0.59	02	4.84	00	0.00	00	0.00
0.60-0.69	07	11.29	10	9.71	00	0.00
0.70-0.79	23	37.10	06	5.83	06	8.96
0.80-0.89	08	12.90	41	39.81	13	19.40
0.90-0.99	15	24.19	46	44.66	47	70.15
Sample	62	100.00	103	100.00	67	100.00

Source: Field Survey, 2020.

Effect of Indigenous Knowledge System of Pest and Disease control on Technical Efficiency of Vegetable Production in the Study Area

The result as shown in Table 4 reveals that technical efficiency of vegetable production in the study area is significantly affected by farm experience, usage of IKS, level of farmer's education and access to extension agent.

The coefficient of farm experience was positive and significant at 1%, which implies that the higher the experience of a farmer in vegetable production the more their technical efficiency.

The coefficient of usage of IKS was also found to be positive and significant at 1% implying that farmers who use the Indigenous pest control methods have higher technical efficiency in the vegetable production.

The coefficient of the level of education of a farmer was positive and significant at 1% which implies that increasing the level of a farmer's education will improve his/her technical efficiency of vegetable production.

The coefficient of access to extension was positive and significant at 1%, implying that an increase in the number of extension visit will improve the technical efficiency of vegetable production.

The coefficient of determination (R^2) shows that the explanatory variables explain about 56.12% of the variations in the factors influencing the technical efficiency of vegetable production leaving about 43.78% unexplained.

Variables such as Gender, age, household size, farm size, access to credit and farm income were not significant in explaining the factors influencing the technical efficiency of vegetable production in the study area.

Table 4. Ordinary Least Square Regression Result for Effect of IKS on Technical Efficiency of Vegetable Production in the Study Area

Variables	**Coefficient**	**t-value**
Gender	0.541	0.916
Age Household Size	1.125 -0.987	2.892 -0.241
Level of Education	0.981***	3.960
Usage of IKS	0.678***	2.925
Farming Experience	0.231***	2.921
Farm Size Access to Extension Service	-0.985 -0.421***	-0.500 -2.722
Farm Income	-0.420	0.312
Access to credit	0.752	0.512
Constant	3.987***	-2.811

***Significant at 1%
Number of observation = 232; LR chi^2 (9) = 71.30; Prob> chi^2 = 0.0000;
Log likelihood = -91.21901 and Pseudo R^2 = 0.5612
Source: Field survey, 2020.

CONCLUSIONS

The study concluded that the usage of Indigenous Knowledge System for pest control in vegetable production increased the technical efficiency of the farmers in the study area.

As vegetable farms that used a combination of both systems of pest control had the highest efficiency in the vegetable production. However, the study recommends that in order to boost the efficiency of vegetable production there should be increase in the sensitization of farmers by government and non governmental agencies on the economic benefits of indigenous knowledge system on pest control in order to boost productivity and efficiency of food production.

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