Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 21, Issue 3, 2021
PRINT ISSN 2284-7995, E-ISSN 2285-3952

DETERMINANTS OF LABOUR PRODUCTIVITY IN SMALL SCALE WATERLEAF PRODUCTION IN AKWA IBOM STATE, SOUTH-SOUTH REGION OF NIGERIA

Sunday Brownson AKPAN

Akwa Ibom State University, Department of Agricultural Economics and Extension, Mkpat Enin, Akwa Ibom, Nigeria, Email: sundayakpan@aksu.edu.ng

Corresponding author: sundayakpan@aksu.edu.ng

Abstract

The study modelled the labour productivity equation for waterleaf farmers in the Uyo agricultural zone of Akwa Ibom State, south-south region of Nigeria. Four hundred and twenty (420) waterleaf farmers were randomly selected for the study. A structured questionnaire was used to collect data, and a multiple linear regression model based on Ordinary Least Squares estimation technique was specified and estimated. The explanatory variables used were derived from an in-depth reviewed of related literature and observed characteristics of the respondents. The empirical results revealed that; farmers' marital status, education, household size, farming experience, access to extension services, quantity of waterleaf stems planted and the amount of credit collected as loans were positive determinants of labour productivity in the waterleaf production enterprise. On the contrary, farm size, quantity of manure used and non-farm income were identified as negative determinants of labour productivity in waterleaf production in the zone. Based on the results, it is recommended that, improved education of waterleaf farmers, provision of fertilizer subsidy and provision of quality planting materials should be considered when developing any policy framework for labour productivity of vegetable farmers in the State.

Key words*: *waterleaf, farmers, labour, productivity, Akwa Ibom State

INTRODUCTION

Waterleaf (*Talinum fruticosum* or *Talinum triangulare*) is one of the popular vegetables grown in the south-south region of Nigeria [14, 1, 2, 4]. The crop is the most preferable softener in most of the fibrous vegetable delegacies in the Southern region of Nigeria. The popularity of waterleaf in the region is also associated with its affordability, the low cost per unit of resource utilization in production, short gestation period and quick returns on invested capital compared to other vegetable and arable crop enterprises [7, 8, 33].

Currently, waterleaf is an important part of urban agriculture, and its production has become one of the most highly preferred livelihood activities among unemployed women in the peri-urban areas, urban and rural areas of the south-south region of Nigeria [32, 33, 23, 6, 34].

Sustained production of waterleaf in the southern region of Nigeria can only be achieved if farm inputs are readily available and utilized in an efficient manner. In this regards, rational farm resource allocation and utilization are prerequisites for attaining higher productivity in the vegetable production in the southern region of Nigeria. Productivity measures the quantity of outputs of a production process relative to the level of inputs. The more output resulting from a given level of input, the more productive the process and the farm factor(s) in consideration [10, 5, 4].

According to Udoh and Akpan [33], vegetables are among the staple food components in the world, and their production has continued to increase due to the increasing awareness of the nutritional value derivable from its consumption. Vegetables are good sources of protein, mineral salts, sugars, vitamins, and essential oils that increase man's resistance to disease [11]. Francisca *et al.*, [16] asserted that the increase in vegetable production, improved food security and have increased employment opportunities to many rural women in Nigeria. According to Kebede and Gan [21], one of the main sources of farm income for small and limited resource based farmers are basically arable crop production consisting of vegetable and non-vegetable crops.

Observing the increasing demand to sustain vegetable production and farm factor productivity, Hussian and Perera [20] noted that the agricultural productivity change is explained by such factors as climatic, agronomic and socioeconomic as well as farm management factors. Likewise, the need to increase food crop production and make food sufficient to the populace is one of the major challenges faced by the Nigerian government. Farmers in Nigeria are not getting maximum yields from resources devoted to their farm enterprises [26, 29, 3]. Factor productivity is crucial for the real income growth, and for improving economic well-being and quality of life, or at least its material aspects [22].

Ogbalubi and Wokocha [25] observed that the availability of labour which is one of the major farm resources has become a serious challenge to small scale farmers in the country. Deotti and Estuch [13] further stressed that the phenomenon is due to the fact that rural-urban migration has continued to prevail despite the presence of disguised unemployment in the urban areas. As noted by Gocowski and Oduwole [17], labour is a major constraint to peasant agricultural production in Nigeria especially during the periods of planting, weeding and harvesting. Following the persistent imbalance in the agricultural labour market, the majority of small scale farmers have resorted to family labours as the main source of farm labour [35]. With the changing needs of the farm families over time, relying on family labour for farm operations might not yield sustainable production. As reckoned by Omotesho *et al.* [28], the need for an alternative source of rarely efficient family labour is overwhelmingly necessary in order to meet the food security requirements of the country in the short and long-run periods. Hired labour, the alternative for family labour, has its own particular issues. For instance, the wage rate for hire labour is rising in some rural communities following increasing rural-urban migration and improvement in educational facilities [13]. The wage is gradually metamorphosing from a general prevailing rate to a more competitive bargaining rate in some rural farming communities in the region following inelastic demand for labour. Currently, labour availability and productivity are critical in sustaining waterleaf production in the southern region of Nigeria.

There are few empirical literature that focused on farm-specific labour productivity in arable crop production enterprises in developing countries. Available literature includes a cross country study conducted by Reardon *et al.*, [30] on the differences in patterns and determinants of farm productivity over agro-climatic zones in Burkina Faso, Rwanda, Senegal, and Zimbabwe. The findings showed that rates of growth in yields and returns per labour-day were low in the four countries studied. They also identified productivity determinants in the four countries to include fertilizers, improved seeds, animal traction, organic inputs and conservation investments. Other determinants were farm size and land tenure, non-cropping income and functioning input and output markets. In Nigeria, Okoye *et al.* [27] carried out a study to determine factors that affect farm-level labour productivity in smallholder cocoyam farms in Anambra State. The empirical results showed that the coefficients of fertilizer, cocoyam setts, capital and farmer’s experience were positively and significantly related to labour productivity at 5% probability level each. Contrary to the above results, farm size and household size had negative relationships with labour productivity in cocoyam farms. Similarly, Anyaegbunam *et al.,* [9] examined labour productivity among smallholder cassava farmers in the Southeast agro-ecological zone, Nigeria. The study found gender, household size and age of cassava farmers as the negative determinants of labour productivity. On the other hand, the quantity of fertilizer, the number of hired labour and land ownership were positive determinants. Omotesho *et al.*, [28] examined the relationship between hired labour use and food security among rural farming households in Kwara State, Nigeria. The results revealed that, the dependency ratio, age and educational qualification of the household head, total household size, and household income significantly influenced hired labour use among farming households. Also, Obike *et al.* [24] examined labour productivity and resource use efficiency amongst smallholder cocoa farmers in Abia State, Nigeria. The results showed that education, farming experience, and capital had positive influences on labour productivity while farm size related negatively.

It is noticed that some of the literature reviewed are old and needed to be updated to reflect the current realities. Also, vegetable crops have not been given fair concentration on the issue of labour productivity determinants in the country. Since the agronomical practices and requirements are not exactly the same for all crops, issues of labour productivity should be crop-specific. Furthermore, none of the studies were conducted in the south-south region of Nigeria. The region has peculiar characteristics such as increasing rural-urban migration, the presence of multinational companies that provide a juicy alternative to farm labours, increasing oil pollution or spillage, and water as well as soil erosion. Hence, special attention should be given to farm labour productivity to ensure sustained vegetable/arable crop production in the region.

Therefore, given the importance of vegetables in job creation, ensuring food self-sufficiency, and as food complements, this study specifically aimed at identifying non-wage factors that influence labour productivity in waterleaf enterprises in Akwa Ibom State, southern region of Nigeria.

MATERIALS AND METHODS

Study Area

The study was carried in Uyo agricultural zone in Akwa Ibom State, Nigeria. The State has six agricultural zones namely: Eket, Ikot Ekpene, Etinan, Uyo, Oron and Abak. Uyo Agricultural zone covers extension activities in Uyo, Ibesikpo Asutan, Itu, Uruan and Ibiono Ibom Local Government Areas. The region is basically agrarian in nature, and crops such as waterleaf, cassava, fluted pumpkin and garden egg are common. Others include cocoyam, maize, water yam, pepper, plantain, and cucumber. Some households grow cash crops such as oil palm, rubber, and cocoa.

Sources of Data, and Instrument for Data Collection

Primary data were used in the study. A structured questionnaire was designed in line with the objectives of the study, and was administered to the respondents, and complemented by personal interviews to ensure the consistency and accuracy of information collected.

Sample Size Selection

From Cochran [12], a representative sample size from a large population of waterleaf farmers in the study area was obtained using the equation (1) specified as thus:

$$S_n = \frac{z^2\rho(1-\rho)}{D^2} \dots\dots\dots\dots\dots\dots\dots.(1)$$

where:
S_n is the required sample size;
Z is the 95% confidence interval (1.96);
P is the expected proportion of waterleaf farmers in total farmers' population in the study area (about 85%);
D is the absolute error or precision at 5% type 1 error.
The sample size is derived as shown in equation 2.

$$S_n = \frac{(1.96)^2 0.85(1-\ 0.85)}{(0.05)^2} = 196 \dots\dots\dots\dots\dots.(2)$$

In order to have sufficient data for the specified regression model, the sample size was scaled up to five hundred.

Sampling Procedure and Sample Size

The multi-stage sampling technique was adopted in selecting respondents for the study. The first stage was the purposive selection of all the five local government areas in Uyo agricultural zone. The second stage was the random selection of five villages from each of the local government known for intensive waterleaf production. A total of twenty-five (25) villages from Uyo agricultural zone were used in the study. The third stage involved a random selection of twenty (20) waterleaf farmers from each of the villages selected, giving a total of five hundred (500) waterleaf farmers used in the study. However, after thorough screening of copies of the questionnaire returned, only four hundred and twenty (420) of them were found suitable to be used in the study.

Measuring the Labour Productivity of Vegetable farms

Partial factor productivity (PFP) in production economics is measured by the ratio of the total quantity of output to the total quantity of specific farm factor. That is:

$$PFP = \frac{total\ output\ of\ waterleaf\ (kg)}{total\ labour\ used\ (mandays)} \ldots.(3)$$

To correct for the variations in the number of hours worked by labour (household and hired labour) in each farm firm, the study conceptualized labour productivity (LPP) in monetary terms as:

$$LPP = \frac{Value\ of\ total\ output\ of\ waterleaf\ produced\ by\ a\ farmer}{Cost\ of\ labour\ used\ (total\ wage\ rate)} = \frac{\sum_{n=1}^{n} P_s Y_s}{\sum_{n=1}^{n} W_r L_t} \ldots \ldots \quad (4)$$

where: P_s is a market price of waterleaf, and Y_s is the total quantity of waterleaf produced and willingly offered to the market by a farmer, while W_r is the wage rate prevalence in the study area, and L_t is the total number of labour used by a farmer for a production cycle. (Note, the labour used consists of family labour and hired labour). Also, the farm labour was categorized into; adult male, adult female and child labour. The wage rate for each of the categories of labour at each stage of farm activities was taken into consideration in computing the denominator in equation 4.

Analytical Framework/Techniques

Following the work of Robinson *et al.*, [31] and Gunter [18], farm labour supply (LS) is a function of human capital (HC), farm income (Y), wage rate (W) and exogenous determinants (V). That is:

$$LS = \int (HC, Y, W, V) \ldots \ldots \ldots \ldots \ldots.(5)$$

The study assumes that the supply of farm labours is directly proportional to its productivity since farmers are being considered rational in decision making. Also, a perfect competitive market situation is hypothesized for the labour market with respect to waterleaf production in the study area. For this reason, it is assumed that a single wage rate exists in the market. Also, since waterleaf production is labour intensive, household farming income would relate directly to labour demand and thus its productivity. Hence, equation (5) can be re-specified as thus:

$$LPP = \int (HC, V) \ldots \ldots \ldots \ldots \ldots \ldots \ldots.(6)$$

Therefore, based on the definition of labour productivity in equation 4, including farm income and wage rate as determinants of labour productivity function will cause endogeneity issue that may lead to econometric problem of simultaneous equation bias. Hence, equation 5 was simplified to eliminate these anticipating econometric problems in the estimation process. Expanding equation 6 implicitly, a multivariate regression model was specified consisting of exogenous variables as in equation 7 to determine the factors causing variability in labour productivity in small scale waterleaf production in the study area. The Ordinary Least Squares estimation technique was used to estimates the labour productivity model. The specified model is expressed in linear form as thus:

$$\begin{aligned} LPP = \ & \delta_0 + \delta_1 GEN + +\delta_2 AGE + \delta_3 MAR + \delta_4 EDU \\ & + \delta_5 HHS + \delta_6 FAE + \delta_7 SOC \\ & + \delta_8 FAS + \delta_9 EXT + \delta_{10} FER \\ & + \delta_{11} MAU + \delta_{12} STM + \delta_{13} NFI \\ & + \delta_{14} CRE \ldots \ldots \ldots \ldots \ldots \ldots \ldots.. \ldots.(7) \end{aligned}$$

where:

LPP = Labour productivity of a farm as defined in equation 4

GEN = Gender of a farming household head (dummy: 1 for male and 0 otherwise)
AGE = Age of farming household head (years)
MAR = Marital status of a farming household head (dummy: 1 for married and 0 otherwise)
EDU = Education of a farmer (years)
HHS = Household size (number)
FAE = Farming experience (years)
SOC = Membership in social groups (years)
FAS = Farm size (hectares)
EXT = Access to agricultural extension services (number of visits in a year)
FER = Quantity of fertilizer used (Quantity multiplied by the unit price in Naira)
MAU = Quantity of manure used (Quantity multiplied by the unit price in Naira)
STM = Quantity of planting Material (Quantity multiplied by the unit price in Naira)
NFI = Income generated outside Waterleaf enterprise by a farmer (Naira)
CRE = Access to farm credit (amount in Naira)

Also, descriptive statistics consisting of tables and means were used to examine the socioeconomic characteristics of the respondents.

Verification of Multicollinearity among Explanatory Variables Used in the Analysis

The Variance Inflating Factor (VIF) and tolerance values were estimated and used to verify the presence of multicollinearity among the explanatory variables. For VIF, the minimum possible value is 1.0; while a value greater than 10 indicates likely collinearity between the specified explanatory variable in question and the rest of the predictors in the model. According to Gujurati and Dawn, [18], VIF is estimated using the formula stated below:

$$VIF_j = \{1/1 - R_j^2\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(8)$$

where: R_j^2 represents the multiple correlation coefficient between one of the explanatory variable (designated as dependent variable) and the other specified explanatory variables in the study. The implicit model explaining the above mechanism is shown in equation 9.

$$X_j = \varphi_0 + \varphi_1 X_1 + \varphi_2 X_2 +, \ldots + \varphi_n X_n + \varepsilon_n \ldots\ldots\ldots\ldots.(9)$$

VIF_j has a unique relationship with the tolerance level as thus:

$$Tolerance = 1/VIF = \left(1 - R_j^2\right) \ldots(10)$$

The higher the variance inflating factor, the lower the tolerance index and the higher the chance of collinearity.

RESULTS AND DISCUSSIONS

Descriptive Statistics

A summary of descriptive statistics of variables used in the study is presented in Table 1. The degree of variability in each of the specified variables showed wide dispersion as evidenced by the magnitude of the standard deviations and the degree of skewness displayed. The findings revealed that about 25.46% of sampled waterleaf farmers were male, while 74.54% were female. This connotes that female farmers dominated their male counterparts in waterleaf production in the region.

The age distribution revealed an average age of 40.48 years and is positively skewed, while 39.09% of the farmers were married. The result implies that, most waterleaf farmers are fast drifting away from their active years to older and less active age. Following FAO [15], the migration of young adults to the cities has resulted in a shift in the age structure of the farming population towards older ages, with clear implications for agricultural labour markets, production and food security. Besides, an average of 11.71 years of formal education was discovered among waterleaf farmers with a minimum of 6 years of school attainment.

Table 1. Summary Statistics for Variables

Variable	Mean	Min.	Max.	Std. Dev.	C.V.	Skewness
Gender (Male = 1; Female = 0)	0.255	0.000	1.000	0.436	1.713	1.127
Age (Years)	40.475	25.000	67.00	9.861	0.244	0.511
Marital status(M = 1; UnM = 0)	0.391	0.000	1.000	0.489	1.250	0.447
Education (Years)	11.705	6.000	16.000	2.506	0.214	-0.733
Household size (No.)	6.000	1.000	14.000	2.693	0.465	0.413
Farming experience (Years)	6.421	1.000	19.000	2.977	0.464	1.314
Socialization (Years)	1.341	0.000	30.000	4.013	2.993	5.149
Farm size (Ha)	0.028	0.002	0.123	0.027	0.976	2.028
Extension access(No. of visits per year	0.552	0.000	7.000	1.397	2.530	2.828
Value of output (₦)	28,586	2,000.0	79,000	19,174	0.671	1.004
Cost of fertilizer used (₦)	3,404.0	0.000	26,560	5,031.3	1.478	2.082
Cost of manure used (₦)	1,833.5	0.000	5,600.0	1,400.8	0.764	0.543
Cost of Waterleaf stem planted (₦)	2,091.3	10.00	1,300	3,044.4	1.456	1.739
Wage earned by labour used (₦)	9,813.7	400.00	33,000	7,342.4	0.748	1.214
Non-farm income (₦)	22,933	0.000	4.8e+05	53,732	2.343	7.046
Labour productivity (₦)	5.028	0.667	63.75	6.619	1.317	5.137
Amount of credit (₦)	1,326.1	0.000	40,000	5,852.3	4.413	4.976

Source: Computed by authors, 2019.

This means that the waterleaf farmers in the region have great potential for technology adoption for improved human capital and farm income. Also, an average household size of 6 members, and an average farming experience of 6.42 years were ferreted out among farmers. This reflects the importance of household labour in waterleaf production. The distribution of farming experience, perhaps, shows that waterleaf production is an emerging crop enterprise on the one hand, and also a transitory source of livelihood for most women folks in the study area.

In addition, the study unearthed a deteriorating nature of socialization, and access to agricultural extension services among the waterleaf farmers in the region. For instance, an average of 1.34 years of membership in social organizations among waterleaf farmers in the region was uncovered, while an average number of contacts with an extension agent during the production year stood at 0.55 times. The results depict the poor status of social capital formation among the waterleaf farmers, and the inefficient agricultural extension service delivery in the study area. Furthermore, the quantity of fertilizer bought showed a high degree of variability relative to the quantity of manure bought by the waterleaf farmers. The quantities of fertilizer and manure acquired by farmers were both skewed to the right, but the degree of skewness was greater in fertilizer than manure. The labour productivity indices were skewed to the right, and averaged at 5.0278, implying that most of the farmers had laboured productivity indices greater than unity. The average wage paid by the waterleaf farmers was recorded as ₦9,813.7 per production cycle, while the non-farm income, labour productivity and amount of credit was noticed to increase at increasing rates among waterleaf farmers in the study area.

Test for multicollinearity of specified explanatory variables in the labour productivity model

The results presented in Table 2 are the Variance Inflating Factor (VIF) estimates used to verify the nature of the collinearity among the specified independent variables. The results indicated that no significant issues of collinearity arose among the explanatory variables in the estimated model. The estimated VIF for each independent variable was greater than unity, but less than the threshold value of 10.

The finding implies that the explanatory variables carried their true signs and the estimated standard error are not inflated due to multicollinarity.

This means that the estimates of the OLS are independent, stable and not very sensitive to minor changes in the model.

Also, the tolerance factors were low, and below unity for every independent variable, implying that multicollinearity was not significant in the estimated models.

Table 2. Estimates of Variance Inflating Factors

Variable	Variance Inflation Factors	Tolerance Ratio
Gender	1.316	0.760
Age	1.747	0.572
Marital status	1.337	0.748
Education	1.323	0.756
Household size	1.406	0.711
Farming experience	1.469	0.681
Socialization	1.557	0.642
Farm size	1.689	0.592
Extension access	1.122	0.891
Quantity of fertilizer used	1.179	0.848
Quantity of manure used	1.709	0.585
Quantity of Waterleaf stems used	1.703	0.587
Non-farm income	1.199	0.834
Amount of credit	1.204	0.831

Source: Computed by authors, 2019.

Determinants of Labour Productivity of Waterleaf Farmers

The estimates of the multiple regression model based on the ordinary least squares (OLS) estimation technique are presented in Table 3. The diagnostic tests for the OLS estimation revealed that about 25.09% of the variations in the labour productivity were attributed to the specified explanatory variables. The F – statistic was significant at 1% probability level, denoting that the estimated R – square was significant and by implication, the estimated equation had goodness of fit. The normality test was statistically significant at 1% probability level, implying that the regression residuals were normally distributed and this justified the used of an Ordinary Least Squares estimation method. The RESET test was not significant at the conventional probability level, also fortifying the fact that the estimated regression had structural rigidity. The null hypotheses of no heteroskedasticity were upheld following the non-significant estimates of the Breusch – Pagan and White's tests for heteroskedasticity statistics. The test finding implies that the OLS estimators and regression predictions are BLUE (Best Linear Unbiased Estimators). This further means that, the estimates are consistent and efficient, hence validating the test of hypotheses of the F-test and the t- test in the model.

The empirical results from the Ordinary Least Squares estimates revealed that the marital status of the waterleaf farmers had a significant positive relationship with labour productivity. A unit increase in the marital status of the waterleaf farmers led to about 2.7976 units increase in labour productivity. This finding suggests that, married waterleaf farmers are more likely interested in generating additional family income from waterleaf production and as such, labour welfare would be paramount to them.

Table 3. OLS Determinants of labour productivity in small scale Waterleaf production

Variable	Coefficient	Standard error	t-value	*p-value*
Constant	−4.48044	1.93968	−2.310**	0.0214
Gender	−0.929776	0.730878	−1.272	0.2040
Age	0.0468709	0.0372474	1.258	0.2089
Marital status	2.79755	0.657778	4.253***	<0.0001
Education	0.311732	0.127549	2.444**	0.0149
Household size	0.385273	0.122346	3.149***	0.0018
Farming experience	0.400188	0.113120	3.538***	0.0004
Socialization	0.0173160	0.0864147	0.2004	0.8413
Farm size	−61.1970	13.2854	−4.606***	<0.0001
Extension access	0.0456912	0.210678	0.2169	0.8284
Quantity of fertilizer used	0.000263295	5.99795e-05	4.390***	<0.0001
Quantity of manure used	−0.000812845	0.000259317	−3.135***	0.0018
Quantity of Waterleaf stem used	0.000380705	0.000119110	3.196***	0.0015
Non-farm income	−1.57464e-05	5.66289e-06	−2.781***	0.0057
Amount of credit	8.98546e-05	5.21103e-05	1.724*	0.0854
Diagnostic Statistics				
R-squared				0.250954
F(14, 425)				10.17058***
RESET test (squares only)				F(1, 424) = 3.278
Normality test				Chi-square(2) =4.85
Breusch-Pagan				LM = 5.57
White's test for heteroscedasticity				9.962
Number of observations:	440			

Source: Data from 2018 planting season in the study area.
*, **, and *** represent a significance at 10%, 5% and 1% respectively.

Another plausible reason is the fact that married farming households would likely have the advantage of having a higher number of household labour. Since this source of labour is part of the total farm labour and sometimes might constitute the larger part of the total farm labour, then the welfare of the farm labour would surely improve, and so will its productivity.

In a similar vein, the coefficient of waterleaf farmers' years of formal education was positive, and constituted a significant determinant of labour productivity in the sub-sector. A unit increase in the years of formal education of the farmers increased farm labour productivity by 0.3117 units. This implies that the more the waterleaf farmers' acquired formal education, the greater the possibility of increasing labour productivity in the farm. Increase in years of formal education has a strong relationship with the efficient management of farm resources and technology adoption. The educated waterleaf farmer would better understand the labour laws and the need to ensure improved wage rates and other labour incentives. In addition, educated farmer would have an improved human capital capable of providing knowledge, skills, analyzing farm issues and proffering solutions as well as providing advisory services to labourers/workers in order to raise farm income and labour productivity. The finding corroborates the previous finding of Obike *et al.* [27].

Also, household size had a significant positive correlation with the labour productivity in waterleaf production. A unit increase in household size resulted in a 0.38527 unit increase in labour productivity. The result satisfies *a priori* expectations, because small scale waterleaf production is basically labour-intensive, and mostly depended on household labour. An increase in household labour would imply an increase in labour availability and, perhaps, yields or farm outputs relative to man-hours used on the farm. The finding is contrary to the submissions of Okoye *et al.*, [27] and Anyaegbunam *et al.*, [9].

Similarly, an increase in farming experience increased the units of labour productivity in the farm. For instance, a year increase in farmer's experience will result in about 0.40019 unit increase in labour productivity. An increase in years of farming experience increases the possibility of attaining an efficient farm resource mix capable of increasing the total farm output. The efficient risk management on the farm is often associated with years of experience due to the adaptive behaviour of farmer. Farming experience has been also known to affect agricultural technology adoption, including efficient farm practices. Understanding workers' welfare is a function of accumulative experiences over time. This is in consonance with the reports of Okoye *et al.* [27] and Obike *et al.* [24].

The slope coefficient of the quantity of fertilizer used was positive and statistically significant at 1% probability level. This means that a unit increase in the quantity of fertilizer used resulted in a 0.00026 unit increase in farm labour productivity. Increase in fertilizer use in arable crop production has always been associated with an increase in farm output resulting in an increase in partial factor productivity. It is the price and, sometimes, its availability and adequacy in quality that have been hindering the efficient utilization of this farm input by resource-poor farmers. Another plausible reason for the result is the economies of size relative to the man-days/man-hour of labour needed. The finding is in agreement with the reports of Reardon *et al.*, [30] and Anyaegbunam *et al.*, [9].

The coefficient of the quantity of stems used by farmers had a significant positive relationship with labour productivity. A unit increase in the quantity of waterleaf stems planted increased labour productivity by 0.00038 unit. This satisfied *a priori* expectation because an increase in the quantity of stems planted would always lead to an increase in the quantity of output correspondingly, provided appropriate agronomical practices are upheld by farmers. The finding is in line with submissions of Reardon *et al.*, [30] and Okoye *et al.*, [27].

The coefficient of farm credit in the labour productivity model indicates that the amount of credit available to waterleaf farmers had a positive and significant association with labour productivity. A unit increase in farm credit marginally increased labour productivity by 8.985 x 10^{-05} of a unit. Farm credit would help in efficient management of farm resources through mobilization of human resources such as labour. It can also be a good source of labour incentive through enhanced wage rate, which will eventually translate to higher partial factor productivity.

On the contrary, an increase in the farm size of waterleaf farmers resulted in lower labour productivity. For instance, a 1% increase in the farm size of waterleaf farmers resulted in a 61.19% decrease in labour productivity. This means that, the larger the farm size the lower the labour productivity. Given the magnitude of the farm size coefficient, it seems farm size is the most important non – wage determinant of waterleaf labour productivity in the region. The finding suggests that most of the waterleaf farmers in the region were resource-poor and could not afford expanded farm investment associated with an increase in farm size. Also, acquiring additional farmlands would have been difficult, as the farmers may not have had sufficient income left to fund other farm operations including wages. Previous reports published by Reardon *et al.*, [30] and Okoye *et al.* [27] as well as Obike *et al.* [24] supported this finding.

The slope coefficient (0.0008) of the quantity of manure used in the labour productivity model was negative. This signifies that. a unit increase in the quantity of manure used will lead to a reduction in labour productivity by 0.0008 of a unit. The result may be connected to the quality of manure utilized by the farmers. Most of the manure used in waterleaf production in the area was derived from poultry droppings. The chemicals in fresh poultry droppings may have been injurious to waterleaf growth and therefore hindered the output growth, and consequently reduced labour productivity. Waterleaf being an herbaceous plant does not have strong resistance to toxic or harmful materials compared to other arable crops like cassava and fluted pumpkins. Another possible reason for the result is that manure is readily affordable by the waterleaf farmers, hence creating an incentive to acquire large quantities for a small piece of land. Heavy application can lead to toxicity of the soil, thereby reducing the quantity of output produced. The reduction in output would lead to low labour productivity. Reardon *et al.*, [30] has reported similar results previously.

In a similar vein, an increase in non-farm income reduces the labour productivity in Waterleaf production in the region. A unit increase in non-farm income resulted in 1.575 x $10^{-05}$of a unit decline in labour productivity. Alternatively, an increase in the non-farm income reduced labour productivity in waterleaf production. This result is in line with the anticipated result because an increase in non-farm income implies increased tendency of diversification or disinvestment in waterleaf farm business. Hence, an increase in non-farm income of waterleaf farmers without adequately compensating for farm investment would likely lower farm earnings and factor productivity. Reardon *et al.*, [30] reported a similar result.

CONCLUSIONS

The achievement of the food self-sufficiency target of the south-south region of Nigeria and Akwa Ibom State, in particular, is anchored on promoting efficient resource utilization and improved productivity of small scale farmers considered as the bedrock of agricultural systems in the region. Labour productivity has become critical, given the persistent rural-urban migration of the workforce, leading to labour scarcity in some rural communities. The attempt to sustain waterleaf production, in particular, implies devising ways to attract labour into farm operations. Certain attributes of farmers are prerequisites, and identifying these characteristics was the major aim of this study. Findings have shown the importance of human capital development of the waterleaf farmers, improved technology in the farm, vibrancy of agriculture-based agencies, and economics of scale in the farm. In order to sustain production of waterleaf in Uyo agricultural zone of Akwa Ibom State, the following policy recommendations were strongly advocated:

Provision of good quality education to the waterleaf farmers should be paramount in developing any policy framework to increase labour productivity of vegetable farmers in the State. The use of fertilizers would enhance labour productivity in vegetable production in the State. The State government should therefore subsidize the price of fertilizers to enable farmers afford them for increased output and labour productivity. the provision of quality planting materials by specialized agencies and all stakeholders concerned is necessary for higher productivity of labour in vegetable production in the area. Also, farm credit is an incentive to boost labour productivity; hence modalities to ease credit supply and demand should be implemented *by* all stakeholders for vegetable farmers in the State.

ACKNOWLEDGEMENTS

The authors appreciate all waterleaf farmers in the study area that participated in this research as we looked forward for more collaborations in future.

REFERENCES

[1]Akpan, S. B., Okon, U. E., 2019a, Vegetable Consumption Paradox: Has Domestic Consumption Match the International Recommended Minimum Standard in Nigeria? International Journal of Advances in Agriculture Sciences; Vol. 4(3):1 – 7.
[2]Akpan, S. B., Udo, U. J., Akpan, P. J., 2019b, Analyses of the gross margins and commercialization of manure and fertilizer based waterleaf (*Talinum triangulare*) farmers in Nigeria. Agricultural and Resource Economics: International Scientific E-Journal, Vol. 5(4):5–31, http://are-journal.com, Accessed on 24th of January, 2021.
[3]Akpan, S. B., Adah, A. J., Udoh, E. J., 2017, Assessment of farm factor productivity of small scale cassava farmers in Oruk Anam Local Government Area of Akwa Ibom State, Nigeria. Nigerian Journal of Agriculture, Food and Environment 13(1):113-120.
[4]Akpan, S. B., Monday, I., 2021, Factors Productivity in small scale upland Vegetable Production in the South – South region of Nigeria. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 21(1): 35-45.
[5]Akpan, S. B., Monday, J., Okon, U. E., 2018, Factors that influence total factor productivity of upland vegetable farmers in Oruk Anam local government area of Akwa Ibom State, Nigeria. AKSU Journal of Agricultural Economics, Extension and Rural Development 1(1): 129 – 137.
[6]Akpan, S. B., Udoh, E. J., Aya, A. E., 2010, Fertilizer–manure substitution among arable crop farmers in Akwa Ibom State: empirical evidence. Global Journal of Agricultural Sciences 9(1): 37–40.
[7]Akpan, S.B., Aya, E.A., Essien, U.A., Akpan, O.D., Bassey, N.E., 2011, Analysis of Total Factor Productivity among small-holder vegetable farmers in Akwa-Ibom State, Nigeria. Nigerian Journal of Agriculture, Food and Environment Vol.7(4):68-74.
[8]Akpan, S.B., Edet, J.U., Ememobong, E.B., Chukwuemeka, I., Udo, F. J., 201, Analysis of resource productivity and the level of fertilizer – manure substitution among vegetable farmers in the Southern Region of Nigeria. Mediterranean Journal of Social Sciences Vol.2(3): 35-46.
[9]Anyaegbunam, H. N., Okoye, B.C., Asumugha, G. N., Ogbonna, M.C., Madu, T. U., Nwakor, N., Ejechi, M.E., 2010, Labour productivity among smallholder cassava farmers in South East agro-ecological zone, Nigeria. African Journal of Agricultural Research Vol. 5(21): 2882-2885.
[10]Ball, V.E., Bureau, J.-C., Nehring, R., Somwaru, A., 1997, Agricultural Productivity Revisited. American Journal of Agricultural Economics 79: 1045–63.
[11]Christian, A., 2007, Fluted pumpkin (*Telfairia occidentalis* Hook F.) Seed: a nutritional assessment. Electronic Journal of Environmental, Agricultural and Food Chem., Vol. 6(2): 1787 – 1793.
[12]Cochran, W. G., 1963, Sampling Techniques, 2nd Ed., New York: John Wiley and Sons, Inc.
[13]Deotti, L., Estruch, E., 2016, Addressing Rural Youth Migration at its Root Causes: A Conceptual Framework. Social Policies and Rural Institutions Division. Food and Agriculture Organization, Rome, Italy. www.fao.org/publications, Accessed on the 5th of March, 2021.
[14]Enete, A.A., Okon, U.E., 2010, Economics of waterleaf (*Talinum triangulare*) production in Akwa Ibom State, Nigeria. Field Actions Science Report 4: 1–5.
[15]FAO, 2013, Reviewed Strategic Framework, Conference. Thirty-eighth Session, Food and Agriculture Organization, Rome, Italy. pp. 15–22.
[16]Francisca, S. I., Eyzaguirre, P., 2007, African leafy vegetables: Their Role in the World Health Organization's Global Fruit and Vegetable Initiative. African Journal of Food, Agriculture, nutrition and Development, Vol.7(3):1 – 17.
[17]Gocowski, J., Oduwole, S., 2003, Labour practices in the cocoa sector of southwest Nigeria with a special focus on the role of children. STCP/IITA monograph IITA, Ibadan, Nigeria.
[18]Gujarati, N. D., Dawn, C. P., 2009, Basic Econometric. McGraw-Hill International Edition. Singapore.
[19]Gunter, L.F., 1986, Wage determination for regular hired farm workers: an empirical analysis for Georgia. Southern Journal of Agricultural Economics 18(2): 197-202.

[20]Hussain, I., Perera, I. R., 2004, Improving Agricultural Productivity through Integrated Service Provision with Public – Private Partnership. A Working Paper 66. Columbia. Sri Lanka: International Water Management Institute.

[21]Kebede, E., Gan, J., 1999, The Economic Potential of Vegetable Production for Limited Resources Farmers in South, Central Alabama. Journal of Agribusiness, Vol. 7(1):63-75.

[22]Kim, J., Park, J., 2017, The Role of Total Factor Productivity growth in middle-income countries. Asian Development Bank Economics Working Paper Series, No. 527. DOI: http://dx.doi.org/10.22617/WPS179136-2, Accessed on the 5th of March, 2021.

[23]Nya, E.J., Okorie, N.U., Eka, M.J., 2010, An economic analysis of *Talinum triangulare* (Jacq.) production/farming in southern Nigeria. Trends in Agricultural Economics, volume *3*: 79-93.

[24]Obike, K.C., Idu, M.A., Aigbokie, S.O., 2016, Labour productivity and resource use efficiency amongst smallholder cocoa farmers in Abia State, Nigeria. Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension 15(3): 7 – 12.

[25]Ogbalubi, L.N., Wokocha, C. C., 2013, Agricultural development and employment generation: The Nigeria experience. IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 2(2): 60-69.

[26]Okoruwa, V.O., Ogundele, O.O., Oyewusi, B.O., 2006, Efficiency and productivity of farmers in Nigeria: A study of rice farmers in North Central Nigeria. A poster paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August, 12- 18, 2006.

[27]Okoye, B, C., Onyenweaku, C. E., Ukoha, O. O., Asumugha, G. N., Aniedu, O. C., 2008, Determinants of labour productivity on smallholder cocoyam farms in Anambra State, Nigeria. Scientific Research and Essay; Vol. 3, pp. 559-561.

[28]Omotesho, K. F., Lawal, A M., Ismaila, D. E., 2014, Assessment of hired labour use and food security among rural farming households in Kwara State, Nigeria. Journal of Agricultural Sciences, Vol. 59(3): 353-361. DOI: 10.2298/JAS1403353O, Accessed on the 27th of March, 2021.

[29]Osanyinlusi, O. I., Adenegan, K. O., 2016, The Determinants of Rice Farmers' Productivity in Ekiti State, Nigeria. Greener Journal of agricultural sciences, Vol. 6 (2), 049-058. DOI http://doi.org/10.15580/GJAS.2016.2.122615174, Accessed on the 27th of March, 2021.

[30]Reardon, T., Kelly, V., Crawford, E., Jayne, T., Savadogo, K., Clay, D., 1996, Determinants of Farm productivity in Africa: A system of four case studies, International Development. p. 22.

[31]Robinson, C., McMahon, P., Quiggin, J., 1982, Labour supply and off-farm work by farmers: theory and estimation. Australian Journal of Agricultural Economics, Vol. 2691): 23-38.

[32]Udoh, E. J., Etim, N. A., 2008, Measurement of Farm-Level Efficiency of Water-Leaf (*Talinum triangulare*) Production Among City Farmers in Akwa Ibom State, Nigeria. J. of Sustainable Development in Agriculture & Environment, Vol. 3(2):47-54.

[33]Udoh, E. J., Akpan, S.B., 2007, Measuring Technical Efficiency of Waterleaf (*Talinum* triangulure) production in Akwa Ibom State, Nigeria. American Eurasian Journal of Agricultural and Environmental Sciences; 2 (5); 518 – 522.

[34]Uko, A. E., Iren, O. B., Effa, E. B., Isong, I. A., 2019, Comparative Efficacy of Organic Manures for Improved Performance of Waterleaf (*Talinum fructicosum* (L) Juss.) In the Humid Tropical Rainforest, International Journal of Sciences, Vol. 8(08):1 – 10. DOI: 10.18483/ijSci.2126, Accessed on ?9th of April, 2021.

[35]Yusuf, I. M., 2018, Analysis of family labour utilization in the production of selected crops in dry-lands: evidence from Kahutu, Katsina State, Nigeria. Agrosearch, 18 (2): 15 – 27. https://dx.doi.org/10.4314/agrosh.v18i2.2., Accessed on 29th of April, 2021.