# Resource Use Efficiency among Urban Vegetable Farmers in Akwa Ibom State, Nigeria

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Keywords: Efficiency- Gross margin- Resource use- Urbanization- Urban Agriculture- Nigeria

#### Summary

The study estimated the efficiency of resource use among urban vegetable (Talinium triangulare) farmers in Akwa Ibom State using a sample of 60 respondents that were randomly selected; 20 from three urban centers in the state. Interview schedules and structured questionnaires were administered to elicit information from the respondents. Data were analyzed using descriptive statistics, multiple regression and gross margin. The results showed that, most (85%) farmers were within the economically active age bracket (21-50 years). All farmers were female with a mean farming experience of 8.5 years. The average farm size was 0.065 ha, and waterleaf was planted as a sole crop to obtain high output. The multiple regression analysis showed that the farmer's farm size, educational level, household size, farming experience and quantity of manure and labour applied, positively and significantly influenced output of waterleaf in the study area. The efficiency ratio of land (2.8), manure (42.11) and labour (0.91), showed that waterleaf farmers were inefficient in the use of these resources. Land and manure were underutilized, while labour was over utilized. Gross margin analysis showed that farmers made profit (gross margin= N287, 252.52 per hectare). Lack of access to credit facilities was the farmers' major constraints.

#### Résumé

# Analyse de l'efficience de l'utilisation des ressources parmi les cultivateurs urbains de produits maraîchers dans l'état de Akwa Ibom au Nigeria

L'étude analyse l'efficience de l'utilisation des ressources parmi les cultivateurs urbains de produits maraîchers (Talinium triangulare) dans l'état de Akwa Ibom au Nigeria, en se basant sur un échantillon de 60 répondants qui ont été sélectionnés au hasard; 20 dans trois centres urbains de l'état. Des questionnaires structurés ont été administrés pour obtenir l'information des répondants. Les données ont été analysées en utilisant des statistiques descriptives, des régressions multiples et des marges brutes. Les résultats montrent que la plupart (85%) des maraîchers étaient dans l'âge des actifs économiques (21-50 ans). Tous les maraîchers étaient des femmes avec une expérience moyenne dans le métier de 8,5 ans. La taille moyenne des exploitations était de 0,065 ha et le légume était cultivé comme une monoculture afin d'obtenir une production élevée. L'analyse de la régression multiple indique que la taille de l'exploitation, le niveau d'éducation, la taille du ménage, l'expérience dans le métier et la quantité de fumier et de travaux appliqués influencent positivement et significativement la production dans l'aire étudiée. Le ratio d'efficience de la terre (2,8); du fumier (42,11) et du travail (0,91) montre que les producteurs sont inefficients dans l'utilisation de ces ressources. La terre et le fumier sont sous-utilisés tandis que le travail est surutilisé. L'analyse de la marge brute montre que les paysans produisent un profit (marge brute égale à 287.252.52 Naira par hectare). Le manque d'accès aux sources de crédit est la contrainte majeure rencontrée par les maraîchers.

#### Introduction

In recent years, urbanization has led to an increasing loss of agricultural land, thus reducing agricultural growth rate in sub-Saharan Africa and Nigeria in particular. Urbanization presents both challenges and opportunities for the developing countries as a whole. There is an indication that the challenges of urbanization out-weigh its opportunities in these regions. This may be because urbanization has not yet been matched with infrastructural and economic development. This in turn leads to urban poverty and food insecurity (9).

Recent facts have shown that the highest urban growth rates are in the developing countries. In

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Nigeria it is put at 5.3% a year, the fastest in the World (20). Today 47% of the world's population live in urban areas and by 2015, the urban population will rise to 53% (24). Consequently, many city dwellers will be faced with the reality of unemployment, inadequate food and shelter, and they are powerless to influence the decisions affecting these issues, all of which are dimensions of poverty with hunger as the most fundamental (29).

Urban Agriculture (UA) which is the growing of crops and raising of animals within and around cities (9), has emerged as a strategic imperative for developing countries (8). Urban agriculture is not a new or recent invention. Agricultural activities within city limits have existed since the first urban populations were established thousands of years ago (10). However, it is only recently that UA became a special focus of research and development attention, as its scale and importance in an urbanizing world become increasingly recognized (21). This is essentially due to its potential for poverty reduction, economic empowerment, and household food security.

It is estimated that 800 million people are engaged in urban agriculture world wide of which 200 million are considered to be market producers, employing 150 million people fulltime (16, 27). These urban farmers produce substantial amount of food for urban consumers. In Accra, 90% of the city's fresh vegetable consumption is from production within the city (24). There is every indication that quite a sizeable number of the urban poor are engaged in urban agriculture (13).

As the population of the urban poor practicing agriculture increases, there is an increased competition for the few, available urban land. This could increase the risk of urban agriculture as urban structures could come without notice and midway into a planting season thereby destroying the crops planted. In addition, there is also the risk of low investment and hence low productivity of urban agriculture because of under capitalization of the poor who are into it.

Several studies have been carried out on urban agriculture in Africa (4, 6, 18, 25). All these studies concluded that urban agriculture has the potential for poverty reduction, food security and employment generation. However, there is still much gap between demand and supply of food with increasing poverty in urban areas, especially consumption poverty. To achieve the Millennium Development Goal of halving the proportion of hungry people by 2015, it is projected that 22 million people must achieve food security every year. This could only be possible if the available resources are efficiently utilized. In this regards, the aim of this paper is to analyze the resource use efficiency among urban vegetable (waterleaf) farmers in Akwa Ibom State. The paper will: (-) determine the economic efficiency of resource use and estimate the production function of urban waterleaf farmers in the study area; (-) estimate the cost of and returns to urban farming with emphasis on waterleaf production; (-) identify major constraints to urban farming in the area.

#### **Research methodology**

#### The study area

The study was conducted in Akwa Ibom state of Nigeria, with a population of 3,920,208 million people (19). The State is a major oil producing area in the country and lies between latitudes  $4^{0}32^{1}$  and  $5^{0}33^{1}$  North and longitudes  $7^{0}25^{1}$  and  $8^{0}25^{1}$  East.

The State lies within tropical rainforest belt, hence it has a longer rainy season (April to November) while dry season lasts between December and March. Qua-Iboe River and Cross River are the major water ways that run across the state. They originate from the Cameroon and flow into the Atlantic Ocean. The rivers provide very rich sea food, fishing grounds for fishermen, and serve as a resource for irrigation farming.

The State has very rich potential for agriculture, and is suitable for food crops farming, tree crops farming, fish farming and livestock farming. Crops widely grown are leafy vegetables like, water leaf, fluted pumpkin, and garden egg. Others are yam, swamp rice, cassava, cocoa yam, plantain, banana, oil palm, rubber, etc.

#### **Data collection**

Purposive and simple random sampling techniques were employed for this study. Because, the study was on urban agriculture; the three major urban areas in the state were purposively selected. These urban centers were Eket, Uyo and Ikot-Ekpene. Twenty urban vegetable farmers were then randomly selected from each of the three selected urban centers. This made a total sample size of sixty respondents. Data were obtained mainly from primary sources using structured questionnaires and interview schedule. The data focused on: socio-economic characteristics of the farmers, length of a production cycle, land area cultivated (ha), (determined by measuring with a tape in square meters). This was then converted to hectares. Output of waterleaf, the amount of labour used in bed making, and planting were recorded over the production period in man-day's. Labour input for women and children were also converted to man equivalent using an adjustment factor of 0.67 and 0.33 for women and children respectively (28). Product prices and labour wages were taken as the average market prices of waterleaf and the ongoing labour wage rate per day in the area respectively.

#### Data analysis

A multiple regression analysis involving the use of Ordinary Least Square (OLS) estimation technique was used to determine the effect of socio-economic variables on the urban farmer's vegetable output. Four functional forms were tried (Linear, Semi-log, Doublelog and Exponential).

The implicit form of the regression model used was: Y=f(X<sub>1</sub>, X<sub>2</sub>, X<sub>3</sub>, X<sub>4</sub>, X<sub>5</sub>, X<sub>6</sub>, X<sub>7</sub>, X<sub>8</sub>, X<sub>0</sub>, U)...(implicitform)...(1)

Where Y = Output of waterleaf (kg)

 $X_1 =$ Quantity of seed (kg)

 $X_2 =$  Labour (in man days)

 $X_3 =$  Manure/organic waste (kg)

 $X_4 = Land size$  (in hectares)

 $X_5 =$  Farming experience (in years)

 $X_6$  = Age of farmers (in years)

X<sub>7</sub>= Educational level (years of formal schooling)

X<sub>8</sub>= Household size (number)

 $X_{a}$  = Frequency of harvest (no. of times/month)

U = Error term

(a) Ordinary linear form

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7 + b_8 X_8 + b_9 X_9 + U$$
 -----(2)

(b) Semi-log form

$$\begin{split} Y &= b_0 + b_1 log X_1 + b_2 log X_2 + b_3 log X_3 + b_4 log X_4 + \\ & b_5 log X_5 + b_6 log X_6 + b_7 log X_7 + b_8 log X_8 + U - - - (3) \end{split}$$

 $b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + b_8 \log X_8 + U - -$ (c) Double-log form

 $Log Y = b_{0} + b_{1}logX_{1} + b_{2}logX_{2} + b_{3}logX_{3} + b_{4}logX_{4} + b_{5}logX_{5} + b_{6}logX_{6} + b_{7}logX_{7} + b_{8}logX_{8} + U - - (4)$ 

Where  $b_0$ ,  $b_1$ - $b_8$  are estimated coefficients,  $X_1$ - $X_9$  are as defined in equation 1. Economic, statistical and econometric criteria were employed to choose the lead equation based on  $R^2$  estimates and the standard error values as well as consistency with a priori expectations.

The efficiency of resources used in urban vegetable production was determined as follows:

r = Marginal Value Product/Marginal factor cost = MVP/MFC

Where

MVP = Product of marginal physical product and unit price of output

MFC = Cost of one unit of a particular resources

r = Efficiency ratio

If, r = 1, it implies that urban farmers are efficient in the use of the particular resource.

r < 1, implies that urban farmers are inefficient (underutilizing resources) in resource use.

r > 1, implies that urban farmer are inefficient (over-utilizing resources).

#### Elasticity of production (E p)

The elasticity of production is a concept that measures the degree of responsiveness of output for a given unit change in the inputs.

 $\begin{array}{l} \mathsf{Ep}=\mathsf{b}.\overset{\mathsf{X}}{\overset{\mathsf{y}}{y}} & \mathsf{Where} \ \mathsf{b}= \mathsf{coefficient} \ \mathsf{of} \ \mathsf{individual} \ \mathsf{inputs} \\ \overline{\mathsf{X}}=\mathsf{mean} \ \mathsf{of} \ \mathsf{input} \\ \overline{\mathsf{y}}=\mathsf{mean} \ \mathsf{of} \ \mathsf{output} \end{array}$ 

#### Gross margin analysis

Gross margin analysis was used to estimate the cost of and return to urban vegetable production.

It is given by: GM= GFI - TVC

Where, GM= Gross margin (N)

GFI= Gross farm income (₦) TVC= Total variable cost (₦)

#### **Results and discussion**

#### Overall level of inputs and output

The summary statistics of the output and major inputs in waterleaf production in the study area show that the average output of waterleaf per hectare was 13,724.02 kg, in a production period of 14 months. Fontem and Schippers (17) noted that the agronomy of waterleaf suggests that its yield per hectare lies between 10,000 and 60,000 kg. The average farm size was 0.065 ha per farmer, indicating that the urban waterleaf farmers in the area were small-scale farm units. The average labour input was 115.87 man days per hectare, which suggests that the urban waterleaf farmers depend largely on human labour to do most of their farming operations. The efficiency ratio for labour, which was less than one, as we shall see below, further confirms this. The average manure and planting material used were 270 kg and 1467.83 kg per hectare respectively.

### Effects of socio-economic variables on urban waterleaf farmers' output

Regression model was used to estimate the effect of socio-economic variables on urban vegetable (waterleaf) farmer's output. The results of the analysis are presented in table 1 after.

The figures in brackets are standard errors. NB\*\*\* Significant at 1%, \*\* significant at 5% and \* significant at 10%. {a} is the lead equation, b are elasticities. Total b= total elasticity of production.

The linear function was chosen as the lead equation given the R<sup>2</sup> value of 0.84, the level of significance of the coefficient of the explanatory variables and their signs (Table 1). This result agrees with the results of Abang and Agom (1). The specified variables were able to explain 84% of the variation in the output of waterleaf in the study area. The F- ratio (Fcal= 29.77137) which shows the overall significance of the equation was significant at 1% level of probability.

All the estimates of the parameters of the variables in the production function were positive except

Coefficient/ Variables	Linear {a}	Semi-log	Double-log	Exponential	
Intercept	670.4222	8.460300***	5.024992***	-35871.93**	
	(2472.539)	(0.242493)	(1.393282)	(17770.51)	
	2484.831**				
Land size	(1198.099)	-1.543026*	0.071616	1580.267	
	b = 0.0117	(2.155974)	(0.131697)	(1679.717)	
	13.70536*				
Labour	(7.557782)	0.001176**	0.130480**	1275.944*	
	b = 0.1157	(0.000324)	(0.59792)	(762.6174)	
	15.442557***				
Manure	(3.307846)	0.001176***	0.611040***	7550.909***	
	b = 0.3038	(0.000324)	(0.114337)	(1458.306)	
	-384.6573				
Frequency of harvests	(635.3168)	-0.026595	0.006323	-394.5689	
	b = -0.046	(0.062308)	(0.078649)	(1003.128)	
	-35.46202				
Age	(65.71420)	0.000935	0.090345	2279.554	
	b = -0.1060	(0.006445)	(0.204446)	(2607.597)	
	765.0441***				
Education	(100.9492)	0.058888***	0.128073***	1854.234***	
	b = 0.4236	(0.009901)	(0.045513)	(580.4978)	
	367.1151**				
House size	(172.0659)	0.021293	0.077510	2153.837*	
	b = 0.2139	(0.016875)	(0.099586)	(1270.162)	
	0.020649				
Planting material	(0.797788)	0.797788	0.014159	-613.3479	
	b = 0.000208	(7.82E-05)	(0.081427)	(898.5551)	
	266.4916**				
Farming	(135.2416)	-0.010703	-0.076655	-2311.195**	
Experience	b = 0.000208	(0.013264)	(0.081427)	(1038.549)	
R <sup>2</sup>	0.842739	0.742763	0.831948	0.839244	
Adj. R <sup>2</sup>	0.814432	0.696460	0.801699	0.810308	
F-ratio	29.77137***	16.04148***	27.50298***	29.00336***	
Observations	60	60	60	60	
Total b	0.916908				

Table 1 Results of the multiple regression/ Production function analysis

Source: Extract from computer analysis results.

frequency of harvest and age of the farmers. The coefficient of land size was positive and significant at 5% level of probability (Table 1). This suggests that increases in land area will bring about increases in waterleaf output. This is further demonstrated by the size of its coefficient (its marginal physical product) which was the biggest of all the factors specified. This is to be expected as the competition between infrastructural development and agricultural activity could hinder the expansion of vegetable production. However, the efficiency ratio for land was 28.67 (Table 2), which suggests that even the little available land was not yet put to optimum use (i.e. it is underutilized) by the farmers.

The coefficient of labour was positive and significant at 10% level of probability. Other studies have shown the importance of labour in farming, particularly in developing countries where mechanization is only common in large (commercial) farms (15, 26). Labour as a factor of production is generally of overwhelming importance (7) and makes up about 90% of the costs of production in many African farming systems (12). The efficiency ratio for labour was 0.91 (table 2), which suggests that the farmers were over-utilizing this resource.

Manure also had a positive relationship with output and was significant at 1% level. This is to be expected as leafy vegetables usually require heavy application of manure. The efficiency ratio for manure was 42.11, which also suggests underutilization of the resource.

Frequency of harvest had an inverse relationship with output, though it was not statistically significant. This implies that the more the number of times waterleaf was harvested, the less the output. This makes sense

## Table 2 Marginal physical products (MPP), Marginal value product (MVP), Marginal factor cost (Px) and efficiency index of Waterleaf farmers in the study area

	MPP	P x (₦)	MVP (₦)	Efficiency (mvp/px) index
Land size (ha)	2484.831	2,600	74,544.93	28.67
Labour (man days)	13.705	450	411.15	0.91
Manure (kg)	15.443	11	463.29	42.11

Source: Regression results, field survey, 2008.

Note: Py = ₦ 30 per kg

as the leaves need some time to regenerate. Efficiency ratio was not calculated for this because market price did not exist for this factor.

Age had a negative but non significant relationship with output. The negative relationship could imply that while older farmers are more risk averse, younger ones are more dynamic, with regards to the adoption of innovations that would enhance their productivity.

Education had a positive sign and was significant at 1% level of probability. Higher level of education enables farmers to acquire and process relevant information more effectively. It also equips them with better managerial skills which eventually leads to improved methods of production and hence higher level output (14, 22, 23). Just as in frequency of harvest and age of farmer, no market price was collected for this resource; hence, efficiency ratio was not calculated for it.

Household size contributed positively to waterleaf output and was significant at 5% level. This could be because larger households provided cheap labour for the farmers and labour also increased output as noted above. We also noted from the efficiency ratio that the farmers were over-utilizing labour as a factor of production. Umoh (26) noted that this situation has variously been attributed to small and scattered land holdings and lack of affordable equipment.

Quantity of planting materials had positive relationship with output although it was not significant. Waterleaf is mostly propagated by stem in the study area. It is therefore possible that while some stems might give rise to more than one waterleaf stand, some may not, such that the quantity of planting material used may not necessarily translate to the number of waterleaf stands in a farm. This may explain the non-significance of the planting material variable.

Farming experience had a positive relationship with output and was significant. This indicates that more experienced farmers were more productive in the waterleaf farming. Experienced farmers may be more knowledgeable in the production system and may therefore be better able to assess and manage the risks involved in the system than inexperienced ones. The calculated elasticities of production with respect to all the variable inputs were less than one (Table 1). This implies that the individual inputs were inelastic, indicating decreasing returns to the various inputs. The sum of the elasticity of production reflects the nature of return to scale. This measures the response of the output to a one percent change in all the inputs. The sum amounted to about 0.9167, implying that if all inputs were increased by one percent, output would increase by less than one percent. In order words, production of waterleaf in the area is said to be characterized by decreasing returns to scale.

#### Costs and returns analysis (Gross margin)

Gross margin was employed as the budgeting technique for this study. It evaluates the gross profitability of a given enterprise. It is useful where the value of the fixed cost is negligible as it is the case with urban agriculture which is operated at small scale level (5).

Cost that was considered here includes cost incurred from variable inputs like manure, cost of renting land, planting materials and labour. The market prices were  $\mathbb{N}$  11 per kilogram of manure,  $\mathbb{N}$  20 per kilogram of planting materials and  $\mathbb{N}$  450 per manday of labour. The average output per hectare was 13,724.02 kilogram. The price per kilogram of output was  $\mathbb{N}$ 30.00. The results of Gross margin analysis is presented in table 3.

From the table after, average cost of production per hectare was  $\mathbb{N}$  124,467.5. Labour accounted for about 41.89% of the total production cost, while cost of renting land contributed 32.15%. The analysis of other variables shows that the percentage share of cost of planting materials and manure to total production costs were 23.59 and 2.37 respectively.

Labour therefore took the highest percentage of total variable costs. This agrees with the observation by Cleave (7) and Dvorak (12) that labour generally constitutes the highest production costs in many African farming systems. The gross margin per hectare was N 287,252.52. This when divided by a production cycle of 14 months (for waterleaf in the study area) gives a monthly income of N 20,518.04.

<sup>&</sup>lt;sup>1</sup>One United States Dollar (\$) equals about one hundred and fifty Nigerian Naira (№) during the time of this study.

Items	Units	Quantity/ha	Price/unit (₦)	Total value (₦)	
Revenue					
Output	kg	13,724.02	30	411,720.6	
Total revenue				411,720.6	
Cost					
Labour	man-days	115.87	450	52,141.5	
Cost of renting land	Hectare	1 ha	40,000	40,000	
Planting materials	kg	1467.83	20	29,356	
Manure	kg	270	11	2,970	
Total variable cost (TVC)				124,467.5	
GM (TR-TVC)	₦ 411,720.02- ₦ 124,467.5= ₦ 287,252.52				

 Table 3

 Average production cost per hectare of waterleaf enterprise

Source: field survey, 2008.

This implies that urban agriculture is profitable in the study area. This amount is more than the minimum wage rate (N=7500) per month in Nigeria. During the field work component of this study, most of the farmers expressed high level of satisfaction with the profit level of the business. These findings on waterleaf production in Akwa Ibom State are similar to that of Adewunmi (3), who worked on poultry enterprise in Ogun State, all in Southern Nigeria.

### Constraints to urban waterleaf production in the study area

During the field work component of this study, the farmers were asked, for each possible constraint, to tick whichever is applicable from among the options: SA= strongly agree, A= agree, U= undecided, SD= strongly disagree and D= disagree. The responses of the farmers to this question show that 100% of them agreed to lack of access to credit facilities as a constraint to urban waterleaf farming in the area. Enete and Achike (13) noted that if urban agriculture is to act as one of the options for tackling urban food insecurity, the urban poor (who are most often the urban farmers) should be sufficiently empowered financially not only to apply purchased inputs in the right quantities but also to adopt innovations in their farming business.

Scarcity of land was also adjudged a constraint by 97% of the respondents. This is to be expected because of the competition between infrastructural development and urban agriculture. In some cases as observed by Enete and Achike (13) in Ohafia, Southeast Nigeria, scarcity of land for urban agriculture forces farmers to rent/buy land in neighbouring rural villages. This was reflected in the average area of land cultivated by the respondents which was 0.065 ha.

Further, 98% and 94% of the respondents indicated poor visits by extension agents and high cost of planting materials respectively as constraints. Extension personnel are usually poorly mobilized, both in terms of wages and logistics, in Nigeria and hence they are also usually poorly committed to their jobs. The problem of high cost of planting material could also be connected with that of lack of credit access, because the farmers may not have been sufficiently empowered, financially, to adequately contain the cost of planting material. The observation by Enete and Achike (13) refers.

The problem of pests/diseases and low productivity were each reported by 20% of the farmers while the problem of theft was reported by 39% of them. These suggest that these three issues were of minor significance in the area, judging from the number of farmers that reported each of them.

#### Conclusion

Output of waterleaf in the study area was positively and significantly influenced by the farmers' educational level, household size, farm size, farming experience and quantity of manure and labour applied. The efficiency analysis indicates underutilization of land and manure and overuse of labour while the gross margin analysis showed that the farmers made profit. Labour accounted for the highest cost of production while lack of credit access was the major constraints facing the farmers. It is therefore recommended that labour saving technologies and credit facilities be made available to the farmers.

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