**ANALYSIS OF ALLOCATIVE EFFICIENCY AMONG DRY SEASON VEGETABLE FARMERS IN SOUTHWEST, NIGERIA**

**ABSTRACT**

Using the readily available and cost-effective resources to achieve the desired production goals is crucial to farmers in Nigeria.The study examined the allocative efficiency among dry season vegetable farmers in selected wetland areas in Southwest Nigeria. Multistage, purposive and random sampling techniques were used to select 450 vegetable farmers for the study. A structured interview schedule was used to collect data from the respondents.

Primary data were obtained on the respondents’ socioeconomic characteristics, yields of wetland vegetables production and cost of production. Data were analyzed using descriptive statistics and stochastic frontier production function.

Results indicated that the mean age of the respondents was 45years, with male dominating (74.20%). Most respondents (66.22%) cultivated an average of 0.38ha.The result revealed that at 1% probability level, the diagnostic statistics, sigma squared (0.025) and gamma (0.367), were statistically significant. Allocative efficiency (AE) estimates indicated that wetland vegetable farmers operated below the maximum efficiency with the mean of (0.65), suggesting that, with current technology, an average farmer has the potential to increase cost efficiency by 35%. Labour wage, cost of seed, cost of fertilizer, water, and rent on land were significant (p<0.01) while cost of herbicide and vegetable output were significant (p<0.10) denoting positive influence on the total cost associated with wetlands vegetable production. Additionally, age, education, and household size increase the allocative efficiency of farmers.

**Key words:** Allocative efficiency, stochastic cost frontier analysis, vegetable, and wetland catchment areas.

**1. INTRODUCTION**

Vegetables are edible plant parts such as flowers, fruits, stalks, leaves, roots, and seeds (Egwuonwu and Onyeaka, 2020). According to (Osei *et al*., 2017), vegetables are commonly farmed as a cheap and reliable source of protein, vitamins, zinc, and iron across the majority of Sub-Saharan Africa.

They have valuable nutritional components that can be used to strengthen and mend the body. Vegetables production and consumption are increasingly gaining popularity in Nigeria (Umar and Abdulkadi,2015). This is probably due to public awareness and concern about health safety.

Majorly, vegetable production is common among small scale farmers which make it unable to meet market demand (Tahir *et al.,* .2019). Currently, a wide gap exists between overall vegetable production and demand. The need to close food and nutritional gaps calls for urgent intensification of the production of vegetables in wetlands environment, which allows all year-round cultivation and production beyond the rainy season (Tahir *et al.,* .2019). Thus, wetland vegetable production has a great potential and its promotion could be one of the solutions to food shortage and unemployment. In Nigeria, wetland vegetable production has been on-going for decades, providing employment and income for the increasing population especially during the long dry season (Olutumise, 2022).

Despite the importance of wetland vegetable production, its cultivation yielded little fruit in augmenting demand (Ume *et al*., 2016). Low soil fertility, ineffective production methods that show up as technical and allocative inefficiencies, poor finance and inadequate extension officers are the main causes of the low yield (Oluwalana *et al.,* 2019). Similarly, a number of studies showed that Nigerian vegetable farmers used resources in an extremely inefficient manner which invariably led to cost exceeding profit realized from production (Omowunmi and Olatomide, 2015). Hence, to achieve productive efficiency, resources must be optimally utilized in terms of cost. Thus, effective resource management is helpful in attaining widespread economic growth.

According to (Onyenweaku *et al*., 2010), enhancing productivity through efficiency improvements is a more economical strategy for raising agricultural yield than using new technologies. Consequently, since achieving an optimally high level of output and productivity which may be achievable with the least expensive farm inputs—is the main objective of any production system. The ability of vegetable farmers to generate a certain level of output with inputs that cost the least at the current market price allows for the sustainability of wetland vegetable production.

Hence, increasing farmer productivity through better resource allocation especially for smallholder farmers who produce a larger percentage of the nation's vegetable consumption was necessary to increase the profit realized from vegetable output (Tahir *et al*., 2019). Also, allocating and managing resources at the farm level more effectively, might improve food security and improve profit level. It is crucial to measure how wetland vegetable produced a certain level of farm output at least cost.

Therefore, it was necessary to determine the allocative efficiency of Southwest Nigeria's wetland vegetable production. This paper examined the allocative efficiency among dry season vegetable farmers in Southwest, Nigeria.

* 1. **OBJECTIVES**

The specific objectives of the study were to;

1. Describe the socio–demographic characteristics of the farmers in the study area;

b. Examine the allocative efficiency of dry season wetlands vegetable production, and

c. Estimate **the** frequency distribution of allocative efficiency Wetlands Vegetable Production

**2. METHODOLOGY**

**2.1 Area of study**

The study was carried out in Southwest, Nigeria. Presently, the Southwest region in Nigeria has six states, viz., Ondo, Ekiti, Lagos, Ogun, Osun and Oyo, and distinctly divided into three major agro-ecological zones with varying climatic conditions (Awojuola. 2001). The study area is bounded in the East by Edo and Delta states, in the North by Kwara and Kogi states, in the West by the Republic of Benin in the south by the Gulf of Guinea. Divided into three major agro-ecological zones (Rain Forest zone, Swamp Forest zone and Derived Savanna zone) with vary climatic conditions.

**2.2 Method of Data Collection, Sampling Technique and Sample Size**

A multi-stage sampling technique was employed for this study. The first stage was the purposive selection of Oyo, Ogun, and Lagos States based on wetlands resources available across the area which favoured vegetable production and marketing in nearby urban settlements. The second stage involved random selection of four Local Government Areas (LGAs)’ that constituted expansive wetland catchments from each state. Then, in the third stage, 50% of the identified communities across the four Local Government Areas noted for dry season, wetlands vegetable production was selected. A totality of twelve wetland communities was thus drawn from each state based on their dependence on wetland vegetable production and their closeness to water bodies. In the final stage, respondents were randomly selected proportionally (10%) based on a list of vegetable growers gathered from the 36 locations. A total of 450 farmers were used for the study. Primary data were used for this study. Data for the study were collected with the aid of structured questionnaires. Data were collected based on allocative efficiency variables such as cost of seed, cost of labour, cost of fertilizer, agrochemicals, rent on land, and price of wetland vegetable output obtained in Naira. Data on socio- economic characteristics obtained include age, sex, marital status, educational background, farming experience, household size and frequency of extension visits.

**2.3 Method of Data Analysis**

The Cobb-Douglas stochastic cost frontier approach was used to analyse the cost efficiency in vegetable production within wetlands catchments. The explicit form of the stochastic cost frontier function, which was estimated for wetlands vegetable farmers are specified as follows:

Ln Ca = f(Pa ,Ya:β) + (Vi+Ui) (i)

Where:

Ca = Total cost of production of the ith firm,

Pa  = Input prices,

Ya  = Output of the ith firm,

β = Parameters to be estimated,

Vi = Systematic component which represents random disturbance cost due to factors outside the scope of the firm,

Ui  = One sided disturbance term used to represent cost inefficiency and is independent of Vi. The cost efficiency (CE) of an individual firm is defined in terms of the ratio of observed cost (Cb) to the corresponding minimum cost (Cmin) under a given technology:

 (2)

CE = exp(U) (3)

Where:

CE = Cost efficiency,

Cb= the observed cost and represents the actual total production cost;

Cmin = the minimum cost and represents the frontier total production cost.

CEE = exp (Ui) (4)

The empirical model of the stochastic frontier cost function is specified as:

lnCj= αo + β1lnP1 + β2lnP2 + β3lnP3 + β4lnP4 + β5lnP5 + β6lnP6+ β7lnYi+ Vj + Uj  (5)

Where:

Cj = Total production cost incurred by the ith farmer in wetland vegetable production (₦/Ha)

P1 = Cost of Labour or the wage rate (₦/manday);

P2 = Cost of seed (₦/Ha);

P3 = Cost of fertilizer (₦/Ha);

P4 = Cost of Agrochemical (₦/Litre);

P5 = Cost of transportation (₦);

P6 = Coat of Water (₦);

P7 = Land rentage (₦);

Y1 = Output (Kg/ grain equivalent).

α0, α1,.α7 = vector of estimated parameters.

Vj = Two-sided normally distributed random error

Uj = One-sided efficiency component with a half normal distribution

**2.3.1 Allocative Efficiency**:

Allocative inefficiency was estimated with the socio-demographic variables as the independent variables.

CE= δ0 + δ1W1 + δ2W2 + δ3W3 + δ4W4 + δ5W5 (6)

Where:

CE = Cost of inefficiency of the ith vegetable farmer

W1 = Age of farmer (years);

W2 = Farming experience (years);

W3 = Literacy level (years spent in school);

W4 = Family size (Number of people living in the same house);

W5 = Frequency of extension contact (Number of visits)

The parameters of the stochastic frontier cost function and cost inefficiency were estimated using the STATA 15.

**3. RESULTS AND DISCUSSION**

**3.1 Sociodemographic Characteristics of Wetland vegetable farmers in Southwest, Nigeria**

Table 1 presents the socio-economic characteristics of the respondents. The result revealed that 2.2 % among the respondents were less than 30 years of age, while 52.4% were between 41 and 50 years of age. Evidence showed that three-quarters of the respondents were between 31 and 50 years. The result conforms with (Ayeni *et al*., 2023) findings that younger people were much involved in vegetable farming in Nigeria. The outcome of the sex distribution of wetlands vegetable farmers indicated that 74.2% were male. Thus, the male respondents were relatively more in wetlands vegetable production than the female in the study area. This might be explained by the fact that women work more in vegetable marketing than in vegetable cultivation. The outcome was in line with the findings of (Ojo and Apata, 2023) that majority of wetland vegetable farmers were male. Southwest, Nigeria.

The result showed that 62.7% of the respondents had a family size of one to five members, while 35.6 % had less than 10 persons per household. The mean family size was five. Due to a relatively large family size, sizeable family labour is potentially available to the respondents. This is consistent with the findings of (Adeshina *et al*., 2020) that families are acknowledged as a significant source of labor supply which is crucial to farmers' efficiency. The result showed that 12.9% of those surveyed had no formal schooling, while 50.7 % had secondary school education. The relative level of formal education attained among wetlands vegetable farmers is expected to influence their behavioral pattern, production outcome, and remove fear of uncertainty due to drought or fluctuation in climate. The result agreed with Amadi (2023), that a farmer's decision-making will be greatly influenced by their level of schooling. The result reveals that 45.8% of the wetlands vegetable farmers had between 11 and 20years’ experience in farming, 39.8 per cent of them having between 21 and 30 years of farming. The average farming experience among the sample was 19 years, thereby indicating that the farmers on the average, have been in the vegetable business relatively for long, and should therefore be conversant with the vagaries in the endeavour. Amadi (2023), affirmed that farming experience promotes efficient use of scarce resources by smallholder farmers in Nigeria. The result in Table 1 also indicated that 83.8 % of the farmers cultivated between 0.10 and 0.50 hectares while 14.7% cultivated between 0.51 and 1.0 hectares of farm lands. The cultivated farmland average was 0.38 ha.

**Table 1. Descriptive Analysis of Socio-demographic Variables of Wetland Vegetable Farmers.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Frequency** | **Percentage** | **Mean** |
| Age |  |  |  |
| ≤30 | 10 | 2.2 |  |
| 31-40 | 97 | 21.6 |  |
| 41-50 | 236 | 52.4 |  |
| 51-60 | 95 | 21.1 |  |
| 61-70 | 10 | 2.2 |  |
| ≥71 | 2 | 0.4 | 45 |
| **Gender** |  |  |  |
| Male | 334 | 74.2 |  |
| Female | 116 | 25.8 |  |
| **Household size** |  |  |  |
| 1-5 | 282 | 62.7 |  |
| 6-10 | 160 | 35.6 |  |
| 11-15 | 8 | 1.8 | 5.0 |
| **Education** |  |  |  |
| No formal education | 58 | 12.9 |  |
| Primary | 116 | 25.8 |  |
| Secondary | 228 | 50.7 |  |
| Tertiary | 48 | 10.7 |  |
| **Farming Experience** |  |  |  |
| 10 | 33 | 36 |  |
| 11-20 | 206 | 45.8 |  |
| 21-30 | 179 | 39.8 |  |
| 31-40 | 29 | 6.4 |  |
| 41-50 | 03 | 0.7 | 19.0 |
| **Farm size** |  |  |  |
| 0.10 | 1.0 | 0.2 |  |
| 0.10-0.50 | 377 | 83.8 |  |
| 0.51-1.00 | 66 | 14.7 |  |
| 1.10-1.50 | 4 | 0.9 |  |
| 1.51-2.0 | 2 | 0.4 | 0.38 |

Source: Field Survey,2022

**3.2 Determinants of Allocative Efficiency of Dry Season Wetlands Vegetable Production**

The Maximum Likelihood (ML) estimates of the stochastic frontier cost function are presented in Table 2. The estimated model had a log likelihood value of 184.59 which is significant at 1%. This shows that the model was correctly specified and that the included explanatory variables collectively explained the variations in wetlands vegetable production cost. The variance ratio (γ = 0.367, p<0.01) indicating that 37 per cent variation arising from allocative inefficiencies. The sigma squared (δ2 = 0.025, p<0.01). This reveals good fit and correctness of the specify assumption of the composite error term distribution. The estimated coefficients of cost are all positive and significant except transport cost which is not significant. This implies that as these factors increased, cost associated with the wetland vegetable production increased. The coefficient of the cost of labour (β=0.423, p< 0.01), this connotes that when the cost of labour increases by 1%, the total cost of production would increase by 0.423% revealing that vegetable farmers incur more labour cost. This may be due to the fact that most operations are done manually which resulted into increase in the number of individuals engaged in vegetable production. Nwahia *et al*. (2020), reported that labour cost determined the total cost of production among farmers in Nigeria.

The estimated coefficient of the cost of seed (β=0.055, p<0.01), this implies that cost of seed in wetland vegetable production has a positive relationship with total cost outlay. The implication is that increase in the cost of seed by 1% will bring about 0.055 per cent increase in the total cost of production of vegetables in the study area. The lower coefficient suggests that some farmers had a practice of planting seeds from previous stocks in the next growing season. The result is in conformity with (Hassan *et al.,* 2020) that the price of seeds has a significant impact on the total cost of production. Similarly, the coefficient of the cost of fertilizer was (β =0.017, p<0.01) and positively significant at 1%. This implies that the cost of producing wetland vegetables will increase by 0.017 % for every unit increase in fertilizer costs. Hassan *et al.* (2022), that the cost of fertilizer factor influenced allocative efficiency among Nigerian small-scale farmers in Nigeria.

The coefficient of agrochemical (0.002, p<0.10), revealing that the price of agrochemicals has a favorable and substantial impact on the overall cost of production. This means that a unit increase in the cost of agrochemicals will result in 0.002% increase in total cost of production. The lower coefficient could be as the result of low usage of agrochemicals among the farmers. (Hassan *et al.,* 2020) revealed positive relationship between cost of production and agrochemicals. The coefficient of water was statistically significant (β= 0.009, p<0.01). This is an indication that 1 per cent increase in the cost of water, increase production cost by 0.01%. The result shows that farmers were not really spending much on water supply due to the nature of the soil. Coefficient of land rent (0.008) is significant at 1 %. This shows that the cost of wetlands vegetable production increase by 0.008 as the cost of land rent increased by 1%. The lower coefficient could be as a result of little money charged on land. The coefficient of output (β =0.022, p<0.10) implying that, 1% increase in vegetable output will result into 0.022% increase in total cost of production. The lower coefficient indicates that some of the vegetable farmers were producing vegetable without minding the outcome of the output and cost attached to production processes.

Table 2 also presented the determinants of allocative inefficiency among wetlands vegetable farmers. The result showed that three explanatories’ variables out of the five included in the model, were significant. Age of the respondents (δ = -0.001, p<0.01) had significant effect on cost efficiency. Hence, as farmers’ increase in age, allocative inefficiency decreases. It implies that older farmers are more efficient in allocating their resources than the younger ones. This could be as a result of farming experience and adoption of new farming technique. The finding agrees with (Nwahia *et al*., 2020) that older farmers typically place a great value on reducing production expenses.

Similarly, the coefficient of education indicated a negative sign for the total cost incurred in the production of vegetable. This was significant at 10% level. The result from the respondents however implied that increase in the level of education of farmers may tend to decrease cost inefficiency. The higher the number of the years of schooling the lower the cost inefficiency in vegetable cultivation. The result tends to suggests that educated wetlands vegetable farmers would be relatively more cost efficient due to better decisions taking in farm inputs cost that will minimize cost and maximize profit or increase wetlands vegetable output. The result is in agreement with (Adeshina *et al.,* 2020) assertion that the level of education determines the allocative levels, efficiency and adoption of new innovation.

The coefficient of the household size for sampled vegetable farmers was negative and significant at 5% probability level. Evidently, only a reduction in house hold size would significantly enhance allocative efficiency in wetlands vegetable production. Larger household size tends to enhance cost efficiency. This may be attributed to cheap family labour available for wetlands vegetable cultivation, which invariably reduces cost of production.

**Table 2: Determinants of Vegetable Farmer’s Production Costs and Inefficiency**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Coefficient** | **Standard Error** | **p-value** | **t-ratio** |
| Constant | 5.685\*\*\* | 0.190 | 0.000 | 29.79 |
| Labour | 0.423\*\*\* | 0.015 | 0.000 | 27.31 |
| Seed | 0.055\*\*\* | 0.010 | 0.000 | 5.81 |
| Fertilizer | 0.017\*\*\* | 0.002 | 0.000 | 7.61 |
| Herbicide | 0.002\* | 0.002 | 0.092 | 1.02 |
| Transport | 0.001 | 0.001 | 0.306 | 6.01 |
| Water | 0.009\*\*\* | 0.013 | 0.000 | 6.97 |
| Rent | 0.008\*\*\* | 0.013 | 0.000 | 1.70 |
| Output | 0.022\* | 0.013 | 0.089 | 5.311 |
| **Inefficiency** |  |  |  |  |
| Age | -0.001\*\*\* | 0.002 | 0.000 | -0.024 |
| Experience | 0.008 | 0.013 | 0.487 | 0.017 |
| Education | -0.039\* | 0.021 | 0.031 | -0.064 |
| Household size | -0.14\*\* | 0.049 | 0.000 | -0.23 |
| Extension visits | -0.219 | 0.185 | 0.604 | -0.819 |
| **Diagnostic** |  |  |  |  |
| Sigma square | 0.025 | **0.017\*\*\*** | **-** |  |
| Gamma | 0.367 | **-** | **-** |  |
| Loglikelihood Function | 184.59 | **-** | **-** |  |
| Mean | 0.65 | **-** | **-** |  |

Note: \*\*\*, \*\* and \* significant at 1%; 5%; and 10%.

**3.3 Estimate the frequency distribution of allocative efficiency Wetlands Vegetable Production**

The frequency distribution of Allocative Efficiency (AE) for the wetland vegetable farmers is presented in Table 3. The table revealed that AE indices for the wetland’s vegetable farmers ranged from 0.18 to 0.89 with a mean of 0.65 %. This implies that the best practicing vegetable farmers operated at 89 % efficiency, while the worst practicing farmers operated at about 0.18 percent efficiency level. The frequency scores in the table indicate that the highest proportion 86.67% of vegetable farmers had AE of 50 to 89 %. Additionally, the result thus showed that the reminder (13.33%) of the sampled vegetable farmers had their allocative efficiency estimates ranging between 20 and 49%.

Evidently, majority of the farmers operating near the allocative efficiency frontier which is 100 per cent. The best allocatively efficient farmer would require just about 11% cost saving to achieve the optimum efficiency level while the least allocatively efficient farmer would require about 82% improvement to attain maximum allocative efficiency level. The result revealed that farmers in the study area were fairly allocatively efficient in producing dry season vegetables given the inputs prices, the producer price and the available production resources.

**Table 3: Frequency Distribution of Allocative Efficiency Estimates Wetlands Vegetable Production**

|  |  |  |
| --- | --- | --- |
| Allocative level | Frequency | Percentage |
| 0.10-0.19 | 3 | 0.67 |
| 0.20 -0.29 | 11 | 2.44 |
| 0.30-0.39 | 17 | 3.78 |
| 0.40-0.49 | 29 | 6.44 |
| 0.50-0.59 | 63 | 14.00 |
| 0.60-0.69 | 120 | 26.67 |
| 0.70-0.79 | 137 | 30.44 |
| 0.80-0.89 | 70 | 15.56 |
| 0.90-1.0 | - | - |
| Mean Allocative Eff. | 0.65 |  |
| Standard Deviation | 0.16 |  |
| Minimum | 0.18 |  |
| Maximum | 0.89 |  |

Source: Field Survey, 2022

**4. CONCLUSION AND RECOMMENDATIONS**

Wetland vegetable farmers in the study area had a mean allocative efficiency of 0.65, which suggests that, given the market price of farm inputs and current technology, an average vegetable farmer's allocative efficiency could be increased by 35% through better utilization of available resources in the optimal proportion. Age, education and household size influenced allocative efficiency of wetland vegetable farmers. Therefore, policy aimed at enhancing farmers education and provision of farm inputs at subsidized rate should be introduced to improve allocative efficiency among wetland vegetable farmers in the study area.

**COMPETING INTERESTS:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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