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Efficiency of the resources used in yam production by yam farmers in Ogoja local government area of Cross-River State

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Abstract

This study examined the efficiency of resource utilization in yam production among farmers in Ogoja Local Government Area of Cross River State, Nigeria. The research was guided by three specific objectives and corresponding research questions. The target population comprised yam farmers within the study area, while the sampling frame was derived from the Agricultural Development Programme (ADP) register of contact farmers. A multi-stage sampling technique was employed to select a sample of 60 respondents.

Primary data were collected using a structured questionnaire administered through scheduled interviews, complemented by personal observations and farm record assessments. The research instrument was subjected to expert validation by a specialist in Agricultural Economics and Extension to ensure its content validity and reliability.

Data analysis involved both descriptive and inferential statistical techniques. Descriptive statistics, including means, medians, and percentages, were used to profile the socio-economic characteristics of respondents and identify constraints affecting yam production. Resource-use efficiency was evaluated using marginal analysis, specifically the Marginal Value Product (MVP) to Marginal Factor Cost (MFC) ratios. A multiple regression model was further applied to estimate the production function coefficients and determine the contribution of key inputs to yam yield.

The findings revealed that major production resources were overutilized, indicating inefficiencies in input allocation. This suggests the need for improved resource management practices and the adoption of labour-saving technologies to optimise productivity and reduce production costs. Based on these results, the study recommends enhanced engagement with extension services, targeted training on efficient input application (particularly fertilizers and pesticides), strengthened farmer participation in cooperative societies to improve access to credit, and increased adoption or leasing of labour-saving mechanisation options.

Keywords: Efficiency, resources, yam production, yam farmers, cross-river state

Introduction

Yams (Dioscorea spp.) are starchy staples in the form of large tubers produced by annual and perennial vines grown in Africa, the Americas, the Caribbean, the South Pacific and Asia. There are hundreds of wild and domesticated Dioscorea species. White Guinea yam, botanically *Dioscorea rotundata*, is the most important specie especially in the dominant yam production zone in West and Central Africa. It is indigenous to West Africa, as is the Yellow yam, *D. cayenensis*. Water yam, *D. alata*, the second most cultivated species, (International Institute of Tropical Agriculture, 2017). Yam is an important dietary element for many West African people. It contributes more than 200 calories per person per day for more than 150 million people in the region. It is rich in starch and can be prepared in many ways. It is available all year round, unlike other seasonal crops. These characteristics make yams a preferred food and a culturally important food security crop (Olumese and Izekor, 2010). Although yam production in Africa is 40% that of cassava, the value of yam production exceeds all other African staple crops and is equivalent to the combined value for the top three cereal crops – maize, rice and sorghum (IITA, 2017).

Yam is a global food, and it is the mainstay, providing income and food security to about 300 million people in West Africa (International Institute of Tropical Agriculture, 2015). According to the Food and Agriculture Organisation, Nigeria is ranked the highest producer of yam accounting for more than 60% of the global production (Central Bank of Nigeria, 2016) [14]. Yams exports generate foreign exchange for Nigeria's Economic activities. The crop sector has been and remains the dominant component of the nation's Agriculture (CBN, 2016). Yam is also an imperative food, playing a significant role in the socio-cultural life of the Nigerian people. It is an important component of marital and betrothal requirements in most regions of the country. It also has a noteworthy social status in gatherings and religious functions, which is assessed by the size of the yam holdings one possesses. It is in some areas celebrated annually during the New Yam Festival, a ritual to thank the god of Agriculture for a bumper harvest. (IITA, 2015), specifically in the South-eastern part of the country, the Igbos celebrate the New Yam festival to thank god for a great harvest. It is culturally rooted in the ancient agrarian Igbo society where wealth is measured by the quantity of yam barns owned. A prestigious guest will only receive yam (Fufu) rather than any other meal in confirmation that he is held in high esteem by the host. In the south-south region, especially in Cross River State, the New Yam Festival (Ipem-Ihihe) is celebrated annually, marking the end of the planting season. In this regard, harvested yams are displayed, and the farmer with the Largest Yam is given the title for the year, special recognition and a prize, as Yam is seen as the king of all crops.

Despite the importance in the economy and culture of the people, the crop faces several constraints that significantly reduce its potential to support rural development and meet consumers' needs for improved food security and enhanced livelihood (IITA, 2015) [11].

Overview of Yam and Its Production in Nigeria

Yam is the common name applied to plants of about 500 species of the genus *Dioscorea* of the Dioscoreaceae family. True yam plants are climbing perennial vines with heart-shaped leaves. Underground tubers vary in size and shape, averaging 3-8 pounds but sometimes reaching 60 pounds or more, Aerial tubers may develop in the axils of the leaves, especially when vines run on the ground, (Ajijola, Awoyemi, Oluwatayo, Aduramigba-Modupe, & Odetola, 2014) [2]. In Nigeria, whole seed tubers or tuber portions are planted into mounds or ridges, at the beginning of the rainy season, but in Cross-river State, yam is traditionally planted into mounds, the size of the mound varies from place to place depending on the size of the setts and the hydromorphic nature of the soil, (Tiku & Enoibor, 2012) [20]. The crop yield depends on how and where the setts are planted, size of mounds, interplant spacing, provision of stakes for the resultant plants, yam species, tuber sizes desired at harvest and in most cases, the overall input combination, (Abdullahi, 2015) [1]. The most common planting material used are the seed yams, these are generally perishable, hence problematic to store and bulky to transport. Farmers do not generally buy new seed yams, usually setting aside up to 30 percent of their previous harvest for planting the next year. Yam typically grows for six to ten months and is dormant for two to four months, depending on the species, the growth and dormant phases correspond respectively to the wet season and the dry season (IITA, 2017). For maximum yield the yam requires a humid tropical environment, with an annual rainfall of over 1,500 millimetres distributed uniformly throughout the growing season. White, yellow and water yams typically produce a single large tuber per year, generally weighing 5 to 10 kg. This means that only one crop cycle is possible per year, possibly restricting supply (Maroya *et al*., 2014) [12].

Yam is also highly vulnerable to a plethora of pests and diseases, as well as population pressure and climate change, and their growing demand has driven cultivation of this crop onto less fertile land (IITA, 2017). Yam production is therefore concentrated in the forest and savannah (the derived and southern guinea savannah) environments. Though yam is grown in all parts of the country (National Bureau of Statistics, 2020) [13], yam production is intense in the agro-ecological zones in the central and southern parts of the country. The most important area for yam production, with over 50% of cultivated land under the crop, covers Ikom, Obubra and Ogoja of the Cross-River State and Abakaliki in Ebonyi State (Bassey, 2017) [4]. The predominance of yams in the yam-producing area is due to the low incidence of export tree crops capable of limiting arable crop production, the high proportion of farmers who grow the crop, its position in crop combinations and the social status attached to the crop (Bassey, 2017) [4]. Generally, due to the high socio-cultural value attached to yams, all regions grow yams, though in much lower quantities in the Northern region, since the arid climate is not well-suited for yam production (Abdullahi, 2015) [1].

Yams are deeply tied to the lives, livelihoods and cultures in West Africa and among Africans in diasporas (Damulak, 2012) [6]. In many parts of Nigeria, it is believed that "Yam is Food" and "Food is yam". At the regional level, yam is a superior economic good in all countries. As incomes increase, consumers shift from cassava to yams. This is related in part to cultural preferences (Sanginga, 2015) [19]. Although yam production in Africa is 40% that of cassava, the value of yam production exceeds all other African staple crops and is equivalent to the combined value for the top three cereal crops – maize, rice and sorghum (IITA, 2017).

The foremost uses of yams are for human consumption, income generation, and for social, cultural, or religious events (Abdullahi, 2015) [1]. Farmers engage in yam cultivation for household food supply; income generation through marketing ware yams; and production of planting material to meet their own needs and generate some income from the sale of surplus seed yams (Sanginga, 2015) [19]. Most commonly, yam tubers are usually eaten boiled, baked, grilled or fried. *Fufu*, a popular yam dish, is a stiff, gelatinous dough prepared by pounding peeled boiled tuber pieces in a mortar. In most yam-growing areas, damaged tubers are often peeled, sliced and sun-dried shortly after harvest to extend their useful life (Abdullahi, 2015) [1]. The dried slices are commonly milled into flour, which is reconstituted with water and boiled to produce *Amala*, a thick brown paste or porridge served with soup. The dried slices are also used to produce feed for livestock. Yam has a potential to be used for industrial starch manufacturing, and yam by-products also have limited uses in pharmaceutical manufacturing (Abdullahi, 2015) [1]. Yams are also important as sources of pharmaceutical compounds like saponins and sapogenins, which are precursors of cortisone and steroidal hormones (Bassey, 2017) [4]. Yam tubers are high in moisture content; they contain about 60% - 85% moisture while their dry matter content ranges between 7% - 40%. This observed high moisture content influences the keeping quality of tubers adversely (Bassey, 2017) [4].

In terms of protein and fat, yam tubers may not be considered a very rich food source. Yam tubers are good energy sources, and the energy is derived mainly from carbohydrates since the tubers are low in fats (Abdullahi, 2015) [1]. Most of the yam species may be considered rich in three minerals, namely: calcium, phosphorus and iron, The vitamin contents of some yam tubers include carotene (pro-vitamin A), thiamine, riboflavin, niacin (nicotinic acid) and ascorbic acid, Whole yam proteins are low in histidine, methionine, leucine, isoleucine, and valine, these limiting amino acids in the yam tubers are the sulphur containing amino acids, (Bassey, 2017) [4]. Hence, yams are low in sulphur but contain other essential minerals.

In general, Yams have significance over and above other crops in the region. Despite its regional importance, yam has received relatively little attention from researchers and extension services relative to crops such as cassava and sweet potato (Maroya *et al*., 2014) [12]. While productivity and even total production are stagnating or even declining in some areas, the amount of crop and forest land allocated to the crop is still growing rapidly (Sanginga, 2015) [19].

Current trends in yam production

According to CBN (2012), Nigeria's Yam production was 34 million tonnes in 2005 and by 2006 increased by 8% to 35.017 million tonnes. According to 2008 figures, yam production in Nigeria has nearly doubled since 1985, with Nigeria producing 36.7 million metric tonnes with value equivalent of $5.654 million annually (CBN, 2012;

Abdullahi, 2015) [1, 6]. Internationally, world production figures in 2011 rose to 56 million tonnes, with Nigeria producing about 37.1 million tonnes, representing 67% of world production (FAO, 2012) [18]. Subsequently, Nigeria produced over 45,004,340 metric tonnes in 2014 (FAO, 2014) [8], which is attributed to the combined effort of the National Root Crops Research Institute and IITA, Ibadan (Bassey, 2017) [4]. Currently, West Africa accounts for 93% of global yams (IITA, 2017). In Nigeria, yam production is valued at $13.7 billion, exceeding that of cassava, maize, sorghum, millet, and rice combined (IITA, 2017). Yam prices have been increasing in recent years due to strong demand for the crop in Africa, Europe and even in the United States of America, where rapidly growing West African migrants' communities still have a big appetite for their traditional preferred staple (Abdullahi, 2015; Bassey, 2017) [1, 4]. Nigeria exported US $27.7 million worth of yams to the United States of America in 2011 (Bassey, 2017) [4], and it is expected that much foreign exchange through the yam trade would be realised in future.

Agriculture contributed 23.38% to nominal GDP in the fourth quarter of 2019, higher than the rates recorded for the fourth quarter of 2018 but lower than the third quarter of 2019, which recorded 23.08% and 25.88% respectively, (NBS, 2020). The full year 2019's contribution stood at 22.12%, higher than the 21.43% recorded in 2018, The Food Crop Sub-sector (with maize, sorghum, millet, rice, yam, cocoyam and cassava as the main food crops grown in the country) contributed about 28% to GDP representing about 75-76% of the share of the agricultural sector's contribution to GDP (Central Bank of Nigeria, 2019; Toluwase & Sekumade, 2017) [21]. Consequently, Crop Production under the Agriculture sector grew by 2.51% in the full year 2019 from 2.26% in 2018 and 3.64% in 2017 (NBS, 2020). Crop Production remains the major driver of the Agricultural sector, and the Agricultural sector continues to be the leading earner of foreign exchange from non-oil exports (Abdullahi, 2015 [1]; NBS, 2020). Despite the increase in the overall contribution of the crop sector of agriculture in the GDP, it was observed that there was a negative growth in the contribution of the yam production as it declined from 3.3% in 2017 [4] to 3.2% in 2018 (Central Bank of Nigeria, 2018) [5]. Though the price of yam tubers increased by 2.1% in 2019 (CBN, 2019). The average price of 1kg of yam tuber decreased year-on-year by –8.60% and month on month by -6.66% to N193.04 in January 2020 from N206.82 in December 2019 (National Bureau of Statistics, 2020) [13]. It can be deduced that yam production has been on a decline even presently. This declining trend observed in yam production may not be unconnected with inefficiency of resource use and allocation (Nsikak-abasi, Thompson, & Onyenweaku, 2013) [16].

Resource Utilization in Yam Production

Yam production has undergone some dramatic changes in many parts of the world. However, the production process from bush clearing, cultivation, chemical application, harvesting and transporting to markets is still labour-intensive (Verter & Bečvářová, 2015) [23]. In addition, farmers must save up to one-third of their harvested crop as seed for planting in the next season. (IITA, 2017). The farm hectarage of yam production has been increasing over the years with corresponding increases in usage of inputs such as fertilisers, herbicides, yam seeds and other agro-chemical inputs (Abdullahi, 2015; Reuben & Barau, 2012) [1, 18]. Unfortunately, the increases in outputs seem not to have been commensurate with those in input usage. It would seem that whereas the inputs were used at an increasing rate, the resultant outputs were increasing at a decreasing rate (Reuben & Barau, 2012) [18]. An increase in yam production in Nigeria has been achieved dominantly through expansion in cultivated area (Fu, Kikuno, & Maruyama, 2011) [9]. Implying that there has been little comparable improvement in productivity. Zaknayiba & Tanko, (2013) [24] further averred that major tuber crops have too low outputs to justify the increasing cost of modern farming inputs, especially fertilizer. The last three decades have not only witnessed a decline in the role of yam production but also a decline in the traditional role of agriculture to drive the economy (Zaknayiba & Tanko, 2013) [24]. Increased agricultural output is, however, required for the reduction of widespread hunger and poverty. Decreased output in agriculture has led to continued importation of food to meet the needs of the ever increasing population (Effiong, Idiong, & Emem, 2018) [7]. The bulk of agricultural outputs are presently being produced by resource-poor farmers with low income and high incidence of poverty (Zaknayiba & Tanko, 2013) [24].

Identification and evaluation of the major inputs used in yam production is, thus, very relevant in order to sustain and increase the level of production and total output of this important staple food/emerging industrial crop (Reuben & Barau, 2012) [18].

Concept of Efficiency in Agriculture

The efficiency of a firm can be defined as its ability to produce the largest possible quantity of output from a given set of inputs (Nsikak-abasi *et al*., 2013) [16]. Economic efficiency occurs when a firm chooses resources and enterprises in such a way as to attain economic optimum (Toluwase & Sekumade, 2017) [21]. The modern theory of efficiency dates back to the pioneering work of Farrel (1957), who drew extensively from the earlier works of Debreu (1951) and Koopmans (1951) to define a simple measure of firm efficiency, which could account for multiple inputs, Farrel identified two components of firm efficiency as technical and allocative efficiencies and the combination of these two components provides a measure of economic efficiency, (Nsikak-abasi *et al*., 2013) [16]. Technical efficiency can be measured either as input-conserving oriented technical efficiency or output-expanding oriented technical efficiency. Allocative efficiency, on the other hand, which is more pertinent to this study, relates to the degree to which a farmer utilizes inputs in optimal proportions, given the observed input prices (Nsikak-abasi *et al*., 2013) [16]. The optimum implies that a given resource is considered to be most efficiently used when its marginal value productivity is just sufficient to offset its marginal cost (Esiobu, Nwosu, & Okereke, 2014) [8]. The Marginal Value Productivity (MVP) has been described as the yardstick for measuring efficiency of resource use at a given level of technology and prices of inputs and outputs (Effiong *et al*., 2018) [7]. The MVP provides a blueprint for effecting resource adjustment on the farm. A firm maximizes its profit with respect to an input if the ratio of its MVP to its MFC is one. A ratio of less than unity shows over-utilisation of the resource, and profit would be increased by decreasing the rate of use of that input. A ratio greater than unity shows under-utilization of resources; an increase in the rate of use of that input will increase the level of profit of the firm (Esiobu *et al*., 2014) [8]. The difference between the MVP and the MFC indicates the level of resource use and also gives the scope of resource adjustment necessary to attain economic optimum (Effiong *et al*., 2018) [7].

Agricultural Productivity and Resource Use Efficiency

Agricultural productivity is defined as a measure of efficiency in which an agricultural production system employs land, labour, capital and other resources towards producing outputs (Effiong *et al*., 2018) [7]. An efficient farm makes better use of existing resources and produce their output at the lowest cost. Resources are considered to be at their highest and best use when they are put into use with the highest comparative advantage to other uses (Toluwase & Sekumade, 2017) [21]. The efficiency of resource use can therefore be assessed from the productivity of the output. This is an imperative issue of the present time, because resource use efficiency issues are the core elements of sustainable crop production in farming activities. Where existing resources such as land, labour, capital and managerial resources are inefficiently allocated, there would be a corresponding decrease in agricultural productivity and reduction in agricultural output (Effiong *et al*., 2018; Toluwase & Sekumade, 2017) [7, 21].

Nigeria, as a country, is endowed with a large expanse of land possessing tremendous potential resources and a favourable climate for producing food and other raw materials for export, domestic and industrial use. Although about 70% of its population is engaged in agriculture, the reality is that Nigeria is yet to attain self-sufficiency in annual food production (Ndubueze-Ogaraku & Ekine, 2014) [15]. The constraint to the rapid growth of food production seems to be that of low crop yields as a result of inefficient allocation of available farm resources. Previous studies carried out on food crop production in Nigeria have shown that food crop farmers have low productivity because of inefficiency in resource use (Abdullahi, 2015) [1]. Furthermore, Effiong *et al*. (2018) [7] established that in Agriculture, low yields are because of inefficient allocation of the available resources, with non-uniformity in distributed farm sizes, labour-intensive agricultural technology and rapidly declining soil productivity. Inefficient use of inputs can jeopardise food availability and its security (Toluwase & Sekumade, 2017) [21]. Inefficient resource allocation could also limit the level of returns to an enterprise and, in turn, affect its attractiveness for resource allocation (Ajijola *et al*., 2014) [2]. In order to achieve increased production, these resources must be available, and whatever quantities are available must be efficiently used (Effiong *et al*., 2018) [7]. Efficiency analysis is a subject of interest among economists in recent times, given that the overall productivity of an economic system is directly related to the efficiency of production of the components within the system (Esiobu *et al*., 2014) [8].

Optimal productivity of resources involves an efficient utilization of resources in the production process (Effiong *et al*., 2018) [7]. The farm-level efficiency of farm resources has important implications for the agricultural development of a nation (Esiobu *et al*., 2014) [8]. Increase in resource efficiency is, therefore, a prerequisite for increased agricultural production. The question of how efficient farmers use farm resources in various enterprises is therefore of considerable interest to agricultural economists (Effiong *et al*., 2018; Esiobu *et al*., 2014) [7, 8]. It is hereby imperative that this study be carried out among yam farmers in the selected study area.

Constraints in Yam production in Nigeria

According to Bassey (2017) [4], The major challenges in yam production can be categorized into ten groups: weed pressure, decline in soil fertility, soil borne pests and diseases, leaf disease, storage pests and diseases, labour cost for land (heap) preparation, and barn making and lack of staking materials, use of traditional technology for production of seed yam, scarcity of planting materials. Other constraints indicated by farmers include lack of effective extension services, lack of suitable land, and inadequate funds to carry out farming activities (Reuben & Barau, 2012) [18]. Lack of access to the available extension services proved another constraining factor (Ume, Kaine, & Ochiaka, 2020) [22]. Similarly, in a study carried out by Abdullahi (2015) [1], the constraints identified in the study areas was majorly inadequate access to credit and poor transportation networks, which is in conjunction with the findings of Ajijola *et al*., (2014) [2]. This is specifically true because where farmers have poor access to credit and have inadequate funds, there would be an inability to purchase necessary inputs such as fertiliser, pesticides, herbicides, as well as acquiring relevant technologies that should steer production. Furthermore, farmers are prompted to keep at least 30% of their harvest as planting materials for the next season; the scarcity of planting materials makes yam production very cumbersome. Yam production is also labour-intensive; sourcing for labour could also constrain yam production in various areas where it is produced. However, Studies infer that farmers sparsely use pesticides because of their high cost and adulteration. As a result, many of the farmers use Indigenous known Technology (IKT), which is often associated with the problem of low efficacy and consequently losses of agricultural produce (Ume *et al*., 2020) [22].

Statement of the problem

Though Agriculture still remains the largest sector of the Nigerian economy and employs two-thirds of the entire labour force, the production hurdles have significantly stifled the performance of the sector (Food and Agriculture Organisation, 2020). Nigeria has faced serious challenges in lifting its production to a level of global competitiveness (Financial Derivative Company, 2019). Over the past 20 years, value added per capita in Agriculture has risen by less than 1% annually (Akindele, Ayok, Dada, 2017). Although there has been a recent rise in productivity, it was derived more from expanded planting areas for staple crops than from yield increase (IITA, 2015) [19]. The agricultural sector's changing shares of GDP are partly a reflection of the relative productivity of the sector, since increased output and productivity are directly related to production efficiency (Tiku, 2012) [20]. Yam is among the top five agricultural products in Nigeria, with a production rate of about 44,661,000 tonnes annually (Akindele *et al*., 2017). The growth rate of yam outputs over the past years has been far from consistent (Nahanga & Becvarova, 2015). This inconsistent growth rate observed corresponds with the findings of the International Institute of Tropical Agriculture in 2016, Yam productivity per hectare has been relatively low, being stagnant or declining due to a number of factors. Such factors could be the decline in the unit output from the various agricultural inputs, decline in soil fertility, soil borne pest and diseases, inadequate planting materials, high cost of labour, labour-intensive operations or even the marketing of the product (Sanginga, 2015) [19]. The declining trend observed in yam production may also not be unconnected with inefficiency of resource use and allocation (Nsikak-abasi, Thompson, Onyenweaku, 2013) [16]. Research has been carried out to proffer solutions concerning the various constraints in Yam production but resource use efficiency has received little attention, this is in conjunction with the findings of the International Institute of Tropical Agriculture in 2015, which indicates that Yam, though a highly appreciated staple crop in most of West and Central Africa, still has limited knowledge on its input use efficiency. Unavailability and high cost of inputs have been observed to be major constraints to Yam production, but the ability to efficiently manage these inputs even when available poses a greater challenge. Inefficiency of resource utilisation can totally jeopardise and hamper food production, availability and security (Etim *et al.,* 2013) [16]. The efficient method of production is that which uses the least amount of resources to get a given amount of the product. The analysis of efficiency is generally associated with the possibility of farms producing a certain optimal level of output from a given bundle of resources or a certain level of output at least cost (Tiku, 2015). Hence, it is vital for Yam farmers to manage their resources optimally for increased and sustainable yam production (Etim *et al*., 2013). It is against this backdrop that the study seeks to examine the resource use efficiency of yam production in the study area.

Objectives of the study

The broad objective of the study is to determine the efficiency of the resources used in yam production by Yam farmers in Ogoja Local Government Area of Cross-River State. The specific objectives of the study were to:

1. Describe the socio-economic characteristics of yam farmers in the study area.
2. Determine the resource use efficiency in yam production in the study area.
3. Identify the major constraints to yam production in the study area.

Research Questions

The following research questions guided the study

1. What are the socio-economic characteristics of yam farmers in the study area?
2. Is the resource use efficiency in yam production in the study area?
3. What are the major constraints to yam production in the study area?

Methodology

The study was carried out in Ogoja Local Government Area in Cross River State, Nigeria. Its headquarters is Ogoja town in the northeast of the area, near the A4 highway at 6°39′17″N 8°47′51″E. It has an area of 972 km² and a population of 242,259 at the 2015 [11] census. Cross River State is a coastal state located in the Niger Delta region, and occupies 20,156 square kilometres. It shares boundaries with Benue State to the north, Ebonyi and Abia States to the west, to the east by the Cameroon Republic and to the south by Akwa-Ibom and the Atlantic Ocean. Cross River State consists of eighteen (18) Local Government Areas.

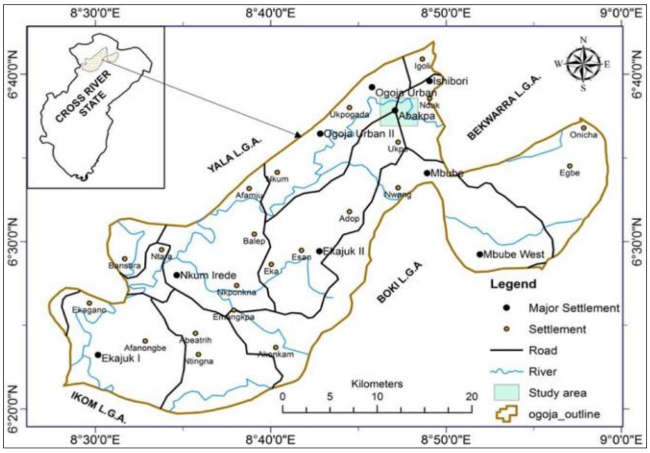

Fig 1: A Map of Ogoja Local Government Area

The study area, Ogoja LGA consists of ten wards; Urban 1, Urban II, Nkum Irede, Nkum Ibor, Mbube West I, Mbube West II, Mbube East I, Mbube East II, Ekajuk I, and Ekajuk II. Their major source of livelihood is subsistence agriculture, basically farming of cassava, yams, palm oil, and palm wine amongst others. The target population consisted of farmers involved in the cultivation of yam in Ogoja Local Government Area of Cross-River State. The sampling frame was a list of ADP contact yam farmers in Ogoja Local Government Area. To determine the sample size, a multi-stage sampling procedure was employed in this study; it comprised of 3 stages. The first stage involved the selection of 3 wards from Ogoja LGA; Mbube East, Ekajuk I & Nkum-Irede. In the second stage, purposive sampling was used to select 2 communities in each ward, giving a total of 6 communities. This selection was based on the characteristics of the communities, as these selected communities specialise in yam production. The third stage involved randomly selecting 10 yam farmers in each of the 6 selected communities. Therefore, a total of 60 respondents was considered during the study as the sample size. The data used for this study were essentially from primary data sources, which included the use of a questionnaire showing various enquiries that were obtained from the yam farmers and from secondary data source which included data already published in books and journals. The major instrument used to collect primary data were structured questionnaire, which was administered to yam farmers through scheduled interviews in addition to the use of personal observations and farm records. Validity of the research instrument was carried out to ensure the reliability of the research instrument (structured questionnaire) by an expert in the Department of Agricultural Economics and Extension, who is the supervisor of the project. The data collected for objective one were subjected to descriptive statistical tools. Tools such as mean, median, and percentage were used to present and categorise the socio – economic characteristics of the respondents and constraints of yam production in the study area. The data collected for objective two were subjected to marginal analysis, specifically the MVP/MFC test. The efficiency of the resources used was assessed based on the ratios of the marginal value product (MVP) to the marginal factor cost (MFC). A multiple regression model was used to derive the coefficients of the variables based on the yield of yams.

Results

Socioeconomic Characteristics of the Respondents

The results of the demographic and socio-economic characteristics of farmers is presented in

Table 1: Socioeconomic Characteristics of the Respondents

Items	Frequency (n=60)	Percentage	Mean
Gender: Male	31	51.7	
Female	29	48.3	
Age: 21-30 years	6	10.0	
31-40 years	17	28.3	
41-50 years	16	26.7	46 years
51-60 years	15	25.0	
61-70 years	6	10.0	
Marital Status:			
Single	5	8.3	
Married	45	75.0	
Separated	6	10.0	
Divorced	4	6.7	
Household Size:			
1-3 persons	15	25.0	
4-6 persons	29	48.3	5 persons
7-9 persons	13	21.7	
≥ 10 persons	3	5.0	
Educational Level:			
No formal Education	21	35.0	
Primary Education	12	20.0	8 years
Secondary Education	10	16.7	
Tertiary Education	17	28.3	
Farming Experience:			
1-6 years	17	28.3	
7-12 years	15	25.0	
13-18 years	10	16.7	14 years
19-24 years	7	11.7	
25- 30 years	9	15.0	
≥ 31	2	3.3	
Farm Ownership:			
Sole Proprietorship	19	31.6	
Family	39	65.0	
Cooperative	1	1.7	
Others	1	1.7	
Membership of Cooperative:			
Yes	4	6.7	
No	56	93.3	
Extension Visit:			
No	58	96.7	
Yes	2	3.3	
Farm Size:			
0.1-0.5 ha	45	75.0	
0.6-1.0 ha	8	13.3	
1.1-1.5 ha	1	1.7	0.57ha
1.6.2.0 ha	5	8.3	
Above 2.0 ha	1	1.7	

Source: Field Survey, 2021

The demographic and socio-economic variables considered include gender of the farmers, age, and marital status, and household size, educational level, farming experience, years of farming, farm ownership, farm size, cooperative membership and extension visit. The result showed that about 51.7% of the farmers were males and 48.3% were females. This result shows that there were more male farmers producing yams in the study area. This correlates with the findings of Tiku and Enoibor, (2012) [20] those who reported that the majority of yam farmers in Cross River state were males. This may be due to the labour-intensive nature of yam farming, hence females might prefer to grow other crops with less labour requirements. About 65% of the sampled farmers were between the ages of 20 and 50 years. This shows that the majority of the farmers were middle-aged and are still in their economically active age, which may result in a positive effect on production. This correlates with the findings of Idumah *et al.,* (2014), who observed that yam farmers in Edo state are also in their active age, as yam farming is laborious. The majority of the respondents were married (75%), which contributed widely to the use of family labour by the households, as their wives and children constituted the labour force, with 75% having over 4 members in their household size. This is in conjunction with the findings of Tiku and Enoibor (2012) [20] who reported that 64.6% of the yam farmers in Cross River State have a household size of 0-10. Furthermore, 65% of the farmers had one formal education or the other. Idumah *et al.,* (2014) observed that formal education has a positive influence on the acquisition and utilization of information on improved technology by the farmers as well as their innovativeness in adopting innovations. Some of the farmers (71.7%) have been farming for over 7 years. This means that they must have acquired good experience in yam farming. Ume *et al*., (2020) [22] indicated that the length of time in the farming business can be linked to age. Age, access to capital and experiences in farming may explain the tendency to adopt innovation and new technology. It was also observed that a larger proportion of the respondents (88.3%) had a farm size of < 1 ha. This may be as a result of land fragmentation due to the predominant land tenure system, which is basically ownership by inheritance. This contradicts the findings of Idumah *et al*., (2014), who reported that land fragmentation is uncommon among yam farmers in Edo state because farmlands are allocated to them by the government on year-to-year basis. The mean farm size cultivated was 0.57 ha. This implies that the majority of the respondents are small farm holders. This corroborates the findings of Toluwase & Sekumade, (2017) [21], who reported that the mean farm size of yam farmers in Ekiti State was 3.6 ha. The result in Table 1 revealed that 97.3% of the respondents did not belong to cooperative societies. However, a 6.7% of the respondents are members of cooperative association. The effects of this result were that most of the respondents in the study area did not enjoy benefits such as having access to credit, market outlets, marketing information and information on new technologies accrued to co-operative societies through pooling of resources together for a better expansion, efficiency and effective management of resources, and for profit maximization. This contradicts the findings of Abdullahi, (2015) [1] which state that a higher percentage of yam farmers in Niger state belong to cooperative societies and cooperative groups ensure that their members derive benefits from the groups which they could not have derived individually. A higher percentage of the yam farmers (96.7%) received no extension visits, as only 3.3% of the farmers received these visits. This implies that the majority of the respondents in the study area may not have access to some recent technologies on the best practices in the study area. This will greatly affect the output level of the yam farmers. This controverts the findings of Abdullahi, (2015) [1], who reported that 41.7% of the yam farmers in the Niger

State indicated that they received no visit by the extension agents, while 58.3% received at least one visit by the extension agents during the 2014/2015 farming season.

Sources and variety of Planting Material used by the Respondents

The source and variety of planting materials used by the respondents is presented in Table 2, the planting materials were specifically yam sett.

Table 2: Sources and variety of Planting Material used by the Respondents

Items	Frequency	Percentage
Variety Planted: Water yam White yam	1 59	1.7 98.3
Improved variety: Yes No	30 30	50 50
Source of Planting Material: Ministry of Agriculture Open Market Farmers in the village Reserved from harvest Relatives harvest	2 15 10 31 2	3.3 25.0 16.7 51.7 3.3

Source: Field survey, 2021

The results revealed that 51.7% of the respondents get their yam setts from the reserves from harvest, 25 % get theirs from the open market, while 3.3% get theirs from Agricultural inputs agencies like the Ministry of Agriculture, 3.3 % get theirs from relatives, and 16.7% get theirs from other farmers in the village. This implies that the majority of the farmers set aside part of their produce for planting, while the role of input supplier in the study area was minimal. This is in resonance with the findings of Toluwase and Sekumade, (2017) [21], who reported that 45.0% of the yam farmers in Ekiti State had their source of yam setts from reserves from previous harvest. The table in addition shows that 98.3% of the respondents planted the white variety of yam, while 1.7 planted water yam. Planting one variety may be due to consumer demand in the target area. This disagrees with the findings of Toluwase and Sekumade, (2017) [21], who reported that 61.7% of the yam farmers in Ekiti State planted different varieties of yam and planting different varieties could be a strategy to avert production risk, crop failure and the infestation of pests and diseases confronted by farmers in the study area.

Production Function results for yam famers in the study area

The production results for yam farmers in Ogoja LGA, Cross river State, Nigeria is presented in Table 3.

Table 3: Production Function results for yam famers in the study area

Variables	Double-log	Semi-log	Exponential
Constant	5.9482*** (9.131)	2381.88 (0.226)	6.7719** (36.77)
Farm Size (X1)	0.6049*** (5.245)	4707.50** (2.525)	0.7547 (0.750)
Labour (X2)	0.1752** (2.094)	2932.47** (2.167)	0.0071 (0.814)
Yam Setts (X3)	0.4109*** (4.738)	-184.144 (-0.131)	0.0013 (0.901)
Fertilizer (X4)	0.0128** (2.096)	261.570** (2.656)	0.00009 (0.501)
Pesticide (X5)	0.0132 (1.239)	-194.84 (-1.132)	-0.0072 (-0.173)
R^2	0.9603	0.7185	0.7458
F-ratio	261.5790***	27.5771***	31.6852***
Akaike Information Criterion	23.1063	1185.988	134.5886

Source: Field survey, 2021. **, ***, statistically significant at 5% & 1% respectively

Based on the economic, statistical and econometric criteria, the double-log model was chosen as the lead equation; the choice was specifically based on the high value of the R^2 (96%) and the low akaike value. The Cobb-Douglas estimates were used in the computation of the MPVs of the inputs utilised, as it represents the elasticity of the inputs. The elasticities of production were all less than 1 but greater than 0, implying that the farmers were in stage 2 of their production. The results in Table 4.3 showed that the coefficient of multiple determination R^2 was 0.9603. This implies that 96.03% of the variation in the output of yam in the area is accounted for by the specified independent variables. The F-ratio (261.579), which was significant at a 1 per cent level of probability, indicates the overall significance and fitness of the model. The results further showed that the coefficients of fertiliser, labour and yam setts were positive and statistically significant, indicating their individual contributions to influencing the output of yam production in the study area, with the exception of pesticides. Labour was positively significant at 5%, which equally conformed to the expected sign of the study. This implies that a 1% increase in the quantity of labour *ceteris paribus,* will increase yam output by 0.1752%. Fertilizer was also positively significant at 5% and influenced yam production in the study area; it equally conformed to the expected sign of the study, this implies that, yam production in relation to the quantity of fertilizer utilized in the study area was inelastic; meaning that 1% increase in quantity of fertilizer other things being equal will only lead to 0.0128% increase in the output level. This is in line with the finding of Izekor and Alufohai, (2015) [11] who found the coefficient of fertilizer to be positive and significant at 5% level in his measurement of resource use efficiency of yam farmers in Edo State, Nigeria.

However, Farm size and yam sett were both significant at 1% level of probability, meaning that 1% increase in the quantity of yam sett *ceteris paribus* will lead to 0.4109% increase in the output of yam and vice-versa. Similarly, a

1% increase in farm size will lead to 0.6049% increase in the output of yam, all things being equal. This further implies that, yam sett and farm size are important variable inputs in yam production considering its high significant level and comparatively high coefficient in the study area. This finding agrees with Abdullahi. (2015) [1] & Idumah *et al.,* (2014).

Resource-use efficiency ratio for yam production in the study area

The efficiency ratio for the resources utilized in Ogoja LGA, Cross river State, Nigeria is presented in Table 4.

Table 4: Resource-use efficiency ratio for yam production in the study area

Inputs	MPP (EP)	VMP xi	MFC (Pxi)	VMP xi/ Pxi	Inference
Farm Size (X_1)	0.6049	748.11	11,300	0.0694	Overutilization
Labor (X_2)	0.1752	216.68	1,077.33	0.2011	Overutilization
Yam sett (X_3)	0.4109	508.18	678.17	0.7493	Overutilization
Organic Fertilizer (X_4)	0.0128	15.83	953.13	0.0166	Overutilization
Pesticide (X_5)	0.0132	16.33	1,117.65	0.0146	Overutilization

Source: Field survey, 2021

The results of Table 4 revealed that farmers were inefficient in their resource use. Farm size, Labor, planting material, fertilizer and pesticides were found to have been over-utilized by the farmers in the area. The over-utilization of labour in the production process could be a result of the many cultural activities involved in yam production, ranging from land clearing, moulding of heaps, wilting of trees, seed-dressing, planting, weeding/application of herbicides, application of fertilizers and staking through harvesting, sorting, cleaning and storage of the tubers. All these activities needed a reasonable number of labourers to get done. Indication of pesticides over-utilization could be attributable to the sheer high prices of these chemicals relative to the mean unit price of yams produced and sold, especially as this input was found not to significantly contribute to yam output (Table 4). Wrong usage of the pesticides could also contribute to the poor input-output relationship as depicted in these findings. Similarly, the volume of pesticides said to have been applied was often exaggerated by persons hired to spray on a commercial basis just to make an excess profit. It was found that organic fertilizer, yam setts, and farm size were also over-utilized by the farmers in the study area. The over utilisation of organic fertilizers specifically poultry droppings may be as a result of its availability and low cost of purchase compared to the high cost of inorganic fertilizer, the high availability of yam setts, due to majority of the farmers reserving some part of their harvest for the next production season thereby increasing the quantity of supplies in circulation may have led to the over-utilization by farmers. The relatively high cost of renting land in the study area may be the reason for the over-utilization of farm size as observed. Farmers may plant more yam setts than required per plot to get more yield rather than renting more lands as necessary due its high cost. This finding corroborates with the findings of Rueben and Barau (2012) [18], Nwosu and Chidebelu, (2014) [8], Olayiwola, (2012), Toluwase and Sekumade, (2017) [21], Ume *et al.*, (2020) that farmers were equally inefficient in resource use in their respective studies.

Constraints faced by yam farmers in the study area

The constraints faced by yam farmers in Ogoja Local Government Area in Cross-river State is presented in Table 4.5.

Table 5: Problems faced by yam farmers in Ogoja Local Government Area in Cross-river State.

Problems	Strongly agree	Agree	Disagree	Strongly disagree	Mean	Remark
Insufficient funds	32(53.4)	17(28.3)	8(13.3)	3(5.0)	3.30	Major Constraints
Unavailability of land	12(20.0)	25(41.7)	19(31.7)	4(6.6)	2.75	Major Constraints
Incidence of pest and diseases	25(41.7)	28(46.7)	5(8.3)	2(3.3)	3.27	Major Constraints
High cost of yam sett	22(36.7)	23(38.3)	15(25.0)	-	3.12	Major Constraints
High cost of Inorganic fertilizer	28(46.7)	9(15.0)	15(25.0)	8(13.3)	2.95	Major Constraints
High cost of transportation	35(58.4)	20(33.3)	3(5.0)	2(3.3)	3.47	Major Constraints
Inadequate extension agents/services	21(35.0)	13(21.7)	3(5.0)	23(38.3)	2.53	Major Constraints
Poor storage facilities	34(56.7)	23(38.3)	2(3.3)	1(1.7)	3.50	Major Constraints
High cost of labour	26(43.3)	23(38.3)	10(16.7)	1(1.7)	3.23	Major Constraints
Unavailability of labour	11(18.4)	8(13.3)	24(40.0)	17(28.3)	2.22	Minor Constraints
Unavailability of yam sett	7(11.7)	22(36.7)	26(43.3)	5(8.3)	2.25	Minor Constraints

Source: Field survey data 2021
(Figures in parenthesis are percentages)

The result of the study revealed the following constraints faced by farmers during yam production process in the study area; Poor storage facilities, high cost of transportation and Insufficient funds were the major problems faced by the farmers with a mean of 3.50, 3.47 and 3.30 respectively while other constraints included unavailability of land, incidence of pest and diseases, high cost of fertilizer, unavailability of labour and inadequate extension agents/services, they were further identified to be statistically significant while high cost of yam sett as well as high cost of labour, were statistically insignificant to the farmers in the study area.

Conclusion

The study concluded that all resources used were overutilised, implying that farmers need to start adopting labour-saving technologies to reduce the amount of labour used. The volume of pesticides utilised should also be more accurately determined, as the volume of pesticides said to have been applied was often exaggerated by persons hired to spray on a commercial basis, just to make an excess profit. Farmers should come to full knowledge of the quantity of pesticides needed on their farm at every farming season. Farmers also need to learn how to apply fertilizer and the appropriate application timing and quantity for optimum results.

Recommendations

The study made the following recommendations based on the findings;

1. Farmers should learn to seek advice from extension agents within their community.
2. Extension agents should be made available to train the farmers on efficient pesticide and fertiliser application to reduce wastage and increase efficiency.
3. Farmers should form and join cooperative societies to take advantage of the opportunities they bring, especially in the area of accessing credit facilities.
4. Farmers should learn to hire or lease labour saving machineries due to the nature of yam production being labour-intensive; this will reduce their labour cost and improve productivity.
5. Programs leading to the creation of off-farm job opportunities should be formulated and implemented. This will go a long way in addressing the problem of labour saturation inherent in small scale Agriculture, especially in the short run, as the small-scale nature of yam farming in the area results in its overutilization, therefore posing a major problem in increasing productivity.
6. Farmers in the study area should connect with other farmers in other areas to get enlightened on the latest opportunities and facilities made available by the Government. The government should also strengthen its policy on the provision of incentives, such as access to affordable inputs, including credit and land. This would make yam farming attractive to younger and middle-aged persons, and possibly older ones, to continue in yam production, most importantly in the short run.
7. Non-governmental organisations should also be introduced into the communities to help enlighten farmers on innovative input-saving techniques.
8. Agri-tech companies such as Hello Tractor, Norina farms, etc. should restructure their services to fit into the lives and capacities of the rural farmers, such as making their services available on feature phones via USSD codes rather than software applications only.

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