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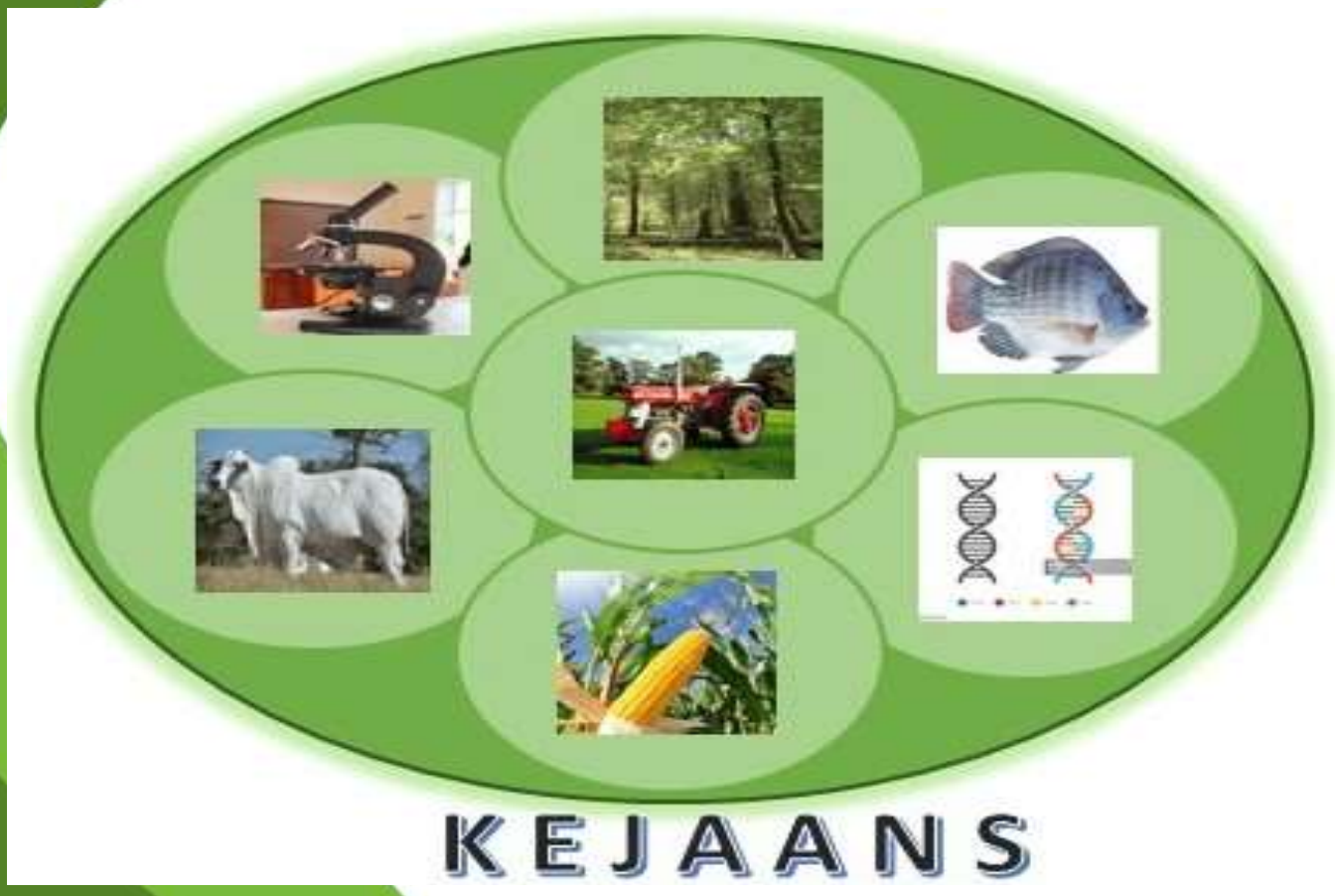

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DETERMINATION OF THE PROFITABILITY OF VITAMIN A BIOFORTIFIED CASSAVA PRODUCTION IN NIGER STATE., NIGERIA

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ABSTRACT

Given the increasing demand for nutrient-rich crops and the potential of bio-fortified cassava to address vitamin A deficiency, the study was undertaken to determine the profitability of Vitamin A bio-fortified cassava production in Niger State. The specific objectives were to; describe the socio-economic characteristics of vitamin A bio-fortified cassava farmers', estimate the cost and returns of vitamin A bio-fortified cassava production, and identify the production constraints faced by vitamin A bio-fortified cassava producers. A Multistage sampling technique was employed to select one hundred and five active vitamin A bio-fortified cassava farmers as respondents. Data were gathered through primary source with the aid of a structured questionnaire while descriptive statistics and net farm income were used to analyze the data. The results showed that the mean age of respondents was 39 years. The Majority (73.3%) of the respondents were male with an average household size of 10 persons, average years of farming experience of 16 years, and cultivating on an average farm size of 3.72 hectares. The average annual income of the respondents was ₦1,623,251.71. Vitamin A bio-fortified cassava production was profitable in the study area with a net farm income and return on investment of ₦716,193.75 and 1.47 respectively, this implies that for every ₦1 invested in the production of vitamin A bio-fortified cassava, 147 kobo was realized. High cost of inputs, insecurity, poor access to financial services, inadequate storage facilities, and inadequate extension services were among the most severe constraints vitamin A bio-fortified cassava farmers in the study area faced. The study concludes that bio-fortified cassava production is economically viable, offering health and economic benefits to farmers in the study area. It is recommended among others, that Government and NGOs should scale-up training programmes on the best practices in bio-fortified cassava cultivation, this can optimize yields and profits.

***Keywords**: Vitamin A, Bio-fortified cassava, Profitability, Production*

Introduction

Vitamin A deficiency is a critical public health issue in Nigeria, with significant implications for child mortality and overall health. It affects vision and immune function, and can lead to severe diseases, the most vulnerable group to these diseases are pregnant women and children under five years old in most rural areas of the country (NRCRI, 2019). Addressing this deficiency is vital for improving health outcomes and quality of life.

Cassava (*Manihot esculenta* Crantz**)** serves as a staple food for millions across Nigeria, providing a significant portion of carbohydrates (32g/100g) and a relatively low protein content (1.9g/100g). Cassava is largely

consumed in many processed forms in Nigeria. Its importance in the industry and livestock feed, is well known, but is gradually increasing, especially as import substitution becomes prominent in the industrial sector of the economy (FAO, 2018). As a cash crop, cassava generates cash income for the largest number of households in comparison with other staples. According to (FAO, 2018), cassava is a choice crop for rural development, poverty alleviation, economic growth and ultimately, food security. It is in view of the above that critical stakeholders have continued to contribute immensely to the debate on the development of cassava sub-sector in Nigeria.

However, traditional cassava varieties lack essential micronutrients, including Vitamin A. As a result, Nigerians who are restricted to the consumption of cassava-based diet could be at risk of being exposed to having diseases associated with vitamin A deficiency (VAD) (Umebali, Nkamigbo, Ekpunobi, and Isiabor, 2021). The Federal Government of Nigeria brought about vitamin A bio-fortified cassava through a process called **bio-fortification**. Bio-fortification is the process of breeding nutrients into food crops, either by using natural breeding techniques or by using genetically modified organisms (HarvestPlus, 2020). The Federal Government of Nigeria announced the release of the Vitamin A cassava varieties on 7th December, 2011, developed by International Institute for Tropical Agriculture (IITA), Ibadan in collaboration with the National Root Crops Research Institute (NRCRI), Umudike and funded by HarvestPlus project and the cassava transformation agenda of the Federal Ministry of Agriculture and Rural Development of Nigeria to cushion the effects of vitamin A deficiency, a micronutrient. The first three-wave Vitamin A cassava varieties released by the National Varietal Release Committee of Nigeria are UMUCASS 36, UMUCASS 37, and UMUCASS 38 and recognized as IITA genotypes - TMS 01/1368, TMS 01/1412, and TMS 01/1371 with intermediate content of vitamin A (40%) (HarvestPlus, 2021). In 2011, the biofortification (Vitamin A Cassava) programme commenced with stem multiplication in ten Local Government Areas (LGAs) in each of the four states of Nigeria; Oyo in the South-west, Imo in the South-east, Akwa Ibom in the South-south and Benue in the North-central. Other developed improved varieties released from 2014-2022 includes NR07/0326, NR07/0506, NR07/0497, NR07/0499, NR07/0427, NR07/0432 (NRCRI, 2019).

Despite the recognized health and nutritional benefits of bio-fortified cassava, its adoption among smallholder farmers in Niger State has been slow and uneven due to various socioeconomic, institutional, and agronomic barriers. In Niger State, where agriculture is a major livelihood, the adoption of such crops could significantly impact both health and economic well-being especially among smallholder farmers who rely heavily on cassava for their daily caloric intake (HarvestPlus, 2020). The introduction of bio-fortified cassava varieties rich in Vitamin A not only addresses nutritional deficiencies but also holds potential economic benefits for farmers and offers a promising solution to address this deficiency. However, the profitability of producing vitamin A bio-fortified cassava is unclear, making it challenging for farmers and policymakers to adopt and promote this technology. While there is a growing body of research on cassava production in Niger State, there is a significant knowledge gap regarding the vitamin A bio-fortified cassava, its impact and the economic viability of producing the crop. It is against this background that this study intends to determine the profitability of vitamin A bio-fortified cassava production in Niger State.

Materials and Methods

Study Area

The study was conducted in Niger State, Nigeria. The State is located in the North-Central geo-political zone of Nigeria. It lies between Longitude 3^0 30"E and 7^0 20"E and Latitude 8^0 20"N and 11^0 30"N. It shares boundaries with Kaduna State and FCT (north-east and south-east respectively); Zamfara State (north); Kebbi State (west); Kogi State (south); Kwara State (south-west); Republic of Benin (north-west). According to (National Population Council (NPC), 2006), the estimated population of the State was about 3,950,249, and based on the annual growth rate of 3.2%, the State has an estimated population of 5,586,000 as at 2017 (Niger State Geographical Information System (NIGIS), 2015), with males representing 51.5% of the State's population while females represent 48.5%. Niger State comprises 25 Local Government Areas and three agricultural zones. Nupe, Gbagi and Hausa are the major ethnic groups in the State.

Research Design

The study adopted a cross-sectional research design whereby data were collected at a single point in time from each of the selected communities. The reason for adopting a cross-sectional research design was because it was simple, economical and time saving. Multistage sampling procedure were adopted for the study. This allows the targeted objectives to be achieved through the use of structured questionnaires. The survey questionnaire captured information on the socioeconomic characteristics of the respondents, constraints faced by vitamin A bio-fortified farmers', and information on vitamin A bio-fortified cassava output was captured. Active vitamin A bio-fortified cassava farmers from the selected communities were the target population.

Sampling Procedure and Sample Size

A multistage sampling method was employed for the study. The first stage was the purposive selection of one Local Government Area (LGA) from each of the three agricultural zones (I, II and III); this is based on their relatively high concentration of cassava production and being among the beneficiaries of HarvestPlus vitamin A cassava stem multiplication program championed by the international financial trust fund (IFAD), the selected LGAs includes; Mokwa, Shiroro, and Wushishi. The second stage involves randomly sampling one (1) community from each of the selected Local Government Areas due to the abundance of active vitamin A cassava farmers in the communities. The selected communities are; Muwo, Gwada, and Loko Goma. The third stage involves randomly selecting 35 farmers from each community based on IFAD grouping, making a total of 105 respondents as sample size. Active vitamin A bio-fortified farmers were identified with the help of the State's ADP/IFAD Staff in the selected local governments.

Data Collection

Primary data used for the study were derived from structured questionnaire administered with the aid of staff from ADP/IFAD and also subjected to descriptive (mean, frequency, percentage, and ranking) and inferential analysis (farm budgeting technique).

Model Specification

Farm Budgeting Technique

This was used to determine the profitability of vitamin A bio-fortified cassava production in the study area. Farm budgeting enables the estimation of the total expenses (costs) as well as total receipts (revenue) within a production period (Olukosi and Erhabor, 1988).

Net farm income was used for the profitability analysis.

The Net Farm Income is defined as:

NFI = TR - TC (TVC +TFC) …… (1)
Where
NFI = Net Farm Income, TR = Total Revenue, TVC = Total Variable Cost, TFC = Total Fixed Cost
The profitability of Vitamin A bio-fortified cassava production was analyzed using the various financial ratios stated in Equations (2), (3), and (4).
The Gross ratio is a profitability ratio that measures the farm's overall success. The lower the ratio, the higher the returns per naira.
GR = $\frac{TC}{TR}$ …… (2)
Where,
GR = Gross Ratio, TC = Total Cost and TR = Total Revenue.
The Operating ratio is directly related to the farm variable input usage. The lower the ratio, the higher the profitability of the farm business.
OR = $\frac{TVC}{TR}$ …..……..…….. (3)
Where,
OR = Operating Ratio, TVC = Total Variable Cost and TR = Total Revenue.
Return on Capital Invested is a profitability index defined as a measure of the amount accrues to the enterprise as net income for every naira invested. The higher the investment return, the more profitable the enterprise.
ROI = $\frac{NFI}{TVC}$ …… (4)
Where,
ROI = Return on Capital Invested, NFI = Net Farm Income and TVC = Total Variable Cost.

Results and Discussion

Socioeconomic characteristics of Respondents

The result presented in Table 1 reveals that the majority of the respondents were male constituting about 73.3% to females 26.7%. The data shows that the male gender were more involved in vitamin A bio-fortified cassava production than female gender in the study area. However, this may be attributed to the fact that women are more involved in processing than production. This assertion is further supported by the findings of (Jirgi *et al*., 2021) who reported that majority of farmers in Niger State are male. The mean age of the farmers is 39years, indicating that most of them were young; still, within their active age, they were agile and energetic. Hence, technologies to enhance their productivity could be successfully introduced and adopted. The Majority (89.5%) of the respondents had formal education (primary (26.7%), secondary (39.0%) and tertiary (23.8%)) while 10.5% had no formal education. Those who are literate are expected to be more innovative because of their ability to get information more quickly, take more risks and be shrewd in resource management. Education is one of the factors that affects the adoption of improved technology positively or negatively. Table 1 further reveals that household size in the study area is relatively large, with most respondents (48.6%) ranging from 6-10 persons. Thus, a mean household size of 10 persons, could increase the supply of family labour and reduce the cost of hiring labour (Joshua, 2019). Large household would prefer the beta-carotene variety (Vitamin A bio-fortified cassava) as it will go a long way in correcting the deficiency in the family's diets, particularly the poor and vulnerable. In addition, 46.7% of the respondents had a farming experience of >15 years, while the least (9.5%) had an experience of 1-5 years. The respondents' mean number of years of farming experience was 16 years. This conforms to the findings of (Gbigbi and Chuks-Okonta, 2021), who found that the average farming experience of cassava producers in Delta State is 16 years. The long years of experience are tangible in the sustainability of production and productivity, as stated by (Agada, Onuche, and Mbah, 2018) that long years of farming could enhance the efficient utilization of farm resources by small-scale

cassava farmers. Table 1 further reveals that the average farm size in the study area is 3.72

Table 1: Socioeconomic Characteristics of Vitamin A Bio-fortified Cassava Farmers

Variables	Frequency	Percent	Mean
Gender			
Male	77	73.3	
Female	28	26.7	
Total	**105**	**100.0**	
Age			
<20	5	4.8	
20-40	64	60.9	39.02
41-60	29	27.6	
>60	7	6.7	
Total	**105**	**100.0**	
Level of Education			
Primary education	28	26.7	
Secondary education	41	39.0	
Tertiary education	25	23.8	
No formal education	11	10.5	
Total	**105**	**100.0**	
Household Size			
1-5	24	22.8	
6-10	51	48.6	10
11 and above	30	28.6	
Total	**105**	**100.0**	
Farming Experience			
1-5	10	9.5	
6-10	29	27.6	16
11-15	17	16.2	
>15	49	46.7	
Total	**105**	**100.0**	
Farm Size			
<1	11	10.5	
1-5	76	72.4	3.72
6-10	14	13.3	
>10	4	3.8	
Total	**105**	**100.0**	
Extension Contact			
Yes	54	51.4	
No	51	48.6	
Total	**105**	**100**	
Annual Income			
<500,000	21	20.0	
500,000-1,000,000	28	26.7	1,643,251.71
>1,000,000	56	53.3	
Total	**105**	**100.0**	

Source: Field Survey, 2024.

hectares. This implies that the majority (82.9%) of vitamin A cassava farmers in the study area were predominantly small-scale farmers. This result is in agreement with (Chikieze, Maurice, and Nwankwo, 2021), who asserted that the low level of farm size indicates the subsistence nature of the rural farmers. Most (51.4%) of the farmers had contact with extension agents while 48.6% had no contact with extension agents. This implies that contact to extension agents will greatly influence adoption pf vitamin A bio-fortified cassava variety. Table 1 concluded by showing the respondents' average annual income of more than 1 million earned by the respondents. This means that farmers in these communities relied absolutely on farm business and must have acquired farming experience over time.

Table 2: Cost and Returns of Vitamin A Bio-fortified Cassava Production in Niger State.

Cost and Return items	**Cost (₦/ha)**	**Percent**
Variable Costs	70,116.24	13.91
Cuttings (bundle)	319,977.85	63.48
Labour (man-day)	89,579.14	17.77
Fertilizer (kg)	9,130.00	1.81
Agro-chemicals (litre)	488,803.23	96.97
Total Variable Cost		
Fixed Cost	10,381.99	2.06
Rent on Land	600.00	0.12
Depreciation on Hoe	300.00	0.06
Depreciation on Cutlass	1,000.00	0.20
Depreciation on Knapsack Sprayer	3,000.00	0.59
Depreciation on Wheel Barrow	15,281.99	3.03
Total Fixed Cost	504,085.22	100
Total Cost		
Returns	1,220,278.97	
Total Revenue (TR)	716,193.75	
Net Farm Income (TR-TC)	1.47	
Return on Investment (NFI/TVC)	0.41	
Gross Ratio (TC/TR)	0.40	
Operating Ratio (TVC/TR)		

Source: Field Survey, 2024.

Constraints to Vitamin A Bio-fortified Cassava Production

The results of the constraints associated with vitamin A bio-fortified cassava production practices in Niger State is presented in Table 3. The constraints were ranked based on their severity and seriousness as perceived by farmers. High cost of inputs, insecurity, poor access to financial services, inadequate storage facilities, and inadequate extension services were perceived as the most severe constraints encountered by vitamin A bio-fortified cassava producers. The high cost of inputs ranked highest, as reported by 82.2% of the respondents, the high cost of inputs leads to most farmers planting without certain farm

inputs resulting in poor yield. Insecurity (67.1%) ranked next, with the menace and detriment of insurgencies across the state taking its toll on farming activities. The result is consistent with the findings of (Angba and Iton, 2020), who found that the high cost of inputs and insecurity were the most severe and highest ranked constraints faced by cassava farmers during its production in Akpabuyo LGA. The least ranked constraint is the problem of pest and disease infestation (54.4%), which was termed as not severe along with poor access to improved planting materials and poor market pricing. The result agrees with (Gbigbi and Chuks-Okonta, 2018), who reported pests and diseases as the least constraints affecting cassava production in Delta State.

Table 3: Constraints to Vitamin A Bio-fortified Cassava Production

Constraints	Frequency	Percent	Rank
High cost of inputs	60	82.2	1st
Insecurity	49	67.1	2nd
Poor access to financial services	49	67.1	2nd
Inadequate storage facility	47	64.4	4th
Inadequate extension services	46	63.0	5th
Poor access to improved planting materials	43	58.0	6th
Poor market pricing	41	56.2	7th
Pest and disease infestation	37	50.7	8th

Source: Field Survey, 2024.
*Multiple response.

Conclusion and Recommendations

Based on the study findings, it was revealed that most cassava farmers in the study area were in their active and productive age, experienced in cassava production and mostly male. This study concludes that the production of Vitamin A bio-fortified cassava in Niger State is viable and profitable. Thus, encouraging its cultivation can play a crucial role in improving public health and providing economic benefits to farmers.

Based on the findings of the study, the following recommendations were made;

Farmers should be advised to take cassava production as a business venture, hence, the better investment they make, the better profit they realize. Government and NGOs should scale-up training programmes on the best practices in bio-fortified cassava cultivation, this can optimize yields and profits. Government should promote training on bio-fortified foods derived from vitamin A cassava to curb the menace of malnutrition and enhance economic development in the study area. Farmers should be encouraged to participate more in cooperatives, this will help in reducing the constraint caused by high cost of inputs. Government should take adequate measures by providing up-to-date surveillance equipment, and appropriate training to ensure that security personnel are well equipped to safeguard farmers in the study area.

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