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Socio-economic analysis of plantain production in Northeastern Nigeria

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Abstract

Purpose: This study examined the socio-economic characteristics, profitability, and production constraints of plantain farmers in Adamawa and Taraba States, Northeastern Nigeria. It aimed to assess the viability of plantain production and the challenges that influence its contribution to rural livelihoods.

Design/Methodology/Approach: A descriptive survey design was employed. Data were collected from 263 plantain farmers using structured questionnaires and analysed with descriptive statistics and gross margin analysis. Constraints were identified and ranked based on frequency and percentage responses.

Findings: Results revealed that most respondents were male (65.4%), married (81%), and had 6–10 years of farming experience (44.5%). Plantain production was profitable, with an average gross margin of ₦376,031.35 per hectare and a benefit-cost ratio of 5.11. Major constraints included high input costs (81.7%), lack of improved planting materials (76.4%), and inadequate extension services (74.9%).

Research limitations/implications: The study focused on Adamawa and Taraba States, and results may not fully represent other regions of Nigeria where plantain is cultivated under different ecological and socio-economic conditions. Future research could include broader geographical coverage and advanced econometric analysis.

Practical implications: The findings highlight the need for targeted investments in rural credit, extension services, improved planting materials, and infrastructure to increase productivity and profitability in plantain farming.

Social implications: Enhancing plantain production can contribute to food security, rural employment, and income generation, thereby reducing poverty among smallholder farmers in Northeastern Nigeria.

Originality/value: This study provides one of the first empirical assessments of the socio-economic viability of plantain production in Northeastern Nigeria, filling a critical literature gap and offering evidence-based insights for policy and development interventions.

Keywords: Northeastern Nigeria, plantain farming, production constraints, profitability, smallholder farmers

Kuzeydoğu Nijerya'da yemeklik muz üretiminin sosyo-ekonomik analizi

Özet

Amaç: Bu çalışma, Nijerya'nın Kuzeydoğu bölgesinde yer alan Adamawa ve Taraba Eyaletlerindeki muz üreticilerinin sosyo-ekonomik özelliklerini, kârlılık düzeylerini ve üretim sürecinde karşılaştıkları kısıtları incelemiştir. Araştırma, muz üretiminin ekonomik uygulanabilirliğini ve kırsal geçim kaynaklarına katkısını etkileyen sorunları değerlendirmeyi amaçlamaktadır.

Tasarım/Yöntem/Yaklaşım: Araştırmada betimleyici anket araştırma deseni kullanılmıştır. Veriler, yapılandırılmış anketler aracılığıyla 263 muz üreticisinden toplanmış ve tanımlayıcı istatistikler ile brüt marj analizi kullanılarak analiz edilmiştir. Üretim kısıtları, katılımcıların verdikleri yanıtların frekans ve yüzde değerlerine göre belirlenmiş ve sıralanmıştır.

Bulgular: Sonuçlar, katılımcıların büyük çoğunluğunun erkek (%65,4), evli (%81) ve 6–10 yıllık tarımsal üretim deneyimine sahip (%44,5) olduğunu göstermiştir. Muz üretiminin kârlı olduğu belirlenmiş; hektar başına ortalama brüt marj 376.031,35 ₦, fayda-maliyet oranı ise 5,11 olarak hesaplanmıştır. Üreticilerin karşılaştığı başlıca kısıtlar; yüksek girdi maliyetleri (%81,7), geliştirilmiş dikim materyallerine erişim eksikliği (%76,4) ve yetersiz yayım hizmetleri (%74,9) olarak tespit edilmiştir.

Araştırmanın Sınırlılıkları/Çıkarımları: Çalışma yalnızca Adamawa ve Taraba Eyaletlerini kapsamaktadır. Bu nedenle sonuçlar, muz üretiminin farklı ekolojik ve sosyo-ekonomik koşullarda gerçekleştirildiği Nijerya'nın diğer bölgelerini tam olarak temsil etmeyebilir. Gelecekte yapılacak araştırmalarda daha geniş coğrafi kapsam ve ileri düzey ekonometrik analizlerin kullanılması önerilmektedir.

Uygulamalı Çıkarımlar: Bulgular, muz üretiminde verimlilik ve kârlılığı artırmak amacıyla kırsal kredi olanakları, tarımsal yayım hizmetleri, geliştirilmiş dikim materyalleri ve altyapı yatırımlarına yönelik hedefli desteklerin gerekliliğini ortaya koymaktadır.

Sosyal Çıkarımlar: Muz üretiminin geliştirilmesi, gıda güvenliğinin güçlendirilmesine, kırsal istihdamın artırılmasına ve gelir yaratılmasına katkı sağlayarak Kuzeydoğu Nijerya'daki küçük ölçekli çiftçiler arasında yoksulluğun azaltılmasına yardımcı olabilir.

Özgünlük/Değer: Bu çalışma, Kuzeydoğu Nijerya'da muz üretiminin sosyo-ekonomik uygulanabilirliğini ampirik olarak değerlendiren ilk araştırmalardan biridir. Böylece literatürdeki önemli bir boşluğu doldurmakta ve politika yapıcılar ile kalkınma uygulamalarına yönelik kanıta dayalı bilgiler sunmaktadır.

Anahtar Kelimeler: Kuzeydoğu Nijerya, muz yetiştiriciliği, üretim kısıtları, kârlılık, küçük ölçekli çiftçiler

INTRODUCTION

Plantain (Musa paradisiaca) is a staple food crop and a source of income for millions of rural households across Nigeria. With an estimated annual production of over 2.4 million metric tonnes, the country ranks among the top global producers. However, most of the output is consumed domestically (FAO, 2006). In the past, production was mainly concentrated in the southern regions of Nigeria, where climatic and soil conditions are favourable. But in recent years, the plantain has also spread to other ecological regions, such as portions of Northeastern Nigeria, specifically, Adamawa and Taraba States. Despite this development, the region has received less attention from researchers who have provided less information about the socio-economic profiles of farmers, the feasibility of production, and the constraints. Addressing such knowledge gaps has become urgent, considering the rising importance of the crop in terms of food security, the generation of income, and rural employment (Aina et al., 2012). The knowledge of the practices that farmers in this region of the country have related to plantain cultivation provides navigational information in which policy and development interventions should be made.

Socio-economic characteristics influence how farmers access resources, make production decisions, and respond to market signals. In Nigeria, plantain farming is predominantly a smallholder enterprise. More than 80 % of agricultural production in the country is carried out by those farmers who can access modern inputs and extension services and credit, very little (Swennen, 1990; Akinyemi et al., 2010). These enterprises are typically run on small farms, families are the primary source of labour, and primitive production techniques are utilised. In Adamawa and Taraba states, most plantain farmers who practice compound farms produce them on degraded fields and have little or no external assistance. The age, education, gender, and size of a farm can be classified as significant determinants of production. A study-level example is that younger and educated farmers are more likely to implement new agronomic practices or introduce farm management. The gender aspects play a part in access to land and access to income earned in sales of plantain (Baruwa et al., 2011). By compartmentalising such attributes, specific interventions can be customised to meet the needs of the various groups of farmers. Interventions should aim to improve access to extension services, credit, and technologies in ways that reflect the lived experiences of farmers in the study area.

Profitability is a key determinant of whether plantain farming is sustainable and attractive to smallholders. Plantain production is relatively cheap, and the crop does not require much mechanisation since it can be maintained using organic fertilisers (household or livestock waste products) (Ndubizu, 1985; Marriot and Lancaster, 1993). In areas of South Nigeria, plantain farming has been continuously found to be economically an excellent activity. Sometimes, high gross margins and desirable benefits-to-cost ratios are described by Akinyemi et al. (2008) and Oladejo and Sanusi (2008) with regard to the small-scale enterprises involving plantain production. In Adamawa and Taraba States, profitability in tomato farming is associated with many factors, such as availability of inputs, scale of operation, and hectares produced per hectare, as well as access to markets and seasonal market fluctuations. These are factors that must be understood to estimate net farm income and evaluate the financial performance of plantain enterprises. When farmers have high costs of production or low prices, returns on investment will be decreased. By knowing cost structures and revenue patterns, the planners will be able to enhance the design of extension packages. Equally, it stresses the use of resources efficiently and inspires adoption of agricultural good practices. Profitability analysis also helps farmers and stakeholders determine whether plantain farming is a reliable strategy for improving rural livelihoods.

Despite its importance, plantain production faces several constraints that limit its productivity and profitability. The most cited maladies are low soil fertility, susceptibility to pests and diseases, low planting materials quality, and lack of access to extension and credit services (IITA, 2007; Ojediran et al., 2018). Market infrastructure is poor in Adamawa and Taraba States, and is then compounded by climate-related risks and poor farmer organisation in these states. Most farmers still use low-quality suckers, which take longer to grow and yield. Lack of organised transport and storage systems, coupled with the nature of the crop as a perishable product, is a key hindering factor in the marketing of the product (Adetunji and Adesiyan, 2008).

Without intervention, these challenges will continue to undermine the growth potential of plantain farming in the region. Addressing these issues requires targeted investment in extension services, the promotion of improved planting materials, and support for farmer cooperatives that can improve access to inputs and markets. It is important that there is an understanding of the nature and magnitude of the constraints encountered by the farmers in order to come up with feasible solutions that can increase productivity and resilience within the plantain value chain. Effective responses must be grounded in local realities and guided by empirical evidence.

The specific objectives were to:

i. describe the socio-economic characteristics of plantain production farmers in the study area
ii. determine the profitability of plantain production among the producers
iii. identify the constraints associated with plantain production

LITERATURE REVIEW

Conceptual review

Plantain (Musa paradisiaca) is a staple crop of considerable economic and nutritional value in Nigeria, especially among smallholder farmers. It is highly consumed as another source of revenue along with food security across a variety of ecological zones. In practical terms, there are various aspects of plantain production, such as management practices in the farm, inputs, and marketing or socio-economic factors that determine the outcome of production. The meso-level theories of agricultural production allow linking these dynamics together. In particular, the production function theory holds that producers seek to produce an optimum, within their set of limited inputs, and this fits well within the realities of small-scale plantain farmers (Battese, 1992). In the conventional farming environment, the ability of producers to control their land, capital, and access to the latest innovations limits them; therefore, resource allocation efficiency comes to the fore in assessing productivity (Esparon and Sturgess, 1989).

The crop is cultivated mainly in homesteads and small plots, often under mixed cropping systems with minimal external inputs. The benefits associated with plantain farming, according to Ndubizu (1985), include low production cost, short gestation (14-20 months), and the fact that a plantation can support multiple intervals of harvest. These features render it appealing to smallholders who are capital-constrained. Plantain farming has the potential of generating rather high income per hectare, especially when agronomic practices are well applied, despite the fact that too little is mechanised (Marriot and Lancaster, 1993).

Several varieties of plantain are grown in Nigeria, with the false horn type being the most dominant due to its adaptability to poor soil conditions (Oladejo and Sanusi, 2008). This important crop becomes a very important source of energy, minerals, and vitamins in the household, being cheap to obtain (Ngeze and Gathumbi, 2004). It can also be utilised in various forms, which are fried, boiled, roasted, or turned into flour, chips, and snacks, consequently reinforcing various market opportunities. Smallholder producers have a tendency to underrate the crop and do little or no chemical application to the soil, as their major sources of input may be organic waste and traditional production methods of this industry (Swennen, 1990). The outcomes are poor production, poor plants, and susceptibility to pests and disease. Understanding the conceptual underpinnings of plantain production within this low-input context provides a foundation for examining the profitability and constraints faced by farmers.

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Empirical review

Empirical research on the production of plantain in Nigeria has always revealed that the plant can greatly enhance the household income and food security, particularly in rural populations. However, it can vary dramatically over geography, farmer characteristics, input availability, and agronomy. Akinyemi et al. (2008) analysed the profitability of plantain production in Southern Nigeria and concluded that there has been a high gross margin even with scanty access to credit and low mechanisation. As indicated in their paper, plantain demanded fewer inputs than other staples such as maize or cassava, which made it desirable among smallholders who leveraged this to maximise the return of their capital inputs. On the one hand, Oladejo and Sanusi (2008) found that in the upbringing of plantain, better returns on investments per hectare were achieved, yet it was underestimated by the producers who used minimal effort in the form of input usage.

Baruwa et al. (2011) pointed out that profitability was more closely associated with the level of production scale, quality of inputs, and accessibility of markets. The farmers near the urban centres had higher revenues because of their superior prices and lower transportation costs. Conversely, the farmers in remote areas had lost as a result of poor prices for the products of their output and post-crop wastage. These spatial variations accentuate the importance of the infrastructure and market integration in developing the farm income. The authors also stated that the majority of the plantain producers had no records of production and, therefore, were unable to compare the cost structures and control them in a better manner. This empirical gap reaffirms the need for capacity building at the farm level with regard to business planning and record keeping.

Studies have also examined the socio-economic characteristics of plantain farmers and how these influence productivity. Aina et al. (2012) found that farmers' age, education level, and household size significantly affected the adoption of improved practices and yield levels. Older farmers were less available than more experienced farmers, who were not willing to wait to experiment with new methods of doing things, since their successors were more educated and were able to adapt good spacing, fertiliser, as well as pest control practices. Decisions on the distribution of resources also depended on gender. In most societies, men were the superior landowners, with women involved in collecting and selling the yield without many rights in decision-making. This division of labour influenced the productivity of the farms and distribution of income among households (Akinyemi et al., 2010).

The literature also cites an unchanged set of limitations restraining plantain production in Nigeria. According to IITA (2007), lack of access to improved planting materials, coupled with lack of extension support, pest infestation, and low fertility, were some of the major challenges. Farmers had to rely on traditional suckers whose growth was elongated, and they produced less, and many depended on domestic wastes as manure. Such low-input systems were not capable of supporting the growing demand, especially in cities where people began to consume more plantains because of population growth and changes in eating habits (FAO, 2011). Ojediran et al. (2018) stated that a lack of awareness of the potential of plantain as a farm product and post-harvesting handling methods were the factors that resulted in excessive losses and small increases in revenues obtained. The perishability of plantain, coupled with limited storage facilities and inefficient transport systems, hindered market expansion and price stabilisation.

Furthermore, regional disparities in production performance have received limited empirical attention. Alternatively, though much has been done with regard to the economics of plantain production in the South of Nigeria, not much has been done in the economic dynamics of plantain production in the North-Eastern states, such as Adamawa and Taraba. Such a gap in the literature is quite critical since farmers within these areas have distinct agroecological and market situations. As an example, the Northeast has a longer dry season, which may disrupt planting and harvesting cycles. Moreover, farmers' socio-economic characteristics vary with farmers in the south, which affects the way farmers participate in plantain production. The absence of data from these regions weakens the national understanding of plantain production and constrains the development of targeted interventions.

Several studies have suggested pathways for improving plantain production. These include promoting disease-resistant varieties, improving access to extension services, and supporting the establishment of farmer cooperatives to facilitate input procurement and market access (IITA, 2007; FAO, 2013). Adetunji and Adesiyan (2008) argued that marketing constraints were as limiting as production problems and required coordinated policy responses. They

recommended that interventions should not only focus on boosting output but also on improving transportation, processing, and storage infrastructure. Addressing both production and marketing issues would enhance profitability and make plantain farming a more viable enterprise for rural households. These recommendations are particularly relevant for under-researched regions, where infrastructure and institutional support remain weak.

METHODOLOGY

Study area

The study was conducted in selected Local Government Areas (LGAs) of Adamawa and Taraba States, located in Northeastern Nigeria. These states possess favourable agroecological conditions for plantain production, including fertile soils and adequate rainfall patterns that support perennial crop growth (Aina et al., 2012). Despite being outside the traditional plantain-producing zones, parts of these states have recorded increased interest in plantain cultivation, especially among smallholder farmers using backyard and compound farm systems.

Design

The study employed a descriptive survey design to examine the socio-economic characteristics, profitability, and production constraints of plantain farmers. This design enabled the collection of primary data directly from producers, capturing both qualitative and quantitative information relevant to the research objectives**.**

Population

The target population comprised registered plantain farmers across five selected LGAs in the two states. These included two LGAs from Adamawa and three from Taraba, with a combined population of approximately 2,700 plantain farmers. These LGAs included Ganye and Toungo (from Adamawa State) and Takum, Ussa and Kurmi (from Taraba State). The selection of these LGAs was made depending on their relative concentration of plantain farmers, environmental appropriateness and their accessibility to collect field data. Such LGAs are the areas where the plantain cultivation over the past several years has grown because of the favourable rainfall and soil. This was facilitated by their inclusion to ensure that the sample was representative of the variety of the production systems, ranging from compound farming and small-scale commercial plots. The farmers who took part in the study were working in production in the last production cycle.

Sampling technique

Due to financial and time constraints, a multi-stage sampling procedure was adopted. From the population, a total of 263 respondents were randomly selected using proportionate stratified sampling to ensure fair representation across the LGAs. This approach ensured that data collected reflected the variations in production practices and farmer characteristics across locations (FAO, 2013).

Instrument of data collection

Structured questionnaires were used to collect data on socio-economic characteristics, input and output levels, cost structure, and production constraints. The instrument was administered through face-to-face interviews, as most farmers had limited formal education and rarely kept production records, relying mainly on memory recall (Ojediran et al., 2018). This study, which involved the administration of structured questionnaires to plantain farmers in Adamawa and Taraba States, Northeastern Nigeria, was reviewed and approved by the Modibbo Adama University Research Ethics Committee. Approval was granted at the meeting held on 26-05-2022, with Approval/Protocol Number MAU/RE22/0049.

Model specification

To estimate profitability, the study employed gross margin analysis (GMA), which is appropriate for smallholder farm enterprises where fixed capital costs are minimal and variable costs dominate production decisions. Following Ndubizu (1985), the gross margin (GM) was expressed as:

$$GM = TR - TVC \quad (1)$$

Where:

GM = Gross Margin (₦ /hectare) A positive GM and a benefit–cost ratio above one indicate that plantain production is economically viable.

TR = Total Revenue (₦/hectare), obtained as the quantity of plantain sold multiplied by the average market price.

TVC = Total Variable Cost (₦/hectare), which includes expenses on suckers, organic fertiliser, labour, transport, and other operational items.

In addition, to extend the profitability analysis and reflect market performance, the study adopted marketing margin models used in agricultural value chain studies (Nzennwa et al., 2025):

1. Net Marketing Margin (NMM):

$$NMM = GM_m - TFC \quad (2)$$

Where:

NMM = Net Marketing Margin (₦)

GM_m = Gross Marketing Margin, defined as the difference between the selling price and the producer's price, less variable costs

TFC = Total Fixed Costs incurred in marketing (e.g., storage, rent, and depreciation of equipment).

2. Marketing Efficiency (ME):

$$ME = (GM_m \div TMC) \times 100 \quad (3)$$

Where:

ME = Marketing Efficiency (%)

GM_m = Gross Marketing Margin (₦)

TMC = Total Marketing Costs, comprising both total variable costs and total fixed costs in the marketing process.

Data analysis

Data were analysed using descriptive statistics such as frequencies, percentages, and means, alongside gross margin analysis for profitability estimation. The identification and ranking of production constraints were based on frequency counts and percentage responses. All analyses were conducted using SPSS and Microsoft Excel.

RESULTS

Table 1 presents the socio-economic characteristics of the 263 plantain farmers surveyed in Adamawa and Taraba States. The majority were male (65.4%), while 34.6% were female, indicating a male-dominated farming population. Most respondents (39.5 %) were within the 31–40 years age bracket, followed by 28.9% aged 41–50 years. The majority (81%) were married, suggesting a strong family-based agricultural workforce. In terms of education, 33.8 % had secondary education, 26.6% had primary education, and 18.3 % had no formal education. About 21.3% had attained tertiary education.

Farm size distribution shows that most plantain farmers operated on small plots. About 44.9% cultivated less than one hectare, while 30% cultivated between one and two hectares. A smaller share of 14.8% managed between 2.1 and 3 hectares, and only 10.3% cultivated more than three hectares. This highlights the dominance of small-scale production systems. Regarding farming experience, 44.5% had 6–10 years of experience, while 25.5% had 11–15 years. These results imply that most plantain farmers are in their economically active years, possess basic education, and have significant farming experience, which may influence their production decisions and ability to adopt improved practices if adequately supported with relevant extension services and inputs.

Plantain production in Northeastern Nigeria demonstrates strong profitability and efficiency based on the estimates in Table 2. Average yield per hectare stood at 425 bunches, with each bunch sold at ₦1100, generating an average revenue of ₦467,500. The production process incurred a total variable cost of ₦91,468.65, giving a gross margin of ₦376,031.35. The benefit–cost ratio was 5.11, meaning that every ₦1 invested in variable inputs yielded a return of ₦5.11 in revenue. This outcome demonstrates that plantain farming offers substantial income potential for smallholder farmers.

Table 1. Socio-economic characteristics of plantain farmers (n = 263)

Characteristic	Frequency	Percentage (%)
Sex		
Male	172	65.4
Female	91	34.6
Age (years)		
21–30	50	19.0
31–40	104	39.5
41–50	76	28.9
51 and above	33	12.6
Marital Status		
Married	213	81.0
Single	50	19.0
Educational Level		
No formal education	48	18.3
Primary	70	26.6
Secondary	89	33.8
Tertiary	56	21.3
Farm Size (ha)		
<1	118	44.9
1–2	79	30.0
2.1–3	39	14.8
>3	27	10.3
Farming Experience (years)		
1–5	60	22.8
6–10	117	44.5
11–15	67	25.5
16 and above	19	7.2

Source: Field Survey (2023)

When fixed costs of ₦20,000 were considered, the net marketing margin amounted to ₦356,031.35. Total marketing costs stood at ₦111,468.65, while the marketing efficiency was 337.3%. This indicates that plantain production generates over three times the value of its marketing expenses, underscoring the viability of the enterprise. These findings support targeted interventions in input supply, extension services, and infrastructure to further strengthen profitability and efficiency in the sector.

Table 2. Profitability and marketing efficiency of plantain production per hectare

Cost and Returns Item	Amount (₦)
Average Production per Hectare	425 bunches
Average Price per Bunch	₦1100
Average Revenue (Total Sales)	₦467,500
Variable Costs	
i. Cost of Suckers	16,037.37
ii. Cost of Organic Fertiliser	13,112.93
iii. Labour	36,902.24
iv. Transport	10,000.00
v. Other Operating Expenses	15,416.11
Total Variable Cost (TVC)	91,468.65
Gross Margin (GM = TR − TVC)	₦376,031.35
Benefit–Cost Ratio (BCR)	5.11
Fixed Costs (TFC)	20,000.00*
Gross Marketing Margin (GMm)	₦376,031.35
Net Marketing Margin (NMM = GMm − TFC)	₦356,031.35
Total Marketing Costs (TMC = TVC + TFC)	111,468.65
Marketing Efficiency (ME = GMm ÷ TMC × 100)	337.3%

Source: Field Survey (2023)

Table 3 outlines the key production constraints encountered by plantain farmers. High input costs were reported by 81.7% of respondents, followed by lack of access to improved planting materials (76.4%) and inadequate extension

services (74.9%). Pest and disease infestation was reported by 69.2% of farmers, while 63.9% cited poor market infrastructure. Other significant challenges included low soil fertility (58.9 %), post-harvest losses (54.0%), and lack of credit access (52.1%). Access to markets in time was also a problem due to lack of proper transport facilities; this influenced the quality of produce and revenue. These restrictions can be seen as an overall result of low-input, low-output system provoked by ineffective institutional support. The access to inputs, training, rural credit and infrastructure would likely be improved, and this could most likely raise productivity and income in terms of solving these issues. Such findings indicate that it is necessary to implement targeted policy and development interventions to alleviate such constraints and enable sustainable production of plantain in the research area.

Table 3. Major constraints faced by plantain farmers

Constraint Identified	Frequency	percentage (%)
High cost of inputs	215	81.7
Lack of access to improved planting materials	201	76.4
Inadequate extension services	197	74.9
Pest and disease infestation	182	69.2
Poor market infrastructure	168	63.9
Low soil fertility	155	58.9
Post-harvest losses	142	54.0
Lack of access to credit	137	52.1
Poor transport facilities	129	49.0

Source: Field Survey (2023)

DISCUSSION

The socio-economic characteristics of plantain farmers in Adamawa and Taraba States reveal demographic factors that shape production behaviour and profitability outcomes. Majority of the farmers were males (65.4%), married (81%), and fell within the productive age income bracket of 31-50 years. Most of them were at minimum with primary or secondary education and this makes them more capable of comprehending better farming methods and putting them into practical use. Education encourages use of innovation since literate farmers handle information more closely and are also responsive to extension training. According to Aina et al., (2012), education has a direct effect on the use of good agronomic practices by crop producers. In the research, most farmers (577) had 6-10 years of farming experience that enhances efficiency and use of resources. The experience will allow the farmers to better handle the risks and therefore make the planting decisions in a timely manner and also react to the changes in the seasonal market. This experience coupled with education does explain why many of the respondents continued to operate at a profit even with absence of external support.

The production of plantains in the study area is largely small-scale with 44.9% of the plantations having less than one hectare and 30% having one to two hectares. This is in line with Swennen (1990) and Akinyemi et al. (2010) who represented Nigerian plantain farms as low- input systems that relied on family labour and organic fertilisers. The use of household labour lowers expenses at the expense of expansion and mechanisation. The reduced size of farms has the disadvantage of limiting the economies of scale, thereby decreasing output per farmer and diminishing competitiveness in the market. The productivity of farms and the size of the farms is clear in terms of the cause-and-effect relationship. Poor access to credit and land does not allow farmers to invest in irrigation or better tools, and this has a direct impact on the level of yield. The liberalization of land access and financing of inputs would consequently raise production and income of rural areas.

Profitability analysis confirms that plantain production is financially sustainable in Adamawa and Taraba States. Economic returns were high and the gross margin was ₦376, 031.35 per hectare and the ratio of the benefits to costs was 5.11. These findings match Akinyemi et al. (2008) and Oladejo and Sanusi (2008) who realized the same level of profitability in southern Nigeria. Its financial performance is very strong because of the low-cost production structure, very little mechanisation and organic fertilisers. These will save money and make the net revenue high. According to Marriott and Lancaster (1993), plantain remains cost-effective in that it does not need a lot of mechanisation and yields more than one harvesting season. Nonetheless, overreliance on the low-cost practices can lower the soil fertility in the long run and limit the yield increase. The only way to achieve sustainable profitability is, therefore, to have a balance between the conventional practice and the gradual process of introducing better inputs and better soil management techniques.

The most drastic constraint of production that was reported by 81.7% of the respondents was that of high input cost. This has a direct negative impact on the profitability because the combination of high prices on the suckers,

fertilisers, and labour will multiply the total variable costs. The same conclusion was made by Baruwa et al. (2011) in southwestern Nigeria, which indicated that the inefficiency in the costs of inputs suppresses farm income. The fact that the same constraint is repeated in other geographic areas shows that there is a structural weakness in the distribution systems of inputs nationally. The same findings were realised by IITA (2007) and Ojediran et al. (2018), who concluded that the lack of access to affordable inputs reduces the productivity of plantain farmers. In Northeastern Nigeria, the poor infrastructure conditions and distance between input markets aggravate the high prices of inputs. Transportation expenses add up to the input prices as they raise transaction margins among traders. This increase in the cost of production is the interaction of market distance with institutional gaps in this regional disadvantage. The policy measures must thus be favourable on decentralised input depots, collaborative procurement and credit-backed subsidy initiatives to reduce the cost implications.

The research has also established that 74.9% of farmers had insufficient extension services that curtail their access to new planting methods and pest control methods. Lack of advisory services weakens the adoption of good agronomic practices, thereby reinforcing yield stagnation. Similarly, 76.4% of respondents reported poor access to improved planting materials. The combination of these constraints creates a cycle where farmers rely on low-yielding suckers, further reducing profitability. Effective extension systems would break this cycle by linking farmers to certified planting materials and technical information.

The marketing analysis produced a net marketing margin (NMM) of ₦356,031.35 and a marketing efficiency (ME) of 337.3%. These figures indicate that plantain production generates over three times the value of its marketing costs. However, this high efficiency coexists with significant marketing constraints such as poor transport infrastructure and post-harvest losses. The coexistence requires interpretation because it reflects structural features rather than superior performance. High ME results from low marketing costs since many farmers sell directly to traders or consumers at farm gates. Minimal storage and transport expenditure artificially raises efficiency ratios. In reality, weak infrastructure and a lack of storage facilities still erode actual income. Therefore, the high ME represents cost avoidance rather than functional market efficiency. Baruwa et al. (2011) cautioned that inflated efficiency values often mask systemic inefficiencies in perishable crop marketing. Addressing transport bottlenecks, market access, and storage limitations would reduce hidden income losses and increase effective profitability.

Post-harvest losses affected 54.0% of respondents, confirming that infrastructure gaps continue to undermine real income. Poor market facilities cause delays that lower produce quality and reduce prices. Farmers selling under distress conditions earn less despite high calculated margins. Investment in storage centres, rural roads, and cooperative marketing would stabilise prices and increase returns. Improved infrastructure would reduce losses, expand market reach, and translate nominal efficiency into genuine profitability.

The findings of the research reveal the relationship between socio-economic, institutional, and infrastructural influences on the production of plantains. Practices are adopted based on education. The production capacity depends on access to credit and inputs. Marketing results are determined by the infrastructure quality. Any weak area in these areas has direct negative impacts on profitability. Interventions towards development should therefore consider several constraints at the same time in order to realize the growth in productivity in the long run.

The findings have policy implications on the part of policy makers and development agencies. The additional training should be on good agronomic practices and effective management of resources. The credit institutions are supposed to create financing items that are business-like depending on the production cycle of the plantain. Governments are supposed to lay more emphasis on rural roads development and input market development. Enhancement of these connections would lower production expenses, enhance marketing performance, and increase the farmer earnings. The findings affirm that the production of plantains, which is facilitated by proper infrastructure and institutions, can be used to spur rural employment and food security in the Northeast of Nigeria.

CONCLUSION AND RECOMMENDATIONS

The study examined the socio-economic profile, profitability and production limitations of plantain farmers in Adamawa and Taraba States, Northeastern Nigeria. The findings indicate that the plantain farming is characterised by married, middle-aged male farmers formal education and moderate experience of farming experience of 6-10 years. The majority of the respondents own small farms of less than a hectare of land, working with the help of traditional tools and using organic inputs and family labour. The enterprise is not costly, though it is viable in terms of its economy. Gross margin of ₦376,031.35 and a ratio of 5.11 of the benefit and cost are indicative of high profitability.

These findings prove that plantain farming has the potential to play a major role in the rural income and employment in case it is well supported with credit, inputs, and extension services.

Nevertheless, a number of interdependent constraints are still restricting productivity and profitability. The cost of inputs being very high is the worst constraint, with 81.7% of the respondents reporting. This increases the cost of production and reduces the margins of earnings. Efficiency is also decreased by limited access to better planting materials (76.4%), and poor extension services (74.9%). These are aggravated by poor infrastructure, pest pressure and post-harvest losses, resulting in a cycle of low productivity and low market returns. These issues being perpetuated have shown that profitability does not necessarily mean that there would be sustainability without structural changes in the input access and the market structure as well as the institutional support.

The results validate that plantain cultivation has high potential to diversify rural livelihoods and alleviate poverty in Northeastern Nigeria, which has never been a part of the traditional plantain belt. Smallholders can use it because of the adaptability of the crop to varying soil conditions and the lack of high mechanisation. However, to accomplish long-term sustainability, there is a need to coordinate the implementation of actions that would respond to the farm-level and structural obstacles. More investment in input supply system, infrastructure and knowledge delivery will turn the realized profitability into consistent growth of incomes and regional agricultural resilience.

Recommendations

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

i. Government agencies and private seed enterprises should establish decentralised multiplication centres for disease-resistant plantain suckers. These centres should supply affordable, high-quality planting materials suited to local agroecological conditions. Policies should also promote the use of organic and inorganic fertilisers at subsidised rates to counteract rising input prices and soil degradation.

ii. Agricultural extension services must be strengthened to provide field-based training on soil fertility management, pest control, and post-harvest handling. Collaboration between extension agents, farmer associations, and research institutes will ensure that knowledge is effectively transferred and locally adapted.

iii. Public and private actors should invest in rural roads, storage facilities, and aggregation centres to reduce post-harvest losses and marketing inefficiencies. Improved logistics will lower transport costs and enhance farmers' ability to reach higher-value markets, thus increasing their effective profit margins.

iv. Financial institutions should introduce flexible, low-interest credit products aligned with the 14–20-month production cycle of plantain. Supporting farmers to form cooperatives will enhance their collective bargaining power, facilitate bulk input procurement, and improve access to finance and markets.

Researchers' Contribution Statement Summary

The authors declare that they have contributed equally to the article and have not plagiarised.

Conflict of Interest Declaration

The authors of the article declare that there is no conflict of interest between them.

Ethical Statement

This study, which involved the administration of structured questionnaires to plantain farmers in Adamawa and Taraba States, Northeastern Nigeria, was reviewed and approved by the Modibbo Adama University Research Ethics Committee. Approval was granted at the meeting held on 26-05-2022, with Approval/Protocol Number MAU/RE22/0049.

REFERENCES

Aina, J.O., Falade, K.O., Akingbala, J.O. and Titus, P. (2012), "Quality characteristics of plantain (Musa spp.) products", *Journal of Food Science*, Vol. 77 No. 2, pp. S69–S74.

Akinyemi, S.O., Aiyelaagbe, I.O.O. and Akyeampong, E. (2010), "Plantain (Musa spp.) cultivation in Nigeria: A review of its production, marketing and research in the last two decades", *Proceedings of the International Conference on Banana and Plantain in Africa, Acta Horticulturae*, Vol. 879, pp. 211–218.

Akinyemi, S.O., Aiyelaagbe, I.O.O. and Lucas, E.O. (2008), "Economic analysis of plantain production in southwestern Nigeria", *International Journal of Agricultural Economics and Rural Development*, Vol. 1 No. 2, pp. 87–93.

Baruwa, O.I., Omonona, B.T. and Fakayode, S.B. (2011), "Technical efficiency of plantain production in Nigeria: A stochastic frontier production approach", *Journal of Agricultural Science*, Vol. 3 No. 2, pp. 153–160.

Battese, G.E. and Coelli, T.J. (1992), "Frontier production functions, technical efficiency and panel data: with application to paddy farmers in India", *Journal of Productivity Analysis*, Vol. 3 No. 1, pp. 153–169.

Esparon, N.M. and Sturgess, N.H. (1989), "The measurement of technical efficiency using frontier production functions of rice farms in West Java", *Bulletin of Indonesian Economic Studies*, Vol. 25 No. 3, pp. 99–119.

FAO (2006), "Food and Agriculture Organisation Statistical Database", available at: http://faostat.fao.org (accessed 10 September 2025).

Food and Agriculture Organization of the United Nations (2007), *The State of Food and Agriculture 2007*, available at: https://www.fao.org/4/a1200e/a1200e00.htm (accessed 10 September 2025).

Food and Agriculture Organization of the United Nations (2013), *The State of Food and Agriculture 2013*, available at: https://www.fao.org/4/i3300e/i3300e00.htm (accessed 10 September 2025).

IITA (2007), *Integrated Pest Management for Plantain and Banana*, IITA Research Guide, Ibadan.

Marriot, J. and Lancaster, P.A. (1993), "Bananas and plantains", in Macrae, R., Robinson, R.K. and Sadler, M.J. (Eds.), *Encyclopedia of Food Science, Food Technology and Nutrition*, Academic Press, London.

Ndubizu, T.O.C. (1985), "Plantain production in southern Nigeria", *Proceedings of the National Workshop on Banana and Plantain*, Onne, Nigeria.

Ngeze, P.B. and Gathumbi, M. (2004), *Learn How to Grow and Market Bananas*, Nairobi.

Ojediran, J.O., Lawal, A.F. and Bamiro, A.O. (2018), "Profitability of plantain production in some selected local government areas of Osun State, Nigeria", *Journal of Economics and Sustainable Development*, Vol. 9 No. 12, pp. 90–97.

Oladejo, J.A. and Sanusi, W.A. (2008), "Economics of plantain production in derived savannah zone of Osun State, Nigeria", *Agricultural Journal*, Vol. 3 No. 5, pp. 362–364.

Swennen, R. (1990), *Plantain Cultivation under West African Conditions*, IITA Technical Bulletin No. 2, Ibadan.