



ECONOMIC ANALYSIS OF IRISH POTATO (*SOLANUM TUBEROSUM*) PRODUCTION UNDER IRRIGATION IN JOS METROPOLIS OF PLATEAU STATE, NIGERIA

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ABSTRACT

The study analyzed the economic performance of Irish potato (*Solanum tuberosum*) production under irrigation in Jos Metropolis of Plateau State, Nigeria. A multi-stage sampling technique was employed to select 220 respondents across Jos North, Jos South, and Jos East Local Government Areas. Primary data were collected through structured questionnaires and analyzed using descriptive and budgetary techniques. The results revealed that the majority (73.2%) of the farmers were male, majority (68.6%) were married and most (85.9%) had formal education. More than half (51.4%) of the farmers were full-time, indicating a strong dependence on agriculture as their primary livelihood. Cost and return analysis showed a total cost of ₦208,156,100, total revenue of ₦465,308,000, and a net farm income of ₦257,151,900, resulting in a return on naira invested (RNI) of 1.7. This implies that irrigated Irish potato production in Jos Metropolis is economically viable. However, farmers faced major constraints such as pest and disease infestation (90.5%), inadequate capital (89.1%), poor access to credit (87.7%), and high cost of technology (86.8%). The study concludes that while potato farming under irrigation offers significant profitability potential, productivity is hindered by capital and technical limitations. Strengthening access to finance, inputs, and extension support could substantially enhance efficiency and output.

Keywords: Irish, Potato, Irrigation, Profitability, Constraints.

INTRODUCTION

Agriculture remains a cornerstone of the Nigerian economy, contributing significantly to food security, employment, and national income. Within this sector, potato (*Solanum tuberosum*) cultivation holds considerable economic and nutritional significance, particularly in the highland regions of Nigeria like Plateau State, where the cooler climate favors its growth (Pam *et al.*, 2021). The agricultural sector plays a crucial role in facilitating economic growth, significantly contributing around 4% to the overall world gross domestic product (GDP). In many underdeveloped countries, this particular industry may potentially contribute to more than 25% of the Gross Domestic Product (GDP) and is recognized as one of the largest sectors globally, with a workforce of over one billion people (World Bank, 2023; Mupfasoni *et al.*, 2018). And it is one of the most important cornerstones for ensuring food security (Hudhud *et al.*, 2015; Neima *et al.*, 2021; Neima *et al.*, 2023). In recent years, the agricultural sector has experienced economic and productive transformation, especially as a result of agricultural trade liberalization and Common Agricultural Policy changes that have resulted in more market-oriented agriculture (Pindado and Sánchez, 2017). Agribusiness is a broad category of operations that provide economic value. Agribusiness includes not only farming but also all of the various industries and services that link farmers to consumers (Fani *et al.*, 2021). Moreover, the development of agribusiness and entrepreneurship is critical and an important policy aim to eliminate poverty, stimulate economic growth, solve environmental problems, and attain food security (Saghalian *et al.*, 2022).

Irish potato (*Solanum tuberosum* L.) is classified within the family Solanaceae and is by far the most efficient tuber crop in terms of tuber yield and days to maturity. It matures in about 80 - 90 days as compared to 9 – 12 months for yam and cassava (Muinat and Damilola, 2017). Potato (*Solanum tuberosum* L.) is an important source of livelihood for smallholder farmers in the eastern highlands of Ethiopia (Gelmesa 2018). However, low soil fertility and soil moisture stress are the major problems constraining potato production in the region (Mohammed *et al.* 2018). Potato (*Solanum tuberosum* L.), is the most commonly cultivated tuber crop and the fourth most important



food crop in the world, after wheat, rice and maize (Haan and Rodriguez 2016). The world's population is expected to exceed nine billion by 2050 (United Nations, 2019).

Irrigation plays an increasingly vital role in enhancing agricultural productivity in Nigeria, mitigating the risks associated with rain-fed agriculture and enabling year-round cultivation (Oyekale, 2020). In Jos Metropolis, the adoption of various irrigation technologies allows potato farmers to ensure a consistent water supply, potentially leading to higher yields and more stable production cycles. These technologies range from traditional surface irrigation methods to more modern systems like sprinkler and drip irrigation (Anyaegbunam *et al.*, 2023).

Despite its crucial role in providing nutritional value and food security in Nigeria, the potato's yield per hectare of 3.8 tons/ha falls below that of top producers in Africa, highlighting a productivity challenge (FAOSTAT, 2022). Potato production under irrigation in Jos Metropolis presents a significant opportunity for enhancing food security and economic well-being in the region. However, observed variations in yield and profitability among farmers utilizing irrigation suggest potential inefficiencies in their production practices (Adamu *et al.*, 2024). There is a need to specifically analyze the technical efficiency of potato production under irrigation in Jos Metropolis to understand the nuances of this farming system and identify opportunities for optimization. Existing studies on agricultural efficiency in Nigeria often provide broad analyses or focus on rain-fed agriculture, with limited attention specifically directed towards irrigated potato production in the Jos Metropolis context.

The findings of this study will provide empirical evidence for policymakers and agricultural development agencies to design and implement targeted interventions aimed at improving the productivity and efficiency of potato farming in the study area. This could include policies related to input subsidies, extension services, irrigation infrastructure, and access to credit. The study will also add to the existing body of literature specifically focusing on irrigated potato production. It will provide valuable insights for future research in related areas and specifically examine the efficiency of potato production under irrigation, providing a better understanding of the benefits and challenges associated with this farming system in the context of Jos Metropolis.

The Broad objective of the study was to examine the economic analysis of Irish potato (*Solanum tuberosum*) production under irrigation in Jos metropolis of Plateau State, Nigeria. While the specific objectives were to;

- i. describe the socio-economic characteristics of the respondents in the study area;
- ii. determine the costs and returns of Irish potato production under irrigation;
- iii. identify the constraints faced to Irish potato production under irrigation in the study area.

METHODOLOGY

The Study Area

Jos metropolis, Nigeria lies within latitudes $9^{\circ}45'00''$ N to $09^{\circ}57'00''$ N and longitudes $8^{\circ}48'00''$ E to $8^{\circ}58'00''$ E. Jos is the administrative capital of Plateau State (Adzandeh, 2015). Jos Metropolis covers parts of Jos North, Jos South and Jos East Local Government Areas. Jos North, Jos South and Jos East LGAs have a projected population of 429,300, 306,716 and 85,602 people respectively based on the annual growth rate 3.3% in 2024. Jos metropolis covers an area of 249.7km², at an altitude of 1,217m (3,993ft) above sea level, it has a more temperate climate than much of the rest of Nigeria (Adzandeh, 2015). The climate is the wet and dry type classified as tropical rainy climate and characterized by a mean annual rainfall of 1,250mm, peaking between July and August. The mean annual temperature is about 22°C but mean monthly values vary between 19°C in the coolest month of December and 25°C in the hottest month of April (Adzandeh, 2015). The city of Jos is the largest settlement in Plateau State. It owes its origin to the introduction of Tin mining on the Jos Plateau and railway lines linking it with Port Harcourt and Lagos, thus bringing the area into the orbit of the world economy. The Tin mining led to the boost in business activities increasing the population of the town making it highly cosmopolitan (Kudu, 2021).

**Sampling Technique and Sample Size**

A multi stage sampling procedure was employed to select respondents for the study. In the first stage, Jos metropolis was purposively selected due to the prevalence of Irish potato farming activities and also because of the availability of water from Dams and ponds occasioned by tin mining. In the second stage the three Local Government Areas (LGAs) within the metropolis were also purposively selected; North, South and East LGAs. In the third stage 4 villages were randomly selected from each LGA making a total of 12 villages; Naraguta, Rikkos, Rantya and Lamingo in the North; Zawan, Vom, Gyel and Du in the South, while Gwash, Gwafan, Kwang and Kwanga in the East, respectively. In the final stage random sampling technique was employed and proportionally (10%) 220 respondents were choosing.

This is shown in the table below.

Table 1: Sample Technique and Sample Size

LGAs	Villages	Sample Frame	Sample size (10%)
North			
	Naraguta	231	22
	Rikkos	176	17
	Rantya	192	18
	Lamingo	156	15
South			
	Zawan	256	25
	Vom	274	26
	Gyel	178	17
	Du	200	19
East			
	Gwash	190	18
	Gwafan	172	17
	Kwang	123	12
	Kwanga	140	14
Total	12	2,288	220

Source: Field Survey 2024

Method of Data Collection

The study used primary data collected through the administration of structured questionnaire to 220 respondents randomly sampled from the study area. The questionnaire is divided into sections to obtain precise information for the study.

Method of Data Analysis

The data collected were analyzed using both descriptive and farm budget statistics. Descriptive statistics; frequency, percentage and mean were used to analyze objective i and iii, while farm budget was used to analyze objective ii.

Descriptive statistics

Descriptive statistics such as frequency, percentage and mean were used to analyze objective i and iii.

Cost and returns analysis

Costs and returns analysis will be carried out using the budgetary technique. Indicators such as net farm income, percentage profit margin and return per naira invested were analyzed to achieve objective ii. The budgetary techniques are as follows:

$$\text{Net farm income (N.F.I)} = \text{GFI} - \text{T}^{\text{C}} \quad \dots(\text{i})$$

Where;

GFI = gross farm income

TC = Total cost

$$\text{TC} = \text{TVC} = \text{TFC} \quad \dots(\text{ii})$$

TVC = Total variable cost;

Seed (₦), fertilizer (₦), labour (₦), and agrochemicals (₦)

TFC = Total fixed cost;



Land improvement (well, drainage, boundary mark, etc.) and depreciation of farm tools/equipments (₦). Depreciation cost (₦) of fixed assets (farm tools/equipments, building), land improvement (wells, irrigation facility, etc.). The straight-line method of evaluating depreciation will be used to estimate the depreciation of farm assets (farm tools such as hoes and cutlasses, etc). The straight-line method of depreciation is specified as;

$$D = P - S/N \quad \dots \text{(iii)}$$

Where;

D = Depreciation

P = Purchase price of the assets

S = Salvage value of the assets

N = Number of years of life of the assets

% Profit margin = Net farm income/Total revenue x 100% (iv)

Returns per naira invested = Net farm income/Total cost (v) (James, 2024)

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Irish Potato Farmers

The result from Table 2 reveals that majority (73.2%) of the farmers were male, while 26.8% were females.

Table 2: Distribution of Respondents According to their Socioeconomic Characteristics (n=220)

Variable	Frequency	Percentage
Age		
25-32	41	18.6
33-40	50	22.7
41-48	53	24.1
49-56	58	26.4
57 and Above	18	8.2
Gender		
Male	161	73.2
Female	59	26.8
Marital Status		
Single	34	15.5
Married	151	68.6
Widow	35	15.9
Level of Education		
Secondary	92	41.8
Tertiary	97	44.1
None Formal	31	14.1
Years of Farming Experience		
2-7	69	31.4
8-13	41	18.6
14-19	47	21.4
20-25	27	12.3
26 and Above	36	16.4
Primary Occupation		
Farmer	113	51.4
Civil Servant	72	32.7
Trader	15	6.8
Artisan	20	9.1
Household Size		
1-5	105	47.7
6-10	52	23.6
11-15	24	10.9
15 and Above	39	17.7

Source: Field Survey, 2024



This finding implies that male dominance is typical in many Nigerian agricultural settings, especially for staple crops requiring significant physical labor. This finding is in line with the findings of Umar and Sani (2021), who reported a higher prevalence of male farmers in staple crop production in the Northeastern States, often linked to traditional land inheritance systems and socio-cultural norms. A good proportion (26.4%, 24.1% and 22.7%) of the farmers were within the age bracket of 49-56 years, 41-48 years and 33-40 years, while 18.6% and 8.2% of the farmers were within the ages 25-32 years and 57 and above years in the study area. This finding implies that predominantly farmers were within their active ages of production in agriculture indicating a workforce with accumulated practical knowledge of potato cultivation. This is consistent with Mohammed and Abubakar (2021), who observed that the majority of active farmers in northern Nigeria are within their productive years, but also noted a trend of youth disinterest in agriculture.

The findings further shows that majority (68.6%) of the farmers were married, with 15.9% widowed and 15.5% single. The high proportion of married farmers suggests stable household structures, which often provide a reliable source of family labor for farm operations, crucial for smallholder farming where hired labor may be costly or scarce. Married farmers also tend to have greater household responsibilities, which can motivate them to adopt practices that enhance productivity and food security. This finding is in line Adamu and Yakubu (2021), who linked married status to larger family labor availability. The result also reveals that a good proportion 44.1% of the farmers had tertiary education and 41.8% had secondary education. Only 14.1% had no formal education. This finding implies that high level of education is a significant asset for potato farmers in Jos Metropolis. Educated farmers are generally more receptive to new information, better able to understand and adopt complex agricultural technologies and can make more informed decisions regarding input use and market participation. This finding is in line with Usman and Aliyu (2021), while noting some improvements, still found a significant proportion of farmers with only primary or no formal education in Adamawa State. This highlights a unique characteristic of potato farmers in Jos Metropolis, possibly due to the commercial nature of potato farming or proximity to urban centers. A substantial portion (31.4%, 21.4% and 18.6%) of farmers have 2-7 years, 14-19 years, 8-13 years of experience in potato farming. While 16.4% and 12.3% had 26 years and above and 20-25 years of experience in potato farming in the study area. This finding implies that the diverse range of farming experience, with a significant number of both relatively new and long-term experienced farmers, provides a mix of perspectives. Experienced farmers possess valuable indigenous knowledge and understanding of local conditions, which can be crucial for adapting to climate variability while the new or beginners might be more open to innovation but may lack practical insights. This is similar to Garba and Bello (2020) who noted that while experience provides valuable insights, it needs to be complemented with updated knowledge through extension services to fully embrace modern practices.

The finding also shows that more than half (51.4%) of the respondents were full-time farmers, while 32.7%, 9.1% and 6.8% were engage in civil service, artisan work, and trading, respectively. The high proportion of full-time farmers indicates a strong reliance on agriculture for livelihood, suggesting a high incentive to maximize potato yield and profitability. The presence of civil servants and artisans as part-time farmers suggests livelihood diversification, which can provide alternative income streams for investment in farming or as a buffer against agricultural risks. This aligns with Adenuga *et al.* (2020), who highlighted livelihood diversification as a common strategy among rural households in Nigeria, often enabling farmers to invest in agriculture from off-farm income. The finding also shows a large proportion (47.7%) of farmers have a household size of 1-5 persons, while 23.6%, 17.7% and 10.9% had 6-10 persons, 15 and above, and 11-15 persons, respectively. This finding implies that smaller to medium-sized households indicates that while family labor is important, it might be limited for some farmers, potentially necessitating reliance on hired labor. Larger households, however, can offer more family labor, which is a cost-effective input in potato production. Mohammed and Abubakar (2021) indicated that household size significantly influences labor availability for agricultural activities in Nigeria.

Cost and Returns on Potato Production among Respondents

The result from Table 3 reveals cost and return analysis which shows the profitability of Irish potato production in the study area. The finding indicate that Irish potato farmers had incurred a total cost (TC) of production at ₦208,156,100 and a total variable cost (TVC) amounting to ₦109,736,100 on Irish potato production in the study area. The components of variable cost include; cost of irrigation equipment (25.03%), seed (13.49%), fuel (6.36%), fertilizer (3.10%), chemicals (2.25%), repairs and maintenance (2.26%) and labour (0.23%) of the total cost incurred, respectively. The finding also shows respondents incurred total fixed cost (TFC) of ₦98,420,000, from land purchase (45.05%) and rents at (2.23%) of the total cost. The finding further shows that farmers had obtained total revenue (TR) from sales of potato at ₦465,308,000. On the other hand, the finding shows gross margin (GM) of ₦355,571,900 and a return on naira investment (RNI) 1.7.

Table 3: Cost and Return Analysis on Irish Potato Production in the Study Area

Variables	Amount (₦)	Percentage
Variable cost		
Cost of seed	28,077,000	13.49
Cost of chemicals	4,684,700	2.25
Cost of fertilizer	6,461,000	3.10
Cost of Irrigation equipment	52,098,000	25.03
Cost of fuel	13,237,000	6.36
Repairs and maintenance	4,697,000	2.26
Labour	481,400	0.23
TVC	109,736,100	
Fixed cost		
Rents	4,640,000	2.23
Land purchase	93,780,000	45.05
TFC	98,420,000	
TC	208,156,100	100.00
Revenue		
Sales of potato	465,308,000	
TR	465,308,000	
GM	355,571,900	
RNI	1.7	

Source: Field Survey, 2024

This finding implies that Irish potato production in Jos Metropolis is highly profitable, with a return on naira investment (RNI) of 1.7. This means that for every ₦1 invested, farmers get a return of ₦1.7, suggesting a net profit of ₦0.7. This high profitability is a strong incentive for farmers to continue and even expand potato cultivation. However, land purchase (45.05%) and irrigation equipment (25.03%) constitute the largest cost components. This highlights the capital-intensive nature of irrigated potato farming with an upfront investment required, which can be a barrier for many farmers, especially given the low access to credit. Ibrahim and Umar (2021), in their study on potato production in Plateau State, also reported positive returns on investment, underscoring the economic viability of the crop. However, the specific breakdown of costs, especially the high proportion attributed to land purchase and irrigation equipment, provides a more detailed picture of the capital requirements.

Constraints Faced in Irish Potato Production

The result from Table 6 depicts the constraints faced by Irish potato farmers in Jos Metropolis.

Table 4: Distribution of Respondents According to their Constraints Faced in Irish Potato Production

Variable	Frequency*	Percentage	Ranking
Pest and diseases	199	90.5	1 st
Inadequate Capital	196	89.1	2 nd
Poor access to credit	193	87.7	3 rd
High cost of technology	191	86.8	4 th
Inadequate farm income	174	79.1	5 th
Inadequate extension services	171	77.7	6 th
High cost of labour	165	75.0	7 th
High cost of planting materials	162	73.6	8 th
Fragmented farm size	71	32.3	9 th

Source: Field Survey, 2024 *Multiple response

The major constraints faced by the farmers were pest and diseases (90.5%), inadequate capital (89.1%) and poor access to credit (87.7%) which were ranked 1st, 2nd and 3rd, respectively. These were followed by high cost of technology (86.8%), inadequate farm income (79.1%), and inadequate extension services (77.7%) which were ranked 4th, 5th and 6th by the farmers in the study area. Others include high cost of labour (75.0%), high cost of planting materials (73.6%) and fragmented farm size (32.3%) in the study area. These constraints highlight a complex and interconnected set of challenges for Irish potato farmers in Jos Metropolis. The dominance of pests and diseases as the top constraint shows the urgent need for effective and accessible pest and disease management strategies, including resistant varieties and appropriate agrochemicals. Inadequate extension services directly impact knowledge transfer and the adoption of improved practices. Usman and Aliyu (2021) and Adamu and Yakubu (2021) both identified pests and diseases as significant factors affecting maize and other crop yields in Nigeria. Ahmed and Shehu (2020) and Mohammed and Sani (2021) consistently highlighted financial constraints as major impediments to agricultural development and technology adoption. Idris and Sani (2020) and Abdullahi and Umar (2020), noted the limited reach and frequency of extension contact.

CONCLUSION AND RECOMMENDATION

The study concludes that Irish potato production under irrigation in Jos Metropolis of Plateau State is a highly profitable agricultural enterprise with significant potential for improving rural livelihoods and contributing to regional food security. In addition, enhancing the capacity of farmers through financial empowerment, technical training, and improved irrigation infrastructure is essential for maximizing production efficiency and profitability.

Based on the findings of this study, the following recommendations are made:

- Government and financial institutions should establish flexible and low-interest agricultural credit schemes to enable potato farmers
- The Plateau State Agricultural Development Programme (PADP) and related agencies should strengthen extension service delivery through regular training and field demonstrations
- Input suppliers and policymakers should collaborate to ensure that quality seeds, fertilizers, and agrochemicals are made available and affordable to smallholder farmers.
- Research institutions should intensify efforts in developing and promoting integrated pest management practices tailored to the local agro-ecological conditions of Jos Metropolis.

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