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PROFITABILITY ANALYSIS OF RICE PRODUCTION USING MANUAL AND MECHANIZED FARMING METHODS IN EWEKORO LOCAL GOVERNMENT, OGUN STATE, NIGERIA.

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ABSTRACT

The increasing cost of production and low supply of rice to feed the Nigerian teeming population is a cause for concern. Hence this study examines the profitability of rice production using manual and mechanized farming methods in Ewekoro Local Government Area, Ogun State. A comparative analysis was conducted to determine the differences in output levels and profitability between the two farming practices using one hundred and thirty two (132) manually and mechanically operated rice farmers. Snowballing technique was used to select the respondents for the study. Data were gathered with the aids of questionnaire and analyzed using descriptive statistics such as frequency count, percentage, means and standard deviation and inferential statistics such as independent t-test. . The findings reveal that mechanized rice farming recorded an average output of 6,133.41 kg/ha, significantly higher than the 1,185.03 kg/ha average output in manual farming. Mechanized farming also demonstrated a greater Net Return on Investment (NROI) of 5.54%, compared to 4.45% for manual farming. An independent t-test further confirmed a statistically significant difference in profitability between the two methods, with mechanized farming proving to be more profitable ($t = 29.598$, $p < 0.01$). The study concludes that mechanization enhances productivity, reduces labor costs, and improves resource management, contributing to higher profitability. It recommends promoting mechanization through increased access to affordable machinery, training programs for farmers, and improved infrastructure.

Keywords: Manual, Mechanized farming, Net Return on Investment

INTRODUCTION

For millions of people worldwide, rice is a staple meal that is essential to maintaining food security, especially in developing nations like Nigeria. Farmers, policymakers, and other stakeholders in the agricultural sector are increasingly concerned about the need for lucrative and efficient production methods as the demand for rice keeps rising (Amanor, 2022). Due to the extensive use of labour-intensive and inefficient manual farming techniques, Nigeria's productivity levels have remained relatively low despite the country's potential to become a significant producer of rice (Olagunju *et al.,* 2021).

Smallholder farmers frequently engage in manual rice farming, which is characterised by the use of basic equipment and human labour and results in poorer yields, greater production costs, and decreased profitability (Eze *et al.,* 2020). On the other hand, mechanized farming makes use of cutting-edge machinery like harvesters and tractors, which boosts productivity, lowers the need for labour, and enhances crop yields (Mogaji and Olumide, 2022). Many of the issues affecting rice production have been acknowledged to have possible solutions in mechanization, especially when it comes to increasing profitability and productivity.

Additionally, smallholder farmers who account for more than 80% of rice production, particularly in rural areas dominate in manual cultivation. For land preparation, planting, weeding, and harvesting, this system usually uses human labour and crude tools, which results in low labour productivity, high drudgery, and constrained yield potentials (Sanusi *et al.,* 2022). Manually grown rice farms often yield less than 2 tonnes per hectare and are frequently limited by post-harvest losses, high manpower expenses, and delayed operations.

On the other hand, rice farming that is mechanically farmed uses tractors, planters, harvesters, and threshers, which enables timely operations, greater yield, and increased efficiency. According to research, mechanized farms can produce 3–5 tonnes of produce per hectare, cut down on operating time by more than 60%, and reduce post-harvest losses to less than 2%, whereas manual systems can attain yields of over 10% (Sanusi *et al.,* 2022). In addition to relieving farmers' physical strain, mechanization can generate opportunities in rural areas for people who operate and maintain machinery.

Additionally, Nigeria's adoption of mechanized rice farming is still restricted because of the high upfront expenditures, limited financing availability, poor rural infrastructure, and land fragmentation, which makes it difficult to deploy machinery (PwC Nigeria, 2021; Sanusi

et al., 2022). Mechanization is becoming seen as a practical way to improve rice output, profitability, and sustainability in spite of these obstacles. However, Nigeria has been hesitant to adopt mechanized rice growing despite its advantages. Its broad use is nevertheless hampered by elements including the high cost of machinery, restricted finance availability, and poor infrastructure (Akinwale and Ojo, 2021). Furthermore, despite the lower financial returns, smallholder farmers who make up the majority of rice producers frequently lack the funds necessary to invest in mechanization, forcing them to rely on manual methods.

The significance of mechanization in raising agricultural productivity and profitability has been emphasized by recent studies. For example, mechanized rice production greatly increased yields and decreased labour costs, which in turn increased profit margins, according to a study by Adeoye and Kolapo (2023). In a similar vein, Okoye *et al.* (2022) found that mechanization improves time management and land use, which benefits farmers' bottom lines. By comparing the profitability of rice production using manual and mechanized farming methods, this study aims to add to the expanding body of information. By concentrating on the financial benefits and difficulties of each strategy, this study will offer information that can guide policy choices and assist Nigerian farmers in making well-informed decisions regarding the adoption of mechanized farming.

These similar difficulties are faced by rice producers in Ogun State's Ewekoro Local Government Area. Notwithstanding the possible financial advantages of mechanization, many farmers still employ manual techniques. There is no research comparing the profitability of manual versus mechanized farming specifically in Ewekoro, Ogun State, despite earlier studies highlighting the good effects of mechanization on rice yields and profitability in other places (Adeoye and Kolapo, 2023).
By examining the profitability of rice production in the area using both manual and mechanized farming techniques, this study aims to close this disparity. Policymakers and farmers alike will benefit greatly from knowing the financial ramifications of each farming method, which will help them make decisions on mechanization investments and raise the standard of living for rice farmers in Ewekoro. This study intends to offer a data-driven analysis that can help sustainable agricultural growth in Nigeria, given the rising demand for rice and the need for more effective agricultural techniques. Hence, these objectives were considered for the study; determine the output level of manual and mechanized rice farming methods on rice production and analyze the cost and effect (profitability) of manual and mechanized rice farming methods on rice production in the study area. The hypothesis for this study is as stated below

H_0: There is no significant difference between profitability of manual and mechanized rice production

Literature review

Archaeological evidence suggests that people have been cultivating rice (Oryza sativa) for thousands of years, with domestication beginning in China circa 5000 BC (Liu et al., 2020). Rice production originated in the Yangtze River region and, via trade networks and migration, extended throughout Asia before eventually making its way to Africa, Europe, and the Americas (Fuller and Castillo, 2016). Nowadays, more than half of the world's population is fed by rice, a staple crop that is farmed in a variety of ecological circumstances in Asia (FAO, 2023).

Paddy fields, which are specifically constructed for water management, are where rice is mostly grown in Asia. Three primary soil types are used to cultivate these paddies: peats or muck soils with a modest peat depth; silts and soft clays that solidify when dry; and firm-bottomed clays that hold moisture near the surface (Kang et al., 2021). For rice plants to flourish in damp conditions, the composition of the soil is essential for root development and water retention (Pandey *et al.,* 2019).

Nigeria is still a net importer of rice because of inadequate local output, despite the fact that rice production is essential to both food security and economic stability in the nation. Rice is mostly grown by smallholder farmers in rural regions, who mostly use labour-intensive manual farming techniques that yield low productivity and profitability (Mottaleb *et al.,* 2019). By lowering labour demands and boosting efficiency, the adoption of mechanized farming techniques has the potential to greatly increase agricultural output. However, because of high machinery costs, limited financing options, and infrastructure issues, mechanization adoption is still restricted in many parts of Nigeria (Olagunju *et al.,* 2021).

Although rice is still a vital component of Nigeria's agricultural economy, its productivity is still below ideal. USDA-backed FAS data shows that between 2020 and 2025, rice output plateaued at about 2.40 t/ha. Production increased slightly from 8.17 million tonnes to a predicted 9.15 million tonnes in 2024–2025, which is significantly less than Nigeria's annual consumption of over 10 million tonnes. Productivity is still among the lowest in Africa, even if harvested areas have increased to 3.6 million hectares (Sale et al., 2024). The yield disparity is glaring: most farmers continue to use low-yielding native seeds that average 2 t/ha, even when enhanced varieties may yield 10+ t/ha (The Nation, 2024: FAO, 2024).

Limited access of high-quality inputs, like better rice seeds, fertilizers, and herbicides, is one of the main obstacles. Traditional seed varieties, which have low yields and poor resistance to pests and diseases, are still used by many smallholder rice producers. More than 60% of Nigerian rice farmers, according to Ogunlela and Ogunbiyi (2022), use uncertified seeds, which lowers yield and makes crops more vulnerable to failure.

Another major obstacle is inadequate mechanization. The majority of rice farmers continue to use labour-intensive, time-consuming, and ineffective manual cultivation methods. Although less than 25% of rice farmers in Nigeria have access to any kind of mechanized equipment, a report by Nwankwo et al. (2023) revealed that mechanized rice fields produced up to 40% greater yield per hectare than manually run ones. Another significant barrier is inadequate irrigation infrastructure. Despite the fact that rice requires a lot of water, just 10% of Nigerian rice farms are officially irrigated (FAO, 2023). Because of this, rice production is highly reliant on erratic rainfall patterns, which leads to uncertain yields, particularly in light of climate change.

Rice production is made more difficult by land tenure concerns and land fragmentation. Small, dispersed plots are used by many rice growers, which restricts economies of scale and deters mechanization. Insecure property rights deter investment in long-term land restoration techniques like bunding or soil fertility augmentation, according to Ajani and Igbokwe (2021).

High post-harvest losses, which can amount to as much as 20–30% as a result of inadequate drying, poor storage, and a lack of contemporary processing equipment, are among the other noteworthy limitations (Adepoju *et al.,* 2022). Furthermore, farmers are unable to embrace better techniques or technology that could increase productivity due to limited access to loans and extension services. According to CBN (2022), fewer than 30% of rice farmers benefit from official credit facilities, despite existing agricultural intervention programs. Furthermore, productivity and access to farmlands have been seriously affected by insecurity in rice-producing regions, especially in the north, which is caused by banditry and farmer-herder clashes. According to Yahaya *et al.* (2023), security concerns have caused more than 40% of rice farms in Benue and Zamfara States to close in the past three years.

Business Day reports a 7% drop in rice output for 2024/25 to 5.23 million tonnes, citing inflationary input prices, insecurity in northern production zones, and energy cost spikes as critical issues Business Day (2025). In Gombe State, pest infestations, particularly from rice yellow mottle virus and gall midge, rank among the top constraints impacting yields (Sale et al., 2024). Smallholder farm sizes and fragmented plots further hinder mechanization, driving up labour costs and limiting scale economies (Olasehinde et al., 2022).

The government's Anchor Borrowers' Programme (ABP) is one initiative to revive the industry. It increased paddy production from roughly 6 million tonnes in 2015 to almost 8.9 million tonnes by 2023, and it increased milling capacity from fewer than ten facilities to more than 100 integrated and cottage mills (Vestance, 2024). Infrastructure investments intended to lessen dependency on rice imports are highlighted by flagship projects like the Imota mill, which can process 2.8 million bags a year and provide both direct and indirect jobs (Erezi, 2023). In order to address micronutrient deficiencies in school feeding programs, the PRiFN initiative, which is supported by the World Food Programme, focusses on fortified rice production through local millers.

Post-harvest handling and storage have been greatly enhanced by mechanization in rice cultivation, especially in Asia, which has decreased post-harvest losses and increased food security (Hossain and Jaim, 2022). However, in many smallholder agricultural systems, widespread adoption is still constrained by issues with infrastructure, cost, and availability to machinery (Mottaleb *et al.,* 2019).

Although mechanization is widely acknowledged as a key factor in Nigeria's rice production, the country's mechanization rate is still extremely low, at 0.27 to 0.3 horsepower per hectare, well below the FAO's recommended 1.5 horsepower per hectare and significantly lower than China's 4.1 horsepower per hectare and India's 2.6 horsepower per hectare (Adu-Baffour et al., 2019; Magezi et al., 2023). Only 2% of Nigerian farmers are thought to be using mechanized techniques at the moment; the majority still use hand tools like hoes and cutlasses, which significantly reduces their ability to prepare their land and their productivity (Onomu and Aliber, 2021).

Despite these limitations, controlled trials demonstrate that mechanization has definite advantages. In smallholder rice farms, mechanized harvesting and threshing decreased post-harvest losses from 9.6% to 0.9%, decreased greenhouse gas emissions by about 1,696 kg CO_2 eq per hectare, and increased harvesting efficiency, all of which increased yields and profits. For smallholder farmers, mechanization is therefore a clear economic opportunity (Castelein et al., 2022). Additionally, mechanization lowers the need for labour, allowing for more effective land preparation and the concentration on higher-value farm work.

These benefits are supported by experience in Sub-Saharan Africa: two-wheel tractors increase farming intensity and yield, while even four-wheel tractors support field expansion and increase labour productivity, though they might not maximise yield per hectare (Adu-Baffour et al., 2019; Magezi et al., 2023). Power tillers and combine harvesters have been tested for rice in Nigerian states like

Kebbi and Nasarawa, which has shortened harvest times and decreased post-harvest losses (Aremu 2025).

Adoption is, however, constrained by major obstacles. Farmers are hampered by high machinery costs, dispersed landholdings, and limited credit availability. In Delta and Benue States, 72% of farmers polled do not use tractors, while those who do earn around twice as much as those who do not (Onomu and Aliber, 2021). Further limiting the growth of mechanization are inadequate infrastructure, a lack of qualified operators and maintenance personnel, and uneven policy support (InfoGuide Nigeria, 2015).

Moreover, economic inclusion has been demonstrated to be fuelled by mechanization. The emergence of mechanization service providers has made it possible for farmers who cannot afford to buy machinery to access services through rental models. This has improved value-chain links throughout agriculture and created jobs for women and youth in operations, maintenance, and agro-processing (Izu, 2024).

In Nigeria, the majority of rice is grown by hand, especially by smallholder farmers who use hand tools like hoes and cutlasses. Time-consuming land preparation, extended harvesting cycles, and high labour inputs result in yield averages of about 2 t/ha, which is far lower than the 4–7 t/ha observed in Asia. This outdated method also adds to widespread inefficiencies. High post-harvest losses of 9–10% are confirmed by studies, resulting in lost income and spoiling emissions. Productivity is hampered by land fragmentation and a lack of technological adoption, particularly in areas like Anambra State where manual labour is the norm and output is well below potential (Aremu 2025).

On the other hand, mechanized rice farming using tractors, power tillers, combine harvesters, and mechanized threshers has shown revolutionary advantages. According to a controlled trial conducted in Nigeria, mechanization improved labour efficiency, decreased greenhouse gas emissions by about 1,696 kg CO_2-eq per hectare, and raised net revenue by around $400 per hectare. It also decreased paddy losses from 9.6% to 0.9% (Castelein et al., 2022). Mechanized farmers in areas like Kwara State produced almost twice as much as those who relied on human labour, demonstrating the potential for mechanization to significantly increase productivity.

Notwithstanding these benefits, mechanization in Nigeria is still very low; only 2% of farmers use mechanized equipment, and the average mechanization rate is only 0.27 horsepower per hectare, which is far less than the FAO standard of 1.5 horsepower per hectare (Business Day 2015). High machinery prices, dispersed land parcels, restricted loan availability, inadequate infrastructure, inadequate support services, and low technical capacity are some of the main obstacles (Onomu and Aliber, 2021). To scale mechanized rice production and increase food security in Nigeria, these barriers must be addressed through cooperative mechanization programs, reasonably priced financing, capacity-building, and supportive legislative measures.

In conclusion, mechanization in rice farming has the potential to significantly boost yields, lower emissions and losses, improve labour efficiency, and aid in the economic transformation of rural areas. However, in order for these advantages to materialise, Nigeria must remove structural obstacles by means of reasonably priced agricultural machinery, capacity building, cooperative models, better infrastructure, and enabling laws that will strengthen mechanization as a pillar of the growth of the rice industry. With the introduction of mechanization, rice harvesting techniques have undergone major change. Binder threshers and combination harvesters are frequently employed to increase productivity in areas where mechanized farming is prevalent. After harvesting, the grain is dried to roughly 14% moisture content to provide appropriate storage and avoid degradation (Zhao *et al.,* 2021). Harvested crops are "shocked" to shield them from rain during the drying process, and manual methods like reaper binders are used in more traditional agricultural systems with less mechanization (Ram *et al.,* 2020).

METHODOLOGY

Study Area

Ewekoro Local Government Area is one of the twenty local government areas in Ogun State and is situated in the southwestern part of the country. Ewekoro is one of the LGA in Abeokuta Zone by Ogun State Agricultural Development Programme (OGADEP) division. It is bordered by Abeokuta North Local Government to the south, Ifo Local Government to the west, Odeda and Obafemi-Owode Local Government to the east. Ewekoro is a Local Government Area in Ogun State, Nigeria. Its headquarters are in the town of Itori, at 6°56′00″N 3°13′00″E. It has an area of 594 km^2 and a population of 55,156 at the 2006 census.

Ewekoro has a diverse agricultural landscape with a significant focus on rice production and best known for big companies such as; Cement factories (Lafarge: West African Portland Cement Company Ewekoro and Dangote group). The region benefits from its fertile soil, suitable climate, and access to water sources, making it conducive for agriculture and is home to a substantial population engaged in various agricultural activities.

Population of the study comprises of all rice farmers in Ewekoro Local Government, Ogun. Convenient selection of Eighty eight (88) manually cultivated rice farmers based on the response rate and Forty four (44) mechanized rice farmers based on response return rate Snowballing sampling technique because there was no comprehensive list of the registered rice farmers in the study area. This

makes a sum total of One hundred and thirty-two (132). Data were gathered with the aid of interview guide, data were analyzed using descriptive statistics such as frequency count, table, means and standard deviation while independent t-test was used to analyze the difference in the profit level of manual and mechanized rice production

RESULTS AND DISCUSSION

Result in Table 1 indicates a significant difference in the output levels between mechanized and manual rice farming. Mechanized rice farming had an average output level of 6,133.41 kg/ha, whereas manual rice farming recorded an average output of 1,185.03 kg/ha. This stark contrast in output can be attributed to the differences in farming practices, particularly the level of mechanization and the size of land under cultivation.

Furthermore, mechanized rice farming typically involves the use of advanced machinery such as tractors, ploughs, harvesters, and mechanical weeding, which not only increase the efficiency of farm operations but also enhance the overall productivity per unit area of land. The larger scale of mechanized farming, often coupled with better resource management, leads to higher output levels. Recent studies support this observation, noting that mechanization significantly boosts agricultural productivity by reducing the time and labor required for key farming activities, thereby allowing for more intensive and extensive cultivation (Eze *et al.,* 2022; Abayomi and Akintoye, 2023).

In contrast, manual rice farming is highly labor-intensive and generally limited by the physical capacity of the farmers. The reliance on manual labor for land preparation, planting, weeding, and harvesting limits the area that can be effectively cultivated and reduces the overall efficiency of the farming process. Consequently, the lower output from manual rice farming is reflective of these constraints. Studies by Bello and Adebayo (2021) and Oluwaseun (2023) have also found that manual farming practices, while common in regions with limited access to mechanization, often result in lower yields due to the high labor demands and the inefficiencies associated with traditional farming methods.

Table 1: Output Level of Manual and Mechanized Rice Farming Methods on Rice Production

	Mechanized Rice Farming			Manual Rice Farming		
Output (Kg/ha)	**Freq**	**Percent**	**Mean**	**Freq**	**Percent**	**Mean**
1000.0	0	0(0)		31	35.2	
1000.1 - 4875.0	2	4.5		57	64.8	1185.03
4875.1 - 8750.0	42	95.5	6133.41	0	0(00	

Cost and Effect (Profitability) of Manual and Mechanized Rice Farming Methods on Rice Production

The results in Table 2 reveal the profitability of rice farming by examining the Net Return On Investment (NROI) for both mechanized and manual rice farming. The analysis shows that for mechanized rice farming, every One Naira (N1.00) invested yields a return of 5.54%, compared to a 4.45% return for manual rice farming. This difference of 1.09 percentage points between the two methods suggests that mechanized rice farming is more profitable than manual rice farming, assuming all other factors remain constant.

The higher NROI in mechanized rice farming can be attributed to the efficiency and productivity gains associated with mechanization. Mechanized farming typically involves the use of advanced equipment and technology, which enhances the speed and precision of farming operations, reduces labor costs, and increases output. These factors collectively contribute to a higher return on investment. Research by Adeyemi and Alabi (2022) supports this, indicating that mechanized farming operations tend to have higher profitability due to reduced operational costs and increased efficiency.

The observed NROI difference of 1.09 percentage points between mechanized and manual rice farming underscores the economic advantage of mechanization in rice production. Mechanized farming allows for the cultivation of larger areas of land, more efficient resource use, and better management of inputs, all of which contribute to higher profitability. This finding aligns with the broader literature on agricultural economics, which consistently shows that mechanization is a key driver of increased profitability in farming (Olagunju and Ikenna, 2023).

Table 2: Cost and Effect (Profitability) of Manual and Mechanized Rice Farming Methods on Rice Production per hectare

Variable	Mechanized/ha	Manual/ha
Total revenue (TR)	953,190,000	352,665,000
Total variable cost (TVC)	125,117,000	55,411,500
Total fix cost (TFC)	94,450,000	8,262,050
Total Cost (TC) = TFC+TVC	219,567,000	63,673,550
Gross margin (GM) =TR-TVC	828,073,000	297,253,500
Net Income (NI) =TR/TC	733,623,000	288,991,450
Return on Investment (ROI) = TR/TC	4.0	3.0
Net Return On Investment (NROI) = NI/TC	5.54	4.54

T-test Result of the Difference between the Profitability of Mechanized and Manual Rice Farming

Table 3 presents the results of an independent T-test comparing the profitability of rice farming under mechanized and manual cultivation methods. The analysis reveals a significant difference in profitability, with a t-value of 29.598 ($p < 0.01$). This indicates that mechanized rice farming is significantly more profitable than manual rice farming. Consequently, the null hypothesis, which stated that "there is no significant difference between the profitability of mechanized and manual rice farming," is rejected.

Mechanized farming allows for the efficient use of inputs and resources, leading to higher yields and lower production costs per hectare compared to manual farming. The adoption of machinery and technology in farming operations enhances productivity by reducing labor costs, improving the precision of input application, and enabling timely farming activities. This aligns with the findings of Olagunju and Adewumi (2022), who noted that mechanized farms tend to be more profitable due to their ability to exploit economies of scale and reduce unit production costs.

Moreover, mechanized rice farming benefits from increased operational efficiency, as machines can perform tasks more quickly and accurately than manual labor. This leads to a reduction in post-harvest losses and an increase in the overall quality of the rice produced. The ability to handle larger-scale production also enables mechanized farmers to better meet market demand and potentially command higher prices for their produce. Studies by Agboola *et al.* (2023) have shown that mechanized rice farmers often achieve higher profitability due to their ability to optimize input use and maximize output.

Table 3: T-test Result of the Difference between the Profitability of Mechanized and Manual Rice Farming

Profitability	N	Mean	S.D	Std. Error	T	Df	p-value
Mechanize rice farming	44	18819840.91	4322796.95	651686.16	29.598	130	0.001
Manual rice farming	88	3377880.68	1641657.63	175001.29			

CONCLUSION

The findings indicate a significant difference in output levels between mechanized and manual rice farming. Mechanized farming achieved an average output of 6,133.41 kg, while manual farming recorded just 1,185.03 kg. The higher output in mechanized farming is attributed to the use of advanced machinery such as tractors, harvesters, and mechanical weeding, which enhance efficiency and allow for larger land cultivation. In contrast, manual farming is labor-intensive and constrained by physical limitations, leading to lower productivity.

In terms of profitability, mechanized rice farming yielded a Net Return on Investment (NROI) of 5.54%, compared to 4.45% for manual farming, indicating that mechanization is more profitable. The greater profitability in mechanized farming stems from increased productivity, reduced labor costs, and better resource management. An independent t-test confirmed a statistically significant difference in profitability between the two methods (t-value of 29.598, $p < 0.01$), rejecting the null hypothesis that there is no difference in profitability.

The study demonstrates that mechanized rice farming significantly outperforms manual rice farming in both output and profitability. The use of mechanization leads to higher productivity, more efficient resource use, and greater returns on investment, making it a more viable option for rice farmers in Ewekoro, Ogun State. The findings align with broader research that highlights mechanization as a key driver of agricultural productivity and profitability. The significant difference in output and NROI further reinforces the economic advantages of

adopting mechanized farming practices. Hence, it was recommended that government should invest in improving rural infrastructure, such as roads, tractors and storage facilities, to support mechanized farming operations and reduce post-harvest losses.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript

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