THE CURRENT STATE OF FARM MACHINERY UTILIZATION AND MECHANIZATION IN TARABA STATE

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ABSTRACT

The imbalance between food demand and domestic production requires improvement and this can be done with the availability of and utilization of farm machinery for carrying out farm operations to enhance large scale production. This study investigated the level and extent to which farmers in Taraba State have delved into the use of modern farm implement to achieved crop production. The study employed a quantitative research design to examine the effects of farm mechanization on productivity and rural livelihoods. The population comprised farmers engaged in crop production, ranging from smallholders to larger commercial operators. Stratified random sampling was used to select 1680 respondents across Taraba state. The state was divided in 168 strata based on the 168 wards in the state. Structured questionnaires were designed and administered to respondents and were later retrieved. Random sampling was used to select 10 farmers from each ward which sums up to 1680 copies of questionnaire distributed across the state. However, only 1570 questionnaires were retrieved and analyzed. The data collected was based on 1, socioeconomic characteristics: Age, gender, education, and house hold size; 2, Mechanization levels: usage of machinery; and, 3, Farm productivity indicators: Farm size, crop diversity, and input use intensity. 4, rural livelihood indicators: Income, employment opportunities, and household well-being. Both descriptive and inferential statistical methods were used to analyze the data and Statistical Package for Social Sciences (SPSS) version 26 was used. Descriptive Statistics include Frequencies and percentages summarize the variables. Inferential Statistics: Multiple linear regressions was used to determine the impact of access to credit, availability of machinery, aff1ordability, technical skills, government policies, and environmental sustainability on mechanization levels. Pearson correlation analysis evaluated the relationship between mechanization levels and productivity indicators. The findings generally revealed that a very small percentage of farmers, amounting 6.06% have access to farm power and machinery owing to multiplicity of factors ranging from economic, government policy, technical skills and so on, and infract, only 11.4% machinery are available to farmers.

Keywords: Farm Machinery, machinery utilization, mechanization, farm size, farm productivity, mechanization levels

1. INTRODUCTION

Agricultural machinery plays a crucial role in improving agricultural productivity. It helps farmers increase efficiency, optimize land use, and reduce labor shortages, ultimately leading to higher crop yields and farm income. Mechanization has been found to reduce agricultural production losses, lower production costs, and improve the quality and efficiency of crop production. Additionally, the use of agricultural machinery can lead to greater areas being farmed, increased crop quantities, and conservation of natural resources, contributing to sustainable agricultural practices (Cheteni et al 2019). Some specific benefits of agricultural machinery include increased efficiency, improved land productivity, and the ability to perform tasks that would be labour-intensive or time-consuming if done manually. Overall, agricultural

machinery is essential for modern farming, offering numerous advantages that contribute to increased agricultural productivity and income (Jegede et al 2021).

I. Despite the potential advantages of using farm machinery to boost agricultural productivity and rural development, there is a significant lack of understanding regarding the extent of mechanization and its effects on farmers in Taraba State, Nigeria. Challenges such as limited access to suitable machinery, insufficient technical expertise, financial constraints, and socio-economic factors can impede farmers from embracing mechanized farming methods, limiting their capacity to enhance productivity, increase incomes, and secure sustainable livelihoods. To tackle these issues effectively, a thorough evaluation of farm machinery usage trends, factors influencing adoption choices, and the socio-economic repercussions of mechanization in Taraba State is essential. This study aimed at identifying key obstacles and opportunities so as to guide evidence-based interventions and policy actions that support inclusive and sustainable mechanized farming practices, improve rural livelihoods, and advance agricultural development in Taraba State. The specific objectives of the study were to Identify the types of farm machinery commonly used by farmers; to evaluate the factors influencing farm machinery adoption, investigate the socio-economic, technological, institutional, and environmental factors that influence farmers' decisions regarding the adoption and utilization of farm machinery and to examine the accessibility of farmers to credit facilities, availability of machinery, affordability, technical skills, government policies, and environmental sustainability in shaping farmers' choices regarding mechanization.

The adoption and utilization of farm machinery have been extensively studied in the agricultural literature, with numerous studies highlighting its positive impact on agricultural productivity and rural development. For example, research by Rehaume *et al*. (2017) found that the adoption of mechanized farming practices led to significant increases in crop yields and farm incomes. Similarly, studies by Takeshima *et al*. (2021) and Semuga *et al*. (2020) demonstrated the positive effects of farm machinery utilization on labor productivity, cropping intensity, and overall farm output. These findings underscore the importance of mechanization in enhancing agricultural productivity and food security, particularly in developing countries like Nigeria. Even though some breakthroughs have been made worldwide in the area of improved food processing technologies, Nigerian farmers still rely so much on traditional methods of processing which in turn reduces the level of productivity.

II. It is noteworthy that range of factors influence farmers' decisions regarding the adoption and utilization of farm machinery, particularly in the area in question. Access to credit and financing options, availability of machinery, technical knowledge and skills, government policies, and socio-cultural factors all play critical roles in shaping farmers' adoption behavior. Understanding these factors is crucial for designing effective interventions and support mechanisms to facilitate the uptake of farm machinery among farmers in Taraba State and Nigeria at large. The objective of this to determine the Current Status of Farm Machinery Utilization as well as to conduct a comprehensive survey to ascertain the extent to which farmers in Taraba utilize farm machinery in their agricultural operations.

The research work was hinged on a theoretical analysis as a basic frame which forms the basis for approach. This approach involved the collection of both quantitative and qualitative data to provide comprehensive insights into farm machinery utilization. The following model was

developed and used in the regression analyses. The Multiple linear regression equation was given as:

$$Y=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\epsilon Y$$

where,

Dependent Variable (Y): level of farm mechanization
Independent Variables (X_1 to X_4):
X_1: Affordability of machines
X_2: Availability of machines
X_3: Technical skills
X_4: Access to Credit
X_5: Government policies
X_6: Environmental Sustainability
β represents the **regression coefficients**, which quantify the relationship between each independent variable (X_1, X_2, X_3, X_4, $X_5$and X_6) and the dependent variable (Y).
β_1: The change in Y (level of farm mechanization) for a one-unit increase in X_1 (Affordability of machines), holding all other variables constant.
β_2: The change in Y for a one-unit increase in X_2 (Availability of machines), holding all other variables constant.
β_3: The change in Y for a one-unit increase in X_3 (Technical skills), holding all other variables constant.
β_4: The change in Y for a one-unit increase in X_4 (Access to credit), holding all other variables constant.
β_5: The change in Y for a one-unit increase in X_5 (Government policies), holding all other variables constant.
β_6: The change in Y for a one-unit increase in X_6 (Environmental sustainability), holding all other variables constant.

2. MATERIALS AND METHODS

The study area used for this research was all the ten wards of each of the sixteen (16) local government areas of Taraba State. Data collection was carried out through surveys using structured questionnaires. The questionnaire was designed based on the objectives of the study and aimed to capture information on farmers' demographics, farm machinery utilization, factors influencing adoption, and the impact of mechanization on agricultural productivity and livelihoods. The sample size was determined based on the population size of farmers in each ward of the local governments in Taraba.

The quantitative data collected through the survey questionnaires were analyzed using descriptive and inferential statistical methods. Descriptive statistics such as frequencies, percentages, means, and standard deviations were computed to summarize the data. Inferential statistics, such as chi-square tests and regression analysis, were employed to examine relationships between variables and test hypotheses.

3. RESULTS AND DISCUSSION

3.1 Results

The results are represented below graphically from Figures 1 to 5. Figure 1 is a graph showing the hectare of farmland cultivated by farmers. The graph was generated using Table 1.

Figure 2 is a curve showing responses on the factors affecting the use of farm machinery. Figure 3 is the Graph showing Impact of using farm machinery and the corresponding level of farm productivity. Figure 4 is the Graph showing the farmers responses to various levels of available supports.

Tables 1, 2, and 3 were used to generate Figures 1, 2 and 3 respectively.

Table 1. Summary of Farm Size of the Respondents

S/No.	Farm size	Frequency	Distribution (%)
1.	Less than 1 hectare	581	40.4
2.	1-5 hectare	476	25.6
3.	6-10 hectare	396	13.1
4.	More than 10 hectare	117	8.9
	Total	1570	100

Table 2. Responses on the Factors that Influence the use of Farm Machinery

S/No	Factor	Frequency	Distribution (%)
1.	Increase in farm productivity	291	24.5
2.	Labor savings	92	16.3
3.	Time savings	130	18.0
4.	Access to credit or subsidies	80	14.7
5.	Availability of machinery	55	11.4
6.	Affordability	20	6.55
7.	Government policies	28	8.19
	Total	693	100

Table 3. Summary of the responses on Impact of the use of Farm Machinery in farm Productivity

S/No	Impact	Frequency	Distribution (%)
1.	Increased significantly	335	54.5
2.	Increased moderately	201	22.7
3.	Remained the same	107	13.6
4.	Decreased moderately	50	1.51
	Total	693	100

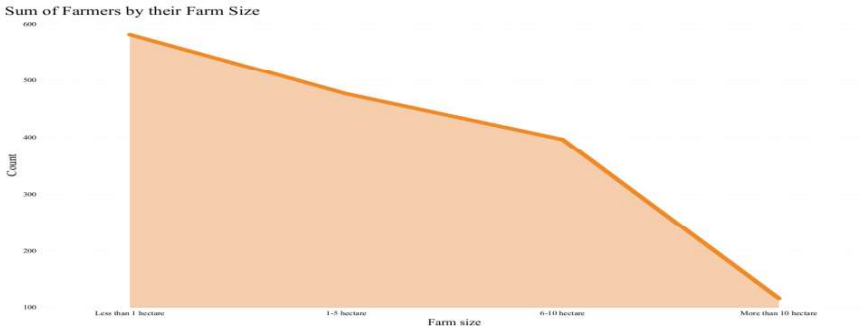

Figure 1. Farm Size of the Respondents

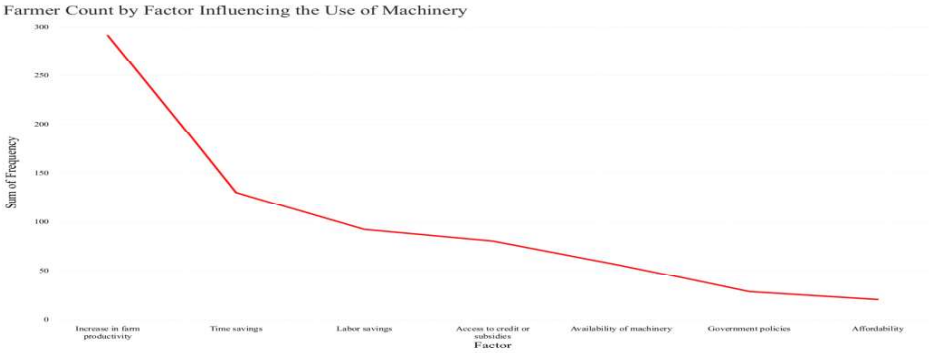

Figure 2. Factors that influence the use of Farm Machines

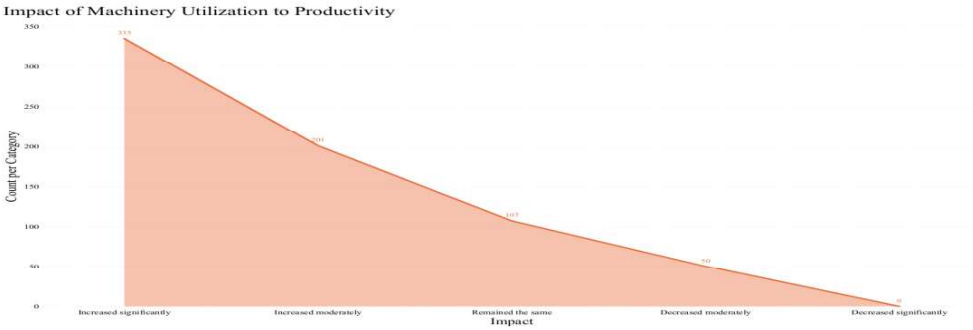

Figure 3. Graph showing Impact of using farm machinery and the corresponding level of farm productivity

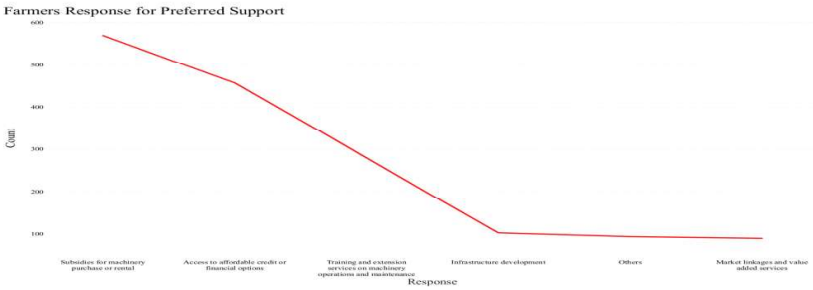

Figure 4. Graph showing the farmers responses to various levels of available supports

3.2 Discussion

Figure 1 reveals the farmers' holdings, the sizes of farmland cultivated by the farmers shows that 40.4% cultivates less than 1 hectare, 25.6% cultivates between 1-5 hectares, while 13.1% cultivates between 6-10 hectares and only 8.9% cultivates more than 10 hectare: thus correlating with the findings of Sennuga and Oyewole (2020) which explains the fact that mechanization generally is hindered and narrowed to small pieces of land where farmers are handicapped in terms of resources to implementing mechanized farming.

Figure 2 reflects the factors which has influenced famers to use farm machinery 24.5% of the respondents adopted farm machinery to increase farm productivity, 16.3% adopted farm machinery to reduce labor, 18.0% adopted farm machinery to save time, 14.7% of the respondents adopted farm machinery to gain access to subsidies, 11.4% of the respondents adopt farm machinery as result of machine availability, 6.55% of the respondents adopt farm machinery because they can afford it and 8.19% of the respondents adopt farm machinery because of government policies.

Figure 3 discusses the impact of farm machinery usage and corresponding effect on farm yields. Findings clearly show an significant impact, thus correlating perfectly with the findings of Odigboh (1999), as well as Olatunji et al. (2022) and Sasore (2005).

Summarily, all the afore mentioned factors suggests that farm machinery have not been so much utilized due to lack of needed resources such as farm inputs, cost, government supports, etc.

3.3 Statistical Analysis

Examine the role of access to credit, availability of machinery, affordability, technical skills, government policies, and environmental sustainability in shaping farmers' choices regarding mechanization. The analysis is contained in Table 4.

Table 4. ANOVA Table of the factors that influence the use of farm mechanization

Variables	**Regression Coefficients (β)**	**Standard Error**	**T statistic**	**Significance**
Intercept (β_0)		0.054	2.215	0.027
Affordability of machines (X_1)	0.457	0.032	14.270	0.000
Availability of machines (X_2)	0.407	0.024	18.000	0.000
Technical skills (X_3)	0.084	0.020	4.816	0.000
Access to credit (X_4)	0.069	0.020	3.094	0.002
Government policies (X_5)	-.136	0.018	-9.572	0.000
Environmental sustainability (X_6)	0.017	0.020	1.154	0.249
R-squared	0.898			
Adjusted R-squared	0.805			
Sig (0.05)	0.000			
F-Statistic	1032.271			

The results of the multiple linear regression analysis provide valuable insights into the factors influencing the utilization of mechanization among farmers. The Model Summary shows a high degree of explanation, with an R^2 value of 0.806. This indicates that 80.6% of the variation in the level of farm mechanization is explained by the combined effects of the independent variables: access to credit, availability of machines, affordability, technical skills, government

policies, and environmental sustainability. The model is statistically significant, as evidenced by the p-value of 0.000 for the F Change, confirming that the predictors collectively have a substantial impact on mechanization levels.

The analysis of variance further supports this finding, with an F-statistic of 1032.271 and a p-value of 0.000. This result indicates that the regression model as a whole is statistically significant and reliably predicts the level of mechanization based on the specified factors.

The coefficients table provides a deeper understanding of the contribution of each independent variable to the model. Among the predictors, affordability of machines (β=0.457, p=0.000) and availability of machines (β=0.407, p=0.000) exhibit the most substantial positive effects on mechanization levels. This suggests that the accessibility and affordability of machines are critical drivers of mechanization adoption among farmers.

Technical skills also have a significant positive influence (β=0.084, p=0.000), indicating that farmers with the necessary skills are more likely to utilize machinery. Similarly, access to credit has a significant but smaller positive effect (β=0.069, p=0.002), underscoring the importance of financial support in enabling mechanization.

On the other hand, government policies exhibit a significant negative effect (β=−0.136, p=0.000), suggesting that existing policies may hinder rather than support mechanization. This finding highlights a potential area for improvement in policy frameworks to better facilitate mechanization among farmers. Lastly, environmental sustainability (β=0.017, p=0.249) does not significantly influence mechanization levels, indicating that while it is an important consideration, it may not directly drive farmers' decisions regarding machinery use.

Evaluation of the relationship between mechanization levels and farm productivity indicators, such as farm size, crop diversity, and input use intensity; is shown in Table 5.

Table 5. Correlation between farm Mechanization and Farm productivity

		Farm Mechanization Level	Farm Size	Crop Diversity	Input Use Intensity
Farm Mechanization Level	Pearson Correlation	1	.546**	.512**	.710**
	Sig. (2-tailed)		.000	.000	.000
	N	1570	1570	1570	1570

**. Correlation is significant at the 0.01 level (2-tailed)

The correlation analysis evaluates the relationship between farm mechanization levels and productivity indicators, including farm size, crop diversity, and input use intensity. The results reveal several statistically significant positive correlations, all at the 0.01 level.

Farm mechanization level is strongly correlated with input use intensity (r=0.710, p=0.000), indicating that higher levels of mechanization are associated with greater intensity of input use, such as fertilizers, seeds, or other agricultural resources. This suggests that mechanized farms tend to adopt more intensive farming practices, which could contribute to higher productivity.

There is also a moderate positive correlation between farm mechanization level and farm size (r=0.546, p=0.000). This finding implies that larger farms are more likely to adopt mechanization, possibly because larger farms have higher resource demands and economies of scale, making mechanization more feasible and beneficial.

Similarly, a moderate positive correlation is observed between farm mechanization level and crop diversity (r=0.512, p=0.000), indicating that mechanization is associated with more diversified cropping systems. Mechanized tools and equipment may enable farmers to manage multiple crop types more effectively, supporting diversification.

Investigate how farm machinery utilization affects rural livelihoods, including income generation, employment opportunities, and household well-being.

Table 6. Regression Showing Relationship between farm mechanization levels and rural livelihood indicators

		Farm mechanization level	Income	Employment opportunities	Household wellbeing
Farm mechanization level	Pearson Correlation	1	.656**	.755**	.776**
	Sig. (2-tailed)		.000	.000	.000
	N	1570	1570	1570	1570

**. Correlation is significant at the 0.01 level (2-tailed)

Correlation analysis explores the relationship between farm mechanization levels and rural livelihood indicators, including income generation, employment opportunities, and household well-being. The results reveal strong and statistically significant positive correlations between farm mechanization and all three indicators, underscoring the significant role mechanization plays in improving rural livelihoods.

Farm mechanization level is strongly correlated with household well-being (r=0.776, p=0.000), indicating that increased mechanization positively impacts various aspects of household living standards. Mechanization likely reduces labor intensity, increases productivity, and enhances access to resources, which collectively improve the quality of life for farming households. The above assertions corroborates perfectly with Daum et al. (2020), and Odigboh (2020).

A similarly strong correlation is observed between farm mechanization level and employment opportunities (r=0.755, p=0.000). This suggests that mechanization creates new jobs, either directly through the operation and maintenance of machinery or indirectly by increasing farm productivity, which can support auxiliary industries such as processing and distribution.

The relationship between farm mechanization level and income (r=0.656, p=0.000) is also significant, indicating that higher levels of mechanization are associated with increased income generation. Mechanized farms tend to achieve greater efficiency and output, which can translate into higher earnings for farmers.

4. CONCLUSION

The results from this study area show that farm machinery is sufficient for increase productivity in farm operations but the level of farm machinery utilization is very low, few farmers in the study area have the means to adopt farm machinery for farm operations and majority cannot adopt farm machinery utilization for several reasons ranging from the lack the technical skills which is essential for modern farming, for example, only 8.9% cultivated 10 hectares and above, over 40% maintained farm sizes below one hectare; 6.5% of the farmers cannot afford machinery and about 14.7 only had access to loan facilities and other incentives through the government, hence, low level of education, finance and in availability of machines to farmers. Farm machinery utilization plays a crucial role in enhancing agricultural productivity and rural development. However, addressing the challenges and harnessing the opportunities associated with mechanized farming require concerted efforts from policymakers, development practitioners, and agricultural stakeholders. By promoting sustainable mechanization strategies and supporting smallholder farmers' access to farm machinery and related services, it is possible to realize the full potential of mechanized farming in improving food security, alleviating poverty, and promoting rural prosperity.

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APPENDIX

Section 1: Demographic information

Q 1: What is your Sex?

Male ☐

Female ☐

Q 2. Age:

S/No	Age	
1	18 - 30	
2	30-39	
3	40-49	
4	50-59	
5	60 and above	

Q 3: Level of Education

S/No.	Academic Qualification
1.	No formal education
2.	Primary education
3.	Secondary education
4.	Tertiary education
	Total

Q 4: Local Government Area

S/No.	LGA	
1.	Ardo Kola	
2.	Bali	
3.	Donga	
4.	Gashaka	
5.	Gassol	
6.	Ibi	
7.	Jalingo	
8.	Karim Lamido	
9.	Kurmi	
10.	Lau	
11.	Sardauna	
12.	Takum	
13.	Ussa	
14.	Wukari	
15.	Yorro	
16.	Zing	
	Total	

Q 5: Farm Size of the Respondents (farmers)

S/No.	Farm size	
1.	Less than 1 hectare	
2.	1-5 hectare	
3.	6 – 10 hectare	
4.	More than 10 hectare	
	Total	

Q 6: What is your Main Agricultural Activity

S/No.	Agricultural activity	
1.	Crop cultivation	
2.	Livestock rearing	
3.	Both crop and livestock farming	
	Total	

Section 2: Farm Machinery Utilization

Q 7: Do you use farm machinery for agricultural operations?

S/No.	Use Machinery
1.	Yes
2.	No
	Total

Q 8: For How Long have you Been Using Farm Machinery?

S/No.	Duration
1.	Less than 1 year
2.	1-3 years
3.	4-6 years
4.	More than 6 years
	Total

Q 9: Which of these Factors can say has influenced your use of Farm Machinery?

S/No.	Factor	
1.	Increase in farm productivity	
2.	Labor savings	
3.	Time savings	
4.	Access to credit or subsidies	
5.	Availability of machinery	
6.	Affordability	
7.	Government policies	
	Total	

Q 10: How frequently do you use farm machinery in your agricultural operations?

S/No.	Duration	
1.	Daily	
2.	Monthly	
3.	Seasonally	
4.	Rarely	
	Total	

Section 3: Reasons for Non-Utilization of Machinery

Q 11: What are your reasons for not using farm machinery?

S/No.	Reasons	
1.	Lack access to machinery	
2.	High costs of machinery	
3.	Lack of technical knowledge or skills	
4.	Lack of credit or financing options	
5.	Unsuitability of machinery for farming operations	
6.	Other reasons	
	Total	

Section 4: Impact of Farm Machinery Utilization

Q 12: What is your opinion on the impact of using farm machinery in farm productivity?

S/No.	Impact	
1.	Increased significantly	
2.	Increased moderately	
3.	Remained the same	
4.	Decreased moderately	
	Total	

Q 13: Has the utilization of farm machinery changed your labor requirements?

S/No.	Response	
1.	Reduced significantly	
2.	Reduced moderately	
3.	Remained the same	
4.	Increased moderately	
5.	Increased significantly	
	Total	

Section 5: Government Policy and Support

Q 14: Do you think there is need for government support or intervention to promote farm machinery utilization?

S/No.	Response	
1.	Yes	
2.	No	
	Total	

Q 15: What type of support would be most helpful?

S/No.	Response	
1.	Subsidies for machinery purchase or rental	
2.	Access to affordable credit or financial options	
3.	Training and extension services on machinery operations and maintenance	
4.	Infrastructure development	
5.	Market linkages and value added services	
6.	Others	
	Total	