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Adoption level of Farm Machines by Crop Farmers in Delta State, Nigeria

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Abstract: The study delved into the examination of the adoption level of farm machines by crops' farmers in Delta State, Nigeria. The specific objectives were to: describe the socioeconomic characteristics of the respondents; ascertain the level of use of farm machine by farmers in Delta State; identify the different type of machines used by farmers in the study area; and to compute the machine use index of farmers in the area. A multi-stage sampling procedure was employed to obtain data from 720 crop farmers with the aid of a well-structured questionnaire. Various descriptive and inferential statistical tools were used for data analysis. The results of the study succinctly portrayed that majority of the respondents sparingly used machines in their farm activities as depicted by the high proportion of respondents with low machine use index (65%). From the findings it was recommended that farmers should be sensitized on the benefits of using farm machines on their farms and that machine hiring centres should be established in the study area to rent machines to farmers at reasonable costs.
Keywords: Adoption, machine use index, crop farmer, mechanization, farm activities

INTRODUCTION

Farm mechanization could be described as the application of labour-saving devices in carrying out farm activities. Agricultural mechanization is the application and adoption of agricultural engineering principles and technologies to agriculture, using mechanical systems, in food, fibre, fuel and fur processing, and also, in the production, processing, handling and storage of agricultural product[1]. Large-Scale Mechanization started in the 19th Century in the USA and was initially encouraged by the availability of land and a favourable export market in Europe in the 1960s and 1970s; a similar agricultural development pattern happened in Thailand. In order to improve agricultural productivity, co-operate organization and Government interest in agriculture especially agricultural mechanization must be aroused[1].The term "mechanization" is used to describe tools, implements and machinery applied to improving the productivity of farm labour and of land; it may use either human, animal or motorized power, or a combination of these. In practice, therefore, it involves the provision and use of all forms of power sources and mechanical assistance to agriculture, from simple hand tools, to draught animal power and to mechanical power technologies. Mechanization is a key input in any farming system[2].

Mechanization systems are grouped into human, animal and mechanical technologies [2]. Based on the source of power, the technological levels of mechanization have been broadly classified as hand-tool technology, draught animal technology and mechanical power technology. The term mechanization is broadly used to describe the overall application of various inputs used in farms[3]. The level, relevant selection and subsequent good use of mechanized inputs in agriculture has a direct and significant effect on final levels of land productivity, labour productivity, the profitability of farming, the sustainability, the environment, and on the welfare of people engaged in agriculture [4]. The productivity of farms depends greatly on the availability and judicious use of farm power by the farmers. Of the tools employed in farm mechanization, the use of farm machines and implements appears to boost agricultural production more than any other means. Agricultural implements and machines enable the farmers to employ the power judiciously for production purposes. Agricultural machines increase productivity of land and labour by meeting timeliness of farm operations and increase work out-put per unit time. Besides its substantial contribution to the multiple cropping and diversification of agriculture, the use of machines also enables efficient utilisation of inputs like seeds, fertilisers and irrigation water. Anazodo [5] and Sims and Kienzle [2]asserted that the objectives of farm mechanization include the following: reduction of drudgery from farm work; increase agricultural productivity; improved timeliness of farm operations; reduced spoilage, waste and other losses of farm products; preservation and proper processing of farm products and food supplies; maximization of yields by improved agricultural operations; enhancing the production of more or surplus food products; improved water supplies and water control systems; improvement of the quality of work and products; reclamation of abandoned land because of primitive operations or inadequate power; development of new land or expansion of land for

agriculture by clearing of obstructions or by draining; levelling or other reclamation operations; and creation a greater measure of well-being for farm families.

In spite of the widespread use of farm machines in different parts of the world, human muscles still contribute about 65 percent of the power for land preparation in Sub Saharan Africa[2]. Nigeria is part of sub Saharan Africa. A famer that is reliant solely on human power can only cultivate about 1.5 ha per year. This will increase to 4 ha if draught animal power is available, and to over 8 ha if tractor power (machine) can be utilized [2]. It is quite usual to utilize different available power sources in order to increase the area cultivated, or to reduce the burden on humans. Tractors or draught animals can be hired for primary tillage and subsequent planting, and weeding can also be done with a combination of power sources and technologies. The use of these alternative power sources can relieve pressure on human labour at critical times of heavy demand. Making more efficient use of human power, together with the efficient application of draught animal power or machines, provides the best immediate strategy for reducing the problem of farm power shortage in Sub-Saharan Africa, thereby increasing agricultural productivity and improving the livelihoods of millions of families in the shortest time. Moreover, the world agricultural scenario indicates that food security is a major concern of every nation [7]. A major review of economic development in Sub-Saharan Africa (SSA) by the World Bank shows that African agriculture will be facing a formidable obstacle [6]. This involves ensuring food security for a rapidly growing population, contributing meaningfully to foreign exchange earnings through the production of export crops and providing attractive and gainful employment for the rapidly growing number of unemployed youths. Jones (1984) attributed the transformation in American Agriculture to mechanization. All technological advances in both developed and developing countries must gear towards increasing food production. The questions that now arise are: what is the level of use of farm machines in Delta State which is in Nigeria, a part of Sub-Saharan Africa? Which farm operations do farmers in Delta State mostly use farm machines? What types of machines (if any) are used by the farmers in Delta State? What is the machine use index for the various farm operations? Thus the objectives of the study were to: describe the socioeconomic characteristics of the respondents; ascertain the level of use of farm machine by farmers in Delta State; identify the different type of machines used by farmers in the study area; and to compute the machine use index of farmers in the area. The following hypothesis, stated in the null form, was tested: there is no significant relationship between some socioeconomic variables and farmers use of farm machines.

RESEARCH METHODOLOGY

The study was conducted in Delta State, Nigeria. Delta state was purposively selected because of high proportion of crops' farmers in the state and proximity to the researcher. Delta state lies roughly between longitude $5^{o}00$,' $6^{o}45$' East and latitude $5^{o}00$,' $6^{o}30$' North. The population of the State is about 4 million (NPC, 2006) and it has a total land area of about 17,440 Km^2. The mean annual rainfall is about 2000mm with a mean monthly temperature of $33^{o}C$ and a relative humidly varying from about 60-90 percent annually. Delta state comprised three agricultural zones – Delta South, Delta North and Delta North.

A multi-stage sampling procedure was used in selecting sample for the study. The first stage involved the random selection of twelve local government areas, four from each agricultural zone. The selected local government area included: Aniocha North, Ika South, Ukwuani and Ndokwa West in Delta North ; Ethiope East, okpe, Udu and Ughelli South in Delta Central; and Patani, Warri South West, Bomadi and Isoko North in Delta South. The next stage was the random selection of crops' farmers from each of the twelve selected local government areas. 60 farmers were randomly selected from each local government area. Thus, a total of seven hundred and twenty (720) respondents were composed and used for the study. A well-structured and validated questionnaire was used to collect data from respondents.

Data generated were analyzed by using both descriptive and inferential Statistics. Descriptive statistics used included frequency counts, means and percentages, likert scale and rating scales, while the Inferential Statistics that was used to test for the stated hypotheses was the multiple regressions (linear model).

The machine use index for the farmers in the study area was calculated for each farmer by dividing the number of farm operations that the farmer applied farm machines to by the total number of farm activities that are amenable to use of machine and the result multiplied by 100 to express it in percentage. This is as shown below:

Machine Use Index (MUI) = Number of farm activities farmers used machine on/ Number of farm activities that machines can be used for x 100.

Based on the MUI, farmers that score 70% and above are high users of farm machines, those that score between 45 to 69% are moderate users of farm machines, while those that score below 45% are poor users of machines. This is as shown in Table 1

Table 1: Format for calculating machine use index of farmers

Category of farmers	Frequency	Percentage
Low machine users		
Moderate machine users		
High users		

RESULTS AND DISCUSSION

Distribution of respondents according to Socio-economic characteristics

The results of the socioeconomic characteristics of the respondents are as presented in Table 2. The results in Table 2 showed that majority of the crop farmers in Delta State are females. This means that females are predominantly engaged in crop production than males. From the age distribution presented in Table 2, it was obvious that majority (92.1%) of the respondents were in the working population class. This could have a significant positive influence on crop production in the area. The result of marital status clearly indicated that 62.4% of the respondents were married. Most of the respondents also had formal education. The household size was moderate for most respondents; the respondents were quite experienced in crop farming, albeit majority (96.4%) operate small holdings of 5 hectares and below.

Table-2: Socio–economic characteristics of respondents

	Variables	Frequency (720)	Percentage (%)
	Gender		
	Male	256	35.6
	Female	464	64.4
.	**Age (years)**		
	Less than 15	18	2.5
	16 – 30	26	3.6
	31 – 45	212	29.5
	46 – 60	425	59.0
	61 and above	39	5.4
	Marital status		
	Not married	221	30.7
	Married	449	62.4
	Widow/widower	35	4.9
	Separated/divorce	15	2.1
	Educational level		
	No formal	48	6.7
	Primary school	102	14,2
	Secondary	492	68.3
	Tertiary	81	11.3
	Household size (number)		
	1- 5	98	13.6
	6 -10	595	82.6
	More than 10	27	3.8
	Farming Experience (year)		
	Less than 5	14	1.9
	6 – 10	136	18.9
	11 – 15	56	7.8
	Greater than 15	514	71.4
	Farm size (hectares)		
	0.1 - 5	694	96.4
	6- 10	17	2.3
	> 10	9	1,3

Source: survey data, 2015

Adoption level of farm machines in Delta State

Table 3 shows the level of adoption of farm machines for various operations carried out in farms by the respondents. The results in Table 3 showed that, apart from weeding and crop processing, where 58.3% and 86.8% respectively adopted, all the other farm activities of the arable farmers witnessed low adoption rates. It is therefore obvious from the result that the adoption rate of farm machines in the study area was generally very low.

Table 3: Level of use of farm machines by farmers in Various Farm Activities

Activity	Adopters		Non-adopters	
	Frequency	Percentage	Frequency	Percentage
Land Clearing	17	2.36	703	97.64
Tillage	15	2.08	705	97.92
Ridging	12	1.67	708	98.33
Planting	10	1.39	710	98.61
Weeding	420	58.33	300	41.67
Harvesting	4	0.56	716	99.44
Crop Processing	625	86.81	95	13.19
Food Storage	22	3.06	698	96.94

Source: survey data, 2015

Types of Farm Machines/Modern implements used in the Area

The various types of farm machines used in by arable farmers in the study area is depicted in Table 4. The most common type of machines used by farmers in the state is the processing machine as attested to by 719 (almost 100%) of the respondents. This is followed by the tractor which is used by the respondents for various farm operations like brushing of land, tilling the soil weeding tree crops' farms and in transportation of farm workers and farm produce. Other machines popularly used by farmers in the area are chemicals of various kinds, planters and ridgers.

Table 4: Types of farm machines used by farmers

Type of machine	Frequency	Purpose
Tractor	458 (63.6)	Land clearing, tillage, weeding, transportation
Ridger	232 (32.2)	Making of ridges
Planter	211 (29.3)	Planting of crops
Chemicals	195 (27.1)	Weeding, pest/disease control
Processor	719 (99.9)	Changing product from raw state
Dryer	58 (8.1)	Removing moisture from crops to safe level
Harvester	8 (1.1)	Harvesting of crops

Figures in parentheses are percentages
Source: survey data, 2015

Factors Militating Against the Use of Farm Machines in Delta State

Table 5 shows the various factors hampering crop farmers from the adoption of the use of farm machines. The results in Table 5 showed that the most serious constraint facing the farmers in this regard is land availability, followed by accessibility. Other constraints against the use of farm machines are cost of the machine/implement, ignorance, poor technical assistance, and government policy. The predominant land tenure system in the area is by inheritance, which confers small holdings on the individual farmers. Under such situations, it is difficult to make use of sophisticated machines. Moreover, most of the crop famers in the state lack access to farm machines. Majority of the farmers asserted that access to most farm machineries is beyond their reach; so for this reason they cannot adopt the use of farm machines. Cost of the machines is another serious constraint precluding the farmers from using farm machines. Most of the farmers are in low income group, so they cannot afford to pay for the farm machines.

Table 5: Constraint to the use of Farm machines in Delta State

Constraint	Mean	Standard deviation	Rank of mean
Land	4.58	0.75	1st
Accessibility	4.52	0.46	2nd
Cost factor	4.12	0.67	3rd
Ignorance	4.05	0.38	4th
Technical problem	4.01	0.43	5th
Government policy	3.56	0.81	6th

Source: survey data, 2015

Machine Use Index of Farmers

The machine use index was calculated for each farmer by dividing the number of farm operations that the farmer applied farm machines to by the total number of farm activities that machine can be used for and the result multiplied by 100. This is as shown in Table 6. The result in Table 6 showed that the MUI of most farmers in the study area is very poor. This is very

obvious in that almost two thirds of the respondents (65%) fall into the category of poor or low users of farm machines. Two hundred and four (28.3%) of the respondents are moderate users of farm machines, while only about 6.7% of the respondents fall into the category of high users of farm machines.

Table 6: Machine use index of farmers

Category of farmers	Frequency	Percentage
Low machine users	468	65.0
Moderate machine users	204	28.3
High users	48	6.7

Source: survey data, 2015

Relationship between some socioeconomic variables and adoption of farm machines

A regression analysis was conducted to determine the influence selected socioeconomic variables on adoption of farm machines; the variables included the ones in Table 2. Adoption of farm machine was the dependent variable, while the socioeconomic variables were the explanatory or independent variables. The model is fit for the data (Chi-square of 86.9; P<0.05) and indicated that all parameters considered were different from zero (Table 7). The R^2 of 78.1 showed that 78.1% of the dependent variable was jointly explained by the independent variables. Perhaps if other variables, like income, were added the R^2 value may likely increase. However the inclusion of other variables was out of the scope of this study, subsequent studies may put this under consideration. Four variables had significant effect on farmers' use of farm machines. Table 7 indicated that household size, educational level, farming experience and farm size were statistically significant at $\rho \leq 0.05$, showing that they determined farmers' adoption of machine. Household size was significantly but negatively related to farmers' adoption of machine. This was so because larger households afford the farmer cheaper labour, and there would be no special need of farm machines. Farming experience positively influence the use of machine (P<0.05). This implies that farmers with many years of experiences in crop farming were the major adopters of machines. The level of education also positively affected farmers' decision to use farm machines (P<0.05), which implies that farmers who are highly literate were more likely to adopt farm machines. There was a positive and significant relationship between adoption and farm size of farmers. This may be due to the fact that farmers with larger farms tend to have more work on hand to do, so they are more likely to use machines to reduce farm drudgery.

Table 7: Relationship between selected socioeconomic characteristics and coping adoption of machine

Characteristic	coefficient	Standard error	t-statistics	p-value
Constant	1.733	1.778	0.811	0.222
Gender	-0.513	0.899	0'699	0.601
Age	-0.077	0.045	0.875	0.412
Marital status	0.089	0.028	0.997	0.422
Educational level	0.499	0.051	3.124	0.031*
Farming experience	0.458	0.049	3.222	0.038*
Household size	-0.741	0.091	2.907	0.0387*
Farm size	0.502	0.388	2.846	0.044*

S**ource:** Field Survey, 2015
*Significant at p< 0.05
$R^{2 =}$ 78.1
R^2 adjusted = 67.2

CONCLUSION AND RECOMMENDATION

The study examined the adoption level of farm machines by farmers in the study area. From the findings of the study, it can be unequivocally concluded that the level of use of farm machines in the area is still very low. In spite of the advantages crop farmers stand to gain by using farm machines, the total number of crop farmers intensively using farm machines is still very low. In the wake of this, the following recommendations are therefore proffered:

- Farmers should be sensitized on the benefits they stand to enjoy by using farm machines on their farms
- Machine hiring centre should be established in the study area to rent out farm machines to farmers at subsidized rates
- Since land is a very serious constraint to adoption of farm machines, the current land tenure system prevalent in the area needs modification so that any who wants land for meaningful agricultural activity can gain access to it.

It is hoped that if these recommendations are implemented, the prospect of crop farmers in the area looks bright.

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