International Journal of Basic and Applied Sciences Vol. 2. No. 3. 2013. Pp. 98-106

Full Length Research Paper

Mechanization Practice: A Tool for Agricultural Development in Nigeria: A Case Study of Ifelodun Local Government Area of Kwara State

Manta, Ibrahim Haruna & Aduba, Joseph Junior.
National Centre for Agricultural Mechanization, P.M.B 1525, Ilorin, Kwara State Nigeria.

Corresponding Author: ADUBA, Joseph Junior

Abstract
The study investigates the effect of mechanisation/tractorization on arable crops in Ifelodun local government areas of Kwara State Nigeria. The Investigative Research Approach Method was employed to retrieve information from farmers through the use of questionnaires. A total of 200 randomly selected farmers (100 each for control and treated) were used for the study. The descriptive statistics (arithmetic mean, frequency and percentage ratio) was used to investigate the socio-economic characteristics. Other tools employed include gross margin analysis and the double log production function. Empirical result showed that the use of tractors as against other conventional farming tools was found to significantly improve arable crop production in the study areas. Farming is a male dominant hobby (95%) with more than half of the respondents spending at least 11 years practicing farming. Land acquisition was mostly by inheritance (68%). The rate of return on investment was ₦197% suggesting that for every ₦1 invested into the arable crop production enterprise, ₦1.97 is made as revenue. This implies that arable crop production is profitable in the study area. Seed, fertilizer and farm size were being over utilized in the study areas, where as agrochemicals was efficiently being utilized. Pests & diseases, rainfall and poor funding among others are the major constraints militating against arable crop production in the study areas. Mean crop yield/ha of tractors users were significantly higher than those of non tractor users.

Keywords: *Arable Crops, Farmer, Mechanization, Technology, Tractorization.*

Introduction

Agricultural mechanisation (AM) is the application of tractorizational technology into the field of agriculture in order to improve agricultural output, as well as deliberate conscious departure from the peasant and subsistence agriculture into a commercial agriculture. This process also involves the development and management of machines for field production, water control, material handling as well as post harvest operation (Rahman and Lawal, 2003).

In another term, AM could be described as application of the most locally appropriate tools, implements, machines, and approaches to make the most sustainable beneficial decisions. If AM is implemented in the right way, it will have a considerable effect on agricultural utilization. It will optimize inputs costs. Initial application of AM was tractor entrance to the land. But during last century or so, AM has found several interpretations; and the description was changed from tractorization to precision farming. This procedure gives evidence of AM maturity. In many parts of the world, AM has made a significant contribution to agricultural and rural development. Levels of production have increased, soil and water conservation measures were constructed, the profitability of farming improved, the quality of rural life enhanced, and development in the industrial and service sectors was stimulated (Bishop, 1997).

To some, agricultural mechanisation is synonymous with tractorization while others take it to mean increase in production per farmer per hectare of land cultivated. Inns (1995) however, opined that AM development depends on the farmers' satisfaction and capability to identify opportunities for achieving sustainable benefits by improved and/or increased use of power and machinery, selecting the most worthwhile opportunity and carrying it through to successful implementation. Because of its obvious contribution, mechanical aspect of AM has been presented till now. But it was a progression of technological innovation that influenced all of society throughout the twentieth century (Foulke et al, 2000). Fernandes et al (2008) mentioned that even in high crowded populations, it can be difficult to attract or retain labourers to work in farm operations. Much of the stimulus for AM has come from laborer shortages in the more economically advanced countries. They described mechanization as tractorization. Mechanization reduces agricultural required labour and can reduce or remove the costs in countries which energy is cheap. But for poorer countries, mechanization forces

increased costs caused by fuel, oil, engines and spares (Pretty, 2008). According to literatures, AM must consider all aspects of agriculture. In some ideas AM refers to tractorization, while others add agriculture machinery usage to mechanization domain.

It has been argued that, since most of the motor powered farm machinery being proposed for Nigeria were designed largely for the labour scarce, capital abundant economic system of the developed world, the introduction of such a sophisticated technology and labour saving machinery into socio-economic environment of underdeveloped country will almost certainly constitute bad economies and will bring with it the seed of social discounted (Rahman and Mijinyawa, 2001).

Nigeria has over 80% of its populace engaged in agricultural activities from where the people derive their means of livelihood either directly or indirectly. Iheanacho*et al.*, (2003) stated that machines used for agricultural production in Nigeria include: hand tools, animal drawn implements, two wheel and four-wheel drive tractors, motorized or mechanically driven post harvest handling and processing machines, crop storage equipment and pumps for irrigation. Thus, agricultural mechanization in Nigeria can be divided into three levels of technology; hand tools technology, draught-animal technology and engine powered technology (Oudman, 1993). As at 1996 Nigeria has an estimated 32,474,000 ha of land under cultivation, 11,900 tractors and 2,729 ha of land cultivated per tractor. This mechanization level is grossly low compare to Niger whose land area under cultivation was 11,097,000 ha, with total tractor owned as 180 and about 61,650 ha was cultivated per tractor (FAO, 1998)

Engine powered agricultural mechanization was introduced in the early sixties through the farm settlement schemes in Nigeria. The technology include the use of a wheel range tractor sizes as mobile power for field operations engines or motors to power such machines as threshers, mills, irrigation pumps, air craft for spraying chemicals and self propelled machine for production harvesting and handling of wide variety of crops.

According to Kepner et al , the increased production that has been achieved during the past century resulted from the growing of better crop varieties, the more effective use of fertilizers, improved cultural practices, and, more importantly, the increased utilization of (i) more appropriate non-human energy and (ii) employing functionally-appropriate machines and implements.

The energy consumption at any stage of agricultural practices is gross for human compare to machine. Stout et al, 1979, reported specific human energy consumption for bush clearing as 1680MJ, and 19.4 man-days were required to prepare a hectare of land, whereas for the same task, the machine required as little as 0.88MJ energy utilization and 0.019 machine-days per hectare. According to the same source, energy utilization for manual weeding was 1320MJ and 2.29 MJ for machine field operation: 32.6 man-day/ha and 0.015 MJ machine efforts were reported. Energy related data from a number of tropical cultivation systems and products for which cassava was one of them have been averaged by Leach 1976 as 0.749 MJ for manual labour and 0.0487MJ when using machine power.

Agriculture is the most important economic activity in Nigeria, in terms of revenue (apart from oil sector revenue) especially in the rural areas. In order to assess the quality and quantity of food production, a national survey was conducted by the Federal Ministry Agriculture. The outcome of this was a document on agricultural development in Nigeria between 1973 and 1985.The general conclusions from the document was the problem of modernization of agriculture through the dissemination of modern technologies for agricultural production (Olukosi*et al.*, 2006). This was to be brought about by investment in mechanical technology programmes through public institutional delivery system such as Agricultural Development Agencies like (ADPs) and others.

Mechanization inputs are often subsidized by low prices for tractors and machinery or by providing tractor hire services at less than their true cost. In many countries animal power and equipment are not getting similar support and encouragement. The smallholder farmer, and the national economy, may be disadvantaged in consequence (Kaumbutho, 1996). Another point of consideration is the cost of the labour supply. It is difficult to assess the costs of power in near-subsistence farming where human labour and in some areas, draught animal power are likely to be the dominating power sources. Consequently it is not possible to make a convincing exact comparison of costs for alternative farming systems under varying degrees of mechanization and with a variety of power sources. Smallholder farmers react mainly to costs paid in cash or cash-equivalent cost (kind).

Government and its various agencies will probably be more interpreted in economic costs, often involving subtle variations in definition. The availability of cash and cash flow are major problems which limit the farmers' ability to use more power to expand or intensify their production system. For most smallholder farmers, personal and family labour is the most readily available, reliable and cheap source of power. The cost of such labour is not readily identifiable unless there is alternative employment which would bring in a cash income (Kaumbuth, 1996).

The primary objective of this study therefore is to determine the effect of tractorization on the output of arable farmers.

Methodology

Study Areas

This study was carried out in Ifelodun Local Government area of Kwara State, Nigeria. Ifelodun is the largest Local Government Area in Kwara State with an estimated population of about 206,042 and an estimated total land area of about 3,435 km^2 (NPC, 2006, KWSMI, 2002). The area is located between latitude 7^0 45N and 9 ^{0}30N and longitude 2^0 30E and 6^0 35E.

It is characterized by dry and wet season. The annual rainfall ranges between 1000mm and 1500mm. Average temperatures between 30^0c and 35^0c and humidity range from 35% to 60%. The major source of livelihood and occupation of the people in the area is farming. Farming is traditional in nature with emphasis on the cultivation of crops such as sorghum, cassava, yam, maize and melon (KWSMI, 2002, Mohammed, 2008).

Sampling Techniques

The data collected for this study mainly primary data and this was selected based on their agricultural activity using multistage sampling technique. The Local Government Areas are Ifelodun. 200 farmers from each of the two Local Government Areas were randomly selected, given a total of 400 respondents. The data/information was collected with the use of structured questionnaire designed and focus group study.

Analytical Tools

Descriptive Statistics

The method employs arithmetic mean, frequency distribution, percentage etc. This technique was used to group and summarize the data obtained from the field.

Gross Margin

This is the difference between the Gross Farm Income (GFI) and the Total Variable Cost (TVC). It is a useful planning tool in situations where fixed capital is negligible portion of the farming enterprises especially in the case of small scale subsistence agriculture (Olukosi and Erhabor, 1988).

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

Where
GM is the Gross Margin,
GFI is the Gross Farm Income and
TVC is the Total Variable Cost.

Gross margin analysis is one method of calculating profitability of small scale cropping enterprises (Olukosi*et. al*, 2006).

Return on Capital Invested

This is defined as the gross margin divided by total variable cost. Return on capital invested is mathematically expressed as;

$$RI = \frac{GM}{TVC} \quad (4)$$

Where RI is Return on Capital Invested,
GM is Gross Margin and
TVC is Total Variable Cost

Production Function Analysis

Regression model was used to examine the input-output relationship. The implicit form of the model is given as;

$$Y = f\left(X_1, X_2, X_3, X_4, X_5, X_6 U_i\right) \quad (5)$$

Where
Y is the Output from Arable crop Production (Kg),
X_1 is the Farm Size (ha),
$X_2$is the Quantity of Seeds (Kg),
X_3 is the Quantity of fertilizer (Kg),
X_4 is the Labour Input (Manday),
X_5 is the Agrochemical (Litres),
X_6 is the Access to Tractor (Dummy Variable were used such as 1to represent Access to Tractor while 0 for otherwise) and
U_i is for the Error term.

The explicit form of this function takes the following forms:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + U_i(linear) \quad 6$$

$$Y = a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + U_i(semi \log) \quad 7$$

$$\ln Y = a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + U_i(double \log) \quad 8$$

$$\ln Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + U_i(\exp onential) \quad 9$$

Efficiency of Resource-use

This was determined by the ratio of marginal value product of variable (MVP) to marginal factor or product cost (MFC) of inputs based on the estimated regression coefficients. Following Rahman and Lawal (2003) and Iheanacho*et al* (2003) efficiency of resource (r) can be given as;

$$r = \frac{MVP}{MFC} \quad 10$$

The rule provides that when r = 1, there is efficient use of resource; r > 1 and r < 1 indicate underutilization and overutilization of a resource respectively. The value of MVP is calculated for, using,

$$MVP = MPPXP_Y \quad 11$$

While MFC is calculated for, using

$$MFC = Px_i \quad 12$$

Where P_Y is the unit price of output, Px_i is the unit price of input X_i and r is the efficiency ratio.

Results and Discussion

Some socio-economic characteristics of the respondents in the study area were considered. This includes sex, marital status, age, education, household size, years of farming experience and means of land acquisition.

Table1: Socio-economic Characteristics of Sampled Farmers.

Variables	Frequency	Percentage (%)
Sex		
Male	190	95
Female	10	5
Marital status		
Married	146	73
single	36	18
divorced	12	6
Widow(er)	4	2
Age		
21-30yrs	40	20
31-40yrs	50	25
41-50yrs	62	31
51-60yrs	34	17
>61	14	7
Education		
Primary	110	55
Secondary	60	30
Tertiary	26	13

Variables	Frequency	Percentage (%)
Non-formal	2	1
Household size		
1-5	28	14
6-10	122	61
11-15	42	21
16-20	8	4
Farming Experience		
1-5yrs	32	16
6-10yrs	62	31
11-15yrs	34	17
16-20yrs	34	17
>20	38	19
Means of land acquisitions		
Inherited	136	68
Gift	14	7
purchased	50	25

Table1 shows that arable farming in the study areas were dominated by male. This is especially true since 95% of the respondents indicated that they are male. Only 5% of respondents were female. The reason for this male dominance in farming activities in the study areas is not far fetch as religion and other traditional believe prescribed that farming activities of female in most African countries and specifically in the study areas should be control by their male folks. Also among the culprits is the fact that female in the study areas has no right to land ownership especially inherited farm land. This automatically confined them to the home. This indeed is a manifestation of the usual gross inequality in gender generally noticed in a typical African countries and calls for concerted effort in empowering the women in these areas. Table 1 also revealed that 31% of the sampled farmers were between the ages of 41 and 50 years. It can therefore be concluded that majority of the sampled farmers were middle aged. This phenomenon could result in a positive effect on crop production in the study areas.

The educational level of the respondents showed that about 55% of the respondents had primary education, 30% had secondary education and 13% had tertiary education. Although respondents in the study areas appear not be highly educated, they obviously may not have problem appreciating new farm ideas and innovations when extended to them. This is true since about 99% of the sampled farmers implied to have at least known how to read and write.

Family size is mostly between 0-10 members (75%). The mean family size is 6 persons. This is not typical of agrarian settlements which is usually characterise with large family size that guarantees free and cheap labour. This is why mechanization could be a tool for sustainable agricultural development as can be seen in subsequent result. It can be inferred from the study that farmers in the study areas are experience farmers since more than half of them (53%) indicated to have spent at least 11 years practicing arable crop production. Table 1 further showed that Land acquisition is mostly by inheritance (68%). As few as 25% purchased land used for farming activities.

Gross Margin Analysis

The result of the gross margin analysis is presented in Table 2. The costs of the various resources used and the benefits obtained from the sales of the various arable crop produce were estimated based on existing market price. A gross return was calculated by multiplying the total quantity of produce harvested by the price of output sold. The average gross return of the respondents was N 45,245.55. For cost of production, total variable cost and total fixed cost were considered in order to calculate the total cost of production. The total variable cost includes cost of labour, chemicals, fertilizer and seeds while total fixed costs includes cost of renting land, and depreciation on farm tools. The linear depreciating method, which assumed a constant rate of annual depreciation, was used to calculate the depreciation on farm tools. The labour system consists of family, hired and group help. The total cost of

labour accounts for 8.11% of the variable cost. The cost incurred on chemical was 6,456.39, accounting for about 8.69% of the variable cost. This cost appears rather high due to the fact that chemicals are usually expensive during farming season. The gross margin and net farm income (profit) were ₦45, 245.55 and ₦16, 550.13 per respondents respectively. The rate of return (ROR) on investment is ₦197%. This implies that for every ₦1 invested into the arable crop production enterprise, ₦1.97 is made as revenue. That is, about 97 kobo is realized as profit. The rate of return on capital invested estimate (RORCI), otherwise called efficiency level is 0.97. This suggest that there is viability of arable crop production enterprise in the study areas since this value is extensively higher than current lending rate (interest rate) charged by financial institutions such as cooperative society and commercial banks in the study areas.

Table 2: Gross margin and returns in investment

Item		Amount (N)
Total Revenue		45,245.55
Labour	3,567.33	
Cost of chemicals	6,456.39	
Cost of fertilizer	10,435.49	
Cost of seed	2,562.99	
Total variable cost	23,022.20	23,022.20
Gross margin		22,223.35
Total fixed cost	5,673.22	5,673.22
Net Farm Income/Profit (NFI)		16,550.13
Rate of Return on investment (ROR)		1.97 (197%
Efficiency level/(RORCI)(%)		0.97 (97%)

Source: field survey, 2011

Production Function

The double-log production function was found to be the leading equation among others (see Table 3).

The value of the coefficient of determination (R^2) indicated that about 68.2% of variation is explained by the inputs included in the regression model, while the remaining 31.8% is as a result of non-inclusion of some explanatory variables as well as other factors outside the control of the farmer. The coefficients of farm size (X_1), quantity of seed (X_2), fertilizer (X_3), labour (X_4), agrochemical (X_5), and access to tractor (X_6) are positive indicating that an increase in each of these variables would lead to an increase in the level of the effect of mechanisation/tractorization on arable crops production. Conversely, coefficient of labour (X_4) and agrochemical (X_5) is negative indicating that a unit increase in this input would lead to a decrease in the level of the effect of mechanisation/tractorization on arable crops produced. One of the expected benefits of 'tractorization' is the gain in timeliness achieved by tractors. However, the study revealed that labour requirement especially during weeding, harvesting and threshing becomes high with tractorization since larger cultivation is carried out (Penin, 1995). Specifically, Table 3 also showed that farm size (X_1) and quantity of seed (X_2) were significant at 1 % levels of probability while access to tractor (X_6) and agrochemical (X_5) are significant at 10 % level of probability. Significant and positive coefficients imply that such variables are determinant of the output (arable crop production). It can therefore be concluded from the foregoing that farm size, quantity of seed, access to tractor use and agrochemicals are determinant of arable crop production in the study areas.

Table 3: Estimation of double-log Production Function

Variables.	**Regression coefficient**	**t-value**
Constant	8.124	14.053***
Farm size(X_1)	0.273	4.092***
Quantity of seed(X_2)	1.241E-02	0.161 NS
Quantity of fertilizer(X_3)	2.391E-03	0.022 NS
Labour input(X_4)	-5.54E-02	0.800 NS
Agrochemical(X_5)	-0.156	1.808*
Access to tractor(X_6)	0.424	3.390*
R^2	68.2	
F-RATIO	11.205***	

******Significant at 1% level of probability *significant at 10% level of probability. NS is not significant***

Resource Use Efficiency

To determine the efficiency of the inputs used, Marginal Value Product (MVP) and the Marginal Factor Cost (MFC) were determined as presented in Table 4. The marginal factor cost which is the unit price for the variable inputs used in arable crop production in the study areas were found to be ₦5,500, ₦4,800 , ₦4,900 and ₦780 for seed, farm size, fertilizer and agrochemical respectively.

Table 4 shows the efficiency ratio of seed, fertilizer and farm size as 0.0103, 0.0022 and 0.2605 respectively, which are less than unity. This implies that seed, fertilizer and farm size are currently being over utilized in the study areas. Therefore, an adjustment in seed, fertilizer and farm size utilization will bring about increase in total value product of about ₦56.84, ₦10.95 and ₦*1250.34* for seed, fertilizer and farm size respectively, other factors kept constant.

Agrochemical was efficiently utilized as seen by its efficiency ratio of 0.9160 which is approximately 1. It is therefore economical to increase the use of these inputs for optimal return in investment in the study area. Hence resource use adjustment be adopted by farmers in the
study areas.

Table 4: Resource use efficiency

Resource	MPP(Kg)	Unit price of input	MVP(₦)	MFC(₦)	R=MVP/MFC
Seed	0.0124	5500.00	56.84	5500.00	0.0103
Farm Size	0.2730	4800.00	1250.34	4800.00	0.2605
Fertilizer	0.0024	4900.00	10.95	4900.00	0.0022
Chemical	0.1560	780.00	714.48	780.00	0.9160

Source: field survey, 2011.

Constraints to Arable Crop Production

Pest and disease attacked, pilfering, inadequate rainfall and lack of fund among others are the major constraints faced by the farmers in the study areas. Table 5 shows the frequency distribution of these constraints as indicated by the farmers within the two local government areas under consideration.

Table 5: Frequency distribution of constraints

	Affected		Not Affected	
Constraints	Frequency	Percent	Frequency	Percent
Pest	106	55.0	94	48.3
Disease	142	72.0	42	21.0
Pilfering (Theft)	50	26.2	150	75.0
Inadequate Rainfall	126	63.0	74	37.0
Inadequate Credit Facility	158	80.0	42	21.0

It can be observed from Table 5 that more than half (55%) of the farmers were affected by pests, while about 71.4 by diseases. Pilfering seems not be of serious concern since about one-quarter of the response indicated to have been affected. 63% of the farmers complained of inadequate rainfall to accommodate their farming activities while 80% of respondents lack proper funding for their agricultural activities. As few as 21% indicated to have benefited from a project support programme from various institutions or organizations.

Table 6: Pair wise Comparison of Crop yield/ha between Tractor Users and Non Tractors Users

Mean Crop yield/ha		Variable	t-value	p-value	Decision
1,856.66(A)	1,252.44(B)	A vs B	604.22	0.001	significant

A = output from tractor users, B = output from non tractor users

The result of the comparison between users of tractors and non users in terms of output from arable crop production (crop yield per hectare) in Table 6 shows significance differences. This implies that access to tractor use significantly improve the output from arable crop production in the study areas (Penin, 1995). Similarly, Singh and Singh (1972) concluded that tractor farms gave higher yields of wheat, paddy and sugarcane and produced a higher overall gross output per hectare than non-tractor farms. NCAER (1973) compared the values of annual farm output per hectare of net sown area under different levels of mechanization. The output per hectare was found to increase as the level of mechanization increased from irrigated non - mechanized farms to tubewell, tractor-thresher farms.

Therefore, for faster agricultural mechanization, the use of tractor and other farm machines should be advocated especially in the developing economy of the third world country like Nigeria.

Conclusion

Results from the study areas shows that mechanisation/Tractorization on arable crop in Ifelodun local government areas of Kwara state, was effective. Farming activities are mostly male dominant with more than half of the farmers indicating to have spent at least 11 years practicing arable crop farming. The gross margin analysis shows high return in investment (about ₦197% RORCI), implying that arable crop production in the study areas is both viable and profitable. Seed, fertilizer and farm size were currently being over utilized in the study areas. Agrochemical was efficiently being utilized. Pests & diseases, rainfall and poor funding among others are the major constraints militating against arable crop production in the study areas.

Recommendation

From the results of findings, the following recommendations are made;

- There is need for the government and other organization to provide a forum for education for the rural farmers on how to adapt and accept the modern technology in agriculture in the study areas.
- Application of modern agricultural technology enable the covering of more land and ensure timeliness operation and better tillage as this is cheaper than hiring manual labour
- Since Modern technology in agriculture in the study area has high potentials in increasing farm productivity, Government through the ADP extension workers should intensify efforts in educating the farmers more on the benefit of mechanisation/tractorization.
- Government should provide financial assistance such as soft loan to the farmers without much difficulty. This will enable the farmers to acquire tractors and other farm machineries so as to fully reap the benefit of mechanisation/tractorization.
- Fragment from holding could be consolidated in other to improve efficiency of farm operation by tractors and redistribute them.
- Government should look into the high Gender inequality observed in the study area.

References

Anthony Penin, (1995): Empirical Evidence of Mechanization Effects on Smallholder Crop Production Systems in Botswana , *Agricultural Systems* 41(1995) 199-210

Bishop C. (1997): A guide to preparing an agricultural mechanization strategy. Food and Agriculture Organization of the United Nations. Rome, Italy. 37 p

CTA. (1992): *Tools for Agriculture Intermediate Technology Publication.*103 – 105 Southampton Row, London WCIB 4HH UK

FAO (1998): Motorized Soil Tillage in West-Africa, A survey on the current use and consequences of tillage done with engine-driven machinery. Food and Agriculture Organization of the United Nations FAO Regional Office for Africa Accra, Ghana and Agricultural Engineering Branch, Agricultural Support Systems Division, FAO, Rome, Italy.

Fernandes E, Pell A, Uphoff N (2008) Rethinking agriculture for new opportunities. In: Pretty J. Sustainable agriculture and food. Volume I: History of Agriculture and food, pp.403-422. Earthscan Publication. UK.

Foulke T, Coupal R., Taylor D (2000) Trends in Wyoming agriculture. University of Wyoming, Cooperative Extension Service, US

Iheanacho, A. C., Olukosi, J. O. and Ogungbile A. O. (2003): Economic efficiency of resource-use in millet based cropping systems in Borno State of Nigeria, Nigerian Journal *of Tropical Agriculture. 2: 33 - 42.*

Inns FM (1995): Selection, testing and evaluation of agricultural machines and equipment theory. FAO Agricultural Services Bulletin (FAO). No. 115.

Kaumbutho, P. G. (1996): 'Chairperson's Welcome Address', in P. G. Kaumbutho et al. (eds) *Meeting the Challenges of Draught Animal Technologies in Kenya.* Proceedings of workshop held on 27-31 March 1995, KENDAT, University of Nairobi.

Kepner, R. A. Bainer, R and Barger, E. L. (1978), Principles of Farm Machinery (3rd edition) AVI Publishing Company Inc. Connecticut, USA.

Kwara State Ministry of Information, (2002): *Kwara State Diary, 2002 PP 1-10*

Kwara State Ministry of Information, (KWSMI, 2002): Kwara State Diary, 2002 PP 1-10.

Leach, G. (1976), Energy and Food Production. IPC Science and Technology Press, Guildford, England.

Mohammed, B.T. (2008): Economic Analysis of Melon (*Citritillus lanatus*) production in Kwara State. Proceeding of 42nd annual conference of Agricultural Society of Nigeria (ASN) held on 19th - 23rd October at Abakaliki pp.57-58.

NCAER, 1973. Impact of Mechanization in Agriculture on Employment. Report of National Council of Applied Economic Research, New Delhi.

NPC (2006): National Population census result sheet.

Olukosi, J.O. Isitor, S.U. and Ode, M.O. (2006): *Introduction to agricultural marketing and prices: principle and application.* Living Book Series, GU publications Abuja, 115p

Oudman, L. (1993): 'The Animal Draught Power Development Project in the Department of Agricultural Engineering', in C. L. Kanali et al. (eds) *Improving Draught Animal Technology*. Proceedings of the first conference of the KENDAT,University of Nairobi: 106-116.

Pretty J (2008): The Environmental and Social Costs of Improvement. In: Pretty, J. Sustainable Agriculture and food. 3(1): 15-58. Earthscan Publication. UK

Rahman, A and Mijinyawa, Y. (2001): Assessment of Tractor Hiring Service in Lagos State Proceeding of the intentioned conference of the Nigeria Agricultural Engineers Enugu 2001.Pp 22 – 25

Rahman, S. A. and Lawal, A. B. (2003): Economic analysis of maize-based cropping systems in Giwa Local Government Area of Kaduna State, Nigeria, *An International Journal of Agricultural Sciences, Science, Environment and Technology*.3:139-148

Singh, Roshan & Singh, B.B.1972. Farm Mechanization in Western Uttar Pradesh - Problems of Farm Mechanization Seminar Series-IX, Indian Society of Agricultural Economics, Bombay, Feb.

Stout, B.A, Myers C.A., Hurand A. and Faidley L.W., (1979): Energy for World Agriculture, FAO, Agricultural Series No. 7, Rome.