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EVALUATION OF THE DEGREE OF AGRICULTURAL MECHANIZATION INDEX ON THE PERFORMANCE OF SOME FARM SETTLEMENT SCHEMES IN SOUTHWESTERN NIGERIA

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Abstract
This study investigated the degree of agricultural mechanization index on the performance of farm settlement schemes in Nigeria. Seven farm settlements were selected for this study. Farm mechanization index of the farm settlements was determined and subjected to SWOT (strength, weaknesses, opportunities and threats) analysis to ascertain their internal strengths, weaknesses, external opportunities and threats confronting farm settlements. Results of the farm mechanization index obtained for each of the farm settlement were 53.6% for Ilora, 56.2% for Akufo, 47.8% for Ogbomosho, 53.6% for Ijaye, 47.7% for Iresa-Adu, 51.6% for Esa-Oke and 43.2% for Iyin-Ekiti. This study revealed that farm mechanization is at semi-mechanized level on the farm settlements and the SWOT analysis indicated that farmers have potential strengths with training facilities, variable climatic conditions (adequate rainfall and soil resources) and purchase of agricultural inputs from cooperative societies but their potential weakness are due to low level of educational background, lack of basic infrastructural facilities and lack of guarantee farm level prices and ready markets for their products in order to maximize profits. The external opportunities lie on the growth of agro allied industries and employment opportunities among young graduates, while external threats are inconsistencies in agricultural policies and lack of adequate insurance policy on crop failure. Hence, failure of farm settlements in Nigeria is subjected to lack of funds at research and operational stage of the project, inappropriate measure of farm mechanization and lack of competent skilled men in the area of implementation, maintenance of farm machinery and equipment which was plague with political internal operating problem.

Key Words: *Farm settlements, Mechanization index, Performance, Evaluation, Nigeria*

Introduction

Farm settlement schemes have been important part of national agricultural project development and as constituent of agricultural policy of Nigeria. Appraisal of farm settlement schemes by most researchers only considered the social and psychological characteristics of the settlers. Detail cognizance of farm mechanization index, productivity of labour and machines has not received better attention. A single measurement of index cannot prove the success or failure of any agricultural projects if the level of their performance is to be ascertained. Hence, associated strengths, weaknesses, opportunities and threats facing farm mechanization in farm settlements must be properly addressed. The study of machine tool technology (MTT) carried out on Nigerian agriculture can only provide priority to small fragmented holdings, but the level of farm mechanization in farm settlements could not be deduced. This was regarded as the first phase of agricultural mechanization in the national plan of Nigeria (Baldwin, 1957; Baldwin *et al*., 1960).

Nigeria is an agrarian country yet cannot boast of self-sufficiency in food production. She is confronted with the need for improved farm mechanization. Farm mechanization is expected to increase overall productivity in food production and also generate employment opportunities for the unemployed youths. The past civilian governments were eager to import agricultural development policies that were already successful abroad. These policies were contained in the first national plan (1962-1968), which was launched in 1962 (Oni and Olayemi, 1975). In view of the importance of agriculture to the economy of Nigeria, a priority was accorded to the development of farm settlement schemes from 1962 to 1968. The farm settlements were regarded as the role models for agricultural mechanization which is the prerequisite of the orderly industrial revolution desired by the Western Nigerian government (Olatunbosun, 1971).

By 1988, Nigeria has experience 40 years of agricultural mechanization with woeful failures and catastrophic experiences (Nwoko, 1990). The level of farm machinery usage was low and there was non- reliability of spare parts (Oladipo, 1992). Farm mechanization includes everything from the improvement of hand tool to the introduction of mechanical power units and associated equipment at any level of complexity in agricultural production, in order to reduce human drudgery, improve timeliness of operation and their efficiency, bring more land under cultivation, increase yields and preserve quality of agricultural products (Esmay *et al*., 1972; Bassi and Dyson, 1994). Nigeria is yet to define its policy on farm mechanization either for the selective or full mechanization practice. A robust agricultural policy that takes cognizance of diverse value chain additions to agricultural production of raw materials could offer a solution to self-sufficiency in food production and also reduce unemployment rate of the nation.

Management practices and effective control of the farm resources indicated direct influence on the crop growth conditions and eventual grain yield (Sahindomi *et al.,* 2013). Researchers had noted that appropriate performance measurement systems for the manufacturing industry and agricultural sector must be investigated to improve industrial and farm productivity

(Bigliardi and Bottani, 2014; Paman and Uchida, 2012; Sahindomi *et al.,* 2013).

Strategic adaptation to changes in agricultural policies by farmers determines the level agricultural productivity and sustainability of farming practices. The overriding influence of existing policy governing agricultural operation in a given locality determines to a large extent the profitability and derived dividend that could be deduced from such practices. The output that could emanate from the agricultural sector relates to the established strength and weaknesses of the prevailing driven force upon which agricultural operations are governed. Establishment of various schemes is to be initiated to rebuild the farming system and to adopt the advance science and technological practices in farming.

The use of machine in farming greatly depends on the soil type and the crop grown in the particular soil. The adoption of machine in farming operation is increasing day by day as it resulted in saving of cost of production and increasing net income of the farmers (Singh, 2006). Therefore, there is a need to ascertain the levels of farm mechanization using the modern mechanization index and SWOT analysis to observe strengths, weaknesses, opportunities and threats as well as performance index. This will assist to predict the present state of farm mechanization in the established farm settlements.

Materials and Methods

Study Area

Field survey was carried out in Oyo, Osun and Ekiti States, which constitute part of old Western region. The area lies roughly between longitudes 3° and 7° north with annual rainfall of 1100 mm and average temperature ranges from 30° C – 32° C. There are two cropping seasons due to bimodal pattern of rainfall distribution. The first cropping season begins from March to July while the second season begins in late August and ends in December. The soils are moderately strong leached soils of low to medium humus content, weakly acidic to neutral surface layers and moderately to strongly acidic subsoil. The vegetation of the study area is tropical rain forest.

Bigliardi and Bottani (2014) provided a systematic review of the literature related to supply chain performance measurement and also tested the use of performance measurement metrics among Italian companies. The result of the study presented set of 39 metrics related to different supply chain processes, and found that the level of adoption of performance measurement metrics is quite high among the companies surveyed. Also, Owombo *et al.* (2012) employed a multi stage sampling techniques to collect information on the socio-economic characteristics, institutional factors and methods of carrying out farming activities. Descriptive, budgetary and logistic regression model were used for the data analysis. However, data required for this study were collected through farm survey and questionnaires. The survey included seven farm settlements that are currently functioning and fully controlled by crops and farm settlement department in seven local governments of Oyo, Osun and Ekiti states.

Approach Methodology

The analytical framework described below provided the basic approach for appraising farm mechanization in the farm settlements. The study was

conducted in three phases. Phase 1 involved a field survey and interactive sessions with the respondents, project supervisors and other schedule officers responsible for farm mechanization on the selected far settlements in ministry of agriculture and natural resources (MANR) and other agencies in Osun, Oyo and Ekitistates.The second phase is the analysis of data using mechanization index approach, which determines the level of farm mechanization practiced on the farm settlement as well as SWOT analysis (Fig. 1) which refers to strengths, weaknesses, opportunities and threats that determine level of success or failure of farm mechanization on farm settlement schemes.

Concept of Mechanization Index and Productivity

According to Nowacki (1974) and Ortiz and Salvador (1980), four degrees of farm mechanization were established.

Degree of Mechanization M1: Operations carried out exclusively by human power were determined by using Equation 1 (Nowacki, 1974; Ortiz-Canavate and Salvador, 1980):

$L_{MH} = 0.1\ H\ T_H/A$ Kw/ha (1)

where;

LMH = Work outlay of human effort

0.1 = Human power in kW

H = Number of operators

TH = time devoted to manual operations in hours

A = area of land (ha)

Degree of Mechanization M2: Operations carried out by man aided by animal drawn machines.

$L_{MK} = K.\ T_K / A$ kWhr/ha (2)

where;

L_{MK} = work outlay of animal drawn machinery

K = Number of working animals

T_K = time used

A = area of land (ha)

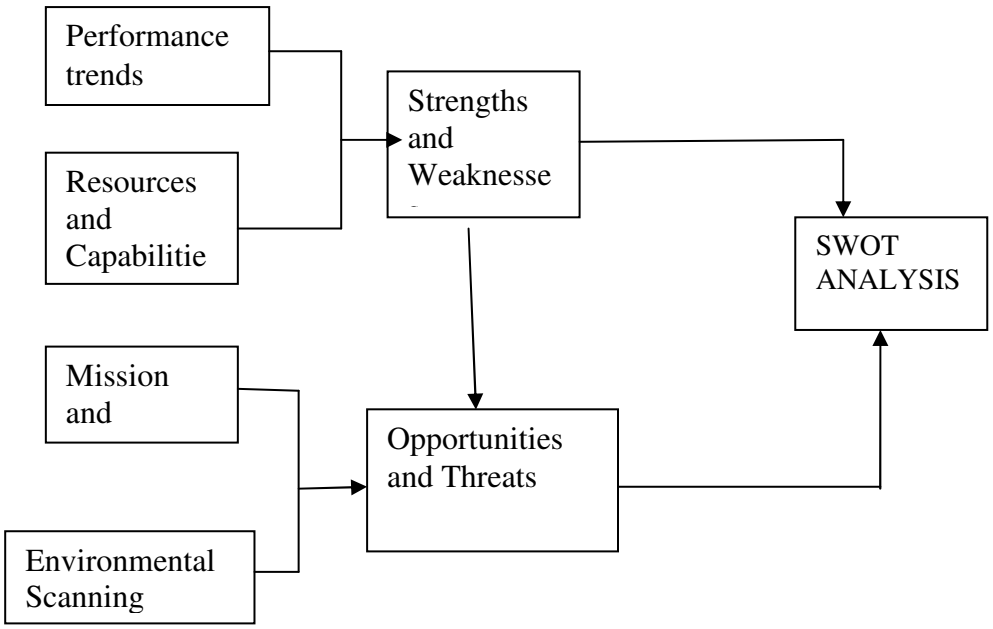

Figure 1: Flow chart of SWOT Analysis (Source: David, 1992)

Degree of Mechanization M3: represents level of motorized machinery coexisting with a high level of participation of operators and animal drawn machinery.

Degree of Mechanization M4: corresponds to use of machinery with mechanical energy source under direct human control.

$L_{MM} = N.T_M/A$ kWhr/ha (3)

where;

L_{MM} = work outlay of a motorized machine

N = horse power of the tractor (kW)

T_M = time used (hr)

A = area of land (ha)

Mechanization index (W_{ME}) which represents percentage of work done by machines, human efforts and machinery was calculated using the relationship below:

$W_{ME} = L_M/ L_H + L_M * 100\%$ (4)

where;

L_M = Work done by machines obtained by summing up all the work outlay by human and machines

$L_M = L_{MH} + L_{MM}$ (5)

L_{MH} = total sum of operation done by man

L_{MM} =total sum of operation done by machines

SWOT Analysis Concepts

Farm settlement management becomes effective if reference is made to the historical antecedent of the farming practices within the location. The most common way of analyzing the current situation of any agricultural investment is to perform a SWOT analysis, which examines its internal strengths and weaknesses, external opportunities and threats. The accuracy with which an agricultural project matches its internal strengths with any external opportunities is primarily responsible for success in the market place. Table 1 and Table 2 show the checklists for conducting SWOT analysis. A combination of the measurement of mechanization index and SWOT analysis would ensure that the analysis carried out on the study area is a true representation of the facts with respect to mordern method of appraising agricultural investments.

Researchers had revealed that field operations and management of farm resources are essential factors that can lead to improvement in agricultural practices and eventual productivity (Khaksar *et al*., (2013); Owombo *et al.* (2012); Muazu *et al.* (2014); Sahindomi *et al.* (2013)). It is essential to note that the strength and weakness of existing practices in a locality and region should be noted and investigated for improvement.

Table 1: A checklist of carrying out SWOT Analysis (Internal vs Internal Factors)

Potential Internal Strengths	**Potential Internal Weaknesses**
A distinctive competence?	No clear strategic direction?
Adequate financial resources?	Obsolete farm machinery facilities?
Good competitive skills	Lack of managerial depth and talents?
An acknowledged market leader?	A deteriorating competitive position?
Proprietary technology	Missing any key skills or competence
Cost advantages?	Plagued with internal operating problem
Agricultural product innovation abilities	Vulnerable to competitive pressures?

Table 2: A checklist of carrying out SWOT Analysis (Internal vs External Factors)

Potential External Opportunity	**Potential External Threath**
Serve additional customer groups	Likely entry of new competitors?
Enter new markets or segments?	Rising sales of agricultural substitute products?
Expand agricultural products line to meet customers' need	Slower market growth?
Diversify into related products	Adverse government policies?
Add complementary products	Growing competitive pressures?
Ability to move to better strategic group?	Growing bargaining power of customers
Faster market growth?	Adverse demographic changes?

Source: Arthur *et al*. (1987)

Results and discussion

Mechanization index and Productivity

Figure 2 shows the percentage of farm mechanization index obtained and they are as follows: 53.6% for Ilora, 56.2% for Akufo, 47.8% for Ogbomosho, 53.6% for Ijaye, 47.7% for IresaAdu, 51.6% for EsaOke and 43.2% for Iyin-Ekitifarm settlements. With 56.2% as the highest value, it indicated that the level of involvement of farm machineries is at semi- mechanized level in all the selected farm settlements. This has not shown a proper significance and acceptability attitudes towards the usage of modern machinery in farm settlements where some operations were carried out manually. Also the only available farm machinery does not received better attention in terms of maintenance since most of them are owned by individual contractors, enough capital could not be raised from hiring purpose and for this reason subsequent routine maintenance cannot be carried out.

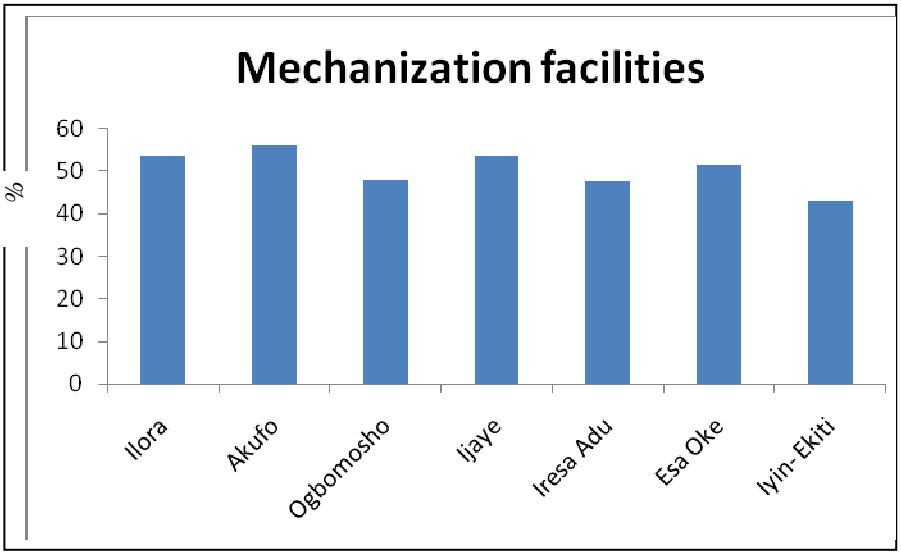

Figure 2: Number of farm mechanization facilities in selected farm settlements

This observation was related to the result of the logistic regression for determination of adoption of mechanization practices as carried out by

Owombo *et al*. (2012). The results revealed that education, extension visit and machine access as significant factors in adoption of mechanization practices. They noted that the need to put appropriate policies that would create better access to these technology and equipment at the right time and at minimum cost would improve their productivity which will in turn improve their income and thus ensures a better livelihood. Muazu *et a,,* (2014) concluded that a mean mechanization index of 0.59 and a total machinery energy of 477.78 MJ/ha were recorded for the direct seeding paddy cultivation in Malaysia. The study noted that highest mechanization index and machinery energy were obtained in the harvesting operation (0.99 and 336.81 MJ/ha) while the lowest values were in pesticides operations (0.19 and 3.97 MJ/ha).

Table 3 shows that the productivity for both machines and labour force was low. The highest value for productivity of machine was 0.004 ha/kWhr at Iyin Ekiti farm settlement and highest value for labour productivity is 0.324 ha/kWhr at Ogbomosho farm settlement. It indicated that the income distributions among farmers are poor due to lack of incentives received from the management in facilitating better practice of farm mechanization. Thus, investment capacity of each participant for purchasing farm machinery and equipment were low, thereby, retarding the farm mechanization programme in the farm settlement.

Table 3 shows that the productivity for both machines and labour forces

Farm Settlement Schemes							
	Ilora	Akufo	Esa – Oke	Ogbomosho	Ijaye	Iresa-Adu	Iyin-Ekiti
Work of machines L_{MM} (kWhr/ha)	425.22	469.98	391.65	335.71	425.22	335.7	279.75
Human work, L_{MH} (kWhr/ha)	4.3	3.25	3.3	3.1	4.4	4.55	4.5
$L_{MM} + L_{MH}$	429.52	473.23	394.95	338.81	429.62	340.25	284.25
Mechanization index (%)	53.6	56.2	51.6	47.8	53.6	47.7	43.2
Productivity of labour, A_h (ha/kWhr)	0.23	0.31	0.30	0.32	0.23	0.219	0.22
Productivity of machines, A_m (ha/kWhr)	0.0024	0.0021	0.0026	0.0029	0.0024	0.0029	0.0036
Total productivity, A_T (ha/kWhr)	0.24	0.31	0.31	0.33	0.23	0.223	0.23

Paman *et al.* (2012) also noted that successful development of farm mechanization is determined primarily by the transition process from manual tools through animal-drawn implements and finally to the application of mechanical power technologies, which will affect mechanization capacity and time

requirement of farm operations. The results of investigation by Paman *et al.* (2012) on the determination of the capacity of rice farming mechanization and the time requirement for farm operation practices in Riau province corroborated that there could be an increase in farming capacity as a result of increasing availability and utilization of power intensive machines on the farm.

In the study of the assessment and requirement of farm mechanization in India by Khambalkar *et al.*(2012) it was established that the power available for the actual cultivable area ranges between 0.268 kW and 0.746 kW, while the power available for the gross total area also ranges between 0.253 kW and 0.276 kW. Khambalkar *et al.* (2012) noted that the farming scenario of Indian agriculture is changing day by day and the scenario relating to use of farm machineries in various region differ significantly from each other.

This result shows that productivity of labour increases as the mechanization index increases while mechanization increases as the productivity of machine decreases. It indicated that excess tractor energy are being expended on the mechanical operations such as ploughing, harrowing, ridging and transportation which resulted that the types of tractor employed on this operation has resulted to loss of energy. However, the aim of increases machine productivity, required good timeliness of operation and putting more land under cultivation through the use of tractors. Hence, tractor needs to be fully addressed.

SWOT Analysis

Potential Internal Strengths

Tables 4 and 5 show the potential internal strength of the selected farm schemes. There is provision for training at Fashola training institute in Oyo State which was owned by the regional government. The institution provides training to farmers, operators and project supervisors on the use of latest technology on farm mechanization practice. There are uniformity of provision of resources and incentives to each participant and a total hectare of land ranging between 4- 10 hectares of farm land was allocated in some of the farm settlements. This enhanced mechanization and acts as suitable beds of technology improvement.

Table 4: Potential internal strengths and weaknesses of the selected settlement schemes

Potential Internal Strengths	**Potential Internal Weaknesses**
Provision of training	Lack of modern infrastructural facilities
Suitable variable climatic conditions	Low level of education among the farmers
Establishment of cooperative societies and ability to purchase on credit	Lack of guaranteed farm level price of the produce
Adequate rainfall and soil resources	Unsteady market of agricultural produce to enhance income distribution
Acquisition of land facilitate the use of farm machinery leading to improved industry and services	Incessant increase of wages on labour does not commensurate with their returns
Abundance of uncultivated land area for future development	Inability of extending government decision to responsible officers for better development
Suitable variable climatic conditions	

Table 5: Potential external opportunities and potential threats of the selected settlement schemes

Potential Internal Opportunities	**Potential External Threats**
Research and development of both local and international bodies	Inconsistence of government on agricultural policy
Investment opportunity of small and medium agro – allied industries	Mischievous acts among the communities and neighbourhood
Uncultivated land for improved technology	Lack of adequate insurance policy on crops failure for expanding agricultural product
Generation of jobs for young and willing graduates	Reduction of cash flow to agricultural machinery and lack of consultants for seeking advice

Potential Internal Weaknesses

Results of Tables 4and 5 show that farmers practiced the same number of manual operation with mechanical operation thus, there were low productivity for each of the farm settlement as related to their farm mechanization index and in general there is low income earning among the farmers. They lack modern infrastructural facilities, use of electricity are not available in some of the settlements. The low level of education among the participants has been a major contribution towards their failure as farmers could not read the operators manual.

There is no guaranteed farm level price and lack of ready market for their farm produce their better arrangements could not be made to sell their farm produce and maximize profits.

Bureaucracy measures taken by the management does not enhance better performance in farm mechanization and this jeopardizes the efforts of farm settlements.

Lack of basic infrastructural facilities such as electricity, accessible roads and portable water are major impediments to farm settlements. Lack of guaranteed farm level prices and substantial ready market of farm produce at peak seasons does not fully encourage settlers in high production and this contributed to their low level of income earning. It was observed that government participation in the programme was low; hence, farmers do not show total commitment to the programme since better incentives are not obtained from government. Inconsistency of government policy towards agriculture in the past has actually affected the performance of farm settlement and this does not give room for mechanization.

Potential External Opportunities

There is investment opportunity of agro- allied industries in farm settlements, therefore farmers have the opportunity of expanding their agricultural products to meet international standard. Establishment of farm settlement gives way to both local research institutes such as cocoa research institutes and internal organizational institutes of tropical agricultural and generates job opportunities for the young ones in the neighbouring communities and also paved ways for the provision of other basic amenities. Public have opportunity to participate in the hiring of equipment to farmers. This has improved the economy of the region. Agricultural mechanization has priority role in increasing agricultural production and modernizing farms.

Potential External Threats

There are considerable mischievous acts among the neighborhood, they felt that the past regional government acquired their land without adequate compensation therefore; they connived with cattle rearer to graze on the farm settlements. There are no substantial ready markets for their products and seasonal disparities in agricultural prices due to exploitative nature of traditional trade have always become major threats to the settlers.

Government involvement and support to farmers in agricultural production had direct influence on productivity and performance of farming operators. This is also in accordance with the observation of Muazu *et al.* (2014), the benefit-cost ratios for an average farmer with and without government support within the block were respectively 1.37 and 1.68 with a mean yield of 7.63 tons/ha. Researchers had diversely noted the significance of agricultural policy, capacity and nature of farming operation with direct influence on the yield in term of output and productivity of agricultural operations (Bigliardi and Bottani, 2014; Paman *et al.,* 2012; Khambalkar *et al.,* 2012; Khaksar *et al.,* 2013; Sahindomi *et al.,* 2013; Muazu *et al.,* 2014).

The analysis therefore clearly indicated that inconsistent government policies on agriculture and lack of insurance policy on crop failure have reduced the morale of farmers on the effort towards farm mechanization. Reduction of cash flow to agricultural machinery and implements especially on the heavy-duty equipment and increase cost of technological and inadequate of consultant services on farm settlements. Hence, excessive outbreak of fire by the cattle rearers and local hunters during dry seasons has generated external threats to the participants.

Conclusions

The degree of agricultural mechanization index on the performance of farm settlement schemes in Nigeria was evaluated. The total farm mechanization facilities available to the selected farm settlement were 426 and out of these 232 (54.5%) were owned by the public sectors and 194 (45.5%) to the private sectors. The overall percentage of farm mechanization facilities functioning and grounded were as follows; Ilora 46% and 54%, 53.8% and 46.2% for Akufo, 52.8% and 47.7% for Ogbomosho, 61.1% and 38.9% for Ijaye, 58.3% and 41.7% for Iresaadu, 65.1% and 34.9% for Esaoke and 60% and 40% for Iyinekiti respectively.

The investigation affirmed that farm operation such as ploughing, harrowing, ridging and transportation only received better attention in term of use of farm machinery as compared to other operations like planting, weeding, fertilizer application, harvesting and post harvesting. Provision of basic infrastructural facilities within and around the farm settlement could attract other investors to develop agro allied industries.

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