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.

Keywords: farm settlements, mechanization index, performance, evaluation, Nigeria

1. Introduction

Farm settlement schemes have been important part of national agricultural project development in the agricultural project development in the agricultural policy of Nigeria. Appraisal of farm settlement schemes by most researchers only considered the social and psychological characteristics of the settlers. A well cognizance of farm mechanization index, productivity of labour and machines has not received better attention. Thus, no single measurement of index can prove the success or failure of any agricultural projects, in order to ascertain the level of their performance. Furthermore, strengths, weaknesses, opportunities and threats facing farm mechanization in farm settlements have not been properly addressed. The study of machine tool technology (MTT) carried out on Nigerian agriculture only gives priorities to small fragmented holdings, but failed to extend their study on the level of farm mechanization in farm settlements, which 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 it lacks self-sufficiency in food production. She is confronted with the need to 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 operations and their efficiency, bring more land under cultivation, increase yields and preserve quality of agricultural products (Esmay et. al, 1972; Bassi and Dyson, 1994). However, Nigeria is yet to define its policy on farm mechanization either for the selective of full mechanization practice, which could offer a solution to self-sufficiency in food production and also reduce unemployment.

Therefore, there is a need to ascertain the levels of farm mechanization using the modern mechanization index and SWOT analysis that give strengths, weaknesses, opportunities and threats as well as performance index, to know the present state of farm mechanization in the established farm settlements.

2. Materials and Methods

2.1 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.

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.

2.2 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 Ekiti states. 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.

2.3 Concept of Mechanization Index and Productivity
According to Nowacki (1974) and Ortiz and Salvador (1980), four degrees of farm mechanization were established.

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

\[ L_{MH} = 0.1 \frac{H \cdot TH}{A} \text{ Kw/ha} \]  

where:
- \( L_{MH} \): 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)

2.3.2 **Degree of mechanization M2**: Operations carried out by man aided by animal drawn machines.

\[ L_{MK} = K \cdot T_{K} \frac{A}{A} \text{ kWhr/ha} \]  

where:
- \( L_{MK} \): Work outlay of animal drawn machinery
- \( K \): Number of working animals
- \( T_{K} \): Time used
- \( A \): Area of land (ha)

1.3.3 **Degree of mechanization M3**: Represents level of motorized machinery coexisting with a high level of participation of operators and animal drawn machinery.

2.3.4 **Degree of mechanization M4**: Corresponds to use of machinery with mechanical energy source under direct human control.

\[ L_{MM} = N \cdot T_{M} \frac{A}{A} \text{ kWhr/ha} \]  

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:

\[ W_{ME} = \frac{L_{M}}{L_{H} + L_{M}} \times 100\% \]  

where:
- \( L_{M} \): Work done by machines obtained by summing up all the work outlay by human and machines
- \( L_{MH} = L_{MM} \)
- \( L_{MM} = \text{total sum of operation done by man} \)
- \( L_{MM} = \text{total sum of operation done by machines} \)

2.4 **SWOT Analysis Concepts**

Farm settlement management cannot plan effectively unless they know exactly where they are starting. 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 these approaches i.e. mechanization index and SWOT analysis would ensure that the analysis carried out on this study is a true representation of the facts and modern method of appraising agricultural investments.

3 Results and discussion

3.1 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 Ogbonosho, 53.6% for Ijaye, 47.7% for Iresa Adu, 51.6% for EsaOke and 43.2% for Iyin-Ekiti farm 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 and some operations were carried out manually and even 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.

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.

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 aims of increases machine productivity, required good timeliness of operation and putting more land under cultivation through the use of tractors. Hence, tractorization needs to be fully addressed.

3.2 SWOT Analysis

3.2.1 Potential Internal Strengths

Table 4 and Table 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.

3.2.2 Potential internal weaknesses

Results of Table 4 and Table 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.

3.3 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.

3.4 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.

Inconsistent government policies on agriculture and lack of insurance policy on crop failure have reduced their morale 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.

4 Conclusions and Recommendation

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%) belonged 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 iresaaddu, 65.1% and 34.9% for esaoke and 60% and 40% for iyinekiti respectively.

Farm operation such as ploughing, harrowing, ridging and transportation only received better attention with the use of farm machinery, other operations like planting, weeding, fertilizer application, harvesting and post harvesting have not yet received good attention of farm mechanization and this contributed to their low productivity. The highest level of farm mechanization was 56.2% which shows that mechanization practice is at semi level and does not show considerable efforts of adopting new technology in all facets of farm operations.

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.

**Recommendations**
The following recommendations are imperatives if farm mechanization will take its pathway in farm settlements also to be regarded as the bedrock of food sufficiency and source of employment for young graduates in Nigeria.

Adult education and training centers should be established at each senatorial district of farm settlements. This will enhance their level of education and improvement in the adoption of new technology of farm mechanization.

Basic infrastructural facilities should be provided to encourage other investors in the development of agro allied industries.

Farm settlements in Nigeria needs coherent and consistent policy to strengthens farmers confidence and to allay their fear of failure that may be associated to adverse natural conditions.

Agricultural mechanization has priority role in increasing agricultural production and modernizing farms. However, the problem of excessive tractor energy used on both primary and secondary tillage operations must be studied carefully and should be related to industrial development through national centre for agricultural mechanization to develop locally made implements with direct inference to the concept of selective mechanization.

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

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

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

<table>
<thead>
<tr>
<th>Potential External Opportunity</th>
<th>Potential External Threat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serve additional customer groups</td>
<td>Likely entry of new competitors?</td>
</tr>
<tr>
<td>Enter new markets or segments?</td>
<td>Rising sales of agricultural substitute products?</td>
</tr>
<tr>
<td>Expand agricultural products line to meet customers’ need</td>
<td>Slower market growth?</td>
</tr>
<tr>
<td>Diversify into related products</td>
<td>Adverse government policies?</td>
</tr>
<tr>
<td>Add complementary products</td>
<td>Growing competitive pressures?</td>
</tr>
<tr>
<td>Ability to move to better strategic group?</td>
<td>Growing bargaining power of customers</td>
</tr>
<tr>
<td>Faster market growth?</td>
<td>Adverse demographic changes?</td>
</tr>
</tbody>
</table>

**Source**: Arthur et al (1987)
Table 3 shows that the productivity for both machines and labour forces.

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

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

<table>
<thead>
<tr>
<th>Potential Internal Strengths</th>
<th>Potential Internal Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision of training</td>
<td>Lack of modern infrastructural facilities</td>
</tr>
<tr>
<td>Suitable variable climatic conditions</td>
<td>Low level of education among the farmers</td>
</tr>
<tr>
<td>Establishment of cooperative societies and ability to purchase on credit</td>
<td>Lack of guaranteed farm level price of the produce</td>
</tr>
<tr>
<td>Adequate rainfall and soil resources</td>
<td>Unsteady market of agricultural produce to enhance income distribution</td>
</tr>
<tr>
<td>Acquisition of land facilitate the use of farm machinery leading to improved industry and services</td>
<td>Incessant increase of wages on labour does not commensurate with their returns</td>
</tr>
<tr>
<td>Abundance of uncultivated land area for future development</td>
<td>Inability of extending government decision to responsible officers for better development</td>
</tr>
<tr>
<td>Suitable variable climatic conditions</td>
<td></td>
</tr>
</tbody>
</table>
Table 5: Potential external opportunities and potential threats of the selected settlement schemes

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

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

Fig. 2: Number of farm mechanization facilities in selected farm settlements