Agricultural mechanization: a strategy for food sufficiency

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Nigeria has set an ambitious target to become one of the top 20 economies in the world by the year 2020. The major drive is to set a solid foundation for sustained rapid socio-economic development which will depend upon synergies among the key sectors of the economy. The fundamental value of Agriculture in the development and growth of the Nigerian is indicated in its contribution as a source of food and raw materials for agro-industrial processing and the linkage effects with employment, national income, market opportunities for industrial output and reduction in poverty and health improvement. Of the numerous benefits from Agricultural, Nigeria has grown to rely heavily on earnings from oil exports without making the investments needed to diversify the economy through sustained agricultural growth and development of other non-oil sectors. In order to improve agricultural productivity, co-operate organization and Government interest in agriculture especially agricultural mechanization must be aroused; this can be achieved through policy development and frame work, funding and establishment of Research Centres; the provision of credit and infrastructural facilities to manufacturers and farmers alike. Taking a look at agricultural mechanization in Nigeria as a strategy for food sufficiency in Nigeria, it was observed that, there is still need for appropriate selection of agricultural mechanization techniques which needs to be carefully chosen from three identified levels of agricultural mechanization technologies. These are, Hand Tool Technology (HTT), Animal Draught Technology (DAT), and Engine Powered Technology (EPT). The future prospects for Agricultural Mechanization in Nigeria strongly rest on the development of machines and equipment locally, along with the adaption of new designs and innovation in Agricultural mechanization technology from imported equipment’s and machines and finally the building and development of expertise for maintenance and sale of powered machines. This paper looks at the prospects of agricultural mechanization as a good strategy to ensuring food security and sufficiency in Nigeria.

Key words: Agricultural Mechanization, Food Sufficiency, Hand Tool Technology, Draught Animal Technology and Engine Power Technology.

INTRODUCTION

Of the 98.3million hectares of Nigeria's arable land-mass, 72% of this has cultivation potential but only 35% of the arable land is under actual cultivation. Despite the high proportion of cultivated landmass relative to the total available space, food production to feed the teeming populace has remained a mirage with the advent of commercial oil exploration in the early 1970s. The Nigerian population, growing at one of the fastest rate, makes agricultural transformation necessary for development of the country. Holmes (1993) stated that in order for Africa to create a future in which man, woman and child have the chance to lead a healthy and productive life, there must be a transformation in Africa's ability to produce food. In future, Nigeria would become the third most populous country in the world, and through better
understanding of agricultural mechanization, will be able to be self-sufficient in food production, rather than a country, pre-dominantly agricultural, but not able to produce adequate food for its populace Abimbola (1984).

The need for mechanization of Agriculture in Nigeria and West Africa has become more acute in recent years due to the urgent need to accelerate food and fibre production for the teeming urban and rural population. Pellizzi (1992) summarized the primary objective of agricultural mechanization as: to minimize production cost, optimize protect quality, product the environment and minimize farm production flexibility.

In spite of huge amounts invested in the procurement of agricultural machine in Nigeria, the level of agricultural mechanization continues to be very low Comsec (1990). In respect of the above, Nigerian engineers have made a lot of progress in developing proto types of machines relevant to our crops soils and socio-economic conditions.

A major review of economic development in sub sharan Africa (SSA) by the World Bank reveals that from the last decade of the twentieth century upwards, an enormous task will be facing African agriculture (IBRD 1989). This includes, ensuring food security for a rapidly growing population, contributing substantially 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. But it has been argued that for real progress, growth and sustainable advancement to occur in the agricultural industry anywhere, it is essential to apply in a balanced proportion what is called a trio of technologies comprising the biochemical, socio-economic and engineering (mechanization) technologies. However, it has been stated that the main reason for mechanization is economic e.g. mechanization in Asia, U.S.A and Europe is geared towards increasing or maintaining the farmer’s net income. Anazodo (1981) observed that in Nigeria despite the rich land resources coupled with huge oil wealth and generally favourable weather, there has been a nineteen-fold increase in goods importation while Adedoyin et al (1996) noted that the level of agricultural mechanization in Nigeria is still one of the lowest in the world. Anazodo (1982) described it as even lower than that in some comparable African countries such as Kenya, Senegal and Ghana.

PROSPECTS OF AGRICULTURAL MECHANIZATION

What is Agricultural Mechanization?

Agricultural mechanization is the application 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. Large-Scale Mechanization started in the 19th Century in the USA and was first spurred by the availability of land and an attractive export market in Europe in the 1960s and 1970s, a similar agricultural development pattern occurred in Thailand.

In Sierra Leone, about 73% of the population are farmers of which about 60% of the total number of adults constitutes the major part. There are about 286 137 small farm holdings in the country, cultivating about 1,2,8,6,348 acres of land with human labour as the major source of farm power, and a limited Draught-Animal Power. An additional 18806 acres are operated by institutional farms and large farms, making a grand total of approximately 1,305,154 acres devoted to the growing of crops. This is about 7.4% of the total land area of Sierra Leone, and the overall average farm size is 4.5 acres. Generally, agricultural mechanization which started in Sierra Leone first in 1946 has been left by the government to progress along its natural source (Kuyembeh, 1982).

The agricultural growth pattern of the USA and Thailand conform to the resource exploitation model, meaning increase in agricultural production as a result of area expansion, rather than increase in land productivity. Two broad stages of farm mechanization process have been identified viz: Mechanization of power intensive operations e.g. land preparation, threshing etc. which generally precedes the Mechanization of control-intensive operations e.g. weeding, harvesting etc. Ani and Onwualu, (2002). A wide range of implements, equipment and power sources can be developed and harnessed in the course of mechanizing agriculture. Mechanization policy measure should include direct and indirect interventions by the government, so as to have impact on decisions made by the farmers. It should also deal with foreign trade, in machinery and equipment, and the development of the machine manufacturing Industries.

BENEFITS OF AGRICULTURAL MECHANIZATION

According to Asoegwu (1998), the following are the benefits of agricultural Mechanization to Nigeria specifically,

i. Timeliness of farming operation can be achieved, the result being that yield, is improved upon generally

ii. Increases in yield quality from farms leading to self-sufficiency

iii. Reduction of dependence on wasteful and low sources of farm power including direct labour, animals e.t.c

iv. Reduce loses in crop handling, leading to improvement in quality of food crops.

vi. Enhances the dignity of the farm worker, therefore serving as a moral booster with the effect that worker
performance is enhance
vii. Wealth generation, through earnings from farming is increased.
viii. The standard of living of the peasant farmer would be enhanced with positive impacts on other aspect of national life like reduced rural dirt, decongestion of rural centres and other social problems.
ix. Quality of farm operations would be improved, proving better soil environment for seed germination and plant growths
x. Supply of manpower is freed for other non-agricultural users
xi. Effective and efficient land use
xii. Permits engagement in new jobs and operations

Need for appropriate agricultural mechanization in Nigeria

The way forward, in the nations quest for improved agricultural productivity rest on the development of mechanized farming. Choudhury et al (1984). To improve on the material well-being of Nigerian, there is the strong need to produces more food for local consumption and export. Development organization in Nigeria could boost the level productivity, through mass cultivation of diverse types of food crops and fibre for the teeming population at minimized cost. The direct result of the current reliance on crude and traditional methods is the galloping inflationary trend that is the bane of the nation. Technological solutions in Agriculture would reverse this trend. This would require a huge capital outlay including the cost of importation of capital equipment and the funding of research and development. Mechanization would serve as a means of restoring the glory of the sector as a major source of foreign exchange earnings. Mechanization of the agricultural sector needs to be provided for a deserved national priority.

Level of agricultural mechanization in Nigeria

The level of mechanization in Nigeria relates to the evolutionary processes that have been influenced by certain socio-economic and natural barriers. By way of classification, the following are the different classes of mechanized farming equipment’s and tools in Nigeria: Hand Tools Technology (HTT), Draught Animal Technology (DAT) and Engine Powered Technology (EPT). Each of the classes is described below.

Hand Tools Technology (HTT)

This is the simplest, and the most basic level of agricultural mechanization in Nigeria. It is the level of technology that has sustained the population through ages. This class of technology has played the leading role among others in the Nigeria context. Farming with HTT is tedious, and inefficient, leading to low productivity and small farm holdings. The HTT relies on man as the source of energy for the driving of tools. Currently, well over 90% of farm operations (bush clearing, land preparations etc) are executed through the above means. Some basic hand tools used in Nigeria include Spades, Rakes, Digging Forks, Hoes, and Hand Planters. Various researchers such as Kuyembeh, (1982) Mrema and Odigboh (1993), Odigboh and Onwualu (1994) Adama, (1996) Musa (1996) etc have revealed that a greater percentage of land preparation, operations in Africa are still carried out using hand tools powered by the human muscle. A farmer using HTT can cultivate only about one hectare of land. He cannot do more than that for certain scientifically established facts (Odigboh, 1999).

Draught – Animal Technology (DAT).

This class refers to the range of implement, machines and equipment that are powered by animals (camels, bulls, mules, and donkey’s etc.) and have been found very useful in farming operations. This level of development in mechanization is also referred to in some literature as the introduction of improved hand tools, animals and tractor drawn equipment. Though use is limited to tillage and transportation, the output of these means is far ahead in worth compared with the HTT. A major limiting factor in the use of this class of technology is the prevalence of tse-tse fly and lack of local production of animal-drawn equipment.

Engine Powered Technology

The EPT is the modern research and development based method of modern technology in agricultural productivity. This involves the use of tractors, engines, and electricity to power motorized machine for farming operations. The vagaries of weather, climatic conditions soil and crop types are important variables in this category. The power sources and their associated implements are available in sizes, power ratings, level of sophistication and technical complexity that vary tremendously.

In terms of relative contribution to overall farm powers in Nigeria, it can be safely estimated that the manual production system amount for 90%, of farm power. Tables 1, 2 and 3 throw lighter on HTT, DAT and EPT; as related to power consumption and rate of coverage of field operations by each of them. Table 1 & 2 indicates a very low level of agricultural mechanization. Table 3 shows that the level of HTT is very low compared to that Tractor. It is therefore more of engine – powered
technology. It is only through this level of mechanization that we can achieve the mandates for establishment of research institutes.

The future prospects for agricultural mechanization in Nigeria

Government at all levels, as well as cooperate organizations interest in farming are geared towards increasing the level of technological application in Nigeria. Farmers must be encouraged to make use of mostly simple low-cost manufactured machines, and equipment. In the advanced and developed countries of the world, agricultural mechanization has led to peak level productivity such that food and fibre production for domestic use is no longer a problem. Appropriate use of mills has made it possible for a very small percentage of their population to provide abundant raw materials for their numerous agro-industries which provide employment for a lot more people than possible with only direct production of agriculture. Through mechanization, adequate food and fibre can be produce to enable the earning of foreign exchange. Previous effort in mechanization of agricultural productivity by various governments had been through the importation of tractors and implement into Nigeria. This has however not been able to solve the problem of our laggard embrace of mechanization. The way forward therefore is for government to encourage the development of machines and equipment locally; new designs and innovations can be adapted from the equipment imported from other countries. Through deliberate policy development and frame-work, government can ensure vigorous agricultural sector changes, which would ensure that the nation's agricultural productivity is boosted. Universities, research Centers and other stakeholders must make ground

Table 1. Human Power Consumption for Various Farming Activities

<table>
<thead>
<tr>
<th>S/N</th>
<th>Activity</th>
<th>Gross Power Consumed (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bush clearing</td>
<td>400-600</td>
</tr>
<tr>
<td>2</td>
<td>Felling of trees</td>
<td>600</td>
</tr>
<tr>
<td>3</td>
<td>Hoeing</td>
<td>300-500</td>
</tr>
<tr>
<td>4</td>
<td>Ploughing with animal draught</td>
<td>350-550</td>
</tr>
<tr>
<td>5</td>
<td>Ridging</td>
<td>400-1000</td>
</tr>
<tr>
<td>6</td>
<td>Planting</td>
<td>200-300</td>
</tr>
<tr>
<td>7</td>
<td>Tractor drawing</td>
<td>150-650</td>
</tr>
</tbody>
</table>


Table 2. Power Output Of Farm Animals In Health Conditions

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Animal</th>
<th>Pull-weight ratio</th>
<th>Power output (watts)</th>
<th>Energy Output per Day (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Buffalo</td>
<td>0.12</td>
<td>520</td>
<td>9.5</td>
</tr>
<tr>
<td>2</td>
<td>Camel</td>
<td>0.13</td>
<td>650</td>
<td>14.0</td>
</tr>
<tr>
<td>3</td>
<td>Donkey</td>
<td>0.13</td>
<td>200</td>
<td>3.0</td>
</tr>
<tr>
<td>4</td>
<td>Horse</td>
<td>0.13</td>
<td>500</td>
<td>18.0</td>
</tr>
<tr>
<td>5</td>
<td>Mule</td>
<td>0.13</td>
<td>400</td>
<td>8.5</td>
</tr>
<tr>
<td>6</td>
<td>Ox</td>
<td>0.11</td>
<td>450</td>
<td>10.0</td>
</tr>
</tbody>
</table>


Table 3. Rate of Coverage of defiled operations for man, animal and tractor h/ha

<table>
<thead>
<tr>
<th>Operation</th>
<th>Man</th>
<th>Oxen</th>
<th>Tractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ploughing</td>
<td>---</td>
<td>17-25</td>
<td>1.7-2.5</td>
</tr>
<tr>
<td>Harrowing</td>
<td>---</td>
<td>8-7</td>
<td>0.8-1.5</td>
</tr>
<tr>
<td>Ridging</td>
<td>80-250</td>
<td>6-8</td>
<td>1.0-1.4</td>
</tr>
<tr>
<td>Fertilizer application</td>
<td>2-70</td>
<td>---</td>
<td>0.4-1.0</td>
</tr>
<tr>
<td>Spraying</td>
<td>2-3</td>
<td>---</td>
<td>0.4-0.5</td>
</tr>
<tr>
<td>Planting</td>
<td>500-100</td>
<td>6-8</td>
<td>1.0-0.5</td>
</tr>
<tr>
<td>Heeding</td>
<td>40-150</td>
<td>4-8</td>
<td>0.8-1.2</td>
</tr>
</tbody>
</table>

Source: Musa, (1988)
breaking inputs. There will be an increase in resulted in quite a large number of prototypes of machine and equipment for local agricultural crops (Odigboh and Onwualu, 1994). In the first national exhibition of locally developed agricultural equipment in 1979; the guide used, affords a good source for identifying individuals and groups, institutions and commercial firms which under take research and development work on farm machinery and equipment. In the Guide, vital information on machines and equipment being developed across the country for different phases of agricultural and food product were provided.

In the area of policy formulation and implementation, in a bid to move the agenda of agricultural mechanization to the next level, where it would contribute significantly to food production. All factors affecting mechanization like the prevalent tradition land tenure system, cost of mechanized cultivation, maintenance and repair cost, underutilization of tractors etc should be looked into and reduced if possible, so as to improve the economic use. In spite of huge amounts invested in procurement of agric machinery in Nigeria, the level of mechanization is still low. This is as a result of over dependence on imported technology as discussed by UNIDO (1982), Cosmes (1990), and Odigboh (1976 and 1992).

CONCLUSION

Mechanization is recognized as the necessary major means needed to accelerate agricultural production and create a period of surplus in Nigeria. Indeed food sufficiency can only be attained in Nigeria by encouraging and promoting local designs and manufacture of implements and equipment at low cost. The provision of credit and infrastructural facilities to manufacturers, and the building and development of expertise, for selling and maintaining of tractor powered equipment and mechanical means for an agricultural operation should be encouraged as a means of strengthening the capacity of farmers to efficiently and effectively engage in agricultural production to meet and surpass for the food needs of the populace.

REFERENCES

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