

CHAPTER 7

AGRICULTURAL MECHANIZATION POLICIES & STRATEGIES IN NIGERIA

by

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INTRODUCTION

Nigeria is the most populous country in Africa with a population estimated at 107 million in 1987 and growing at a rate of about 3.0% per annum. About 30% of the population (about 35 million) live in urban areas and are dependent on the rural population for their food requirements. The formulation of policies and implementation of strategies for mechanizing Nigeria's agriculture have not been accorded the necessary attention and both have not been systematically pursued. Although Nigeria is blessed with abundant land with an area of 98.3 million hectares out of which 72% is considered as suitable for agriculture, only about 28.31 million hectares are currently under cultivation. Several efforts by the various governments (Federal and State) over the last three decades to formulate policies and implementation strategies for agricultural mechanization have not been significantly effective due to the ad hoc approach and poor funding and non-integration of engineering technology research and development as well as training and extension within the entire agricultural development system. The current state of agricultural mechanization technology systems management is inadequate in assisting the Nigerian farmer to increase the productivity and overall production of the agricultural sector. Thus essential farm mechanization inputs, including equipment and spare parts are very scarce and their prices are exorbitant and hence not within the reach of majority of the farmers. Consequently, over 90% of farm operations in Nigeria (ranging from bush clearing to land preparation, planting, weeding, pest control, harvesting and primary processing) are still being carried out using handtools which depend entirely on human muscle as the major or only source of farm power. The application of animal power technology is still limited and restricted. In this paper a review of Nigeria's agricultural development efforts with specific reference to agricultural mechanization is presented. The aim is to identify the constraints, review possible options and draw up recommendations for a more realistic approach in the application of agricultural mechanization technologies for an enhanced agricultural development.

PERFORMANCE OF THE AGRICULTURAL SECTOR SINCE INDEPENDENCE

Agriculture is an important occupation in Nigeria. About 70% of the population is dependent on it directly or indirectly for its livelihood. It provides the bulk of the employment, income and food for the nation's rapidly growing population as well as supplying raw materials for agro based industries. Majority of Nigerian farmers are subsistence small holder farmers. They farm about 1 to 2 hectares of land which is usually scattered over a wide area. The farming system is mainly rotational fallow agriculture involving alternating a period of cropping with a period of bush fallow. Some farmers engage in semi-permanent or permanent agriculture and mixed agriculture. Farmers employ family labour and utilize low level mechanization inputs. With the exception of the Northern States where animal power is used, the only tools used by the majority of Nigerian farmers are the hoe, cutlass and harvesting knives. At independence in 1960, Nigeria was by and large, self sufficient in food production, and the bulk of her merchandize exports were agricultural products. Cocoa, palm kernels, rubber, groundnuts, and cotton were the major agricultural exports and Nigeria was a leading world exporter. Since independence however, agricultural policies, strategies, and programmes have undergone many significant changes. These changes were a consequence of changes in governments (from civilian to military - and military to civilian, etc.). In general government philosophy on agricultural development has gone through three major phases from 1960-1970; 1970-1985, and from 1985 to today.

The period from 1960 to 1970 was characterized by a decentralized approach to agricultural development in Nigeria. The centres of agricultural development activity were the regions or states with the Federal Government playing only a supporting role. As such, approaches to agricultural development were not uniform. But generally, the approaches adopted involved a combination of private sector/small farmer and government direct production approaches. The period from 1970 to 1985 was characterized by a much greater involvement of government, especially the Federal Government, in agricultural development efforts. New policies, programmes and projects were launched at rates that were hitherto unknown in Nigeria. This was, in a way, a reaction to the rapid deterioration in the state of the country's agricultural economy towards the end of the 1960's and the beginning of the 1970's. It was also in response to the devastating effects of the Nigerian civil war on the agricultural economy in particular. More agricultural development institutions were created and more special programmes and projects were launched in the 1970-1985 period than at any other corresponding period in the history of Nigeria. These included the establishment of the Nigerian Agricultural and Cooperative Bank (NACB) and the launching of special agricultural credit schemes; the National Accelerated Food Production Programme (NAFPP); the integrated Agricultural Development Projects (ADPs); the reorganized commodity marketing boards and new food crop

commodity marketing boards as epitomized by the Nigerian Grains Board. The Federal Government took over the procurement and distribution of fertilizers, launched ambitious input subsidy schemes and a guaranteed minimum price scheme for grains. Most of these programmes and projects were instituted and implemented under the ambit of two umbrella "programmes". The first was the Operation Feed the Nation (OFN) from 1976 to 1979 and the second was the Green Revolution Programme from 1979 to 1983. Some of them also found expression in government investment in direct large-scale agricultural production. An important indicator of the degree of government involvement in agricultural development efforts in Nigeria during this period is the amount as well as the relative share of government budget going to agriculture which increased significantly.

The period between 1985 - todate may be characterized as the period of Structural Adjustment Policy where there has been massive devaluation of the naira and reduction in Government expenditure. All these have affected the agricultural sector quite significantly especially investment on agricultural mechanization inputs. Despite huge investments in agriculture, during the period from 1970 to 1985, the performance of the sector has been disappointing. This is evidenced by:

- (a) a decline in the agricultural sector's share of the Gross Domestic Product from an average of about 56 percent in the 1960-69 period to about 20 percent in the 1981-85 period;
- (b) a systematic decline in the share of the country's total labour force in agriculture at an average annual rate of 1.3 percent since 1960 without a corresponding increase in production;
- (c) increasing shortage of food to Nigerians as evidenced by increased food imports and high rates of increase in food prices, particularly since 1975;
- (d) the virtual disappearance of agricultural commodities from the country's export trade; and
- (e) increasing shortage of agricultural raw materials required by industries.

This decline in the agricultural sector has inevitably affected the pace and progress of agricultural mechanization.

AGRICULTURAL MECHANIZATION POLICIES AND STRATEGIES

During the colonial period, attempts were made to improve agricultural mechanization in Nigeria from the handtool technology by introduction of draught oxen technology at Daura in 1922 (Musa 1988). The northern part of

the country (from latitude 12°N) which is tsetse free, and where farmers have the tradition of keeping livestock was a suitable area for such an attempt. Farmers in the southern part of the country, due to the tsetse fly problem had no tradition of keeping draught animals and relied entirely on the handtool technology for their farming operations. In addition the cash crops grown in the south were perennial - cocoa, palm kernels, rubber, as opposed to the north where the cash crops were annuals groundnuts and cotton. Due to the higher rainfall common in the south, the southern farmers have different subsistence food crops - cassava, yams, and plantains which required less primary tillage compared to the subsistence crops of the mid-belt and northern parts of the country - where maize, sorghum, millet are the common subsistence crops. Animal traction was therefore much readily adopted in the north and has remained an important source of draught power up to today. In the early 1950s a few tractors were introduced both in the south and north of the country (Aboaba 1988). By 1956 a Tractor Hiring Unit (THU) was established in the then Northern Nigeria by the State Government, and ploughing was done for farmers at a nominal charge. This became quite popular and demand increased significantly over the next decade. Similar Tractor Hire Units were started in the Western and Eastern states. Due to the nature of the farming systems in the south, and perhaps less demand on an annual basis on tractor power these did not develop initially that well. The Tractor Hiring Unit in Western Nigeria did not get a firm footing until 1958 when tractors were hired out to farmers cultivating paddy in Oyo and Ibadan.

Following the nation's independence in 1960, intensified efforts were made to improve agricultural production through improved mechanization technology by introducing different programmes and schemes. In the late 1960s, Farm Training Institutions (FTI) were established in eight different locations in the Northern Nigeria, namely; Gongola, Borno, Kaduna, Sokoto, Kano, Katsina, Niger and Plateau states to train farmers on mixed farming technologies and the use of oxen for farm work. It was hoped once these farmers returned to their villages, they would pass on the technology to others. The civil war of 1967-70 did interrupt agricultural mechanization efforts in the south of the country. Policy makers however were beginning to get concerned on the pace and scope of agricultural mechanization. Concern was particularly raised on the handtool technology being used in the humid areas of the country. The second national development plan had the following on agricultural mechanization:

"No realistic change can be expected from the present nature of Nigerian agriculture from the drudgery attached to it until the farmer finds an alternative to the hoe and cutlass technique of production. The clearing of bush, the preparation of land, the sowing of seeds, the various post planting operations are all processes in which the farmer's present tools can do little for high productivity per man day or per acre. Removing the physical drudgery and the cause of low output need not, however, involve the use of sophisticated farm machinery

and equipment. Cheap simple implements can replace the hoe and other traditional implements which make farming a tedious and unattractive occupation. The use of small motor powered implements and animal drawn implements and carts will be encouraged. To achieve this, research programme on these problems will be intensified during the plan period" (FMI 1970)

Nigeria was then considering introducing power tillers and small tractors as an answer to the mechanization problems in the south of the country where draught animals cannot be used due to the tsetse fly problem. Other advisors were also advocating trying these power tillers even in the north of the country as it was felt that in the long term draught animal technology will not be adequate to meet the power requirements there (Rana 1971, Gemill and Eicher 1973). The feeling was then that since these power tillers had been so successful in Japan they could also, with some modification, be used in the humid zone of Nigeria where the rainfall was plentiful and the situation there was nearer to the wetland farming system found in Japan which had been successfully mechanized by these power tillers in the 1950s. This trend was however contrary to what the FAO team which had been called in before the civil war to advise on long term agricultural development in Nigeria (1960-1980) had recommended. The FAO team had cautioned against these power tillers. A few of these power tillers had been tried in the Western State and the results were rather varied (Oluwasami 1975, FDA 1971).

The FAO team had cautioned that although small, single axle tractors were superficially attractive they had however never proved successful in any country with conditions similar to those of Nigeria. FAO team alleged that it was common experience that these garden tractors were extremely tiring to operate (especially in tall crops where the exhaust fumes do not disperse) and that there was seldom any marked increase in the acreage that a man could cultivate. Few crops could be harvested by these machines, although auxiliary equipment such as water pumps and sprayers could be very useful in intensive farms such as vegetable gardens. The tractors and implements themselves were expensive because of the low volume of production. Also the selling price was extremely high because the cost of financing, and after sales service is much the same for one garden tractor as for one conventional farm tractor. Operating costs were high in relation to output because of high fuel and repair bills. Many makes were available with a wide range of accessories and implements, but most required careful setting and constant adjustment if they were to perform any useful work. Some were provided with a high speed gear for road work, but the capacity of the trailers was very low and the cost per ton-mile was considerable (FAO (1966)). This advice was however fairly subjective and no figures were given to support the FAO arguments. In addition this type of technology had just then been developed and adopted in Japan and had, in reality never been tried in any Tropical African country by then. A National Study Group on Agricultural Mechanization was therefore in a predicament on what policy to advise to be followed as regards the

mechanization of the handtool technology agriculture in the Southern part of the country.

In their report, the Study Group on agricultural mechanization observed that the engagement of handtools in the country's agriculture "had become a forceful repellent to farmers and it will be progressively more repulsive with time". The study group felt that the priority in research and development of handtools will be futile because of among other reasons: failure of attempts to introduce exotic hand-tools in the past; dearth of experts on handtools; and social attitudes of the farmers towards the use of handtools (FDA 1971). It was felt that the young generation of farmers who would be school leavers were likely to detest the use of any implements that will make farming a more difficult manual work than other jobs (like motor driving, motor vehicle mechanic's work, tailoring, hair cutting, etc.) which people of their own comparable education do. The committee concluded by observing that the effects of any improvements of handtools which may result out of research and development efforts, on agricultural production are unlikely to be spectacular, and thus Government efforts should not be wasted on this technology.

Likewise draught animals were ruled out in so far as the south was concerned, as it was concluded that introducing them would involve not only teaching the farmers the techniques of handling draught animals, but also the techniques of animal husbandry. Doubts were also expressed about the long term utility of draught animals in the tsetse free northern states. Among the reasons advanced for this pessimism was that the northern states had a long dry season and the peak of work demand, came at the end of the dry season when the animals are in poor condition and food for draught animals and people is in short supply. It was also argued that even though the number of draught oxen had increased quite significantly up to 1965, the power provided by the total stock of these draught animals in the entire northern states was by then merely equivalent to 450 medium powered tractors (Rana 1971). It was further argued that even if this high increment rate (of use of draught animals) could be maintained and the limitations of Biological reproduction, the necessity of replacements and such other factors like the recent drought are ignored, it would be more than 40 years before each farmer in the tsetse free areas of the northern states can own a pair of draught animals" (Rana 1971). The technical advice to policy makers on draught animals as a source of power was therefore pessimistic.

Since independence, all the state Governments had introduced Tractor Hire Units (THU). These THU's were owned by Government - Ministry of Agriculture and Natural Resources, or by cooperatives or individual entrepreneurs. They provided tractor hire services to farmers for land preparation (primary ploughing and harrowing) and in some cases even planting and were used for transport during the off season. The agricultural mechanization study group observed that "More operations are now done by tractors, after-sales service has slightly improved and the operator's and the

mechanic's competence has improved with time. Thus the annual output of the tractor has increase considerably. The average yearly hour-output per tractor in the Western State has attained 600 - and 800 - levels for the Government and the private hire services respectively. During the current active season of March-June 1971 the average output per tractor reached 90 and 130 acres (of full complement of regular operations ploughing, discing and ridging or mechanical planting) respectively for the Government and private hire services" (FDA (1971)). Even though an optimistic picture of THU was being reported by the agricultural mechanization study group, a more cautious approach was being advocated by other research workers (Kolawole (1971, 1974); Gemill and Eicher (1973)).

This debate coincided with the first oil boom in Nigeria of 1973/74. Government revenues increased significantly and there was optimism throughout the country. Money was no longer a problem and hence the tractor hire units were significantly expanded. During the period of the Third National Development Plan 1975-80, Federal Government as well as the State Governments expanded their activities in direct production of essential agricultural products by establishing food production companies. The National Accelerated Food Production Programme (NAFPP) was established to use individual farmers to produce and multiply improved seeds of rice, maize, sorghum,, wheat and cassava for wider distribution to farmers for planting. In addition the Nigeria Agricultural and Co-operative Bank and the Agricultural Credit Guarantee Scheme were established for provision of credit for agricultural production. The Governments also expanded their irrigation schemes and rural electrification programmes. In order to facilitate these expanded activities of Federal and State governments in the promotion of the production of some crops and to improve access of small farmers to the services of farm machinery, State and Federal Governments imported a lot of crawler tractors, agricultural tractors and complementing agricultural machinery for establishment of land clearing units; establishment of tractor hiring units; establishment of central, field and mobile workshops to provide repair and maintenance of farm machinery. The extent of subsidies by governments on land clearing and tractor hiring services ranged from 30 percent in some states to 75 percent in other states. Some state governments also undertook the purchase of Agricultural equipment and spare parts for resale to farmers at subsidized prices.

During the Third National Plan period, seven states namely Kaduna, Sokoto, Bauchi, Benue, Plateau, Kwara and Niger with the assistance of the Federal Government and the World Bank established the Agricultural Development Programmes in Funtua, Gusau, Gombe, Ayangba, Lafia, Ilorin and Bida to improve socio-economic activities such as agriculture, rural road construction, dam construction, water supply, livestock production etc. A component of the programmes is the establishment of Farm Service Centres (FSC) from which small-holder farmers could obtain items of farm inputs including farm machinery. As a result of all the activities described above,

massive importation of land clearing equipment, road making equipment, agricultural tractors and machines took place during this period.

In addition the National Centre for Agricultural Mechanization was established as part of the Federal Department of Agriculture. The Centre was sited at Ilorin, Kwara State with the following objective, among others:

- provision of guidelines with respect to importation of agricultural machinery.
- encouragement and motivation of local design and manufacture of equipment and machinery for agricultural production for the various local conditions.
- aiding and promoting effective cooperation among various institutions by encouraging multi-disciplinary approach in the improvement of mechanization of the agricultural production processes.
- provision of supplementary facilities for manpower training and development in the different fields of agricultural engineering.

During the Fourth National Development Plan 1981-85 Government policy of direct agricultural production was modified and changed to equity holding in commercial ventures with the private sector. Emphasis was therefore placed on encouragement of private entrepreneurs to establish large scale farms. Agricultural production and processing was transferred from Schedule II to III of the Nigeria Enterprises Promotion Act to allow foreigners to own up to 60% of the equity of an agricultural enterprise. Commodity Boards, Grain Production Company and State Agricultural Development Corporations were encouraged to go into partnership with private indigenous or foreign investors in establishing large scale farms. The main highlights of the policies and programmes for agricultural mechanization during the Plan period were:

- (a) making agricultural machines available to the farmers through the Federal and State programmes of provision of mechanical services under the agro-service system (FSC) and through subsidizing the purchase of mechanical equipment by individual farmers.
- (b) establishment of about 285 agro service centres and mechanical workshops for facilitating access by farmers to farm inputs as well as agricultural machines.
- (c) provision of subsidy to encourage farmers to mechanically clear land and to bring under cultivation a total of 250,000 hectares

between 1981 and 1985.

The latest policy document, the Agricultural Policy for Nigeria reprinted in April 1989, still emphasises the following as the objectives of mechanization policy in the country:

- (i) Reduction of the drudgery of agriculture by providing mechanical power to replace some of the labour required in agricultural business.
- (ii) Reduction of high cost of agricultural production which arises from high labour wage rates and the high share of labour cost in the total cost of agricultural production.

A number of strategies mapped out in the Agricultural Policy for achieving the objectives stated above summarized the thrust of post independence efforts in promoting access of farmers to agricultural mechanization. These strategies are reproduced below for ease of reference:

- "(i) The responsibility for land clearing for agricultural purposes will essentially be that of agencies of the state governments. In this regard, government will provide advice on proper agricultural land clearing methods as well as regulate the activities of all land clearing and development agencies.*
- (ii) Government will, in appropriate cases, subsidize agricultural land clearing.*
- (iii) To promote privatization of tractor hiring units, state governments will be encouraged to support a programme of assistance to entrepreneurs to enable them to get bank loans to set up private agricultural mechanization enterprises and/or tractor hiring units (THUs) and repair workshops.*
- (iv) Training will be provided to tractor and land clearing operators in the proper use of these equipment to prevent soil loss and reduce soil erosion.*
- (v) The use of small motorized farm machines, ox-drawn equipment (animal traction) and processing equipment will receive greater attention than ever before. The identification of such machines and their local development and fabrication by the use of small-scale farmers will be promoted on a continuous basis. Government will also promote the local manufacture of medium and large size farm machinery for land preparation, crop cultivation, harvesting, processing and storage on large-scale farms.*

- (vi) *The development of the National Centre for Agricultural Mechanization will be accelerated to enable it to perform its function of standardization of farm machinery and equipment and the promotion of the production of locally designed prototypes.*
- (vii) *Active encouragement will continue to be given to Universities, Polytechnics and Research Institutes on accelerating the development and local fabrication of suitable equipment for use by intermediate and small farmers. The participation of the private sector in the commercialization of prototypes will continue to be promoted."*

Thus the agricultural mechanization policies and strategies in 1989/90 in Nigeria have moved through a complete cycle back to where we were in 1970-73 where the emphasis was on power tillers and tractor hire units. From a technical point of view one could argue that the oil boom years (1974-89) were years of confusion in so far as agricultural mechanization policy formulation is concerned. There was no clear policy on agricultural mechanization and there was a lot of ad hocism on the agricultural mechanization front. It was also the period when there was unprecedented massive importation of tractors into the country. This massive importation has however not changed much the way our agriculture is undertaken for it is still dominated by the handtool technology. It is not even clear how many tractors are available in the country. For although statistics do show that on the average between 1979-85 the country has been either importing or locally assembling about 2000 tractors per annum, our survey of 1985 shows that there were only 15,900 tractors in the country by December 1985. From 1975-83 a total of about 22,000 tractors were sold in Nigeria. (Makanjuola 1984) (Anazodo *et.al.* 1986) (see Table 20). FAO figures do show that the tractor population in Nigeria has never exceeded 11,900 between 1970-1987. If the importation figures are an indication of the tractor numbers available, then the number should be by far above 16000 tractors, otherwise the rate at which tractors get out of use in Nigeria is quite high (Table 21).

Another critical issue, in so far as agricultural mechanization policy is concerned, is the role of Draught Animal Power in agriculture. This is particularly important for the Northern States of Nigeria which are tsetse free and livestock keeping plays an important role in the agricultural system. The use of draught animals started in Northern Nigeria from 1928. (Gwami (1990); Phillip *et.al.* (1988)). It is estimated that up to 1965 only 36,000 farmers had adopted this technology (mostly in ridging) (Gwami 1990).

Further it is estimated that by 1980 only 100,000 farmers were using this technology out of a total of 7.115 million farmers in the Northern States of Nigeria (less 1.5% of farmers) and they were cultivating less than 6% of the total area cultivated per year (see Table 19). The factors which have led to this low level of adoption despite over 60 years of extension effort, and the fact that farmers in the North have a livestock keeping tradition include lack of

appropriate implements, the oil boom in the 1970s which led to farmers preferring the socially more prestigious mechanical power cultivation, etc. among others (Gwami 1990, Phillips *et.al.* 1980, Gefu *et.al.* 1990, Otchere *et.al.* 1988). In addition there is a large scale manufacturer of animal draught implements based in Kaduna (EMCOT Ltd.).

TABLE 19: Estimates of area under different cultivation systems in Northern States of Nigeria

	<i>Cultivation systems</i>		
	Hoe	Animal Power	Tractor
Number of farmers (million)	7.5	0.1	0.015
Area cultivated (ha/farmer/year)	1	5	50
Total area cultivated annually (million ha)	7.5	0.5	0.75
Per cent of total area (%)	86.0	5.5	8.5

Source: Phillips *et.al.* 1988

All studies by socio-economists and livestock scientists do show that this technology ought to be profitable if adopted by farmers. Yet the statistics as in Table 19 do show that 86% of the cultivated land is still cultivated by the back breaking and arduous handtool technology. In addition other studies do show that there is a shortage of labour especially during the peak of the season. (Norman 1975). Why then have farmers not adopted this technology? Millions of dollars have been spent, by the State Governments, Federal Government and donor agencies such as the World Bank in popularizing this technology over the past 60 years but the adoption rates, from the empirical evidence available are quite disappointing. It is important that research is undertaken to determine why this technology has not been adopted inspite of its apparent advantages and long term extension efforts. It certainly has room, in particular in the Northern States, but its adoption rate so far, does show that there is something wrong - whether in the way it is being extended to farmers, cost, or in the technology itself. This requires research. There is no point in spending million of dollars, on this technology, if what can be shown, after 60 years, is an adoption rate of less than 6% of the cultivated land and with 86% of the cultivated land still being cultivated by the handtool technology.

MANUFACTURE OF AGRICULTURAL MACHINES

In Nigeria, three levels of agricultural machinery manufacturers can be identified: (a) modern large-scale tractor assembly plants; (b) medium-scale manufacturers; (c) hand-tools manufacturers. There are at present two tractor assembly plants in Nigeria, namely the National Trucks in Kano and Steyr Nigeria Limited, in Bauchi. The factories were set up to assemble lorries and agricultural tractors, e.g. the Steyr plant in Bauchi has an annual capacity for assembling 8,000 lorries and 2,000 agricultural tractors. The total annual production capacity of the two assembly plants is 5,000 tractors. The two plants

commenced production in 1980. Table 20 shows the relationship between imported completely built units (CBU) of tractors and the units of locally assembled tractors. The high sales of 1980 and 1981 are a result of the Green Revolution campaign efforts of the various governments in Nigeria. The capacity utilization of the assembly plants has ranged from 20-54% and it is apparent that this utilization rate is low. Steyr assembles two basic models, the 60 kW (80hp) two wheel and four-wheel drive types, and the 82 kW (110 hp) two-wheel and four-wheel drive types. The Fiat Company produces also two basic models of comparable sizes.

TABLE 20: Break-down of tractors sold in Nigeria

Year	CBU (imported)				Units locally assembled		Total
	M.F.	Ford	J.D.	Others	Steyr	Fiat	
1979	-	-	-	-	-	-	600
1980	500	350	300	-	900	950	3,400
1981	1,550	-	150	355	1,822	1,623	3,400
1982	260	-	570	-	450	570	1,850
1983	-	-	660	-	740	600	2,000

M.F. - Massey Ferguson; J.D. - John Deere

Apart from low utilization of their installed capacities, tractor assembly, like heavy truck assembly which is the main function of the plants, did not do well for many reasons. In particular, local manufacture of components did not develop. Thus with the introduction of Structural Adjustment Programme, the devaluation of the naira and the high bank interest rates, it has become very prohibitive to purchase tractors assembled from imported semi-knocked down parts e.g. the cost of a medium size agricultural tractor and a set of matching implements ranges from US\$25,000.00 to \$40,000.00.

Animal drawn implements manufacturing has enjoyed reasonable success in Nigeria. The pioneer company, John Holt Agricultural Engineers Limited produced about 4000 units of animal drawn implements in 1966. The production went up to between 8000 and 10,000 units annually with exports to ECOWAS countries like Ghana, Mali, Togo, Republic of Benin and Zaire. The most common animal drawn implement is the Ransome Emcot plough and ridger. The other animal drawn implements manufactured are carts and trailers. Manufacture of post-harvest processing equipment has been boosted by the advent of the Structural Adjustment Programme. Efforts are now being made to produce some of these processing machines locally as the cost of importation has gone up considerably. In particular, livestock feed mills, rice dehullers, grain threshers and maize shellers are produced by many

companies. These companies however have difficulties in obtaining credit facilities, raw materials, standard parts and semi-manufactures like bearings, electric motors and small petrol engines.

TABLE 21: Estimated Agricultural Machinery in Use in Nigeria at the end of December 1985

Type of Agricultural Machinery	Total Number in use
Farm Tractor (four-wheeled or two-axle)	15,906
Crawler Tractors	1,256
One-axle Tractors	419
Trailers	4,529
Disc ploughs	9,544
Disc harrows	7,953
Sprayers	6,362
Ridgers	4,529
Grain Planters	1,361
Root and Tuber Crop Planter	5
Cultivators/mechanical weeders	258
Grain Harvesters	163
Grain Threshers	1,022
Grain Shellers	2,710
Crop Dryers	263
Modern Storage Structures	128

Source: Anazodo et.al. (1986)

Hand-tools are produced mainly by local craftsmen and artisans. Their products are, in the main, hoes, cutlasses, and harvesting knives. The needs of the farmers for these categories of hand-tools are met by these manufacturers. The major drawback of this level of manufacturing is the use of metals that are not hard wearing and rust-resistant, and the application of low-level technology. Their manufacturing technology, has in many cases remained that of 19th century. In many cases these are family owned undertakings and the technology is passed from father to son. There has not been any serious attempt to have a vertical integration between these village blacksmiths and the more sophisticated medium and large scale manufacturers of agricultural implements. Further, little has been done to upgrade the skills and plant of these village blacksmiths. An agency may be required to be set up which can help these village level artisans who are now playing a crucial role in manufacturing of handtools (which is crucial for agriculture in the whole country) so that they can improve their fabrication and manufacturing technologies. They should also be assisted by being integrated vertically with the medium scale and large scale manufacturers and also to diversify into other services like repair and maintenance of agricultural machinery and implements including tractors.

RESEARCH AND DEVELOPMENT EFFORTS

There have been quite a number of research and development efforts in Nigeria in the field of agricultural mechanization. These have been undertaken mostly by Departments of Agricultural Engineering in Universities and Polytechnics. Although the National Centre for Agricultural Mechanization is supposed to spearhead agricultural mechanization research activities in the country, it has not been able to perform this function for a number of reasons. The National Centre in an in-house publication entitled "*Brief on Achievements, Capital Expenditure and Constraints in the Establishment of the National Centre for Agricultural Mechanization at Ilorin, Kwara State*" discussed the constraints militating against the development of the centre. These constraints included amongst others:-

- "(i) Failure to promulgate the enabling decree that will establish the Centre as a semi-autonomous unit within the Ministry of Agriculture and Natural Resources.*
- (ii) Failure to appoint a full-time Director for the Centre thereby subjecting it to frequent changes of policies where the supervising senior staff in the ministry is replaced by a new man. Each time there was a change, the new staff needs time to acquaint himself with the project before taking policy decisions on the centre. This slowed down the progress of the Centre.*
- (iii) Inadequate funding leading to non-completion of the physical facilities, non-procurement of adequate laboratory and workshop equipment.*
- (iv) Shortage of experienced staff."*

Thus the contributions of this centre in R&D efforts have so far been quite limited.

Most of the research results in farm mechanization come from Universities and Polytechnics and a great proportion of these activities are devoted to the design and development of equipment and machines. Many of these results have not gone beyond the stage of publication in journals for a number of reasons some of which include:

- (i) Reward system in Universities places a high premium on journal publications without regard to the potential industrial application of the research work.*
- (ii) Scarcity of manufacturing firms with good understanding and mastery of industrial production processes and who have the capacity for taking the risks of developing research results into marketable products.*

- (iii) Scarcity of raw materials and semi manufactures such as bearings, etc.
- (iv) Scarcity of manpower with good experience in industrial research, industrial process, management and marketing.
- (v) Reluctance of banks to support investment in agricultural equipment manufacture.
- (vi) High interest rates resulting in difficulties in raising working capital to produce locally developed machines.

These are some of the factors which have so far impeded the building up of a well developed local research and development capacity.

EMERGING ISSUES FOR CONSIDERATION FROM NIGERIA'S EXPERIENCE

With the adoption of the IMF's advised Structural Adjustment Programme (SAP) and some of positive effects of the activities of the newly established Directorate of Food, Roads and Rural Infrastructure, the National Directorate of Employment and various agricultural promotional schemes of state governments as well as the Federal Government, many Nigerians have taken up agriculture either as a full time employment or to supplement their family incomes. The present momentum can only be sustained on the basis of vast increment of inputs used and the adoption of farming systems that will allow these inputs to be put into effective use. In terms of mechanization there is a need for considerable increment in the quantity and quality of agricultural machinery and implements available for all phases of agricultural operations. With current exchange rates, the amount of local currency required to support the foreign exchange necessary for the importation of agricultural machinery is enormous. There is therefore a need to fabricate/manufacture the machines locally. In order to develop this local capacity, the nation needs to re-examine some of the policies and strategies on:

- farming systems
- research priorities in equipment development
- bridging information gap
- creation of data bank of manufacturing plans
- commercialization of research findings
- expansion of indigenous manufacturing capability and capacity
- industrial extension services
- need to standardize machinery & equipment imported.

Let us consider each in turn.

Farming Systems

During the late 1970s, IITA in Ibadan carried out a number of experiments on zero tillage and developed a variety of equipment pulled manually or by a single axle tractor for planting, fertilizer application and weed control. The rotary injection planter for planting cereal grains through surface thrash was a particularly useful equipment. Despite all the advantages of soil preservation under this system and the fact that there is no need for conventional land preparation of ploughing and harrowing, farmers did not adopt the system. It is important therefore, to re-examine this technology and remove whatever impeding factors farmers faced in adopting it. The main reasons for resuscitating interest in this farming system include among others: the system improves soil fertility and prevents soil erosion and the system is based on low power equipment input. The main machines are the micron sprayers, the single axle tractor as the prime mover and complementing implements like the rotary injection planter and fertilizer applicators. The advantage is that, at the present level of manufacturing capability, all the machines, with the exception of the single axle tractor, and a few specialized parts (e.g. bearings, etc); required by this farming system can be manufactured locally.

Research Priorities in Equipment Development

Hand tools - It is important for research efforts to be directed at more rewarding problems. While the improvement on the hoe handle, shape and quality of hoe blade may raise hoe efficiency, the increase in productivity with this system cannot be spectacular. In short, with respect to the hoe and cutlass, no amount of improvement, in their efficiency and management, no greater effort in terms of use of better materials and no amount of improvement in the design of blades can transcend the technical limitations that result from the fact that these tools still have to be powered by human muscles. Having made this observation, it is important to note that the hoe and cutlass are the only tools available to the farmers. In the recent past, the costs of these tools have risen significantly especially in the case of cutlass which is normally imported into the country. There is therefore a need to develop the local capacity for producing better quality hoes and cutlasses which does not require much R&D effort.

Animal drawn equipment - The use of animal power should be expanded in the tsetse free areas of Northern Nigeria. In order to facilitate the achievement of this objective, efforts on the creating of grazing lands for livestock should be intensified. The design of suitable yokes should be improved so that an increased number of animals can be put to work simultaneously thereby increasing the work output per unit time. However as we noted earlier, there is need also to undertake research on why this technology has not been widely adopted in the Savannah belt despite over 60 years of extension efforts. Currently less than 6% of the cultivated land in the northern states is cultivated by use of this technology (Phillips *et.al.* (1988)). Socio-economic studies have

shown that this type of technology increases both the productivity of labour, as well as timeliness of operations. However its adoption has been quite limited and in most cases only the ridger has been adopted. There is need to determine whether the problem is with the technology itself; method of extension, or there are other unknown factors which impede its adoption. It is obvious that millions of dollars have been spent in research, development, manufacturing and extension efforts on this technology over the past 60 years. The adoption rates are however quite disappointing. It is important to determine what is the problem.

Motorised equipment - Modernization of agriculture cannot take place without some measure of motorization. Refusal to use motorized machine will result in condemning farmers to perpetual menial, arduous, low level productivity jobs, which may consume a lot of energy but which require very little skills. If jobs do not require a lot of skills, workers behave like machines, making only the simplest or no decisions. They can therefore be replaced by motorized machines which when controlled by skilled operators will do the work better, faster and more effectively. With the cost of a conventional medium power tractor and implements ranging from US\$30,000.00 to \$40,000.00, it will be difficult to satisfy the mechanical mechanization needs of the farmers in spite of the renewed interest of the various governments in the tractor hire services. It is therefore important to put emphasis on machines that can be powered by small two and four stroke petrol and diesel engines. With this approach in view three groups of machines are of interest. The first group consists of equipment for transporting people and material in the rural areas. In the Northern States where animal power is available to pull agricultural equipment, the use of animal drawn carts must be expanded. With the high current costs of conventional agricultural tractor, the idea of a multipurpose transport equipment which could double as a vehicle with load carrying capacity of 250 to 500 kg and as a device for pulling agricultural implements becomes attractive. Research activities should therefore be devoted to reactivate interest in this group of equipment. Efforts in this area should start by reviewing past experience in the World in this class of vehicles. The scope of current efforts of the Directorate of Food, Roads and Rural Infrastructure in the development of a tricycle for use in the rural areas should be widened to include the development of the multipurpose transport equipment. The experience gained from the tricycle indicates that a 250 to 350 cc two stroke petrol engine capable of developing 15 to 20 kW will be adequate for the multipurpose transport device. In order to facilitate the evolution, use of existing standard components and sub assemblies like gearboxes, differential units and clutches from the motor cycles, dumpers and similar vehicles should be considered. The search for this multipurpose vehicle should benefit from experiences of similar vehicles such as the small four-wheel tractor manufactured in Thailand, the IRRI three wheel motorized cart, small four wheel tractor developed by IRRI-PAK programme, the Tinkabi tractor manufactured in Swaziland and the Eicher tractor manufactured in Haryana, India.

In order to complement the multipurpose transport vehicle, there will be a need to develop a set of matching soil working, seed planting, fertilizer spreading and similar equipment. The second group of equipment which are mainly post harvest machinery has enjoyed some attention within the country. A number of local designs are available for threshers, shellers, decorticators, mills, pulpers and hullers. The designs need to be expanded to include crop destoners particularly rice destoners as well as water handling equipment like irrigation pumps. The third group of equipment which has not attracted enough attention consists of manual or motorized crop maintenance equipment like dusting equipment, sprayers and spreaders for insect and weed control.

National Centre for Agricultural Mechanization - The National Centre for Agricultural Mechanization as an engineering research centre in agriculture should be resuscitated by:

- (i) enacting the enabling decree to make the centre function
- (ii) providing adequate funding so that the centre can acquire equipment and facilities for workshops, laboratories and field research, as well as staff
- (iii) providing adequate infrastructural facilities on the site.

Creation of a data bank of manufacturing plans - Among the major problems which small scale manufacturers face are lack of in-house capacity and capability for producing technical drawings and technical specifications for machines to be manufactured, lack of financial capacity to engage the services of consultants to produce such drawings and in general lack of access to such information. It is helpful therefore to have a national bank of designs and drawings and technical specifications for a set of equipment needed by the farmer. In order to achieve this objective, the following suggestions are recommended for consideration:

- (i) Establishment of the quantity of equipment requirements of farmers for the various agricultural operations.
- (ii) Documentation of agricultural machines developed by the various research institutes, universities and polytechnics.
- (iii) Preparation of design drawings and technical specifications for all types of equipment required by the farmer.
- (iv) Dissemination of the drawings and specifications among indigenous machine manufacturers.

It is noteworthy to give briefly the experience of the Directorate of Food, Roads and Rural Infrastructures in this area. The Directorate at inception was faced with the problem of promoting indigenous manufacture of equipment for the nation's rural development programme. It was noted that the manufacturers do not have drawings of such equipment and that they lack technical and financial capability and capacity for producing the drawings. The Directorate decided to undertake production of such drawings and the

guidelines for manufacturing of the machines from the drawings. Prototypes of the machines are produced to prove and debug the drawings which are then given to manufacturers to use. Some of these drawings are done in-house while others are done with the help of consultants. The experience so far indicates that this is a very useful experiment as: the in-house ability to produce design drawings for the machines improved continuously with time; the consultants have also benefited considerably from the designs; the manufacturers find the design drawings and technical specifications very useful and cost saving.

The National Office of Industrial Property working in close collaboration with the Standards Organization of Nigeria, the National Centre for Agricultural Mechanization, African Regional Centre for Engineering Design and Manufacture, the Universities and the Polytechnics could coordinate and keep the data bank. It could release periodic newsletters on the information available in the data bank and circulate this information to small scale manufacturers who could then select and request whatever they want for free or for a fee.

Encouragement of local manufacture of agricultural machinery - The Structural Adjustment Programme has created a favourable environment for local manufacturing of equipment. The establishment of the National Economic Reconstruction Fund is designed to stimulate manufacturing capability and therefore create a more favourable environment for the manufacture of engineering products. However attention still needs to be given to some factors which tend to negate the favourable environment.

These include:

- (i) high interest rates which has made borrowing for investment in manufacturing activities quite difficult.
- (ii) difficulties experienced by small scale manufacturers in obtaining loans for working capital from the banks.
- (iii) high cost of manufacturing plant and machinery which have to be imported because the Machine Tool Industry in Nigeria is still in its infancy.
- (iv) difficulties in getting the design data and manufacturing details, and
- (v) difficulties in getting special steels and other raw materials locally for manufacturing, because the existing steel companies do not produce special steels.

In order to further improve the conditions for promoting local

manufacture of agricultural equipment, there is a need for setting up facilities for producing special steels in the country and for developing more industrial centres in different parts of the country. The plan to have industrial estates served with basic infrastructure at every local government headquarters must be pursued more vigorously. In addition, information or data bank on the quantity and types of machines required for ensuring adequate level of mechanization must be established. This will help direct the attention of manufacturers to the essential machines. The usefulness of this information will be enhanced if there is an inventory of existing equipment in use in the country. The National Centre for Agricultural Mechanization or the bank for manufacturing plans suggested above if properly staffed and financed should be in a position to undertake these assignments.

Industrial Extension Services & Basic Industries

The role of the Standard Organization of Nigeria, in these early stages of industrialization should be more of promotion and encouragement of manufacturers as against attainment of higher level of quality in their production. The document entitled "Report on Nigeria Audit of Indigenous and Emerging Technologies/Machinery for Processing Agricultural Raw Materials into Industrial Input Volumes I and II" published recently by the Raw Materials Research and Development Council contains information on agricultural processing equipment for manufacturers is helpful in locating sources from which such equipment can be obtained locally. The coverage of subsequent editions of this document should be expanded to cover the whole spectrum of agricultural machines. In addition the document should be updated regularly perhaps bi-annually. Each state is expected to have an Industrial Development Centre. These centres are expected to provide industrial extension services in the states. Experience to date shows that the centres are ill equipped, poorly staffed and underdeveloped for this purpose. It is therefore important to have adequate funding and programmes for industrial extension and liaison services for small scale industries in agricultural machinery manufacture and agricultural products processing. The manufacture of agricultural machine and equipment employs the same process, tools and production equipment as for the whole of metal working industry. Agricultural machines manufacture could therefore generate the driving force in stimulating manufacturing activities which the motor vehicle assembly industries may have failed to achieve. If the momentum is maintained and there is vertical integration between the small scale manufacturers and the medium and large scale manufacturers, then an industrial base can be built up.

Need to Standardize Equipment & Machinery Imported

During the oil boom years, there was a great proliferation of the types of tractors and agricultural equipment imported into Nigeria. For example, in 1976, ninety five percent of the tractors were of medium size (about 37 kW) and 2 percent were high (75 to 104 kW). In that same year, about 10 companies

were involved in the distribution of different types of tractors like Ford, David Brown, Steyr, John Deere, Fiat, Massey Ferguson and Deutz. The estimated importation that year was about 2000 tractors. The total tractor stock in Nigeria by that year was estimated at 19,000 units. Thus, with such a small population of tractors, a high diversity in the types and the large number of distributors, it is not surprising that dealers do not stock enough spare parts necessary to keep the tractor in operating conditions. The establishment later on of the two tractor assembly plants was aimed at correcting this problem. Other types of agricultural machines like the combine threshers etc. which have been imported in smaller quantities also showed almost as much variety as the tractors, in the types and sizes that were imported. The problems resulting from such low volumes of sales are poor after-sales service and inadequate supply of spare parts. State governments in order to tackle these after sales problems decided to purchase up to 10 percent of fast moving parts along with new machines. The success of this policy depended on the good judgement and ability of the maintenance engineer to stock the right and proper parts. This also tied down a lot of the operating funds of the Ministries. State Governments also set up mobile workshops to help farmers repair their machines. The encouragement given to dealers to allocate 15 percent of initial cost of machine order to the supply of spares did not yield the expected results because dealers did not cooperate and did not stock spare parts at the level suggested. There is need to examine this issue further. It is important for the government to standardize the tractor fleet to two or three makes and then assist in the establishment of the right dealership for these makes and spares. Nigeria government should decide on this and ensure that either by decree or legislation that the tractor and other expensive agricultural implements are standardized to two or three makes. Care should be taken to avoid creating a monopoly from one or two countries.

Improving Performance of Tractor Hire Units

There is need also to look into ways and means of improving the performance of the tractor hire units be they Government owned and managed or privately owned. Experience with these tractor hire units (THU) so far has been either disappointing in so far as their profitability is concerned. Given the large numbers of smallholder farmers who require services from these units, it is important that we develop better ways of managing them. In the early years, some of THU had begun to show some profits in particular the private ones. What is important in our opinion is to manage such units in a commercial manner, without interference from the political and civil service system. Experience shows that they can be successful if they are managed commercially, supported in training of their operators and are allowed to charge commercial rates for their services. This is an area where the research systems need to come up with better management systems for such THU's.

CONCLUSION

In this paper, we have reviewed agricultural mechanization policies in Nigeria over the past 3 decades. Mechanization wise, Nigeria's agriculture has a dual system with majority of farmers in the south of the country relying on the handtool technology and the farmers in the north relying on a combination of handtool and animal powered technologies. There have been several attempts at introducing mechanically powered technologies in both parts, but so far the situation has not changed much. The formulation of agricultural mechanization policy and working out of an implementation strategy has, by and large, been done in an ad hoc manner without clear objectives both short and long term. It is however the desire of everybody from politicians, military leaders, academics and the common man himself, that the small holder farmer should be liberated from the drudgery of the handtool technology. With the oil boom of 1974-75 there was a massive increase in the tractor stock in the country from less than 1000 tractors by 1971/72, to over 7500 tractors by 1974/75 (FAO, 1972, 1982). However success with mechanically powered mechanization has been elusive.

With a population which is currently over 100 million, and with about 30% of this in urban areas, and this population is expected to increase to about 157 million by 2000 AD with a similar proportion in urban areas, the demand for food and other agricultural products is going to increase quite significantly over the next decade. In the past the oil boom allowed Nigeria to meet its food deficit through importation, but now with the Structural Adjustment Programmes, this is not possible. The food has to be produced locally. There is no way that this food can be produced without increased levels of mechanization of Nigeria's agriculture. Increased population will also put more pressure on the agricultural system, and the slash and burn agriculture practised in the humid south cannot environmentally be sustained. Better ways of clearing land, which are environmentally safe will have to be developed. All this requires increased utilization of agricultural mechanization inputs. It is imperative therefore for the country to formulate better agricultural mechanization policies with clear short, medium and long term objectives. The formulation of such policies will have to be coupled with drawing up of implementation strategies and in all this, the aim should be not only to reduce drudgery to the farmers but also ensure the sustainability of the agricultural resource base i.e. land as well as increasing agricultural production and productivity.