

CHAPTER 9

AGRICULTURAL MECHANIZATION POLICIES AND STRATEGIES IN TANZANIA

by

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INTRODUCTION

Tanzania is located on the eastern coast of Africa between latitudes 2°S to 12°S. Total land area is about 88.6 million hectares with potential agricultural land area being about 45 million hectares (Table 28). Rainfall varies from 600 mm in the central and mid-west of the country to 2000 mm in the South-West and parts of the North-West and East. In some parts of the country the rainfall pattern is bimodal (in particular in the East and North-East) and in others it is unimodal (in the south and west of the country). The population is estimated at 24.7 million by 1990, and growing at the rate of 3.2% per annum. The livestock population is estimated at about 12 million cattle, 1 million donkeys and 3 million sheep and goats. The livestock is concentrated in the central and northern regions of the country (Dodoma, Singida, Shinyanga, Mara, Mwanza, Arusha). Over two thirds of the country (and in many cases the more fertile areas) is tsetse infested and it is difficult to keep livestock in such areas. There are many river basins and it is estimated that the annual discharge into the Indian ocean is in the region of 74 billion cubic metres. The per capita GDP is estimated at US\$200.00 (1986). The country has been facing severe economic crisis in the last decade due to a multiplicity of reasons - drought, wars, falling commodity prices, rising fuel prices, etc. However over the past 3 years the economy has begun to pick again registering a real annual growth of GDP of about 4.7% (GOT (1988)) (Table 28).

The demographic pattern shows disturbing trends. About 49% of the population of Tanzania is in the dependent age groups (i.e. children under 15 years, and old people over 65 years) and 51% constitute the economically active groups of the population (Table 29). Thus the economically active group is expected to not only produce enough food to feed themselves but also for the numerically increasing dependent groups. Further the ratio of the urban dwellers is increasing at a much faster rate than the overall increment of the population (Table 29). The urban population is expected to increase to about 35% of the total population of Tanzania by the year 2010 AD. The implication of this is that by 2010 AD, for Tanzania, the population of urban dwellers will

be more than her total population in 1970. This means therefore that the rural population (with only 54% of them being economically active) will be expected to produce enough food to feed not only themselves but also an ever increasing urban population. A more disturbing trend, is that the migration to the urban areas is mostly by the younger ones (less than 25 years) and the average age of rural population is progressively increasing (Rashidi (1980)). This will have serious implications on the food and overall agricultural production, if the current levels of mechanization are maintained.

STRUCTURE OF THE AGRICULTURAL SECTOR

The most striking feature of the agricultural sector in Tanzania is its diversity in terms of farm sizes and enterprises. The sector can be broadly divided into 4 groups of farmers. The first group are the Peasant Subsistence Farmers (PSF) who produce primarily for subsistence (mostly food crops) - relying only on their own labour and that of their families, using mostly handtools with their technical methods being traditional (i.e. they use their own seeds and do not use any purchased inputs such as fertilizers and crop protection chemicals). Their yields are low, of the order of a few hundred kilogrammes per hectare and enough only to meet the subsistence requirements of the family. The average size of farm holdings for this group of farmers is less than 2 ha. They cultivate about 60% of the arable land cultivated in Tanzania and constitute together with their families about 70% of the population. (GoT (1986)).

The second group are the Small Scale Farmers (SSF) who produce food crops for subsistence and cash crops for the market. In high potential areas, such farmers may cultivate less than 1 hectare (e.g. slopes of mount Kilimanjaro, Meru, and Southern Highlands in Tanzania) whereas in the low potential areas they may cultivate areas from 5 to 10 hectares (central & western Tanzania). They in many cases and for most field operations depend on their own labour and that of their families and sometimes this is supplemented by draught animals where these are available (Tabora, Mwanza, Singida, Arusha, Shinyanga; Mara regions). In other areas they are able to hire tractors to plough their land if these are available. In Tanzania this group of farmers cultivate about 25% of the arable cultivated land and constitute about 20-25% of the rural population. This group of farmers is responsible for production of a significant proportion of the cash crops which are exported (coffee 60%; cotton 95%; tea 30%; tobacco 40%; pyrethrum 60%; cashew 80%) and also a reasonable proportion of the marketed surplus grain which is used to feed the urban population.

The third group are the Middle Scale Farmers (MSF) who produce cash and food crops for export and internal market. In many cases they tend to be local merchants, Government officials and other nonfarm people who have savings and decide to invest in agriculture or some of the Small Scale Farmers who have expanded their scale of operation to become Middle Scale Farmers. Their land holdings vary from 5-50 hectares depending on the location, (high

potential areas 5 hectares, low potential areas 50 hectares or above). They use both divisible (seeds, fertilizers, pesticides, etc.) and indivisible technologies (machinery, etc.) and they employ labour for their field operations. They normally can obtain credit from the credit institutions and in high potential areas of Tanzania they are full time farmers. They are also the ones who are able to own draught animals, or tractors and these may be hired to do contract ploughing for the Small Scale Farmers. In the 1960s this group of farmers was quite active, in particular in the high potential areas, but due to the socialist policies followed during the 1970s many of them abandoned farming or reduced their scale of operation to the level of small scale farmers. However since 1980, this group has increased quite significantly due to a change of policy by the Government.

The fourth and last group are the Large Scale Farms (LSF). These are in most cases large scale capital intensive enterprises owned by the farmer himself or large Trans National Corporations or the State. Their size varies from 50 hectares (in high potential areas) and may be as large as 10,000 hectares. They grow cash crops for export (coffee, tea, tobacco, wattle, beef) or food crops for the internal and/or urban market (wheat, rice, barley, sugar, maize, beans, etc.). Some are owned by the state, (NAFCO, TSC, and SUDECO farms) and other by private companies, (e.g. Tea, Coffee, Sisal, and Dairy Farms). They form an important part of the agricultural sector and are crucial to the economy of Tanzania (they produce about 100% of sisal, 80% of wheat, 60% of rice, 80% of sugar, 70% of tea, 60% of tobacco, 40% of coffee). It is estimated that these farmers cultivate about 500,000 hectares (10% of cultivated land) Yields on these large farms tend to be 90-100% more than SSF (ODI, 1989).

The above structure of the agricultural sector in Tanzania has remained the same over the past 3 decades with the exception of a few years when the MSF's were seriously disrupted. It is these farmers who are expected to produce enough food to feed the ever increasing population (expected to double in the next 25 years) and cash crops which are exported to earn foreign currency for purchasing the necessary inputs required not only by the agricultural sector but by the other sectors. Tanzania, has been forced in some years to import upto 20% of her cereal grain requirements due to drought. There is however still plenty of uncultivated land (and in many cases quite fertile) and she should be able to feed her increasing population by both intensification and expansion of the area under cultivation. Increased levels of mechanization will be required if this is to happen.

To summarize, therefore, the agricultural sector, in Tanzania, faces five major challenges in the next two decades:- (i) the production and productivity by all four groups of farmers (PSF, SSF, MSF, LSF) must increase to provide food for the increasing population and cash crops for export. (ii) in order to achieve an increase in production and productivity there must be a faster technological change in agricultural practices. This means modern farming

TABLE 28: Agricultural Statistics in Tanzania

1. Total Area x 10 ³ ha.	94,509
2. Total Land Area x 10 ³ ha.	88,604
3. Potential Agricultural Area x 10 ³ ha.	45,030
4. Cultivated Area x 10 ³ ha. (including ranches)	5,030
5. Forests, Pastures, and others x 10 ³ ha.	43,574
6. Cultivated Land under	
(a) Large Scale farms x 10 ³ ha. (% of cultivated area)	560(11)
(b) Small scale/peasant farms x 10 ³ ha. (% of cult.area)	4,470(89)
7. Irrigated Land Area x 10 ³ ha.	140
8. % of Total Agric. Area Cultivated	11%
9. % of Cultivated Area Irrigated	2.1%
10. Methods of Land Preparation	
(a) Handtool Technology % Cultivated Area	80%
(b) Animal Draught Power % Cultivated Area	14%
(c) Mechanical Power (tractor) % Cultivated Area	6%
11. % Agriculture to GDP	65%
12. % Agriculture to Exports	75%
13. Per Capita GDP (1987) US\$	200
14. % Food Imports to total consumed (average)	10%
15. Principal Export Crops	Coffee, Cotton, Sisal,Tea Tobacco, Cashew, Diamonds

SOURCE: IBRD (1987), SADCC (1988), FAO (1986), GoT (1988)

inputs must be supplied and judiciously used in the agricultural fields. (iii) whatever is produced must be transported, processed, and marketed/exported to the consumer/outside markets with minimum waste. (iv) all the above three must be done in a way which ensures that the agricultural resource base (i.e. land) can continue to produce on a sustainable basis i.e. there must not be environmental degradation. (v) to design and implement with persistence policies that will generate the resources required to revitalize the agricultural sector and enable it to meet the above four challenges, and for Tanzania for the next decade, in circumstances of severe economic austerity. Agricultural mechanization will play a crucial role, in enabling the agricultural sector to meet its challenges.

TABLE 29: **Rural/Urban Population in Tanzania**
(ALL figures x10³)

Year	Total Population	Urban Popu.	% of Tot.	Rural Popul.	% of Tot.
1960	10201	491	5%	9709	95%
1970	13300	922	7%	12378	93%
1980	17934	2117	12%	15817	88%
1990	24774	4495	18%	20279	82%
2000	34031	8502	25%	25529	75%
2010	45363	14717	35%	30646	65%

Growth rate 1970-1990 - 3.2%

Urban population Growth rate - 7.5%

EVOLUTION OF AGRICULTURAL MECHANIZATION 1920-1990

Period before Independence 1920-1961

As shown in Table 28 - only about 5.3 million hectares of about 45 million potential arable land in Tanzania is cultivated. Even the remaining 43 million hectares of land area, which is classified as not suitable for arable production receives reliable rainfall, compared to semi arid countries like Botswana and Namibia. It is only in a few areas of the country where there is land shortage. This factor of perceived abundance of fertile land has significantly influenced mechanization policies right from the beginning of this century when the Germans were ruling Tanganyika. The Germans acquired Tanganyika after the

Berlin Conference of 1884 and British got the Zanzibar islands. Tanganyika then called German East Africa included the area now occupied by Rwanda and Burundi (the later two countries were given to Belgians to administer after the 1st World War in 1918 and Tanganyika became a League of Nations Trust Territory under British rule). As with all other colonial powers then, they regarded Tanganyika as an important source of raw materials. The Germans used a dual structure to ensure agricultural production from their colony - large estates were established for crops such as sisal, coffee and tea, and these were farmed by German settlers with partially forced labour, and they encouraged the 'natives' to grow crops such as cotton through indirect coercive methods as imposition of poll tax, hut tax, and sometimes direct coercion. The land acquisition by the German settlers did not create a conflict with the natives as there was still plenty of land. The shortage was of labour, which forced the Germans at times to use coercive methods to get it.

At the end of first world war the British took over Tanganyika and allowed the German settlers to remain and also encouraged British and Asian businessmen and farmers to take up farming in the country. There was not however a large influx of settlers as in Kenya, partially because of the League of Nations mandate (Austen (1968); Ruthenberg (1964); Illife (1971)). Native farmers were also encouraged to grow cash crops - Chaggas and Merus on the slopes of Mt. Kilimanjaro and Meru, Hayas in the West Lake region, Sukumas and Nyamwezi's - north western zone (Mwanza - Shinyanga) and Nyakyusa's in the Southern Highlands (Mbeya). The level of mechanization, was by combined handtool and draught animals on the settler farms; and predominantly handtool on the native farms. The Sukumas however adopted draught animal power during the 1930's. Although the Sukumas occupied a large area South of Lake Victoria (Mwanza, Shinyanga, Taboya regions) a large stretch of this land was uninhabited in the 1920s and 1930s because of tsetse flies. The Sukuma people have traditionally kept large herds of cattle. In the 1920s and 30s the British decided to launch major anti-tsetse fly campaigns (by clearing the trees) and introduced some rudimentary veterinary services. These anti-tsetse fly campaigns were positive, and the Sukumas moved with their cattle to these new areas. Although there were also campaigns to reduce stocking levels, this met with immediate resistance from the Sukumas from a cultural point of view. The Sukumas also at this time adopted draught animal power (DAP) technology and cotton production from small scale farmers increased quite significantly in the 1930s and 1940s. Although cotton cultivation and DAP technology was adopted and is still being used today, this has been done at a great environmental cost - for the two regions Mwanza, Shinyanga, are now almost semi deserts due to the clearing done in the 1930's and 40's (McCall (1974); Ford (1971)).

After the second World War, the British, in order to solve the food-oil shortage in post war Britain, initiated the largest mechanized agriculture scheme undertaken in Africa by then through the Groundnut scheme. Large areas of central and southern Tanzania (Kongwa, Urambo and Nachingwea)

were cleared in 1946-1950, to establish large scale mechanized groundnut production. The plan was to grow groundnuts on large scale farms totalling one million acres. A huge number of tractors were imported - some of them battle tanks rudimentarily converted to crawler tractors to clear the land and start production of groundnuts. This scheme failed after 5 years of trial-due to a number of reasons - lack of proper planning, soil compaction due to the heavy equipment used, poor land planning and soil analysis and poor managerial skills. (Wood (1950); Burch (1987)). The tractors imported were sold to local settler farmers and a few were bought by African merchants, who started partially mechanized agriculture in other areas (Ismani, Geita, Arusha - Moshi areas, Urambo, etc.). When the groundnut scheme was abandoned in 1950 - the situation reverted to what had existed before. The groundnut scheme was however the biggest ever mechanized agriculture project tried in Tropical Africa and that it failed despite the massive British Government financial and technical support indicates the complexities of agricultural mechanization in Tropical Africa. It is a pity that this project, despite being on a much larger scale mechanization wise than any other project which has been attempted by the independent African Governments has not received that much research attention in comparison to those started after independence.

Period after Independence (1961-1990)

On the advent of independence in 1961, a World Bank Mission was commissioned in 1959, and was assigned the task of looking into Tanganyika's economic future. The mission submitted its report in 1960 (IBRD 1960) and recommended more intensive use of the land resources of the country on a more sustainable basis. The mission noted that other than a few pockets where small holder farmers had intensified their agriculture and were producing for the market (Kilimanjaro, West Lake and Southern Highlands) the majority of the other tribes lived in scattered hamlets and practising shifting cultivation in the areas which were more fertile. The mission concluded that it would be impossible to intensify agriculture in such areas and thus it would be quite difficult to improve such farming systems. The mission therefore recommended:

" something more is required whether through intensive campaigns in settled areas, involving a variety of coordinated measures, or through planned and supervised settlement of areas which are at present uninhabited or thinly inhabited. Infact, the Mission judges that the second of these approaches is in general the more promising in the present conditions of Tanganyika."
IBRD (1960)

The World Bank mission therefore recommended transforming the traditional agriculture rather than improving it. The final decision on the World Bank report was left to the Government of independent Tanganyika which duly accepted all the main recommendations of the mission in 1962 and implementation started almost immediately.

With the assistance of various donors, including the World Bank, some 40 settlements were established in various parts of the country with settlers being recruited from the areas of land shortage, urban unemployed and peasants from areas neighbouring the new settlement. The settlements were highly mechanized, with the land being opened up by crawler tractors and initial land preparation being done by tractors. There were settlement managers mostly ex-colonial British agricultural officers who were supposed to manage the settlements and the production process. An example of the over mechanization (Kates et al 1969) was Upper Kiteto Village in Mbulu district - Arusha region where 100 settlers were growing maize on 1600 acres of land with 10 tractors 2 combine harvesters and other assorted implements. Neighbouring private farmers had much less machinery and implements and employed much less labour. However there was euphoria on these settlements, the government was quite keen on their success, donors, some with idealistic views, were ready to help in transforming the type of agriculture (Ingle (1972)). Although over 60% of Government investment in these settlements was in the form of agricultural machinery and implements as well as vehicles and other equipment, there were hardly any agricultural mechanics or engineers employed. The managers themselves were expatriate general agriculturalists and in some cases economists, sociologists, anthropologists and political scientists were employed as settlements managers. This issue of manpower was crucial to the success of these settlements.

There were also a number of other mechanization schemes started during this period (1961-66). An interesting example in this regard, was the pool of 159 tractors bought on credit by the Government in 1963 and handed over to the Victoria Federation of Cooperative Union (VFCU) to hire out to farmers under the Sukumaland Cotton Block Scheme. Under the scheme blocks of 121-202 ha of land were to be cultivated by tractors and individual plots of 1.62 ha were to be allocated to farmers for cotton production. Each tractor was theoretically supposed to cultivate 121.5 hectares per annum. The tractors were serviced and managed at a Central Workshop owned by VFCU. There were a lot of problems, in particular in keeping these tractors operational (mostly technical) and each tractor by 1964/65 managed to cultivate only about 27 ha. Although this scheme continued to operate upto 1968/9, and additional tractors were bought, it had to be abandoned by then and the tractors were sold to progressive farmers and tractor drivers who continued to provide private tractor hire services not only to other farmers in the region, but also to other areas in East Africa (TSAE 1972: Migot Adhola 1969). Other initiatives in mechanization were undertaken by the Tanganyika Farmers Association - a private association of progressive farmers which provided credit facilities for purchase of tractors and had a fleet of combine harvesters for hire by the large scale wheat/maize farmers.

By 1965, it became apparent both to the Government and donors that the village settlement schemes were a failure, and the World Bank attributed the major reason for this failure to the premature mechanization (de Wilde

1967) despite having advised on their establishment earlier on (IBRD 1960). Given the type of investment and the technical skills available (both local and the donor supported technical experts) it is not surprising that these schemes failed. The schemes had been quite expensive and had utilized a significant proportion of Government money, and their production was quite small. It was then realized within Government circles that, if the vast majority of Tanzanians living in scattered hamlets all over the country were to develop then a less capital intensive modality of bringing them together had to be devised than what had hitherto been adopted in the village settlement schemes. The country could not afford the level of mechanization which had been adopted in these schemes. Secondly the manpower available in the country then could not maintain the expensive technology used. It was then that the ruling Party adopted the proposals put forward by the President Nyerere through his essay *Socialism and Rural Development* (Nyerere 1967).

The new policy aimed at bringing the rural peasants, majority of whom were living in scattered homesteads, into communal villages. The new rural development strategy had eight objectives: (i) establishment of self-governing communities (ii) better use of rural labour (iii) taking advantages of economies of scale (iv) easier way of dissemination of information and provision of services (v) avoidance of exploitation (vi) increasing standard of living of the people (vii) facilitation of national planning (viii) facilitation of national defence (Maeda 1976). The Ujamaa villages policy was part of a national policy as enunciated in the Arusha Declaration on socialism and self reliance. The idea of bringing the rural dwellers together, most of who lived in scattered hamlets had been tried before by the German and the British Colonial authorities and on advice of the World Bank by the Tanganyika government under the village settlements agency in 1961/65. Whilst Germans had tried to do this through coercion, the British had tried and used various methods and in independent Tanganyika this was done through provision of higher levels of mechanization (1961-67). Under the Ujamaa villages policy, it was hoped that through political persuasion the peasants will be mobilised and start the villages at their own level of technological development. As production increased they will then be able to purchase tractors and other modern implements and inputs rather than being provided these initially as had been done in the village settlement schemes between 1961 and 1965.

There was no clear policy on mechanization during this period of Ujamaa transformation (1967-1973). Some villages were provided with tractors, others were encouraged to use animal powered mechanization and most continued to use the handtool technology. Some regional authorities bought tractors through the Regional Development Funds (RDF) which were to be hired out to Ujamaa villages and individual farmers. These tractors were controlled from the regional office and had to travel long distances to reach the villages and farms. The programme was quite uneconomical to run and the regional authorities sometimes used promise of provision of mechanization inputs as a means of attracting peasants to settle in Ujamaa villages. It was

also during this period that Rene Dumont visited Tanzania and propounded the ideas he had first raised in his book - *False Start in Africa*. In 1972, the ruling party's National Executive Committee (NEC) meeting in Iringa issued a major policy document on agriculture. This document - called the Iringa Declaration, advocated for increased utilization of modern inputs - fertilizers, crop protection chemicals and better crop husbandry. On mechanization, the document placed more emphasis on utilization of draught animal power for cultivation and its introduction in areas where it was not being utilized. Thus a number of oxenization centres were established all over the country even in areas which were tsetse infested and the people had no animal husbandry tradition. (It should be realized that about 2/3 of Tanzania is tsetse infested - in particular the more fertile southern part of the country). The Ubungo Farm Implements (UFI) factory which had been constructed in Dar-es-Salaam to manufacture farm implements was directed to increase its production of oxen drawn implements.

Although much money was spent in establishing oxenization centres all over the country, it would seem however this had little impact especially in the tsetse infested areas. In some areas such as Mwanza region the percentage of land ploughed by tractors actually increased (TSAE, 1972, 1973, 1974). This was not through Government efforts but more through private initiatives. As we mentioned earlier, the tractors which had been used in the Sukumaland Cotton Block Scheme were in 1968/69 sold to progressive farmers and in some cases tractor drivers. Many of these farmers and drivers developed, over the next eight years, one of the most efficient tractor hire scheme in Africa. They used to plough the land for the farmers in Mwanza/Shinyanga area around August/September/October, thereafter drive across Tanzania to Arusha/Kilimanjaro area where they ploughed in October - December and then drive across the border into Kenya where they used to plough around the Machakos/Taita area in January/February and from there they drove across to Western Kenya (Kakamega, Nyanza Province and Rift Valley areas) where they ploughed in March/April/May and drive back into Tanzania through Musoma around May/June to start the cycle again in August/September in Mwanza area. It was not uncommon between 1969 to 1975 to meet a fleet of 30-40 tractors driving across Tanzania on the Mwanza/Arusha road. They maintained close contacts with the farmers they ploughed for, and I recall between 1970-72 one such driver used to come every October to plough my father's maize fields in Arusha.

At that time, Kenya and Tanzania together with Uganda were under the East Africa Community and there was virtually free movement of people between the 3 countries. It thus made it possible for these tractor drivers from Mwanza area to be able to cross the border to follow the work in accordance with the season. After 1974/75 season however political tensions developed within the East Africa Community and the free movement of people across the border became quite difficult without passports, which the drivers could not be bothered to obtain. After 1976 it became impossible to cross the border as

the East Africa Community collapsed in January 1977 and the border between Tanzania & Kenya was closed until 1983 when it was reopened. The closure of the border and collapse of the community broke their cycle through Kenya and it became unprofitable for them to move from Mwanza area to Kilimanjaro. Unfortunately, there has been no comprehensive study of this venture which may be called tractor taxis. However reports given at the Tanzania Agricultural Engineers Society Conferences indicated that these drivers were able to achieve over 2000 tractor hours per annum and most of them were able to plough 800-1200 acres per annum (TSAE 1972,73,74). These tractors provided a crucial service to many small scale farmers in the areas they transversed at an affordable cost and as it was noted by Alcober et.al. (1983) in a survey of small scale farmers in the Mwala/Mbiuni/Makueni area of Machakos district in Kenya. Many small farmers reported in June 1983 that the last time they had their land deep ploughed to break the hard pan was in the early 1970's when the Tanzania tractor drivers used to come to plough for them in January-March of each year. (Alcober et.al. (1983))

In 1974/75 the Government decided to seek UNDP/FAO assistance to develop an agricultural mechanization policy. A senior agricultural engineer was hired for a period of 2 years under the auspices of FAO and was required to assist the Ministry of Agriculture in policy formulation; programming and project implementation in the field of agricultural mechanization (Project No. URT/75/018/01/12). An associate expert was hired to assist the expert, and a number of short term consultants were also hired to undertake studies on different aspects of mechanization in the different agro-ecological zones (Dagg 1978, Beeny 1975, Fear 1976). Numerous internal reports were produced between 1975-79, and in 1980, through the FAO expert, the Ministry of Agriculture, presented the results of this project in the form of an agricultural mechanization policy to the Tanzania Society of Agricultural Engineers (TSAE) Conference held in Tanga in March 1980. The policy emphasized animal powered cultivation, with recommendations to open several ox-training centres; use of what is called improved "handtool" and it recommended that tractor powered mechanization should only be introduced in justifiable areas (Dagg 1980). Although the policy was presented as a Ministry of Agriculture Mechanization Policy it was apparent to the participants in this conference that this was a result of the UNDP/FAO study and what was being presented was what had already been tried in several regions since 1967 and there was nothing much to show of these past efforts. There was a heated debate in particular from the national agricultural engineers attending this conference, and the FAO expert could not answer many of the criticisms levelled at the policy presented.

It is not clear what happened to the 'policy' after the 1980 TSAE conference in Ministry circles; however, it appears it was quietly forgotten, the expert left the country on completion of his contract and as it is often with many of these projects, no policy was adopted.

TABLE 30: Tractors in use in Tanzania

1950	2057
1955	2550
1960	2580
1965	3500
1970	6500
1975	9000
1980	15500
1985	18533

FAO Production Yearbooks: Vol. 13, 24, 29, 36, 42;
TSAE (1981)

* Tractors - include both crawler & four wheel tractors but excludes 2 wheel tractors.

Things were however happening on the mechanization front. The Ministry of Industries, had reached an agreement with Finnish Company Valmet, to start assembling Valmet tractors in Tanzania in 1978. By 1981 the company had established jointly with the Tanzania Government, a company to start assembling the tractors from semi knocked down (SKD) components with about 15% local content. The local company TRAMA started assembling the tractors in 1981 and was given monopoly on tractor imports and manufacturing. Valmet had experience with tropical mechanization before, having established itself in Brazil in the 1960s and where it controlled about 40% of the market. They were however new to Africa and initially their tractors were unpopular due to a number of problems - lack of good dealers all over the country, unfamiliarity to tractors drivers and mechanics with the new tractors, etc. However they established a training centre for mechanics and tractor operators and made some modifications to their designs to suit local conditions. They have since 1981 been assembling 300-500 tractors per year.

Also in 1981 the Government decided to transfer TAMTU (Tanzania Agricultural Machinery Testing Unit) from the Ministry of Agriculture and merged it with the Arusha Appropriate Technology Project (AATP) to form a new parastatal called CAMARTEC (Centre for Agricultural Mechanization and Rural Technology). TAMTU had existed since 1957, and was responsible for testing agricultural machinery. However in the 1970s it got involved in research and development activities (mostly in the intermediate technology

field) and started some manufacturing activities - oxcarts and a few ox-drawn implements, inter row cultivators, ox ploughs, etc. Initially it got some technical assistance from ILO and a number of other agencies. However by mid 1970's it was understaffed and nationally many people were questioning the utility of its test reports and its research and development efforts. Some of the implements TAMTU developed received much wider attention, for example, a senior official of the World Bank reported that "TAMTU has developed an inter row weeder at a cost of US\$7 to 15. This instrument can result in a two thirds to three quarters reduction in weeding time". (Lele (1975)). The reality however was far from this claim. AATP had been established in 1977 - through SIDA assistance by the Small Industries Development Organization (SIDO) a parastatal under the Ministry of Industries. Its specific objective was to develop appropriate technologies for the rural areas - biogas, charcoal stoves, solar cookers and driers, windmills, etc. Its research effort was then mostly directed at developing energy saving devices. It had some outreach programmes in some villages but it would seem many of these were working because of the donor support, once this was stopped in the 1980s its projects in the villages collapsed. Nevertheless AATP had quite good PR, in particular to the international experts attending conferences at the Arusha International Conference Centre.

Although the decision to move TAMTU to the Ministry of Industries was a Government decision, some officials in the Ministry of Agriculture were not very happy with this decision (TSAE 1983). They felt, maybe rightly, that putting both the manufacturing and testing of agricultural machinery under one ministry may not be to the best interests of the farmers. Ministry of Agriculture, in addition, was not very happy with the monopoly given to TRAMA Valmet to import/assemble only Valmet tractors. They were thus able to convince the Government to rescind this decision, and in 1984, through a credit line from Italy and in a project implemented by FAO, 200 Fiat tractors were imported for Morogoro region. It was intended to import another 200 tractors for Mbeya region. Fiat through its local company INCAR (Tanzania) had been active in the country in 1950s and early 1960s. However its share of the market by 1973 was insignificant (Dagg 1978). In 1985 following the trade liberalization policy, the other companies - which had not been active in the country from 1978, were allowed to open up (Massey Ferguson, Ford, International Harvester, John Deere) and to import their tractors. Thus the monopoly given to TRAMA - Valmet ended. However TRAMA - Valmet has continued to assemble its tractors in a more competitive market. Also the Mbeya Farm Implements Factory started production in 1982 - but was plagued by a number of teething technical problems. The Ubungo Farm Implements Factory, on the other hand had its management overhauled in 1983, and appears to be doing quite well now in particular in manufacturing of handtools and some animal drawn implements.

There was not much activity in the policy direction between 1982-87. TRAMA-Valmet was assembling tractors internally, the other companies were

allowed to import tractors, and individuals and villages were purchasing these tractors and implements, through loans made available by Cooperative and Rural Development Bank. In 1987 the ruling Party issued a major policy statement on developments in the country for the next fifteen years 1987-2002 (CCM, 1988). This policy statement was important in two ways in so far as agricultural mechanization was concerned. First it recognized the important role of the capitalist farmers in the economy. Hitherto the Party had been apprehensive of capitalist farmers, although it quietly tolerated them. But this time, it clearly pronounced their importance and directed the Government to assist them as long as they did not annex land belonging to the peasants and small scale farmers. As we noted earlier, these capitalist farmers - had been important in adopting mechanized agriculture from the early 1950s but during the period 1967-75 many of them had to lie low due the socialist policy pressure. Secondly the Party recognized the importance of mechanization - both tractor and animal powered and pronounced a policy to be followed on agricultural mechanization.

The Party document spelled out a clear policy on mechanization. To quote the Party document (translated from Swahili by the author) (para 59)

"... Our experience has shown that the system of distributing tractors by giving them to individual farmers and Ujamaa villages, who do not have the basic technology of servicing and utilizing them, will not help that much in revolutionizing the agriculture in the villages. The only sure way, which has emerged in the World, of speeding up the scientific and technological revolution in agriculture and building up socialism is the establishment of mechanization and other input centres whereby the farmers are provided with this service without carrying the burden of servicing these tractors. The centres should be responsible for servicing these tractors. In addition the centres should train the farmers on how to use and service these tractors so that eventually these centres can be run by the farmers themselves. ..." (CCM 1988)

The statement goes on to note that for the first time the Government has set aside money to establish eight such centres and the Party recognizing that science and technology are crucial for the development of rural areas, should ensure that there is a long term plan to ensure that by the year 2002, these tractor centres are able to service at least 50% of the small holder farmers in the country. Concurrently with this the statement goes on to state the importance of animal drawn technology in areas where this is feasible in particular in primary cultivation and rural transport to liberate the peasant, in particular women, from the drudgery of carrying loads on their heads.

This is an important statement, first the detail to which the Party went into in this statement. That the Party could in a major policy statement (covering all sectors - Socialism, Agriculture, Industries, Tourism, Cooperatives, Natural Resources, Defence, Foreign Affairs) which is 95 pages long, devote 3 pages of this for agricultural mechanization is in itself a notable event. The Party being supreme in accordance with Tanzania's constitution, and this policy statement was being presented to its National Conference (which is the supreme policy making organ in the Party) indicates the importance with which mechanization is taken. The policy enunciated by the Party is quite broad. One hopes that in establishing these mechanization centres, the Government will try to learn from past mistakes. Different types of management of tractor hire schemes have been tried - from the settlement schemes (where the Government provided to the settlers tractors almost gratis); Cooperative hire schemes, like the Sukuma Cotton Block Scheme, Regional Development Fund Tractors and private hire schemes. It will assist in planning for future centres if the Government analyzes why most of these past schemes failed and tries to avoid repeating the same mistakes. The Government has of course been facing severe economic problems over the past 5 years, and its ability to embark on a large scale scheme is quite limited and it is too early now to pronounce on the success or failure of these new strategies.

Success cases

We have concentrated in the preceding paragraphs on mechanization of tillage operations firstly because this has been the area of mechanization which has been quite controversial, and also where the most arduous farming operations are involved especially when handtool technology is being used (Nwuba & Kaul, (1986), Mrema (1984)). However on the post harvest front there have been quite a number of successes. This is in particular in the milling of cereal grains. Unlike in other African countries (Zambia, Zimbabwe, Kenya) over 90% of the maize, sorghum and millet flour consumed in the country (and this is the staple diet of the population both urban and rural) is milled by small scale hammer mills. There is only one large scale miller - National Milling Corporation, which supplies about half the requirements of Dar-es-Salaam. There are over 10,000 such small scale millers scattered all over the country and owned by individual merchants, village governments or cooperatives. It is difficult now to find milling of grains being done by the traditional stone method - which used to take so much time and energy of the women population. Four companies in the country are now manufacturing these hammer mills - Jandu Plumbers, Manick Engineers in Arusha, Mangula Machine Tools in Morogoro and another company in Mwanza region. This technology has spread mostly through private initiative and some villages were assisted in buying these milling machines through loans from the Cooperative and Rural Development Bank. Majority of them are driven by small diesel generators - Honda, Lister, etc. and they can mill up to 2 tonnes per day, and each family takes 20-50kgs of maize at a time to be milled by these millers for a price.

A few other innovations on the post harvest front are worth mentioning. These include maize shellers - like the one developed by the Department of Agricultural Engineering of the Sokoine University of Agriculture (Kahungu 1988) which is driven from the PTO of a tractor. Many farmers (in particular medium scale farmers) in the high potential areas are now using this type of sheller for shelling their maize instead of the traditional method of hitting the unshelled maize in a sack. By having these shellers tractor owners can also hire out their tractors for shelling maize during the slack season. Other developments include the coffee pulpers for arabica coffee - used in the Kilimanjaro/Arusha and Mbinga areas. Many of these are now locally manufactured and they go a long way towards reducing the labour requirements for processing arabica coffee. Many of these tasks in post harvest processing have traditionally been done by women and children. With the introduction of compulsory Universal Primary Education in 1978, this did significantly reduce the contribution of children in such tasks. One may argue that by mechanizing such tasks, where the progressive farmers usually hired female labour, then you are reducing the employment opportunities for these poor women. However the cost of labour, in relation to prices paid for the produce in Tanzania, is such that there is no option other than mechanizing if these progressive farmers are to remain in business.

INSTITUTIONAL FRAMEWORK FOR AGRIC. MECHANIZATION

In Tanzania, quite a number of institutions/departments have been involved in mechanization. These have included Government departments in the Ministries of Agriculture, Industries, Economic Planning, Finance, Local Government and Prime Minister's Office; parastatal organizations as well as private and international organizations such as FAO, ILO, etc. The Village Settlement Agency established in 1962 to 1965 on advice of the World Bank, was under Prime Ministers Office between 1961-62, and later on Vice President's Office from 1962-64. It received technical advice however from the Ministry of Food, Agriculture and Cooperatives which was also responsible for the Sukuma Cotton Block Scheme described earlier. In 1966 a new Ministry of Rural Development was created to oversee the settlement schemes, and this was later charged with the implementation of the Ujamaa villages programme when the policy of Ujamaa villages was adopted in 1967. Each of these ministries, including agriculture, had functional officers in the regions. The head of the regional administration in each region, has been the Regional Commissioner (a political appointment) who also doubles up as the Regional Secretary of the ruling party. The regional functional officers however received their money and directives from the Ministry headquarters in Dar-es-Salaam.

Below the regional authorities there were the Area Commissioners who were in charge of districts with each ministry having a functional officer at district level as well as District Councils which were the local Governments. Some districts had two councils - one for the urban area (Town Council) and another one for the rural area (District Council). All these institutions were

supposed to be involved in some form of development and some of the projects in the region and districts were national projects controlled directly from ministry headquarters in Dar-es-Salaam. Quite a number of these district and regional officers had tractors under their control for specific projects. An American Company McKinsey and Co. was hired by the Government to advise on the management/administrative structure of the regions for effective rural development in 1969 (Hyden 1980). They produced their report which was implemented with assistance from several donor agencies. They advised on decentralization of power from the metropolis and each Regional and Area Commissioner was given a Regional Development Director and District Development Director respectively who were to be incharge of all development work in his region/district and all functional officers were required to report to him and obtained their operating funds from district/regional headquarters (Hyden 1980). This was implemented in 1972, and the Regional Development Fund Tractors were then placed under the Regional Development Directors (RDD).

Concurrently with the implementation of the decentralization system on advice of McKinsey and Co. commodity authorities were also established for the development of production, processing and marketing of the various crops. Thus Tanzania Cotton Authority (TCA); Coffee Authority of Tanzania (CAT); Cashew Authority of Tanzania (CATA); Tobacco Authority of Tanzania (TAT); Tanzania Tea Authority (TTA) were all established as parastatal organizations responsible for their specific commodities - right from supply of inputs, extension services, marketing and exporting. These authorities had their regional offices in the regions where their crops were grown who worked independently of the regional and district agricultural officials. They had their own vehicles/tractors - most of them supplied by donor agencies like the World Bank/EEC etc. These authorities were established, in the mould of the Kenya Tea Development Authority which was regarded by senior officials in the World Bank as a successful example of rural development administration (Lele (1975)). In addition to these crop authorities and the regional and district officials there were also, in a number of regions, strong cooperative unions (VFCU, KNCU etc.). It was therefore common, between 1972-79 for a villager, to get tractor services from 3-4 organizations as there was no coordination between the crop authorities, the regional and district authorities and the cooperatives. The cooperatives were abolished in 1975 and most of their activities were taken over by the Crop Authorities.

The crop authorities and the regional development directorates (through the various Integrated Rural Development Programmes (IRDP)) were heavily funded for their development activities by the donor agencies - World Bank, (Tobacco, Cashew, Cotton and a number of regional IRDPs); EEC (Coffee, and a number of IRDPs); ODA (a number of IRDPs); USAID (National Maize Project, and a number of IRDPs); GTZ (a number of IRDPs and Sisal) (GoT - (1976, 77, 78)). Most of this assistance was in the form of loans for technical assistance and inputs in the form of fertilizers, tractors, processing plants and

vehicles for extension and administrative support. As mentioned above there was no coordination at all in the regions and hence despite a massive increase in number of tractors between 1970-80 (when the tractor population in Tanzania more than doubled) (Table 30) there was no major change in the level of mechanization in the country and upto today 80% of the cultivated area is still being ploughed by handtool technology (Mrema 1981, 1984, 1989). A significant proportion of Tanzania's current \$5 billion debt was incurred in the 1970s when this administrative diaspora existed. It is pointless to blame Tanzania Government now while many of the projects were conceived and planned with the assistance of the major donors by their planning departments which are staffed by highly qualified economists and other experts.

In addition to the crop authorities and the regional directorates which were involved with the farmers directly, a number of other institutions under the Ministry of Industries & Trade - were also involved in mechanization efforts. These included the National Development Corporation - whose two companies - Mbeya Farm Implements and Ubungo Farm Implements (UFI) were involved in manufacturing of farm implements. Initially, UFI used to market its implements through the Regional Trading Companies which were quite inefficient, however after 1982 it was allowed to market directly through private retailers and agents. The State Motor Corporation partially owned TRAMA-Valmet - which was involved in assembling of Valmet tractors, and it owned two other companies - until 1986, which had the local franchise for Massey Ferguson and Ford Tractors. The franchise for the International Harvester tractors was under another Ministry of Industries and Trade parastatal - Agricultural Implements and Supplies Co. - AISCO while for John Deere a private company KJ Motors had the franchise. There have also been waves of different makes of tractors coming in the country. There was a wave of Indian Swaraj (35 hp) tractors - 200 of them were imported in 1982/83 which were quite unsuitable for the Tanzania soils. The Japanese, through the integrated rural development project for Kilimanjaro region provided over 300 Kubota tractors which were pooled as a project administered by Japanese experts at least in the first five years and providing tractor hire services to small holder farmers in Kilimanjaro region. There was no follow-up with spares after the Japanese left, as Kubota was quite a new make in East Africa and many of them are now abandoned near Moshi town. One hundred Tinkabi tractors were imported from Swaziland with World Bank assistance and given almost free of charge to institutions which wanted to test and try them (Nyantahe 1985). Many of these have now been converted to stationary power sources for grain milling.

MANPOWER DEVELOPMENT FOR AGRIC. MECHANIZATION

One of the key problems which has affected all agricultural mechanization programmes in Africa has been the lack of appropriately trained manpower and with the right type of managerial and entrepreneurial skills. Indeed looking back at attempts in mechanization in Africa over the last 50 years ,

one wonders if the British and French who were involved as colonial powers and implementers of some of the large projects in the 1950s had the right type of manpower. For what is often ignored or glossed over by many of the experts and researchers (Eicher & Baker (1982); de Wilde (1967); Lele (1975)) is the fact that to date the greatest failure in agricultural mechanization in Africa is the Groundnut Scheme of 1946-51 in Tanganyika. This project was being implemented by hundreds of British "experts". Further many of the recent mechanization projects from 1960 - onwards have been donor assisted and in most cases there has always been an expert or several experts from the donor country/agency on site during the implementation stage. This has been the case whether the projects have been of intermediate technology level or tractorization. The failure of mechanization projects in Africa therefore may well be equally placed on the donor agencies as on the African Governments.

At the lowest level, farmers need to be trained on how to use and service any new agricultural machinery and implement. A serious mistake which has often been committed when trying to introduce draught animal technology in areas where the people have no livestock husbandry tradition is to assume that the training of such farmers on the use of draught animal power can be accomplished in a short period of 2-3 months. For the farmer, in this case, has to be trained on how to take care of the animals, to detect quite early if the animal is sick (and this is crucial in areas where livestock diseases are common) and learn how to harness and use the animal in ploughing. In other cases the farmer has been expected, after such short training, to go out and be able to train his own animals how to plough. Even in areas where farmers have the livestock husbandry tradition not every farmer can train his oxen how to plough. Indeed even in Europe and North America, when horses were used for tillage, most farmers used to purchase horses which had already been trained. It is the complexities involved in training farmers the animal husbandry tradition and how to use them in ploughing that has made some of us be skeptical of the prospects of introducing draught animal technology to people who have no livestock husbandry tradition (Mrema 1981, 1984).

Another area which has often received quite superficial treatment is the training of tractor drivers and operators. Gifford (1981) suggests that a competent tractor operator can be trained in a period of six to eight weeks. Our experience with the TRAMA-Valmet training programme in Tanzania shows that even 9 weeks of training to a driver who has basic driving skills is not enough to make him a competent tractor operator. One thing which ought to be realized at the outset is that most of the tractor drivers come from a technologically backward tradition. Few of them have handled mechanical appliances before. In addition they have to operate the tractors in areas which are far from service centres and as such they have to know more about the machinery in case of a breakdown in the field. Next to the tractor operators are the tractor mechanics/agricultural mechanics. Unfortunately this is a cadre of manpower whose training has been ignored in most countries in Africa. Training for such mechanics, where it is offered, has always been undertaken

as an appendage to vehicle mechanics training. It is only recently that the National Vocational Training Centre which is responsible for all craft training in Tanzania has realized that tractor mechanics require a different type of training from that given to automobile mechanics. They are thus in the process of designing a different and extensive course for tractor mechanics. Hopefully when such mechanics come on the market then the number of tractor graveyards will be reduced.

Higher up the career ladder is the training of the agricultural engineering technicians. Training at this level of manpower started in East Africa not through Government efforts, but through an individual. In 1939 Lord Egerton (a settler farmer in Njoro Kenya) endowed his farm and money to establish a college to train 'sons and daughters' of farmers the 'science and practice' of agriculture. Egerton College was therefore established to fulfill this function. Initially the college was admitting only 'sons and daughters' of the white settler farmers from all over East and Central Africa. However from late 1950s it began to admit African students. One of its most successful programmes was the three years diploma in agricultural engineering. This programme which combined both practical and theoretical skills produced very competent agricultural engineering technicians many of them still working in large scale agriculture throughout Eastern and Southern Africa. No wonder the white farmers in these countries were and have remained quite successful in their large scale mechanized farming. Unfortunately Egerton College has now become a University and has started in addition a BSc. degree in the same area. It remains to be seen if the quality of the diploma programme will remain the same. A diploma programme in agricultural mechanization was started at the Ministry of Agriculture Training Institute (MATI) at Mlingano Tanga. This is a 2 years programme and was started with assistance of the Government of Netherlands and FAO. However the quality of its graduates cannot be compared to those graduating earlier on from Egerton College (Rajabu (1986).

Above the technical manpower is the professional cadre trained to BSc. degree level and above. Most of the BSc. degrees in general agriculture are modelled on the BSc. (Agric.) degrees started in Makerere and Ibadan in early 1950s which in turn were based on the University of London external degree in Agriculture. Emphasis in these programmes is on the 'science' of agriculture and little 'practice' of agriculture is taught. Students do courses from several departments concentrating mostly on the Biochemical and Socio-Economic aspects of agricultural science. Agricultural Engineering courses if offered, are less than 10% of the total contact hours (usually 150-250 hours total). Majority of students registered in these programmes come from peasant/small holder farmer families and they are exposed to the sophisticated agricultural machinery for the first time in their degree training and this exposure is a very limited one. They are expected on graduation to work as extension workers, in research and as farm managers in commercial farms. They are expected to manage the Government tractor hire schemes, where these are available and in most cases with poor technician and artisan support, and poorly trained

tractor drivers. They are the most technically trained in the district yet their exposure to agricultural machinery during training is in most cases very limited. (SACCAR 1990)

When Governments in Africa took over formerly settler owned farms (as it happened in Tanzania in 1970s) they have usually appointed these BSc. (Agric.) graduates as farm managers. Agricultural machinery and implements form over 60% of the capital investment in any large scale commercial farm in Africa. Yet in our appointment criteria we often insist on a graduate who is a high flier in agricultural economics and farm management. This would have been ok if the level of training of our supporting staff had been better. However it is at the lower levels where we are even weaker. Many commercial farms which were once productive in Northern Tanzania (West Kilimanjaro) have degenerated into agricultural machinery and implement graveyards. In an attempt to increase the engineering knowledge of some BSc. (Agric.) graduates, mild specialization in agric. engineering was started for a few students at Sokoine University of Agriculture from 1975. Graduates through this option have performed quite well when it comes to management of large scale mechanized commercial farms. (Dibwe (1983); Materu (1990)). A good proportion of farm managers of the National Food and Agricultural Corporation (NAFCO) in Tanzania which farms over 100,000 ha. are graduates who did the agricultural engineering option in Morogoro (Dibwe 1983).

It is important to realize that agricultural engineering is quite a new profession in both Britain and the former British Colonies where higher education has been very much influenced by the former. Indeed the first BSc. degree in Agricultural Engineering started to be offered in Britain only in 1966 and upto now there are only 3 Universities which offer degrees in agricultural engineering in the whole of the British Isles (Newcastle, Dublin and Silsoe). In some of these Universities quite a number of students taking the BSc. (Agric. Engineering) degree are overseas students. It is only in North America and India (and here it is mostly due to starting of the State Agricultural Universities in 1960s through assistance from USA) that the agricultural engineering profession is quite well developed, and the North American programmes have been offered for over 90 years. In Eastern and Southern Africa, training of agricultural engineers started only in 1976 in Nairobi University. The second programme to be started is that of Sokoine University of Agriculture in Tanzania which started in 1983 graduating its first cohort in 1988. Training of agricultural engineers is an expensive undertaking and where these programmes have started it has been done jointly between faculties of agriculture and engineering. Perhaps our Universities should have started with programmes in agricultural engineering rather than the more conventional fields of engineering like civil, mechanical and electrical.

RESEARCH IN AGRICULTURAL MECHANIZATION

One of the weakest areas of our National Agricultural Research Systems

(NARS) has been in the area of agricultural engineering. Too often these research centres have tended to follow what the international donor agencies want and have employed expatriate engineers to develop the so called 'appropriate' technologies. Millions of donor funds, and supporting national funds have been spent over the past 3 decades in these projects. As Starkey (1986) has noted equivalent to over US\$40 million has been spent on research and development of the wheeled tool carrier all over the world, yet it is one example of a rejected intermediate technology. There are many more such technologies which have costed so much money in research and development efforts but are yet to be adopted. Further research on mechanization policies undertaken in most of Africa has been done by economists who have concentrated on proving how uneconomic it is to introduce tractor mechanization in these parts of the World and how economic the so called appropriate technologies are (Lele (1975); ILO (1976); Singh (1976); Kinsey (1976); Kinsey (1984); Kinsey & Ahmed (1984) Binswanger (1984), Pingali *et.al.* (1987) If they are so economic why then haven't they been adopted by farmers? Such researchers do often blame Governments, extension systems, etc. for non adoption and not the technology itself. The few centres which have been established in Africa on Agricultural Engineering Research (e.g. CAMARTEC in Tanzania) end up concentrating on development of these appropriate technologies with team after team of expatriate researchers supported by the donor organizations. We believe it is now time for these centres to begin research on why these technologies are not adopted, and why have tractorization schemes failed and if there are examples of success why these have succeeded. This type of knowledge will be more useful for the next two decades than trying to reinvent the wheel with these appropriate technologies.

DISCUSSION

Synthesis of Past Experience

We have in the preceding paragraphs reviewed mechanization policies and strategies in Tanzania over the past 50 years. Six distinct periods, can be discerned, in Tanzania, in so far as evolution of agricultural mechanization policies and strategies is concerned. The first is the period before 1930 which may be called the handtool technology period. The predominant type of mechanization technology then, both on the German and later British settler farms, and the native farms was the handtool technology. The settler farmers used various coercive methods to get the natives to work on their farms using the handtool technology. This was followed by the period between 1930 and 1945 which may be called the Draught Animal Power Technology period. During this period, advances in Veterinary Medicine, in particular the control of the tsetse fly through bush clearing made it possible for the pastoral tribes (Sukuma) in the North and North West to live and settle in new areas where they could not do so before because of livestock diseases. They also adopted the ox plough and started cotton production. It is still in these areas where draught animal power is used up to today. However although they adopted

the draught animal technology, the method they were advised to use by the Veterinary officers to get rid of the tsetse fly has led to one of the greatest environmental disasters in Africa today! Large areas of Mwanza, Shinyanga, Tabora and Singida regions in Tanzania are now almost semi deserts because of the bush clearing which was undertaken in 1930's to get rid of the tsetse fly and the inherent overstocking culture of the inhabitants of these areas!

The third period in Tanzania are the years between 1945 and 1960 which may be called the commercial farming period. The tractor had been developed and perfected in Europe and North America. Settler farmers were therefore encouraged to settle in new areas in East Africa as now they need not rely on the troublesome and "lazy" native labour for their field operations. Hence large scale mechanized farms were established in Tanzania and the native farmers continued to grow their food and cash crops on their small plots. It is also during this period that the British Colonial authorities established the largest ever mechanized agriculture project in Africa - the Groundnut Scheme - which was established in Southern, Central and Western Tanzania. After five years of trying they failed and abandoned the project in 1950. It is also during this period that there emerged a class of African medium and large scale farmers who started growing commercial crops like wheat, maize, beans etc. Also the small holder farmers formed strong cooperative unions which were at this stage mostly involved with marketing of their produce (KNCU - Kilimanjaro Native Cooperation Union, VFCU Victoria Federation Cooperative Union, BCU - Bukoba Cooperative Union). Although some of them had started before 1945, their growth during the period 1945-60 was phenomenal.

There follows then in Tanzania the decade between 1960-70 which may be called the period of the World Bank Transformation Experiment . This was the period when on advice of the World Bank the rural transformation experiment was tried . During this period a large number of villagers and urban unemployed were settled in new areas and provided with capital intensive machinery and implements to transform the rural areas and increase productivity and production. This World Bank induced experiment at mechanized agriculture failed dismally and from the agricultural machinery graveyard of this experiment, there emerged however, maybe the first tractor taxi's in Africa. These were the Sukuma tractor drivers, who bought the boarded tractors and offered ploughing services to small farmers all the way from Mwanza through Arusha/Kilimanjaro in Northern Tanzania to Eastern and Western Kenya. After this follows the period 1970-83 which may be called the Ujamaa period. This was the period when the greatest social engineering work was undertaken in Africa and 13 million peasants living in scattered hamlets all over Tanzania were moved and settled in 8000 or so Ujamaa villages; with the main objective of among other things providing them with social services - schools, health and water, and agricultural inputs to produce communally or individually. It is also a period which may be regarded as one of mechanization diaspora, where different agencies and government

departments tried to provide to these farmers mechanization services - tractor and animal powered (Commodity Authorities; Cooperatives, District and Regional authorities and NGO's). Finally is the period between 1983 to today which may be called the Structural Adjustment period. During this period IMF/World Bank Structural Adjustment experiments are being followed at least on the fiscal front, and private commercial agriculture is being encouraged alongside the small holder/peasant agriculture undertaken by the peasants in their Ujamaa villages.

LESSONS FROM TANZANIA'S EXPERIENCE

What lessons then can we learn from these past efforts in agricultural mechanization in Tanzania? On handtool technology, which is the main type of technology used by the majority of farmers, the type of implements used are by and large the same as those used 50 years ago (i.e. the hand hoe (jembe); the matchete (panga); axe (shoka); and to a lesser extent - slashers, sickles and shovels). The country has set up two large scale manufacturing plants for these implements (the UFI factory in Dar-es-Salaam, and the Mbeya Farm Implements factory). Although several consultancy studies had advised (MoA-GoT (1976); CFTC (1980)) that the manufacture of handtools should be relegated from the two factories to small scale artisans and blacksmiths, it appears however that these suggestions have not been taken up by the government and these two still continue to dominate the market. Artisan production of these handtools is constrained by scarcity of raw materials and lack of tools and expansion of this sector is contingent upon widening markets through development of infrastructure (ILO (1978)). Unlike in West Africa where most handtools are fabricated by artisans and blacksmiths, in Tanzania and East Africa in general, it would seem the manufacture of handtools will continue to be dominated by large scale manufacturing enterprises. It would seem also the scope for improvement of the handtools to increase the labour productivity is limited and it is likely that design of these handtools will remain the same in the next 2 decades as it has been over the past 5 decades.

On draught animal power, it would seem that despite massive research efforts in developing new implements by such organizations as TAMTU/CAMARTEC, University, Uyole Agricultural Centre, etc. (tool carriers, inter row cultivators) and accompanying extension thrust extending over a period of over 60 years these new implements have not been widely adopted by farmers. Where DAP is being used, farmers are still using the traditional 'victory' mould board plough introduced earlier on in this century in Africa. In a few areas DAP is also used for transport with a variety of oxcarts (with wooden, metal wheels or pneumatic tyres). Further even the number of trained draught oxen is quite small. The FAO survey of 1976-79 revealed that there were only under 300,000 trained oxen in Tanzania in 9 regions. Most of them concentrated in the Mara/Mwanza/Shinyanga regions (see Table 31). It is unlikely that the other regions not covered in this survey, (e.g. Dodoma, Tabora, Iringa) have more than 100,000 draught oxen between them. Therefore

the total number of draught oxen by 1988 - even assuming a high growth rate is less than 600,000. This is in a country with over 12 million cattle and where draught animal technology has been in use for over 60 years. It would seem therefore either there is something seriously wrong with the technology and hence the non-adoption by farmers despite the apparent advantages or there is something wrong with the way it is being extended by the extension system.

TABLE 31: Trained Oxen and Ox-implements (1976/79)

Regions/Ecological Zones	Trained	Ox-implements
<u>High Potential Areas</u>		
Kilimanjaro	1,882	1,228
Morogoro	349	107
Mbeya	3,368	18,937
<u>Medium Potential Areas</u>		
Mara	26,244	10,217
Mwanza	23,488	6,077
Shinyanga	102,540	34,332
<u>Low Potential Areas</u>		
Arusha	30,396	35,893
Tabora	45,243	34,753
Singida	52,973	26,868
	295,030	174,554

Source: FAO/Kilimo, "Agro-mechanisation Survey 21/11/76 - 30/06/79. FAO Dar-es-Salaam, 1981

Further despite concentrated effort over the past 50 years in introducing this technology in the other regions where there is no livestock husbandry tradition, it would seem that these efforts have not succeeded. It may well be better therefore to allow such regions to skip this stage of technological evolution and move straight to mechanically powered technologies. Finally if the introduction of DAP technologies is to lead to massive clearance of the trees in order to control the tsetse fly and hence livestock disease as it has happened in Shinyanga/Mwanza/Mara regions of Tanzania, over the past 50 years, then the environmental cost of this is just too much and by and large we may be better off without DAP technologies in such areas.

On tractorization a number of lessons emerge from past experience of

Tanzania. In this regard we have to accept that agricultural production will continue to be undertaken in a dual structure of medium/large farms, and peasant/small holder farms. In land surplus countries such as Tanzania there is no pressure on egalitarian grounds to acquire these large farms and redistribute them to small holders. They will thus continue to operate and appear to be good examples where agricultural mechanization has worked quite well in a number of them. The main lesson here is that mechanized agriculture works well where the managerial and technical staff are able to manage the agricultural machinery and implements which constitute 60-70% of the capital invested. Despite some failures in Tanzania where newly established state farms or acquired settler farms failed to operate profitably, there are however quite a good number of these large farms which are managed and operate efficiently and they are crucial to the economy of the country in certain areas (eg tea, sugar, coffee, sisal, wheat and tobacco in Tanzania). For the small holder farmers, three methods have been used in Tanzania to provide tractor services. First the Government tried to provide the agricultural machinery and implements to farmers settled in the new settlements in the 1960's and in the Ujamaa villages in 1970's and left the management of the machinery to the settler/farmers themselves. The second method was for the Government to control and manage the tractors through the District/Regional authorities, Crop Authorities, or cooperatives who provided the tractor hire service to the small scale farmers. The last method has been for private tractor owners to provide such services without any Government intervention. The Sukuma tractor owners whom we've described earlier appear to have been quite successful in this regard and one sometimes wonders if the border between Tanzania/Kenya had not been closed in 1976/77 how they would have been faring by now.

Preliminary empirical evidence seems to suggest that all the Government tractor hire schemes have been plagued by teething problems and have ultimately failed after a few years of operation. The main lesson however from this analysis is that we do not yet know why they failed or if they were uneconomical. It is difficult to say categorically, from the empirical evidence available whether past attempts at tractorization; (be they through Government subsidies, or Government and Parastatal tractor support and hire schemes) have failed because mechanization for these small holder farmers is inherently uneconomic, or because it suffered from technical, managerial and organisational problems which can be overcome or avoided! Analysis of many past schemes has been just too superficial and in many cases this has been done by economists with pre-conceived ideas on tractorization (Singh 1978). Record keeping in many of the Government and Parastatal tractor hire schemes has been so poor for one to undertake any meaningful study.

In quite a number of cases analysis of mechanization projects has been done many years after the project has collapsed. Singh (1978); Pingali *et al.* (1987) and Kinsey (1984) in 1976-85 all used farm management data obtained by Collinson in 1962-63 season (Collinson 1964) to justify their blanket

prescriptions on the economies of tractor and draught oxen use in Sukumaland in Tanzania. Anybody familiar with the Sukumaland region in 1962-63 and late 1970's will appreciate the fact that the farming systems in this area had undergone tremendous changes in the period 1965-75 especially as a result of the Ujama villages programme. Thus their prescriptions and recommendations would seem to have been based on outdated data. A key problem however which transcends all mechanization schemes, in all countries has been lack of properly trained manpower at operational, artisan, technician and managerial levels. The lesson here is that if mechanization is to succeed then investment in human resources development must be made first.

Finally, another point which is worth noting is the fact that donors (both bilateral and multilateral) have greatly influenced mechanization policies, strategies and pace in Tanzania. Too often these donors, through the international experts and short term consultants they have sent to these countries have had a free reign in policy formulation and programme planning and implementation. We should add here however we are not saying that these experts and consultants should not be sent; all that we are saying is that if these experts and consultants come, and in particular in a technical area like agric-mechanization, and there is no internal capacity to critically analyze and evaluate their proposals/reports, taking into consideration the local reality then the danger of repeating mistakes becomes quite great. All this would seem to suggest that there is no shortcut to having your own critical mass of well trained technical staff. A number of examples can be cited in this regard. One is the different types/makes of tractors available in each country. There are about 12 different makes of tractors found in Tanzania. For some makes there is a whole range of tractors at different power ratings. Many of these tractors, at least in Tanzania, have been imported through donor assistance. For a market with a total of about 18000 tractors we find it difficult, why we cannot standardize to 2-3 makes and 2-3 power ratings. For even in Britain where there are over 500 000 tractors and each year over 22 000 new tractors are added to the fleet, there are only about 8 dominant makes (FAO (1986); Gibb (1988); Kurdle (1975)).

CONCLUSION

Mechanization technologies have perhaps been the ones which have attracted interest from all those who have been involved in Tanzania's development over the past 5 decades - politicians, economists, sociologists, agriculturists, engineers, donors, etc. This has also made them quite controversial. It would seem that the percentage of land cultivated by the three levels of mechanization technology - handtool, animal and mechanical powered has by and large, remained at the same level over the past 30 years (80, 10-14, 6% respectively). This is the case despite an almost three times increment in the number of tractors in the country. Although, politically, policy emphasis has for a greater part of the Tanzania's 30 years of independence, been on animal powered mechanization, the numbers of trained oxen used in agriculture has

shown only marginal growth over the same period and area cultivated by animals has remained the same. Some observers and researchers (Kjoerby (1983); Johnston (1984)) have attributed this lack of progress in animal powered mechanization to contradictions in policy; with the policy makers saying one thing in public, and doing the opposite in practice. This would seem to indicate that at the grass roots level (i.e. districts) the development practitioners are not themselves convinced of the case for draught animals. There is evidence to show that large stocks of ox-drawn ploughs, and ridgers have remained unused, and unsold in godowns of the regional trading companies to the extent that the main manufacturer UFI has faced liquidity problems (ILO 1978). If the policy makers at the national level have been convinced on the need to promote the use of this technology, it would seem lower down the system, at district level, there is still a lot of persuasion which has to be done. Yet, quite a number of villagers have contributed money to buy village tractors in quite a number of villages in Tanzania.

It would appear that in the development process, agricultural mechanization is a conundrum. For inspite of many economic studies and consultancy missions we are still far from evolving an agricultural mechanization policy which appears to be working in particular for the small holder farmers. Further tillage methods have, by and large remained the same with almost entire reliance on the handtool technology. Even more serious, we cannot precisely say what was wrong with our previous attempts at mechanization. All that we have are macro analysis of the projects, often undertaken long after the projects have collapsed and concluding with blanket prescriptions like "inappropriate technologies" etc.

It would seem that agricultural mechanization is one area where everybody is experimenting - the Government, individuals, donors, etc. These are indeed expensive experiments and one way or another we need to get out of the experimentation and develop policies and strategies which can lead to an improvement of the situation. We have had many failures in this long and arduous struggle to mechanize our agriculture. Perhaps the key factor which has been missing in all the previous attempts is the human resources required for mechanization. It would seem, agricultural mechanization can only succeed, if there is a critical mass of properly trained and enterprising managers, who understand the technology involved, supported by competent and hard working technicians, artisans and machinery operators. It may well be more prudent to start with getting this type of human resource before we embark on any large scale mechanization be it animal or mechanically powered. Doing otherwise, it would seem, we shall end up in the 21st century using technologies which were abandoned in the 19th century in other continents.