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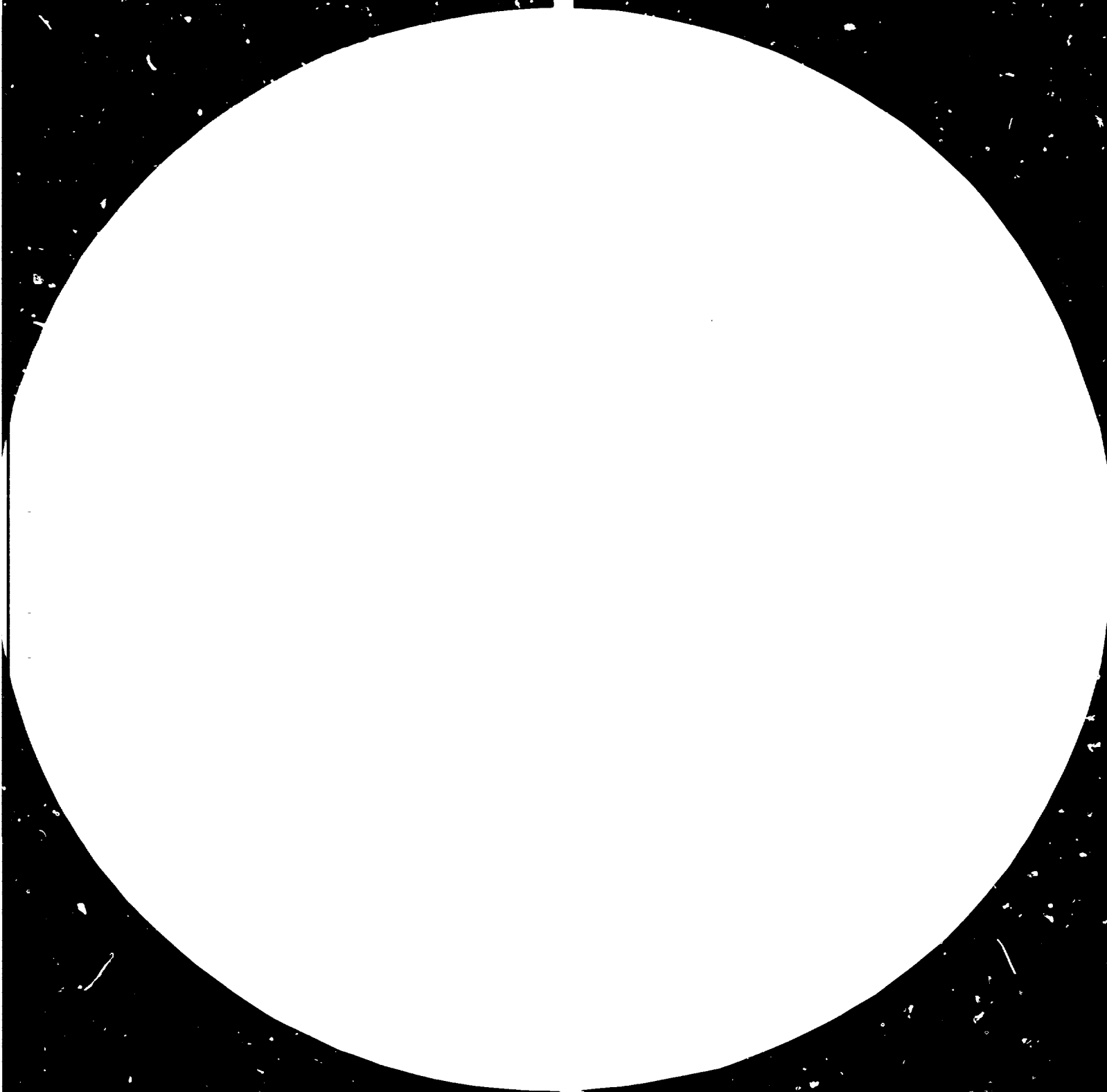

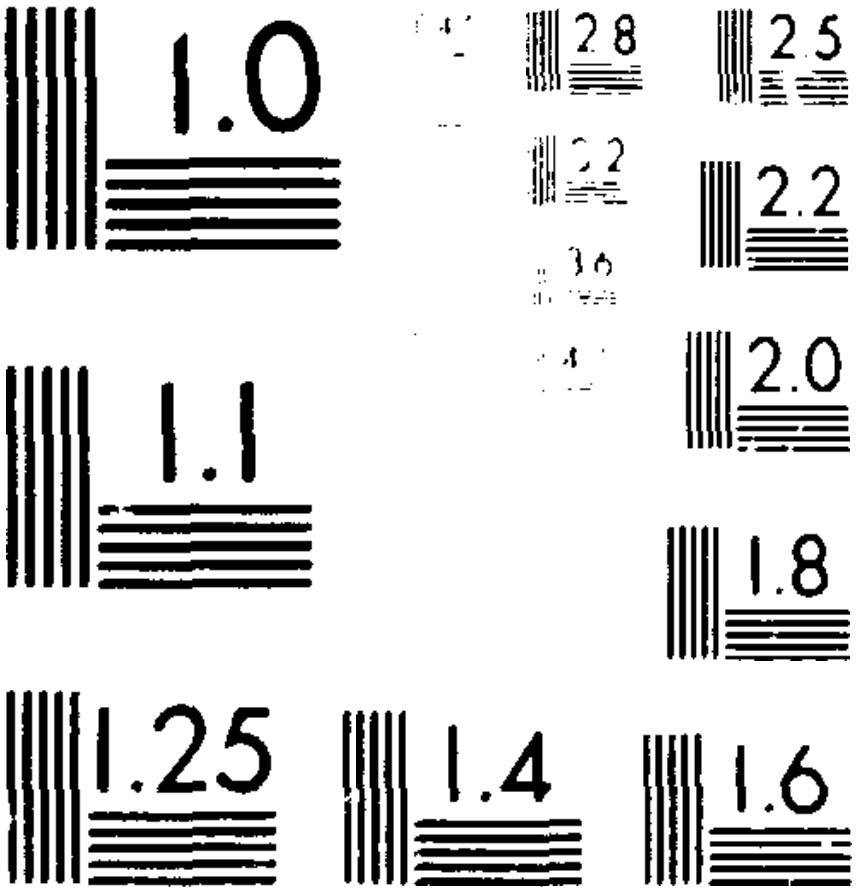

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ISSUE PAPER NO.1:

PRESENT SITUATION, PROSPECTS AND STRATEGICAL CHOICES FOR THE DEVELOPMENT OF AGRICULTURAL MACHINERY IN AFRICA IN THE CONTEXT OF THE LAGOS PLAN OF ACTION*

prepared by
the secretariat of UNIDO

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CONTENTS

INTRODUCTION

At the beginning of this decade, 1981-1990, the agricultural situation and food production in most African countries has further deteriorated. The average rate of growth of agricultural production during the period 1970-1980 fell to 1.3% per annum (2.3% in the preceding decade), while the population increased by an average of 2.7%. The continent, which was previously generally self-sufficient in cereals, now has to import about 10 million tons and exhibits a very worrying degree of dependence on imported food, while at least a third of the population suffers from malnutrition or famine. The running down of staple food production, the considerable increase in the food requirements of the large cities, the changes in the patterns of consumption, the insecurity and the dependence on foreign supplies are symptomatic of the changes and the realities of a crisis in foodstuffs production from which few African countries seem to be able to escape.

This alarming situation, which affects the essential aspirations of Africans in terms of food and health, requires widespread changes in development policies in general and in the agricultural policies in particular. A central problem must be tackled, that is, the problem of mechanization, or more generally, equipping African agriculture with capital goods. The "agricultural revolution" which the Lagos Plan of Action[1] calls for, cannot come about except, among other conditions, as a result of a well-supported development of local production and of the use of farming implements and plants suited to the multiple requirements of agriculture, the farmers and the environment. This would allow not only quantitative growth in agricultural and food production, but also the re-establishment of the major social, economic and ecological equilibria, frequently lacking at the present time (under-nourishment, the exclusion of the farming community from development, rural depopulation, desertification, soil erosion, etc.).

The first UNIDO Consultation on agricultural machinery, held at Stresa, Italy (15-19 October 1979) underlined the importance of this sector and the need to define and set up in each country a national integrated agricultural/industrial strategy in respect of local manufacture. It is the gravity of the problems encountered on the African continent that led to the selection of this

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(1) Lagos Plan of Action arising from the implementation of the Monrovia strategy for the economic development of Africa, OUA-ECM/ECO/9 (XIV), Rev. 2.

region for the first UNIDO Regional Consultation, while Recommendation "m" adopted in Stresa[2] outlined the objectives of the preparatory work to be done for the Consultation by UNIDO.

Based on 16 case studies[3] conducted by African experts, UNIDO drew up a "diagnosis of the present situation and trends of production and use of agricultural machinery in African countries," which forms a basic document for the first subject of discussion[4] (UNIDO/IS.288).

The purpose of Issue Paper No. 1 is to submit the results of these works to the participants and to discuss them. Subsequently, an analysis of the current situation and of the trends of agricultural machinery will be presented, followed by a global explanatory schema for this situation. This will be followed by a definition of the major challenges in the future and of the objectives assigned to mechanization by the Lagos Plan of Action. In response to these challenges, different routes for mechanization will be proposed, aimed in particular at meeting the needs of small farmers and the development of local production. This first document will give priority to analysis and consideration of the facts, while Issue Papers Nos. 2 and 3 will extend this first stage to the action.

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(2) Report of the First Consultative meeting on the Agricultural Machinery Industry. ID/239 (ID/WG.307.9/Rev.1), page 6: "UNIDO will undertake a survey in Africa in order to investigate the practical implications of the planned production of low-cost and intermediate agricultural machinery, its problems and requirements and to identify the types of products required. The survey will help to determine the planning and location of manufacturing units based on actual needs and demand."

3) These countries adequately represent the whole African situation (developing countries). The countries examined are: Algeria, Egypt and Sudan (North Africa), Senegal, Mali, Ivory Coast, Togo, Nigeria (West Africa), Cameroon, Zaire, Burundi (Central Africa), Ethiopia, Kenya, Tanzania, Zambia, Madagascar (East and South Africa). However, the data available relating to other countries, where adequate, has been incorporated in this analysis.

(4) The first world study on the Agricultural Machinery Industry (UNIDO/ICIS.119, 29 June 1979) and its summary (119/Add.2) complete this document file.

I. THE SALIENT FEATURES OF THE PRESENT SITUATION AND TRENDS IN AGRICULTURAL MACHINERY IN AFRICA

Production

1. Industrial production on a limited scale where small and medium size companies prevail

Table 1 [5] (see annex, pages 35-38) is an original attempt to analyse the whole fabric of African industry involved in the production of agricultural equipment. The apparatus of industrial production of the continent[6] comprises approximately 90 companies and 15,500 people. SONACOME of Algeria alone employs 6,000 people and is an exception. Generally speaking, if Africa is considered without North Africa (which alone employs 9,000 people) the productive capacity consists of about 70 companies employing 6,500 people (the average is less than 100 employees; in the African countries south of the Sahara there are less than five enterprises employing 300 or more employees). If the average turnover in industry[7] is estimated at 12,000 dollars per employee, then the annual (semi)-industrial production of agricultural equipment on the African continent will be approximately 150 million US dollars per annum for the period 1978-80 (about 50 million in added value). In the majority of countries south of the Sahara, this sphere of activity consists of one (rarely more than one) enterprise, employing from 50-200 people, usually founded in the period 1950-1970, operating only for the internal market (exports are extremely rare), with a very varied production which often includes the manufacture of non-agricultural equipment, based on operations such as assembling, cutting and welding (rarely of machining) with a low added value and highly dependent on imports of raw materials and of semi-finished products. The design and internal engineering capacities in the companies are very poor in the majority of the African countries. The direct or indirect role of the State in relation to these companies is often preponderant.

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(5) This table was compiled from information contained in the 16 case studies carried out for UNIDO and from partial information available at UNIDO. All participants are invited to advise the Secretariat of any further information which could help to improve this tentative table.

(6) Excluding the Republic of South Africa and Namibia.

(7) Based on data contained in the case studies. However, a 20% reduction has been made in all cases to take account of the production of non-agricultural equipment.

A distinct regional specialization is apparent in the types of product produced by these enterprises: roughly speaking, production of tractors and drawn equipment in Algeria and Egypt, manufacture of animal drawn equipment in West Africa with two different forms of organization: (semi)-industrial and centralized production (SISCOMA in Senegal), and decentralized production based on the formation of craft cooperatives (e.g. COBEMAG in Benin, ARCOMA-COREMMA in Upper Volta, etc.); the production of hand tools in large units in Central Africa (e.g. CHANIMETAL in Zaire, where tractors are also assembled); and very diversified production in East and South Africa.

2. The basic but often ignored role of craft production

Craftsmen often play a determining role in the supply of hand tools and traditional equipment for small farmers as well as in the maintenance of this equipment. Because they are spread out over the territory, these craftsmen have been neglected in favour of industry and are subjected in addition to competition from industrial products and imported tools and equipment. Having been for a long time excluded, the "beggars" of industry and of growth, their importance[8] was nevertheless rediscovered during the decade 1970-1980, resulting in training, financial and technical aid programmes, in original methods of regrouping into cooperatives leading, in particular, to semi-industrial production and to integration into the fabric of industrial production, through the medium of maintenance and sub-contracting operations. However, the rift between industry and craft remains the dominant trend.

3. The very limited part played by national production in meeting internal demand for agricultural equipment and the continuing dependence upon imports

For most types of agricultural equipment, and particularly the more modern, the degree to which the demand is met by local production is extremely low, for

(8) Quantitatively, in Mali for example, there are some 3,000 craftsmen which represent an enormous production potential; the only industrial unit however (SMECMA) has 160 permanent employees.

the whole of the continent and for the majority of the countries taken individually, at about 15%[9]. It is primarily from imports that the current African market is supplied. For the tractors alone, the imports of the developing African countries can be estimated at about 30,000 units for a production of about 10,000. The apparent level of self-sufficiency is therefore 25%. In reality, with the exception of Algeria and Egypt, this production consists primarily of final assembly of tractors and the real level in value is far lower. In addition, it should be pointed out that it is the larger producing countries which import the most, since they are, as a general rule, the countries which are the more developed, the richer, and which have the largest internal markets.

For traditional equipment, hand tools and animal drawn equipment, the degree to which demand is satisfied is considerably higher if the final products are taken into account. However, hand tool imports can reach very high levels, (Tanzania, Sudan) while imports of raw materials and semi-finished components required for animal drawn equipment often represent over 60% of the value of the products. The direct and indirect intervention of foreign suppliers remains essential to the whole supply of agricultural equipment used on the African market.

4. The difficulties encountered by existing companies and their principal causes

The agricultural machinery sector in Africa is undergoing a crisis. Four indices show this: the low level of actual use of the existing capacities, the decreases in turnover, orders and financial profitability, the disappearance or inactivity of some companies and the low level of formation of new companies and the rarity of projects announced or started. These difficulties can be attributed to structural and conjunctural causes. Structurally, the enterprises have to contend with the weakness of their national industrial environment which requires most raw materials, semi-finished products and production equipment to be imported, as a result of which there is not only a dependence on foreign sources and a limitation of the local added value, but also major difficulties in operating the enterprises as a result of the delays and risks in the delivery of these imports. Inadequacies at the scientific, banking and servicing levels are another burden on these companies, all the more so when the countries are less developed. But there is a second order of structural difficulty downstream of the companies, in the demand and marketing field: the main problems are the intrinsic limitations of the outlets, the insolvency of the farmers, the lack of control over commercialization of their products which is entrusted to intermediate organizations which frequently

(9) Based on a total import figure of 870 million dollars in 1978 and on a production estimated at 150 million , the African market would be about one billion US dollars and the apparent level at which this market is met by local production about 15%. This would be about 5% in added value.

constitute a screen between them and the users, and the hazardous nature of the outlets. Thus many companies have no control either upstream or downstream. This weakness has been exacerbated during the last 5 years by the world economic crisis (considerable increase in the costs of raw materials and other imported products, marked reduction in the internal market connected with the agricultural and economic crisis and the reduction in farmers' incomes, and more aggressive competition from abroad). These exogenous factors have been amplified by the inherent inadequacies of certain companies, particularly at the management level.

5. Thus, at the present time, many agricultural machinery companies in Africa find themselves in a serious financial situation, risking extinction. However, in spite of the importance of these difficulties, the means of production does exist in the majority of the countries and long experience has been acquired by these companies and their staffs. The dynamism of these structures has been shown, in particular in the sphere of animal drawn equipment and individual items, in various forms, characteristic of the national or sub-regional context(10).

Demand

6. The basic under-equipment of African agriculture and in particular of the traditional small farmers

Approximately 30% of African farmers have at their disposal only traditional hand tools, 15% make use of animal drawn equipment and 5% employ tractors. A rough estimate shows another aspect of this situation: if the number of persons living directly from agriculture in Africa is estimated at 300 million and, taking as a base the 1978 market of one billion dollars, the expenditure per individual on agricultural equipment would be approximately 3 dollars per annum (about 20 dollars per family) or less than 0.5% of the average income per capita. Analysis of the level of agricultural investment(11) confirms this flagrant under-investment in African agriculture and the aggravation of this phenomenon by the poverty of the countries considered. On average, the African countries import 5-10 times the amount in value of cereals for foodstuffs than of agricultural machinery which contributes to the local production of these same cereals.

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(10) Some original experiences: semi-industrial production of animal drawn equipment by blacksmiths' cooperatives on the pattern of the original COBEMAG in Benin, small cooperative units for the production of simple machinery, generally manual (for example, CEDECO in Zaire), craft villages in Ethiopia, the Tanzanian experiment, etc.

(11) See First World-wide Study on the Agricultural Machinery Industry UNIDO/ICIS 119, June 1979.

7. Declining demand and a widening gap between the demand which can be met and the actual needs

In 1979, Africa's share in the total worldwide imports of agricultural machinery (code SITC 721) was a mere 3.3%[12][13], 4.4% for tractors and approximately 7% for hand tools. In 1978 the total imports of agricultural machinery amounted to 867 million US dollars (31% for hand tools, 21% for agricultural equipment and 45% for tractors).

From 1971 to 1978, these movements were developing in Africa as in the rest of the world (value stagnation), but African imports underwent a sudden drop in 1979, estimated at 30% by value. Thus, starting in 1975 but particularly since 1979, the African demand has decreased sharply. This structural under-equipping cannot but get worse since the annual purchases cannot even ensure replacement of existing equipment. These figures fully support the views of African experts in the case studies and the fall off in business observed in the case of the agricultural machinery companies. The result has been a widening of the gap which separates the demand which can be met (the market) from the potential demand and the requirements, in particular those of the small traditional farmers, left on one side by mechanization and economic growth.

8. Failures in the mechanization of farming through over emphasizing the role of tractors

Mechanization must not be equated with tractorization. However, the current confusion between these two concepts explains the dominant role of the tractorization model in mechanization in Africa. Introduced into Africa during the colonial period, magnified by its performance in developing countries, strongly marketed by multi-national producing firms and local commercial networks, this model has been fostered in Africa mostly through State organizations and farms, development operations and rich private exploitations, representing the whole of the demand which could be satisfied. To a great extent, it still continues to monopolise the funds available for mechanization and to obscure the needs for other agricultural plant, in particular those connected with food crops which are handled with traditional hand tools. Although intended at the outset to improve agricultural production, this model has in general proved to be a failure, primarily because it led to stagnation and even decreased productivity of land and manpower and failed to adapt to traditional small-scale agriculture. This type of mechanization, which is necessary for certain types of operation and cultivation, today finds itself in a deadlock which is not only technical and financial (the

(12) It is 0.1% for worldwide exports - source: UN Statistical Handbook of International Trade, Vol. II, 1976-1979, New York. See table 2 (annex) relating to imports into Africa.

(13) Algeria and Nigeria alone represent more than 40% of the market for the continent.

amounts owed by the African countries), but also "social". On the other hand, animal drawn cultivation has progressed significantly in favourable countries and sub-regions, thus proving beneficial to small farmers engaged in food crop production and, in some cases, to certain profitable crops such as cotton. Its overall impact remains, however, limited.

9. The complex and irrational nature of the demand for agricultural equipment

The agricultural machinery market consists of a variety of social groupings of different types and different interests: foreign equipment manufacturers (often multinational companies) and their commercial representatives, public authorities, state owned companies, agricultural development companies, importers and local intermediaries, distributors and rich farmers but rarely the user farmers. The whole of this commercially orientated system, even when it actually aims at modernizing and developing agriculture (for example, agricultural or rural development schemes) leads in the end to a marked division of demand into the privileged sector of the population which can be satisfied and the demand of the small farmers which cannot be met. The consequences of this situation are that it is impossible to provide food crop cultivation with modern equipment (vicious circle); the widening of the gap between the two categories of demand; the enrichment of a minority of intermediaries who are neither productive nor creators of wealth; the lack of sustained interest in the key supervisory problems (supplies of spare parts, maintenance, training of users and operators) which are essential for heavy equipment, resulting in deterioration of stocks and a forced demand for replacement; the stocks of machinery are often so widely varied (makes, models and techniques) as to make it often impossible to solve these maintenance problems; the difficulty for the national manufacturers in basing their production programmes and their investments on a clear and stable picture of the requirements, of the size and of the exigencies of their markets.

This demand for agricultural equipment is seen as the order for an imput necessary to agricultural development operations (in the same category as fertilizers, seeds, insecticides ...) within the framework of a spot market. This "trivialization" and breakdown of the demand, further combined with strong commercial interests, makes it difficult to realize a coherent and efficient agricultural machinery policy.

10. As a result of this analysis of the essential facts of the present situation in the production and use of agricultural machines in the majority of developing African countries, it can be seen that there is a generalized imbalance, a fundamental difference between offer and demand, or more precisely, between local production on the one hand, the home market which can be met, and the actual needs of the whole of the agricultural sector on the other hand. A striking paradox is also apparent:

while the local equipment production units satisfy an average of only 15% of the stated requirements of the market which can be achieved, these units are also experiencing a serious shortage of outlets and are operating below capacity.

II. A PROPOSED EXPLANATORY FRAMEWORK

The failure of agricultural mechanization in Africa reflects a complex problem, but also one which is often ill-defined and approached with political aims and insufficient means.

11. The complex problem of agricultural mechanization in Africa

The mechanization of African agriculture is an integral and inseparable element of the whole complex which forms each African socio-economic political system and each country. The interdependence between the social, cultural, economic, financial and ecological factors acts both as the control and the constraint of these systems as shown by the contents of the case studies and the few examples which follow:

- Mechanization is connected with and at the same time dependent upon the agricultural systems and methods, the relative priorities between food crops and export crops, the selection of a pilot crop, technological developments, etc.[14]

- A simple decision in the matter of credit or of farm prices, but also on agrarian reform, or social or economic organization of the rural environment has a considerable influence on the demand for equipment.

- The deterioration of the financial situation in numerous African countries has a direct influence on the levels of imports, in particular of large items (tractors) in addition to the financing of the projects or the agricultural machinery production units. It reinforces the power of foreign participants, notably through the financing of these projects.

- But in the last resort, it is the farmer who uses the machines. Everything will depend upon his interest, on his values and on his expertise.

A rule can be derived from this inter-dependence[15]: any development of the whole of the system will react on one of its parts (agricultural mechanization) and vice versa. This is why the failure in agricultural mechanization is explicable (in part) by the difficulties encountered in the socio-economic development of Africa, particularly in the agricultural sector, and the destabilization of the African economies as a result of internal factors (social, cultural and economic changes as in the field of education, the ethnic or political divisions, rural depopulation, etc.) and by external factors (world economic crisis, foreign debts, the role played and pressure exerted by foreign companies, patterns of food consumption, etc.).

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(14) For example, developing "no-tillage" techniques would make cultivating operations pointless and make the heavy tractorization model obsolete.

(15) See the FAO study "Agricultural Mechanization in Development. Guidelines for strategy formulation" - Rome 1981, distributed to the participants.

In return, the inadequacies of mechanization policies have contributed to this overall situation, to the poor performances by agriculture, to exacerbation of the problems of the rural areas (under-nourishment, under-employment, rural depopulation, low income, etc.).

12. A badly phrased problem

- The failures of agricultural mechanization indicate some inadequacy in the classical development theories in grasping the intrinsic finalities of development in general, of agricultural and rural development, the true participants (the people who must be mobilized and involved, in particular, the peasant farmer), and the actual conditions where the battle can be won (on the ground, at the "daily" level)[16].

- The "productivist" mechanization approach, which favours the quantity produced, the short term financial profitability and the condition of "solvency" to the detriment of the essential needs of the population and of other problems central to development (under-employment, salaries, town-country equilibrium, etc.). The problem of solvency is certainly central, but it is also inappropriate where, at the outset, it is a question of equipping poor populations living in a subsistence economy and therefore by definition "insolvent" (on a short term) according to classical criteria.

- Mechanization was considered in the first instance as a substitute form of energy for human labour in order to maximize productivity per farmer, whereas in Africa, mechanization must aim at complementing man and machine (and animal when its use is possible) in order to maximize the productivity of the land and feed the whole population (this latter growing by nearly 3% per annum) and to create employment in rural areas.

- The lack of attention given to the conditions and equilibria of the ecological environments concerned (exhaustion of land, erosion and desertification) but particularly to the social context and to African cultural values. The aspirations of the rural population itself (safe food supply, independence, a desire for modernization coupled with a certain measure of distrust and the elimination of arduous tasks), their customs but also their cultural techniques, are all factors which have not been taken sufficiently into consideration. If poverty is essentially the central core of under-development, it is above all the failure to understand and mobilize the African individual and his rural family which is the main reason for the failure to overcome this poverty and to increase agricultural productivity. This is particularly serious in Africa when attempts are made to adapt the man and the environment to the machine and not the reverse. One disturbing factor is the attitude of many of the African rural population who, after two decades of development, exhibit two opposing tendencies: migration to the towns (mainly by young people) or a withdrawal into the traditional community life. Both of these uncontrolled attitudes are responsible for a fantastic abuse of human and national resources and underlie problems that are becoming more and more uncontrollable (such as city growth), and carry the seeds of economic and social eruptions.

(16) General errors of orientation made regardless of the political and ideological orientations of the countries concerned, and whether they are "supplier" countries or African countries.

- The harmful gap between the production and use of agricultural equipment. Traditional hand tools made by smiths and imported tractors are two extreme examples illustrative of the association/disassociation between these two levels of production and the use of agricultural equipment. The fields of equipment design, field tests, training of the users, maintenance and the supply of spare parts show the prime importance of this link between manufacture and use. Recourse to imported materials (an average 90% of the market) and even the selection of industrial manufacture concentrated in urban areas, will bring with it a considerable risk of the breakage of this link and of final failure. Indeed, one of the strengths of the craftsman resides in the fact that he lives on the spot, knows the users and their requirements and can undertake the maintenance and simple essential repairs of the equipment.

1.2 Limits of the technological systems of mechanization

Three major systems currently characterize mechanization in Africa: manual cultivation using hand tools (dominant), cultivation using animal traction and motorized cultivation(17).

The three systems each have their own limits and characteristics, as shown in detail in Table A. None of them individually can solve all the problems of mechanization which are of great diversity: variations of soils, climates, crops, methods of cultivation, systems of land tenure and the users' levels of purchasing power, technical competence and values. None of these constitutes a complete and all powerful system of mechanization. Ignorance of the intrinsic limits of these models has been a major cause of the difficulties encountered, and to this must be added poor appreciation of the actual conditions of use. Thus the heavy tractorization model necessitates work on land development, on transport and repair infrastructures, on regular supply of spare parts and implies a high technical competence of the operators. These conditions can rarely be found together, leading to considerable increases in the actual cost of the model and to a considerable reduction in its theoretical efficiency.

One simple question is worth asking: "Why have other and more suitable systems or equipment not been developed, at least at a representative level ?". There are a number of complementary reasons:

- the limits of these mechanization models were not known; on the other hand, the "myth of the tractor" was very strong, in view of its success in the agricultures of developed countries;

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(17) Essentially expressed by using standard tractors of medium and high horsepower, possibly combine harvesters and also public works equipment.

Table A - Present characteristics of the mechanization in Africa with respect to the three principal farming/mechanization systems

Farming systems / Characteristics	Hand farming	Animal drawn farming	Tractorization
Bases of the system	Agricultural system basically man-dependent, using human strength to accomplish all tasks, either directly or with the aid of simple traditional tools.	Agricultural system based on the use of animals to carry out all or part of the agricultural work. This implies a complementary agriculture/ husbandry system and the use of animal drawn equipment.	Agricultural system making use of the motor and more precisely of the tractor to carry out all or part of the agricultural work. This implies in particular a corresponding set up of the environment to ensure the operations of machines and sets of heavy equipments.
Machines used	- nil (picking) - simple tools (machette-hoe) - simple machinery to be carried (back carried sprayer) or pushed (cart-hoe) or stationary (sheller-pump)	- simple machine (cart-swing-plough - harrow) - more sophisticated machinery (plough - sower - multicultor)	- tractor with heavy equipments (plough - disk harrow - sower drill-trailer) - motorized fixed machinery (thresher - motopump) - self-propelled machine
Initial investment level *	* The purchase cost of the equipments corresponds to about . US$ 10/labourer/5 years for simple hand tools . less than US$ 100/labourer/ 5 years for simple machinery	* The purchase cost of the equipments is evaluated at US$ 325/10 years To this is added the cost of purchase and rearing and training an animal evaluated at US$ 400/animal (ox)	* The cost of motorized set of equipment including one tractor (45 HP) is evaluated at . US$ 11,000/8 years and US$ 16,000 if a thresher is included.
Agricultural operations performed with appropriate equipment	- partial clearing - light preparation of soil - upkeep and protection of cultures - help to harvesting and to the transformation of products	- light preparation of soil - sowing - upkeep of cultures - light transportation	- preparation of soil - sowing - transportation - accessorily: threshing - irrigation
Types of crops affected	All crops: . food crops based on cereals roots or fruit . cash crops, annual (cotton - groundnut) or perennial (palm tree - sugar cane) . for export (coffee - cocoa - citrus fruit)	. Crops based on cereals (rice - corn - millet - wheat) . Annual industrial crops (cotton - groundnut - tobacco)	- crops based on cereals (rice - corn - wheat) - annual industrial crops (cotton - soya) or pluriannual (sugar cane - bananas) - perennial crops (palm tree - coffee - cocoa)
Present limits	* Productivity remains low	* Taking into account the strength of the animals and the present technological limits, few operations and cultures can profit from mechanization, especially among the tuberous food crops.	* Some operations can be mechanized easily (transportation) . Others not so easily because they require a treatment of the parcels of land (land clearing, anti-erosive terrasses) or a change of technique (flat culture or line culture) . Finally, some operations for example harvesting can rarely be mechanized.
Categories of farmers and farming units affected	- small individual farming of the family type (less than 5 Ha), but also - medium and large plantations where much of the work is still manual.	- individual exploitations of medium size family type (less than 20 ha) the agricultural production of which is especially based on cereals	- middle or large size farming where production is based on cereals or industrial crops including: . some family farming of more than 20 ha . large private farming . private, mixed or State agro-industrial units . State farms . production co-operatives
Present limits		* All non-mechanized work using animal drawn equipment in farming is done by hand and exceptionally with the use of motorized machines such as deep tilling	* The degree of mechanization of labour is rarely total but in general limited to a few cultural operations, requiring consequently the use of human labour

* These estimations are taken from the FAO study entitled "The demand for agricultural machinery and equipment in Africa up to the year 2000".

Table A (continued)

Farming systems / Characteristics	Hand farming	Animal drawn farming	Tractorization
Positive aspects of different systems	- low level of investment with direct supply available to farmers from local blacksmiths - the system is adapted to the agro-ecological environment (cultivation on ridges with several types of plants on the same parcel) - the conditioning of the land concerns basically the control of water - no training is essential	- introducing animal drawn farming allows to relieve some bottlenecks (preparation of soil) and makes transportation easier - the investment level is limited and made profitable by an increase in production - conditioning is easily feasible by farmers (partial grubbing and land clearing) - maintenance can be carried out by local artisans and blacksmiths - production can be by craftsmen or industrial without requiring major investments in equipment - the low degree of complexity requires little supervision - the system adapts to the agro-ecological environment without disturbing it	- introducing heavy mechanization allows: . to valorize waste land . to increase production by expanding arable land . to carry out some arduous work (deep tillage) . eventually to improve the valorization of inputs by introducing modern farming techniques - Very high attractiveness of the tractor, as a synonym of modernity - Can compensate for a lack or absence of farm labourers.
Present limits and bottlenecks of production systems	- Low productivity of workers using simple tools, does not allow progress beyond the subsistence level - Refusal of youth to continue working using traditional methods (arduous and demeaning tasks) - Overall under-equipment of farms especially in terms of harvesting, storing, processing and transport	- Low productivity level corresponding to strength of animals - Several operations, in particular tuber farming cannot be mechanized - Need to raise animals (grazing areas or keep fodder crops) - Absolute need to resort to credit to purchase animals and equipment, granted to co-operatives only and in the framework of development operations - Need to set up a supply system for spare parts (maintenance) - Low level of interest shown by the young who dream of modernization through motorization - The development of animal drawn farming is limited to . areas of traditional husbandry . rather flat regions only slightly infested with parasites (tse-tse) . and applicable only to few types of farming (in particular harvesting constitutes a bottleneck) . competitivity in the use of land for husbandry or for crop growing in densely populated areas	- Lack of local manufacturing and difficulty to import for some "poor" countries - Weak conditions of infra-structure (patches hard to reach - distribution networks hard to establish) - Badly prepared territory (land clearing - anti-erosive terrasses) - Little adaptation of equipment and farming techniques in Africa in particular food crop farming - No system of farming credit adapted to the purchase of equipment - Low productivity of farming (in particular food crop farming) - Low level of income of family production units - Increasing discrepancy between cost of mechanization and sale price of agricultural products - Low level of training and competence of technicians to use and maintain equipment - Operating costs very high - Favours soil erosion

- foreign and local business circles had a strong interest in the development of heavy equipment;

- the scattered nature of efforts to promote other techniques, often locally and on a small scale;

- the lack of purchasing power of the customers concerned and generally the lack of organization and of credibility of demand[18].

14. The inadequacy of political measures and options

The preceding analysis shows the general absence, in the majority of countries, of a clearly expressed and controlled mechanization policy[19], and the absence of an industrial policy for the local manufacture of the machines. At a financial level that part of financial resources devoted to agricultural investment (in particular traditional) and especially to mechanization is often still very low. Agricultural equipment in Africa represents, on average, only 4% of the total of mechanical and electrical products imported. Investment in agricultural equipment is equivalent to only one hundredth of the agricultural production of the African countries (south of the Sahara) ! Agriculture, in general, receives on average less than 10% of public expenditure (22% for administration, 15% for education)[20], while 30% of the population depend directly on this sector. Moreover, these figures relate to agriculture as a whole. In fact, an average of perhaps 90% of these overall limited funds go to the "modern" farming sector, and only a very small part to traditional agriculture. A similar inadequacy exists in respect of the production of agricultural equipment: whilst the value of the products of the manufacturing industry in Africa is estimated at $ 28 billion industrial production of agricultural machines accounts for less than 0.5% of this amount (in added value) !

Since 1975 many people have become acutely aware of the failures and mista made in the past within the countries, by international organizations and by development specialists. These changes are clearly expressed in the national development plans and in the Lagos Plan of Action in which agriculture and nutritional self-sufficiency have become the basic objectives.

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(18) In this field, the enquiry carried out involving eight multinational companies during the first world-wide study on this sector, carried out by UNIDO in mid-1979, showed the reluctance of these companies to develop products specifically suited to the African market because of the narrowness and the uncertainty of the possible outlets (the African market represents only 3% of world imports of agricultural machines).

(19) See FAO study quoted on (15), page 9 of this note.

(20) These ratios are taken from the World Bank Study "Accelerated Development in Sub-Saharian Africa - An Agenda for action", Washington, 1981.

III. ELEMENTS OF INTEGRATED AGRICULTURAL/INDUSTRIAL STRATEGIES

The need for mechanization strategies based on new relationships between agriculture and industry formed one of the central points of the debate and of the agreement achieved during the first world-wide consultation on the sector[21]. The question now is to go beyond this point and attempt to define the basic aims of such strategies in the case of the African countries, on the basis of the information on the present situation supplied by the diagnosis, of the challenges in the immediate present and the future in the field of agriculture and foodstuffs, and of the whole general framework of African development defined by the African policy-makers themselves (Lagos Plan of Action).

A) The challenges from now until the year 2000 and the objectives of the Lagos Plan of Action:

15. For the African States the third decade will primarily be one in which several important problems will have to be faced:

- accentuation of population pressure (2.92% growth per annum between 1975 and year 2000 will mean a population of 639 million in the year 2000 for Africa south of the Sahara), which means a sharp rise in food requirements, a worsening of underemployment (agriculture employs 80% of the work force, and this latter should grow by 2.8% per annum on average between 1980 and the year 2000, as against 2% in the preceding decade)[22];
- a continuation, if not an increase, in the rural exodus (current level approximately 6%);
- a reduction in the reserves of cultivatable land (less than 1% increase per annum) and hence a reduction in the average ratio of cultivatable land/population to be fed;
- a worsening of balance of payments deficits;
- destabilization of the social systems.

The FAO Studies[23] allow a quantitative measurement to be made of these developments, forecast from now until the year 2000; the growth in the foodstuffs requirements for the whole of the continent will necessitate an annual growth in agricultural production of 3.9% between 1980 and 1985 and 4.2% between 1985 and 1990, namely four times the growth recorded during the course of the preceding decade (approximately 1% per annum).

Such results presuppose a very marked increase in investments in agriculture, of more than 4% per annum; their volume ($6 million in 1975) would double or triple

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(21) See the report on this Consultation (ID/239/ID/WG.307/9/Rev. 1) pages 13, 14 and 15. The problems of such strategies are presented in the First World-wide Study, UNIDO/ICIS 119, Chapter IV, pages 142 to 149.

(22) Source: Study by World Bank quoted above, see note 20.

(23) "Agricultural-Horizon 2000" - Rome 1981.
Regional Food Plan for Africa. ARC/78/5, July 1981.

from now to the year 2000 according to the proposed scenario (in constant dollars). The part of agricultural mechanization in the total amount of these investments would increase from 20% in 1975 to 35% in the year 2000.

16. These challenges have been perceived by African authorities and clearly expressed in the Lagos Plan of Action; the main sections relating to agriculture and mechanization are quoted below:

*17. At the root of the food problem in Africa is the fact that Member States have not usually accorded the necessary priority to agriculture both in the allocation of resources, and in giving sufficient attention to policies for the promotion of productivity and improvement of rural life.

18. For an improvement of the food situation in Africa, the fundamental requisite is a strong political will to channel a greatly increased volume of resources to agriculture, to carry through essential reorientations of social systems, to apply policies that will induce small farmers and members of agricultural co-operatives to achieve higher levels of productivity, and to set up effective machineries for the formulation of relevant programmes and for their execution. The development of agriculture, however, should not be considered in isolation, but rather integrated within the economic and social development processes. Emphasis should also be put on the latter aspect, particularly the problem of improving the conditions of rural life.

19. For an effective agricultural revolution in Africa, it is essential to involve the youth and to arrest the rural-to-urban drift. Policies have to emphasize consistently the need not only to improve the living conditions on the farms but also to increase farm real incomes as a means of making agriculture more attractive and remunerative. New dimensions of inter-country co-operation are called for, but primary responsibility for a break-through in food and agriculture lies with individual Member States operating in their respective national contexts.

20. Over the years 1980-85, the objective should be to bring about immediate improvement in the food situation and to lay the foundations for the achievement of self-sufficiency in cereals and in livestock and fish products. Priority action should be directed at securing a substantial reduction in food wastage, attaining a markedly higher degree of the food security, and bringing about a large and sustained increase in the production of food, especially of tropical cereals with due emphasis on the diversification of agricultural production. Urgent measures are recommended in each of these areas.

Food production

25. Food development must be promoted in an integrated manner, and should take into consideration the problem of transportation and distribution of farm products at the level of consumers. Food self-sufficiency should take into consideration the nutritional values of foodstuffs and solve simultaneously the problems of under and malnutrition.

26. The set-up of agricultural production should be based on adequate and realistic agrarian reform programmes consistent with political and social conditions prevailing in respective countries. Improved organization of agricultural production must be given priority so as to increase agricultural production and productivity.

* Numbering of paragraphs in the Lagos Plan. UNIDO is responsible for the underlining.

Op. cit., see footnote 1, page 1.

(a) Food crops

28. All Member States should adopt necessary measures for the implementation of regional food plan for Africa adopted by African Ministers of Agriculture. The main immediate objective should be to bring about quantitative and qualitative improvement in food-crop production (cereals, fruits, tubers, oil seeds, vegetables, etc.), with a view to replacing a sizeable proportion of the presently imported products. Besides, the production of these food products should be encouraged in countries which have the potential for these crops. More particularly so as to replace the increasing demand for wheat and barley, special attention should be given to the cultivation of cereals such as millet, maize and sorghum.

29. Areas in which urgent action is recommended include:

- promotion of better agricultural practices, particularly the intensive use of improved input packages and plant protection measures;
- modification of techno-economic structures of production so as to provide small farmer and members of agricultural co-operatives with necessary incentives to increase production;
- better utilization of water for irrigated cereals on ongoing irrigation schemes, and initiation of new schemes;
- soil and water conservation;
- flood control and drainage;
- intensification of the use of improved hand tools and drought animals, and promotion of mechanized farming where justified;
- physical infrastructural development, including the building of small bridges, dams, access and feeder roads, and the improvement of education, health and other social facilities much of which at this stage should, as far as possible, be undertaken through voluntary self-help participation.

Agricultural services

41. Agricultural mechanization has a priority role in increasing agricultural production and in modernising farms. However, this problem must be studied very carefully and should be related to industrial development so that it will not further increase the dependency of Member States on the developed world. In the process of agricultural mechanization, special emphasis should be put on animal traction in countries that have not yet reached the appropriate level of motorization.

Industries

52. Member States accord, in their development plans, a major role to industrialization in view of its impact on meeting the basic needs of the population, ensuring the integration of the economy and the modernization of society. To this end and in order for Africa to achieve a greater share of world industrial production as well as to attain an adequate degree of collective self-reliance rapidly, Member States proclaim the years 1980-1990: Industrial Development Decade in Africa.

56. The industrialization of Africa in general, and of each individual Member State in particular, constitutes a fundamental option in the total range of activities aimed at freeing Africa from under-development and economic dependence. The integrated economic and social development of Africa demands the creation, in each Member State, of an industrial base designed

to meet the interests of that country and strengthened by complimentary activities at the sub-regional and regional levels. Industrialization of this kind will contribute, inter alia, to:

(a) the satisfaction of basic needs of the population;

(b) the exploitation of local natural resources;

(c) the creation of jobs;

(d) the establishment of a base for developing other economic sectors;

(e) the creation of the basis for assimilating and promoting technological progress;

(f) the modernization of society.

Medium-term objectives up to the year 1990

66. To attain self-sufficiency in the following sectors: food, building materials, clothing and energy:

Production in sufficient quantities of agricultural inputs such as fertilizers, pesticides, agricultural tools and machines.

From these extracts from the Lagos Plan of Action, the following essential points should be noted:

- the multiplicity of the objectives sought: improvement in the quantity of food products, combined with a search for self-sufficiency and assurance of food supplies, also development of employment, income, living conditions, all steps to make the agricultural life more attractive and modern;

- integration of agricultural development with the whole of the social and economic development process and, in particular, with rural development;

- the diversity of the spheres of action justifying the production of a wide variety of agricultural plant and equipment (assurance of food supply, substantial reduction in losses in storage, transport and distribution, improvement of the physical infrastructures, control of water and irrigation, etc.);

- the production of agricultural tools and machines in sufficient quantity to reduce dependence on the industrialized world, within the framework of an industry catering for basic essentials and of the modernization of the society.

Attention should, nevertheless, be drawn to the apparent contradiction between the necessity for a proper policy for equipping agriculture and the rural world (which is essential in view of the preceding objectives) and the limited importance attributed to agricultural plant, considered as an input in the same class as fertilizers and pesticides (see paragraphs 29 and 66).

B) Two basic strategic approaches

17. In practical terms, each African country today finds itself faced with the need to increase the production of agricultural machines and equipment considerably so as to meet the needs of agriculture and of the rural populations (to reestablish the offer/demand equation). This problem revolves around two basic questions:

- What types of mechanization, and which agricultural equipment is necessary ?
- How can they be designed and produced in adequate quantities, using local resources ?

Thus the problems of the national strategy for the manufacture of agricultural equipment rest first on knowledge of the requirements, the demand, connected to mechanization technologies but also to other aspects of mechanization and of the agricultural policy (credit system, development structures, farming techniques and input supplies, training of peasant farmers, etc.). The anticipated characteristics of the mechanization technologies are thus found to be at the very heart of the problem. Here, two choices are possible which underly different strategies:

- acceptance of a continuation of present trends in mechanization;
- a search for new and different ways.

a) Continuation of current trends in mechanization:

18. The three dominant systems of mechanization (manual cultivation, animal drawn cultivation and motorized cultivation) have previously been analysed. A kind of "historical mechanization" would lead, of necessity, to the almost total replacement of power of mechanical origin (represented in particular by heavy tractorization) by human labour, passing where possible through the stage of animal traction. This movement would be inescapable, since it constitutes the only possible response to desertion of the countryside by rural inhabitants, attracted by the very superior salaries and living conditions in the towns and to the necessity for a marked increase in agricultural activity and the control and bringing under cultivation of new reserves of land. The existing system for mechanization would not be fundamentally altered but simply adapted by seeking to control the conditions under which it operates and the interdependence of its factors, and to plan its development.

The local production of agricultural equipment would be geared towards the manufacture of hand tools in larger quantities and of better quality, and of animal drawn equipment, would strengthen the experiments with small and simple items of equipment, of local assembly of tractors, or of other heavy plant, or perhaps integrated local production in some cases (Algeria, Egypt, Kenya, Tanzania, etc.).

However, dependence on overseas imports of raw materials and high technology items would remain a permanent obstacle. Orientation towards motorized equipment of high technological complexity would reduce the level of self-sufficiency and of local or regional supplies for the great majority of the African countries in a low or medium state of development.

19. In preparing for this Consultation and at the request of UNIDO, FAO carried out a study[24] on the future development from now until the year 2000 of agricultural mechanization and the demand for agricultural equipment by African countries. On the basis of certain hypotheses (see the document sent to participants), this work permitted a quantitative and qualitative description of the needs for equipment to be produced by country and sub-regions[25], giving emphasis to the three traditional power/energy sources in agriculture: man, animal and machine. In 1975, these three sources represented 83%, 13% and 4% respectively of the energy consumed by African agriculture. These ratios will have changed to 82%, 11% and 7% by the year 2000, as a consequence of average annual growth rates of 3%, 1.3% and 8% respectively. The annual demand for tractors will grow from 40,000 units in 1980 to 174,000 before the end of the century. The gross annual investment costs in tractors will increase from US$ 500 million in 1980 to US$ 880 million in 1990 and US$ 2.1 billion in the year 2000.[26]

Using a normative approach (an attempt is made to satisfy the theoretical requirements for agricultural mechanization), but assuming that the trends towards heavy mechanization continue, the forecast as a whole forms a very useful reference basis for consideration and discussion. The influence of recent trends, the actual projects of the participants and the major constraints of the African countries on the realization of the proposed scenarios can thus be envisaged.

b) Seeking and promoting new ways for mechanizing agriculture

20. These derive logically from the limits and failures of traditional methods of mechanization, the importance of the new challenges presented by agricultural mechanization (from taking into account the objectives of the African countries expressed in the Lagos Plan of Action), and from the desire to re-establish from the start the link between manufacture and use of agricultural equipment.

The logic of this approach is to reconsider the problems of agricultural mechanization in relation to its key functions, the main participants (the peasant

(24) "Agricultural Mechanization and the Demand for Agricultural Machinery and Equipment in Africa up to the Year 2000. An analysis of Results and Implications of the FAO Study at 2000", by H.E. Jahnke and M. Sievers, Universität Kiel - Institut für Agrarpolitik und Marktlehre, June 1981 (this document has been sent to the participants).

(25) See Annex, Tables 3 and 4, pages 40 and 41.

(26) These data were extracted from the study quoted in (24) and relate to the "pessimistic" scenario B. It is in constant 1975 dollars. If it is recalled that the industrial production of agricultural equipment in Africa was estimated at about US$ 150m in 1980, it can be seen that the imports of tractors and related equipment alone amount to more than 5 times the value of production!

farmers) and the specific constraints of the environment and of the country.

21. The basic functions of agricultural mechanization in the majority of the African countries (taken from the diagnosis and objectives of the Lagos Plan)

In order to give the rural world the means of breaking away from its basic constraints and of controlling its own development in the long term, agricultural mechanization must:

- Contribute, as a priority, to growth in staple crop production by farmers, on the basis of their essential needs (nutritional self-sufficiency, elimination of the most arduous tasks and reduction of the time taken) and their legitimate aspirations (evolution towards better living conditions, security and independence, increase in incomes, etc.)[27];

- Effect overall equipment of agriculture and of the rural world, favouring progressive modernization of agricultural holdings and their integration into the whole of socio-economic development;

- Increase jointly the value of the factors of human labour and cultivatable land, mainly by intensification of agricultural production;

- Take account of the modifying factors which could profoundly and rapidly alter the dynamics of the agricultural and rural system (rural depopulation, literacy, spread of knowledge, etc.);

- Reestablish the integrity of the relationship between production and use of agriculture equipment, and develop local production of such equipment by mobilizing the whole of the national productive capacity. This equipment must be suited to the needs and aspirations of the peasant farmers (and not the reverse) and to the local conditions of use and maintenance.

It is essential to note the difference which exists between these functions and "tasks" of mechanization and the narrow traditional concept of mechanization, associated strictly with the working of the soil and immediately translate it into terms of products (hand tools, animal drawn equipment, and tractors). The problem is of an entirely different dimension. It is for this reason that it must be expressed by a different concept (that of equipping agriculture with the means of production) and effected with suitable new means: the search for new technological systems of mechanization appears as a primary condition which will allow this change.

22. The opening up of technological systems for mechanization in which agriculture, crafts and industry are complementary and interdependent

The limits and failings of the dominant systems of mechanization (hand tools, animal-drawn cultivation and classical tractorization) have been described above.

(27) It is only on this condition that the peasant farmer can both produce enough to meet the needs of the population as a whole (and that of the urban centres in particular) and also for export.

Are these systems, where they exist, the ones most capable of meeting the immediate challenges and objectives of the Lagos Plan ? The answer to this is a categorical no. The ratios taken from the FAO works concerning the proportions of the various energy sources, are essential in this respect (see preceding page).

- It is imprecise to see the exclusive key to the problems of mechanization in Africa in the development of animal-drawn farming, since this part of the system will be in overall decline;

- The mechanized proportion will only increase from 4% to 7% of the total energy requirements. Thus, with the exception of some countries, the importance of classical mechanization will remain low, although it will concentrate more than 80% of the financial resources devoted to mechanization and will involve only a minority of the peasant farmers;

- Human labour, at more than 80%, will remain the essential source of energy and labour in agriculture. Must traditional hand tools remain the almost exclusive form of man-machine association for many hundreds of millions of African individuals, even though imports of modern manufactured consumer goods or equipment intended for the middle and privileged classes of African towns are increasing ?

It is thus necessary to leave this "primary era" of agricultural mechanization and to develop equipment and technologies which would help improve, complete, enlarge the current dominant systems. Although unsatisfactory as a whole, these cannot be ignored since they are supported by strong trends.
It will be necessary to look for different and/or complementary systems of mechanization, allowing true chains of mechanization of a progressive nature to be set up. Such technological systems of mechanization must make use primarily of the small peasant farmers' equipment and envisage a progressive transition between the traditional system and the modernized system, together with development of local manufacture of agricultural equipment, supported on the two essential and complementary pillars of industry and the craftsman.

It has become abundantly clear that these systems and equipment must take into explicit account the whole of the fixed and mobile production equipment associated with the agricultural process as a unit, land equipment and equipment from the associated rural environment and activities (transport, transformation). Table 3, page 40, in the Annex, shows the essential role of these items of production equipment in investment, in particular for countries south of the Sahara.

Table B shows in simplified fashion the potentialities of the three main types of production unit (village blacksmiths, small workshops and industrial units) for the manufacture, maintenance, the supply of spare parts or the sub-contracting of a wider range of agricultural plant and equipment. It shows the first possibilities in this adjustment of the agriculture/craftsman/industry relationship.

In positive terms, the necessary opening up of the technological systems required can be achieved in the three complementary ways proposed below:

Route 1: The promotion of basic equipment for traditional peasant farming units, with the emphasis on food crop production;

Route 2: The progressive modernization of agricultural holdings by using simple machines (motorized or otherwise) in line with the individualized mechanization of various operations;

Route 3: An equipping process based on the essential function of transport.

C) Three new routes to mechanization, based in particular on the local production of equipment

a) Route 1 : Production of basic equipment for traditional peasant farming units, with the emphasis on food crop production.

22. The fundamental underequipment of peasant farmer units

The traditional farming sector represents the majority of the population of the African States, living essentially at subsistence level, practising manual cultivation with traditional techniques and having little time for the production of cash crops. In particular the equipment is limited to some simple tools bought on the local market (hoes, machettes, etc.) and sometimes some animal-drawn machines, which hardly allow agricultural production to expand nor efficiently remove the factors affecting the insecurity of the food supply (crop protection, control of water supplies, etc.).

Thus the promotion of basic equipment made up of simple materials within the farmers production system should give priority to:

- increasing security in the production of food crops:
- reducing the difficulties of daily tasks;

Table 8. AGRICULTURAL EQUIPMENT, TECHNOLOGICAL LEVELS AND PRODUCTION STRUCTURES

Products			Activities		Production structure					
Class of products	Products showing an increasing degree of complexity of utilization in each class	Examples of equipment	Degree of complexity for manufacturing	Other agricultural machinery-related activities	Village blacksmiths* (and re-grouping of blacksmiths)		Small workshops and semi-industrial units		Industry* (having simple or multiple activities)	
Hand tools	1. Traditional tools	Hoe, machette, knife	A. Heterogeneous production (using recycled metal	E. Maintenance	A1	E1/E2				
	2. Modern tools	Cutter, saw, scythe	B. Homogeneous production (using current rolled bar materials)	F. Manufacture of spare parts			B1/B2			
			C. Quality control (with heat treatment	ST.Sub-contracting				ST2	C1/C2	
Hand-operated machinery and fixed equipment	1. Simple machines	Cassava scraper, husker, peeler, sheller, silo, dryer, pump	A. Assembly without manufacture of parts	E. Maintenance	A1/A2	E1/E2				
			B. Manufacture of simple and assembled parts	F. Manufacture of spare parts	B1	F1	B1/B2	F2/F2		
	2. Complex machines	Winnowing machine, thresher, mill, sprayer	C. Manufacture of all parts	ST.Sub-contracting		ST1		ST2	C1/C2	
Animal drawn machinery	1. Simple machines	Cart, simple plough, harrow	A. Assembly without manufacture of parts	E. Maintenance	A1/A2	E1/E2/E3	A2/A3	E3	A2/A3	
	2. Assembled machines	Share plough, multi-cultivator seeder	B. Manufacture of simple and assembled parts	F. Manufacture of spare parts	B1/B2	F1/F2/F3	B1/B2/B3	F2/F3	B1/B2/B3	F2/F3
	3. Complex machines	Equipment for treatment and harvesting	C. Manufacture of all parts	ST.Sub-contracting	C1	ST1/ST2/ST3	C1/C2	ST2/ST3	C1/C2/C3	
Intermediary motorized machinery	1. Simple fixed machines	Motorized pump, mill, thresher	A. Assembly without manufacture	E. Maintenance	A1	E1/E2	A1/A2	E1/E2/E3	A3	
	2. Mobile machines	Simplified tractor, motorized hoe	B. Manufacture of simple and assembled parts	F. Manufacture of spare parts		F1	B1/B2	F1/F2/F3	B1/B2/B3	F1/F2/F3
	3. Specialized machines	Portable sprayer, chain saw, under-brush clearer	C. Manufacture of all items (except motors) and assembly	ST.Sub-contracting			C1	ST1/ST2/ST3	C1/C2/C3	
Motorized equipment	1. Simple machines	Fixed platform trailer, fixed-tooth cultivator	A. Assembly without manufacture	E. Maintenance		E1	A1/A2/A3	E2/E3	A3	
	2. Assembled machines	Plough, disk harrow, gyro-crusher	B. Manufacture of simple items and assembly	F. Manufacture of spare parts		F1	B1/B2	F1/F2/F3	B2/B3	F1/F2/F3
	3. Complex machines	Seeder, sprayer, planter, harvester	C. Manufacture of almost all items and assembly	ST.Sub-contracting			C1	ST1/ST2/ST3	C1/C2	
Tractors and specialized machinery	1. Tractors	Standard, articulated, crawler, tractor	A. Semi-knocked down	E. Maintenance				B1/B2	A1/A2	
	2. Sophisticated machines	combine, cane harvester, cotton picker	B. Completely knocked-down	F. Manufacture of spare parts				F1/F2	B1/B2	F1/F2
			C. Total integration	ST.Sub-contracting				ST1/ST2	C1/C2	

* For each category, the manufacturing of agricultural machinery may represent a top activity or added to other activities (mechanical manufacturing - repairs - commerce or agriculture).

- clearing certain bottlenecks in the production cycles. This would also allow the local markets, and in due course the urban centres, to be supplied.

23. Definition and choice of equipment

In choosing equipment, farmers generally give preference to equipment which enables them to save their crops from climatic threats (threshers, hullers, specialized tools, etc.) and makes prolonged preservation and storage of products possible (driers, silos, etc.) equipment used in the daily processing of food products (mills, grinders, decorticators, etc.), for water supplies (lift pumps, irrigation pumps, etc.), and for transporting men and products (carts, light motorcycles, trailers, etc.).

From agro-sociological studies, and taking physical factors, food requirements and the constraints of the socio-cultural order into consideration, it is now possible to pinpoint certain types of specific basic equipment, characteristic of homogeneous socio-agro-ecological zones, which allow the fundamental requirements of the rural population to be satisfied.

This equipment can be broken down according to the different levels of social organization:

- Per labourer: one or two cultivating and harvesting implements in addition to traditional implements;
- Per family: a manual seed drill or planting machine, a manual thresher or huller, a stationary drier, a bin or silo and a hand cart or animal-drawn cart.
- Per group of families or village: a motorized mill or grinder, a manual lift pump, a motorized irrigation pump, and a small motorized vehicle for transport.

The overall investment will be between $500 and $1000 per family, over a minimum period of five years. At the present time, there is an infinite variety of types of machine of all sizes and complexity used (or having been used) throughout the world which can generally be adapted without difficulty to local conditions. Their promotion would require that they first be adapted technologically in such a way that the users could manage not only their use but also their maintenance and running repairs (importance of local or regional design and engineering capabilities), the search for economic solutions which will enable direct acquisition by the users (subsidy, credit, tax relief, etc.), and the

establishment in the country of networks for the manufacture, supply and maintenance of the equipment.

24. Manufacture of the equipment

The great diversity of requirements, allied to the extreme heterogeneity of agricultural production units, requires the production centres to be sited as close as possible, not only for manufacture of the final product but also for maintenance and repair. Decentralized craftsman production, supported upstream by national or regional industrial production for the manufacture of complex items (engines and gearboxes) or high quality sub-assemblies (semi-finished products, complex items, etc.), is a satisfactory way of balancing supply and demand.

Encouraging experiments, which generally remain very localized for various reasons, are already being reported from the majority of countries. In fact, at this stage, problems are arising in the training and organization of blacksmiths, and of supplying a variety of materials and equipment. Certain countries benefit, in this area, from wide experience in the production of animal-drawn equipment which can serve as a basis for widening the scope of production, and may even serve as a model for other countries.

b) Route 2 : The progressive modernization of agricultural holdings by using simple machines (motorized or otherwise), in line with the individualized mechanization of various operations[28].

25. Basic approach

Using a standard tractor (model taken from industrialized countries) each machine can be drawn by the tractor, performing a series of farming operations. If the motor unit is immobilized for a long period, or if it is impossible to carry out work at the right time, there will be a systematic drop in production. On the other hand the size and cost of the equipment will necessitate grouping farmers into cooperatives in order to make efficient use of equipment.

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(28) Also known as "task mechanization" or "specific mechanization".

At the other extreme each farming operation may be performed separately, the machine being operated manually or by means of a suitable small motor. Specialized machinery may be purchased progressively, the farmer himself determining his choices and priorities on the basis of his technical needs and his economic situation (main crop, level of income, etc.). This formula, based on the rational mechanization of holdings, allows the burden of debt to be reduced, the technical knowledge of the peasant farmers to be improved over a period of time, and the farms to be progressively modernized.

26. Definition and design of machines

A first group of equipment covers stationary, hand or motorized machinery, generally used after the work of cultivation: harvesting equipment (thresher, pod-stripper, huller, etc.), processing equipment (decorticator, mill, grinder, peeler, depulper, winnowing machine), and water handling equipment (water extraction, irrigation or drainage pumps, etc.). These machines, which are very widespread in the industrialized countries, currently constitute the basic equipment of large farm units or groups of holdings in many African States.

A second group of equipment, made up of mobile machines, allows some cultivating work to be mechanized: soil working equipment (power driven cultivator, sowing and fertilizing equipment (small seed drill, fertilizer spreader, planting machine, etc.), and miscellaneous equipment (drill). These machines are simply drawn or pushed or driven by a small motor and manually operated.

A third group of equipment covers light machines carried by the user, allowing certain operations to be mechanized without modifying the cultivating systems: treating equipment (back-pack dusting equipment, sprayer, low-volume spreader, etc.), and equipment for destroying invasive plants (rotary hoe, brushwood killer, etc.).

All these machines are, in general, relatively simple in design and easily operated, even by operators with little experience. On the other hand the very large number of models and types enables the very great diversity of farm products to be taken into account whilst still allowing the basic components (for example, the engine) or the operating principles, to be standardized to the

greatest extent. Motors[29] are often synonymous with modernization, and not using them for driving small machines would condemn the peasant farmer to a permanently archaic technology.

27. Production of equipment

The majority of machines result from the assembly of certain more or less complex mechanical sub-assemblies whilst generally retaining the same operating principle for a particular family of products. Thus it is possible to break down manufacture into three distinct groups which can be carried out by complementary units:

- Economic production, on a very large scale, of independent complex units (engine, gearbox, etc.), manufactured, if necessary, under licence from components which have been tested over a long period by national or regional industrial units;
- Medium or small scale production of simple, but specialized, independent mechanical sub-assemblies (mills, threshers, pumps,etc.) carried out by craftsmen or semi-industrial enterprises.
- Assembly of units on basic chassis by decentralized craftsmen enterprises, fully equipped for jobbing work, and simultaneously undertaking maintenance of the equipment.

The production scheme based on the interdependence and complementary nature of the production units would permit very considerable flexibility in adapting the products to the actual needs of the market.

c) Route 3 : An equipping process based on the essential function of transport

28. The prime importance of the transport function

Transport constitutes a major constraint at the heart of any agricultural system, related to scatter and to the distance from the places of work, both for transporting people and for conveying products of every type (water, wood, materials, agricultural products, etc.). At the present time the most common method, in the absence of control of the infrastructures and for the most deprived populations, is for the individuals or the animals to transport themselves (transport on foot).

(29) The motor itself no longer constitutes a fundamental obstacle, and is currently experiencing a rapid and widespread distribution in Africa: two-stroke petrol engines for the motor scooter and power saw or four-stroke for the car, motor pump, diesel engines for decorticators, mills, lorries and small electric motors on all vehicles. The infrastructure, which is still minimal, is following the spread of the equipment: fuel storage depots and stocks of standard parts, on the spot training of mechanics and repair men, and repairs carried out with recycled material.

The handcart remains in very limited use near urban centers; the bicycle and motorcycle, on the other hand, are becoming the favoured means of light transport. With the use of animal-drawn cultivation in agriculture the small cart is by far the most frequently used type of transport. Similarly in motorized cultivation the principal function of the tractor is still transport (by means of a trailer), this operation being, however, the only one which is motorized either on traditional or modern plantations, whether small or large. The change from one method of transport to another represents an improvement in the productivity of labour but, on the other hand, the opposing economic and technological obstacles and the constraints of cost and maintenance, the necessity for controlling the infrastructures (widening of roads, construction of bridges, etc.), will have to be mastered; the specific case of the use of animals necessitates an integration of agriculture with husbandry which is only possible in traditional stock breeding regions or where land reserves are adequate.

29. Definition of equipment

The predominant function is that of transport but also the drawing of equipment currently used in animal-drawn cultivation. The technological design must allow manufacture, maintenance and repair both locally and nationally, simplicity in operation, and comparative multi-functionality in use, with the capability of being specifically adapted according to the dominant crop. This could be a small carrying vehicle[30] (with a working load of 300 to 500 kg), and capable of drawing (tractive power equivalent to that of one or two pairs of oxen), which looks like a standard tractor. It differs profoundly, however, in being based, on the one hand, on the principle of assembly of simple components and readily available parts and, on the other hand, on its ability to evolve in time from an economic basic module for towing or carrying equipment or even for use at a fixed site. This equipment, driven by a low-power motor (5 - 15 HP), combines simplicity of design with a modern appearance and, in particular, opens the route to equipping small traditional units and local manufacture.

(30) The name "simplified tractors" will not intentionally be employed for these transport vehicles. Nevertheless, it is today the "simplified tractor" concept which has given rise to a variety of experiments and developments in Africa, many of them promising (TINKABI, BOUYER, PANGOLIN, etc. tractors). This route, often known as "intermediate motorization", is based on similar reasoning to that presented here.

30. The manufacture of this type of transport vehicle

The design results from the assembly of complex components (engine/gearbox) on a mobile chassis, whilst seeking the maximum similarity to motorized stationary machines used. The production of independent complex components (engine, gearbox, hubs, etc.) would be drawn mainly from products widely available on the market for various uses (cars, industrial or public works machines, etc.). These components could be imported or manufactured in the country or in the sub-region in an industrial unit, by mass production, within the framework of licence agreements with companies whose products have been well tested on the market. The chassis components would likewise be drawn from materials currently available on the market (sections, sheet, nuts and bolts, wheels, etc.). Assembly could be carried out in specialist craft shops or semi-industrial units, as for current drawn or carried equipment. In particular, they should have the maximum similarity to current animal-drawn cultivating equipment in order to facilitate the transfer between the two systems and to simplify problems of manufacture and maintenance by standardization of the materials and components. Repair by replacement of components (engines, gearboxes, etc.) or widely standardized items (filters, tyres, etc.) would avoid prolonged immobilization. Rural craftsmen could possibly undertake repair of the components (after training and with adequate equipment).

* * *
*

The three routes proposed do not, properly speaking, constitute a replacement system of mechanization but rather different approaches to mechanization, not based exclusively on the product, the machine itself, but on a priority function and "target" (the basic equipping of the small peasant farmer and the transport function) and on a new way of responding to a problem (the progressive modernization of small holdings by the individualized mechanization of agricultural operations). These approaches combine, from the start, the requirements of design/manufacture/maintenance of agricultural equipment. The diversity of implements, equipment and plant is met by multi-functionality and complementarity of the productive structures, in particular the craftsmen, the small rural industry and industry proper.

The existence of these different routes to mechanization shows that the technological constraint can be overcome. This must also be true for the political constraint of the system. In fact, it is essential that the choice of mechanization to be undertaken in each country should rest on a clear and determined vision of the evolution of rural society and of its role in the rest of society. The desire to develop this agricultural and rural society, and the men, women and children which comprise it, by giving them the maximum opportunity and responsibility, implies reappropriation of the production factors (such as land, water, fertilizer, etc.), efforts at education and training, and the availability of the necessary plant and equipment for production. Any national policy for the mechanization and equipping of agriculture therefore assumes, from the start, that each government should define this desired evolution of the farming and rural society and develop, as a consequence, the necessary institutional and financial mechanisms.

Questions submitted for discussion

I) Questions concerning the first part: "The present situation and trends in agricultural machinery in Africa"

The picture of the state of agricultural mechanization in Africa, drawn up on the basis of 16 case studies conducted by African experts, aims at providing an intelligence of this situation. It is suggested that the participants at the consultation discuss the following major points:

Questions:

1. Amongst the features of the existing system of production already described, what are the essential facts that should be brought forward and discussed as being most relevant to the present realities, and forming the necessary basis for future development ?

2. What are the main factors in the crisis now facing agricultural mechanization in Africa, in respect both of demand and of production ? Is this crisis circumstantial and/or structural, "internal" to this sphere of activity, or connected with the general economic and social situation in African countries ? What are its potential dimensions at national, regional and international levels ?

3. What are the current trends and changes, within or outside the "system" of agricultural mechanization, which seem to be most significant for the future ?

II) Questions concerning part two: "A proposed explanatory framework"

The purpose of this chapter was to try to clarify the causes of the double structural imbalance observed: on the one hand the increasing gap between the enormous potential needs of African agriculture and of the mass of peasant farmers and a market of limited purchasing power (sometimes even regressing) and, on the other hand, the inability of the existing industrial manufacturing apparatus to respond to the requirements of this market in a significant fashion, this role being left essentially to imported equipment and technologies. Analysis has shown that agricultural mechanization cannot be regarded as a simple input in agricultural production but constitutes a decisive element in a complex, multi-dimensional system (political, economic, agricultural, social) where interrelationships between these elements of the system are fundamental.

Questions:

1. Does this integrated and broadened approach to mechanization appear to be a necessary frame of reference for consideration and discussion ?

2. Based on the overall explanatory framework already submitted, what are the key elements of the system of mechanization, the types of relationship and constraint which have been insufficiently perceived and overcome and which have brought about this double structural imbalance between needs, market and local supply ?

3. What are the main lessons for the future which can be drawn from the experience of African countries ?

III) Relating to part three: "Elements of integrated agricultural/industrial strategies":

African countries are confronted with enormous challenges in respect of food production and agricultural/rural development. These have been stated in particular in the Lagos Plan of Action. The great question facing each country is that of the choice between the continuation of present trends in the matter of mechanization or a policy of voluntary change, established on the basis of new objectives, technological systems of mechanization and modes of action. This latter orientation implies the necessity for each country to draw up and prosecute a proper policy for equipping agriculture and the rural community.

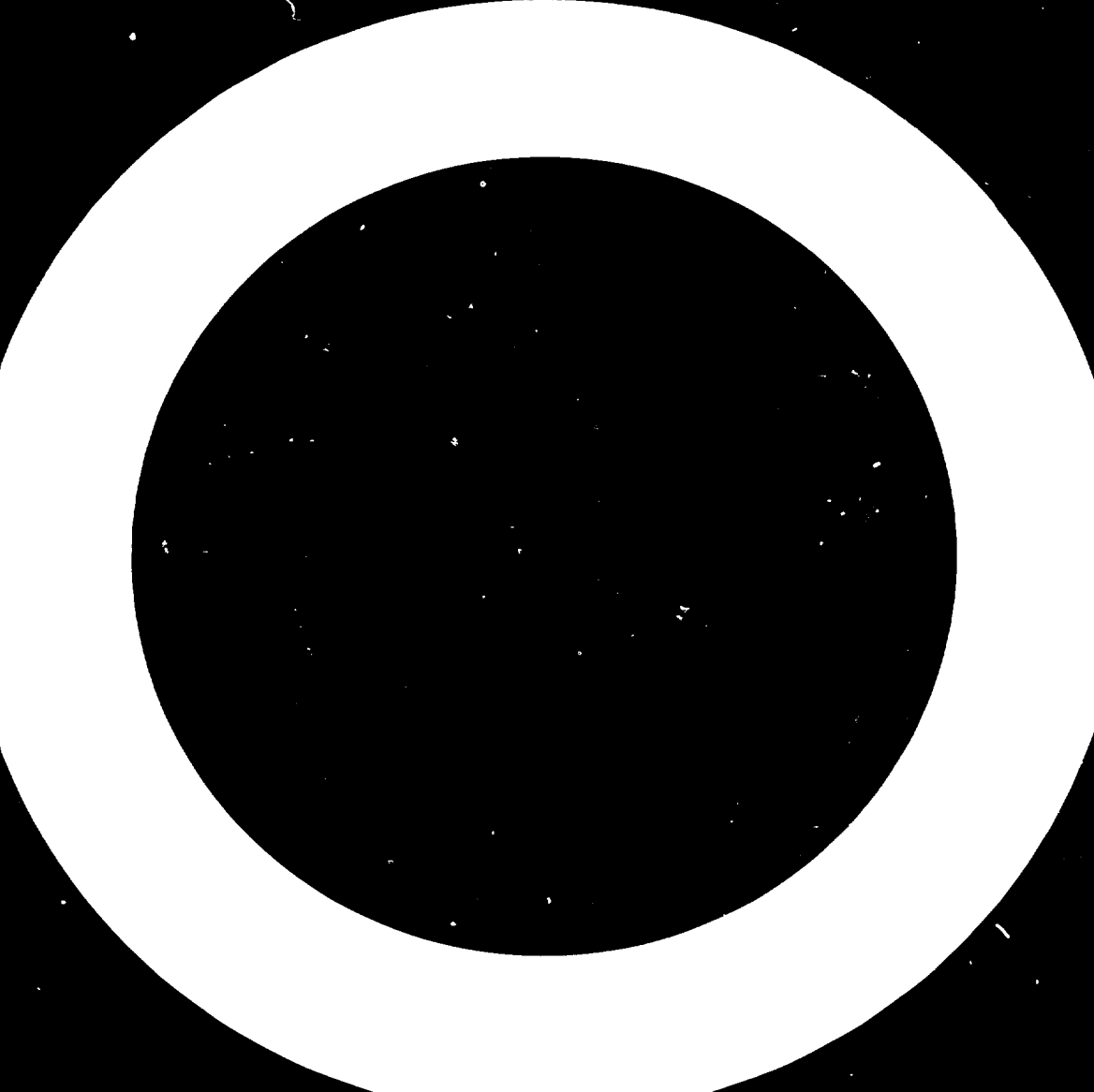
Questions:

1. Taking into account the challenges and objectives expressed in the Lagos Plan of Action, do the African countries feel that the present trends in mechanization and former strategies are, first of all, desirable and, if so, feasible ?

2. What routes to mechanization and alternative technologies appear capable of meeting the priority needs of the African countries ?

The three complementary routes described tentatively in this part of the document (promotion of basic equipment for the small peasant farmer, modernization of holdings by individualized mechanization of different agricultural operations and an equipping process based on transport as a priority function), in particular are proposed for discussion. The specific situation in each country or sub-region will be taken into account.

3. What are the practical conditions which will permit a positive break with the present unsatisfactory trends and a swing towards the proper policies of equipping agriculture and the rural population ?



ANNEX

List of Tables

Table 1a. Industrial activities connected with the production of agricultural machinery in Africa, by country and sub-regions, 1981

COUNTRIES	Number and name of industrial enterprises (starting date)	Juridicial Status	Staff	PRODUCTION: Agric. equipment only	PRODUCTION: Main activity	PRODUCTION: Types of agric. equipment manufactured	PRODUCTION: Number of units produced/year	Rate of utilisation of capacities	Particular characteristics
North Africa									
Algeria	4 SONACOME (units in Constantine, Sidi Bel Abbès and Oma)	public	5,960	no	Mechanical and metal constructions	Tractors, motors, combines and tractor equipments	3280 u.; 8000 u. 238 u.; 1400 u.(1979)		34,000 employees (total)
	SACRA	private	unknown	no	Agricultural machinery	Tractor equipment	6500 u. (programme 1981)		
	DAHOUN	private	100	no	Agricultural machinery		5300 u. (programme 1981)		
	ONAMA	public	unknown	yes			5700 u. (max.year (1977)		Main activity: import of agricultural machinery
Egypt	5 BENIERA COMPANY	public	500	no	Foundry + mech.constr.	Tractor equipment			
	TANTA MOTOR COMPANY	private	200	no	Agricultural machinery	idem+motor mount. on fixed equipment	4500 u. (1980)	100 %	Tractors import
	NASCO	public	unknown	no	Assembling of vehicles and motors	Tractor assembling, trailers	2500 u. (1980)	unknown	11,000 employees (total)
	EL SALLAM WORKS	private	unknown	no	Agricultural machinery			unknown	
	SISMAN COMPANY	private	unknown	no	Agricultural machinery	Tractor equipments			
Sudan	no industrial production								
Morocco	6 ATMAR	unknown	≃ 60	yes	Mechanical construct.	Tractor equipment	≃ 8000 units	≃ 30 %	
	COMAGI	unknown	unknown	yes	Assembling of tractors and equipment	disc harrows	200 units	unknown	Import and assembling of M.F. tractors and equipment
						trailers	30 units		
	INTERNATIONAL HARVESTER	unknown	≃ 60	yes	Tractor assembling and manufacturing of equip	disc harrows	50 - 100 units	unknown	Import and tractor assembling
	FRENDO	unknown	13	yes	Mech. construction	disc harrows	400 units	not fully realised	Import of 20-30 ploughs/year
						sprayers	30-40 units		
	STOKVIS	unknown	45	yes	Assembling				Tractor assembling FIAT
	BONDY-MAROC	unknown	60	no	Mining equipment	trailer bars, frames of disc harrows	60 units	60 %	
Tunisia	4 SOTUMO	public	90	no	Motor assembling	Diesel engines for irrigation pumps	4400 units	60 %	Project: mechanical complex for 2200 tractors, 700 agric. mach., 6250 diesel engines
	AMS	public	unknown	no	Manufacturing of var.. metal parts	handtools	unknown	unknown	General remarks: several small scale industries and mechanical workshops; ≃ 800 employees
	STIA	unknown	unknown	no	Car and vehicle assembling			70 %	
	SICAME	private	200	no	Assembling of transport equipment		unknown	unknown	
Lybia	no information available								
Total North Africa	≃ 19 enterprises employing approximately 9,000 persons (estimate)								

Sources: Case studies concerning Algeria - Egypt - Sudan
Other informations from UNIDO

Table 1b. Industrial activities connected with the production of agricultural machinery in Africa, by country and sub-regions, 1981

COUNTRIES	Number and name of industrial enterprises (starting date)	Juridicial Status	Staff	PRODUCTION: Agric. equipment only	PRODUCTION: Main activity	PRODUCTION: Types of agric. equipment manufactured	PRODUCTION: Number of units produced/year	Rate of utilisation of capacities	Particular characteristics
West Africa									
Senegal	1 SISCOMA (1964)	mixed a/	350 + seasonals	yes	Agricultural machinery	animal draw equip. and various machines	123,000 units (1979)		30% of production was exported; closed operations in Sept. 1980
Mali	1 SMECMA (1974)	public	160 + seasonals	yes	Agricultural machinery	animal drawn equipm.	23,000 units (1980)	65 %	
Ivory Coast	2 AKI (1960)	ltd.comp.	50	no	Foundry and rail road equipment	pumps, machetes, axles, animal drawn equip.	unknown		has taken over IVOIROUTILS with a total of 400 employees
	FRACASSI	private	50	no	Boiler making	agricultural trailers	250 units		
Togo	1 UFROMA (1980)	co-operat.	15 + seasonals	yes	Agricultural machinery	animal drawn equip.	700 units (1980)	60 %	has started operations in 1980
Nigeria b/	5 JOHN HOLT, AGRICULTURE ENGINEERING LTD.; NIGERIA ENGIN.WORKS; SARMA PRODUCTS EX SERG.ARB'S CARPENTRY WORKSHOP; JAURO MAKERIS PLOUGH LTD.	private	unknown	unknown	unknown	hand tools, fixed equip., ploughs, ploughshares and fixed equipments			two units are at present assembling tractors
Mauritania	no industrial production								
Upper Volta	2 SOVICA (1966)	private	30	yes	Agricultural machinery	animal drawn equip.	~ 4000 units (1976)	unknown	
	ARCOMA/CORENMA	handicraft co-operat.	50	yes	Agricultural machinery	animal drawn equip.	~ 2500 units	unknown	3 central ARCOMA workshops are connected to 11 CORENMA branch workshops and village workshops
Ghana	2 AGRICULTURAL ENGINEERS LTD.	private	200	yes	Agricultural machinery	ploughs, harrows, tools, hoes,	unknown	unknown	main activity: equipment for the processing of products
	CROCODILE MANCHET LTD.	private	unknown	yes	Agricultural machinery	cutlass, barrows, spades, shovels	~ 1300 units	75 %	
Benin	1 COESMAG (1972)	handicraft co-op.	650	no	Agricultural machinery	animal drawn equip.	unknown		the main workshop is connected with 7 district workshops
Niger	5 DARNA	handicraft co-op.	12	yes	Agricultural machinery	animal drawn equipment and hand tools	unknown	unknown	
	ACREMA		unknown	yes	Agricultural machinery				Each central workshop is connected with 3 secondary workshops and village workshops
	UCOMA		unknown	yes	Agricultural machinery				
	SEFAMAG (1978)	private	20	yes	Agricultural machinery		unknown	unknown	
	SONIFAME (1965)	private	300	no	Agricultural machinery		unknown	unknown	former blacksmiths co-oper.
Cap Verde	no industrial production								
Gambia	1 CHAN SECKA LTD.	unknown	unknown	no	General metal work	hand tools	unknown		
Sierra Leone	1 TADC	unknown	unknown	yes	Agricultural machinery	rice threshers, riddles, sowers, oil-presses	750 units		
	2 small enterprises: AGRICULTURE DIVISION WORKSHOP	unknown	unknown	yes	Agricultural machinery		unknown		
	WEST AFRICAN MACH. LTD.	unknown	unknown	yes	Agricultural machinery	hand tools	unknown		
Guinea	1 (not specified)								
Guinea-Bissau	no industrial enterprice								
Liberia	no information								

Total for West Africa = 23 enterprises employing approx. 2,000 persons (estimate)

a/ mixed with private management b/ based on the document of M.Mitra, 5 September 1980.

Source: -Case studies concerning Senegal - Mali - Togo - Nigeria
-UNIDO informations

Table 1c. Industrial activities connected with the production of agricultural machinery in Africa, by country and sub-regions, 1981

COUNTRIES	Number and name of industrial enterprises (starting date)	Juridicial Status	Staff	PRODUCTION: Agric. equipment only	PRODUCTION: Main activity	PRODUCTION: Types of agric. equipment manufactured	PRODUCTION: Number of units produced/year	Rate of utilisation of capacity	Particular characteristics
Central Africa									
Cameroon	1 TROPIC (1966)	private	254	no	Agricultural machinery	hand tools, animal drawn equipment	1650 tons (1980)	90 %	Export (20 %) to the member countries of UDEAC
Zaire	6. CHANIMETAL	Subsidiary a/	unknown	no	Foundry	Hand tools	744,000 units (1980)	unknown	
	UVAZ	public	unknown	yes	Agricultural machinery		1.440,000 units(1980)	unknown	
	ACNEFON	private	unknown	no	Metal construction		unknown	unknown	
	FIAT-ZAIRE	Subsidiary a/	unknown	no	Vehicle assembling	Tractors	26 units	unknown	
	INZAL	Subsidiary a/	unknown	unknown	unknown		7 units (1979) b/	unknown	
	MAGIRUS DEUTZ ZAIRE	Subsidiary a/	unknown	unknown	unknown		26 units	unknown	
Burundi	(1) Bujumbura Unit	(public)	(25)	(yes)	Agricultural machinery	(Hand tools)	(80,000)		Has never been in operation.
Chad	1 SOMAT	private	unknown	yes	Agricultural machinery	Animal drawn equipment	unknown		Production interrupted by Civil War.
Centr.Afr.Reg.	no industrial production								
Gabon									
Congo									
Equat. Guinea	no information								
Sao Tomé	no industrial production								
Rwanda									
Angola	2 (unspecified)					Animal drawn equip.	unknown	unknown	
Total Central Africa	~10 enterprises employing approx. 1000 persons (estimate)								
East and South Africa									
Ethiopia	1 ETHIOPIAN HAND TOOLS FACTORY	public	120	no	unknown	Hand tools	600 tons (1979)	100 %	Belongs to the group of National Metal Works Corpor.
Kenya	12 c/ Small and medium enterprises	private	unknown	unknown	unknown	Hand tools; animal drawn equipment; tractor equipment; fixed equipment (mills, dryers)	unknown	unknown	Examples: K.Kay Engineering Services Ltd.; Hammers Engineering; Aroch Engineering, etc.
Tanzania	2 UFI	public	700	yes	Agricultural machinery	Hand tools; animal drawn equipment	1.1 million and 10,000 units (1980)	50 %	Close co-operation between UFI and TAMTU
	TAMTU (2 small enterprises unspecified)	public unknown	150 unknown	yes unknown	Agricultural machinery unknown	Animal drawn equip. Tractor equipment	3,500 units unknown		

(continued)

a/ Subsidiary of a multinational company
b/ Very irregular production - assembly of 400 units in 1977
c/ According to the document of Mr. Mitra, 5 September 1981. Only half of these enterprises are of significant size.

Sources: -Case studies concerning Cameroon - Zaire - Burundi - Ethiopia - Kenya - Tanzania.
-UNIDO Informations

Table 1d. Industrial activities connected with the production of agricultural machinery in Africa, by country and sub-regions, 1981

COUNTRIES	Number and name of industrial enterprises (starting date)	Juridicial Status	Staff	PRODUCTION: Agric. equipment only	Main activity	Types of agric. equipment manufactured	Number of units produced/year	Rate of utilisation of capacities	Particular characteristics
East and South Africa									
Zambia	3 NORTHLAND ENGINEERING	private	80		unknown	Animal drawn equipment, hand tools, mills	70,000 units and 40,000 units	unknown	
	SHONGA STEEL	private	unknown	no	unknown	Animal drawn equipment, hand tools	3,000 units and 300,000 units	unknown	
	LENCO	public	unknown	no	unknown	carts and agricult. trailers	1,000 units and 1,000 units	50 %	
	(12 small and medium enterprises, unspecified)	private	unknown	no	unknown	Animal drawn equipment, hand tools, fixed equipment	unknown		Examples: Rucan Industries, Scaw Ltd., Demer
Madagascar	3 SIDEMA	public	250	no	Metal construction	Animal drawn equipment, hand tools	12,800 units and 144,000 units		
	TOLY	public	150	no	Foundry	Tractor equipment	1,500 units (1978)		
	BARDAY	private	100	no	unknown	Animal drawn equipment	4,000 units		
Botswana	1 unspecified	unknown	unknown		Agricultural machinery	Hand tools	unknown	unknown	
Lesotho	no information								
Swaziland	1 NATIONAL INDUST.DEV.ORG.	unknown	unknown	yes	Agricultural machinery	Tractors (TINKABI)	unknown	unknown	capacity: 100 units (1977)
Zimbabwe	4 UNITED SPRING AND FORGING	unknown	unknown	yes	Agricultural machinery	Hoes, hand tools, heavy forged parts	unknown	unknown	
	BULUWAYO STEEL PRODUCTS	unknown	unknown			Animal drawn equip.	unknown	unknown	
	ZIMPLOW Limited	unknown	unknown			Animal drawn equip. motorised equipment	90,000 units	unknown	Assembly of tractors MF
	TIATO Industries								
Malawi	1 AGRIMAL	unknown	170	yes	Agricultural machinery	Hoes, ploughs, cultivators	800,000 units 2,000 units		
Djibouti, Mozambique, Comoros, Réunion, Seychelles	no information								
Mauritius	2 BELL Ltd.	private	unknown	yes	unknown	Motorised machines for sugar	45 units	unknown	
	TAYLOR SMITH LTD.	private	unknown	no	Steel products	Sugar machinery, spare parts for transport equipment			
Uganda	3 UGMA	public	unknown	no	Foundry	Hand tools	unknown	10 %	
	TESO-Soroti	public	unknown	unknown	unknown	Animal drawn equipment, hand tools	unknown		
	MOES Limited	unknown	unknown	unknown	unknown				
Somalia	no industrial production								
Rest East and South Africa	- 35 enterprises employing approx. 3500 persons (estimate)								
North Africa	(rough estimate) 87 enterprises employing 15,500 persons								

*) Without Rep. of South Africa and Namibia

Sources:- Case studies concerning Zambia and Madagascar.
- UNIDO information

Table 2. Agricultural equipment imported by African countries between 1972 and 1979.

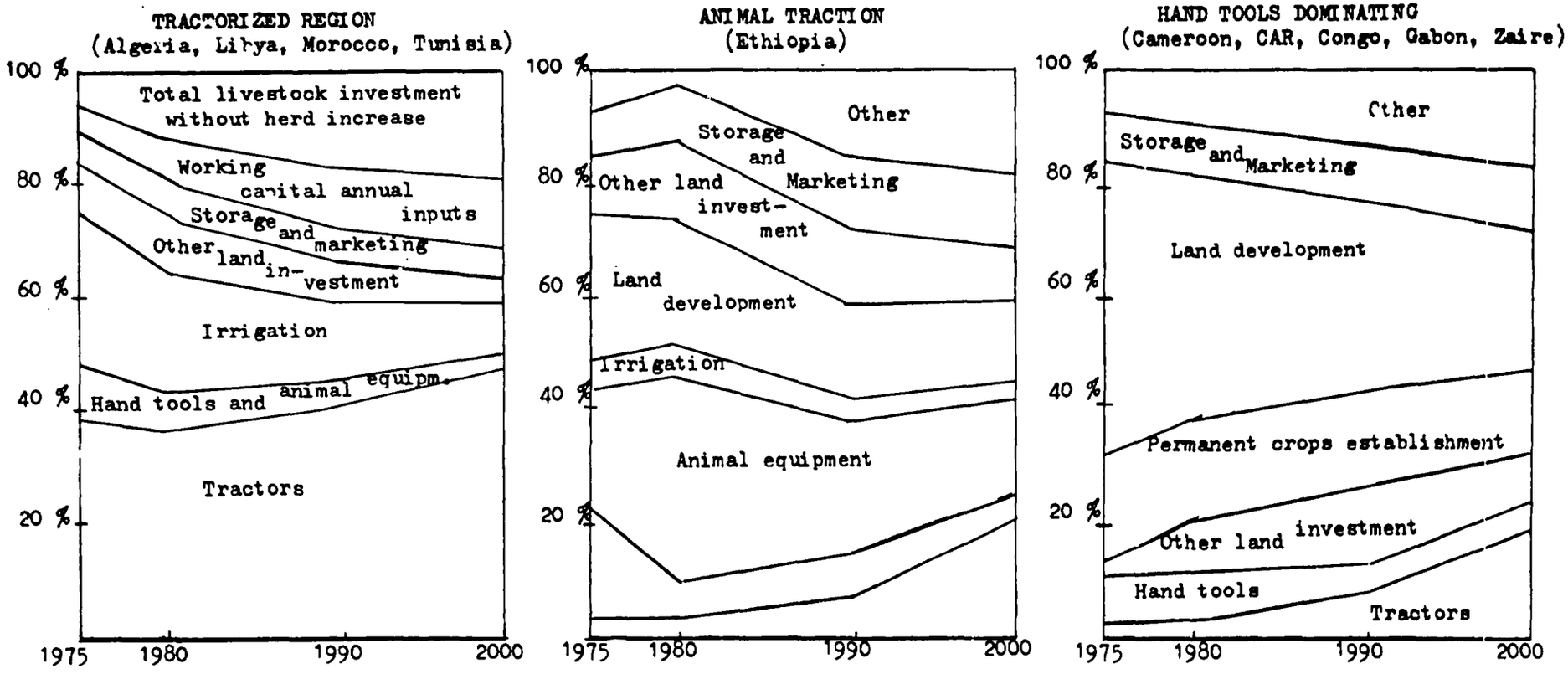
US$ million FOB

No SITC Rev. 2		World export	Export to Africa *	Share of exports to Africa (%)	World export	Export to Africa *	Share of exports to Africa (%)	World export	Export to Africa *	Share of exports to Africa (%)	World Export	Export to Africa	Share of exports to Africa (%)
		1972			1973			1974			1975		
695	Handtools **	1,417.6	89.7	6.3	1,893.1	106.0	5.6	2,450.9	148.0	6.0	2,734.8	212.7	7.8
721	Agricultural machinery	1,902.9	51.8	2.7	2,775.0	69.2	2.5	3,667.5	104.2	2.8	4,437.2	175.7	3.9
721.1.2	Agricultural machinery for cultivating soil and harvesting	1,298.1	41.6	3.2	1,813.6	54.8	3.0	2,496.5	79.0	3.2	3,352.3	140.8	4.2
722	Tractors	1,697.0	111.0	6.5	2,191.2	145.4	6.6	2,854.1	209.2	7.3	4,371.7	357.9	8.2
	TOTAL	5,017.5	252.5	5.0	6,860.1	320.6	4.7	8,972.5	461.4	5.1	11,543.7	746.3	6.5
		1976			1977			1978			1979		
695	Handtools **	3,020.6	207.6	6.9	3,786.2	281.7	7.4	4,627.4	297.7	6.4	n.a.	n.a.	n.a.
721	Agricultural machinery	4,365.3	114.4	2.6	4,104.2	153.5	3.7	4,898.1	179.7	3.7	6,493.1	215.2	3.3
721.1.2	Agricultural machinery for cultivating soil and harvesting	3,240.2	879.0	2.7	3,167.8	106.3	3.4	3,744.2	124.0	3.3	4,419.5	148.2	3.4
722	Tractor	4,581.3	325	7.1	5,156.3	382.8	7.4	5,548.1	389.8	7.0	5,949.8	262.4	4.4
	TOTAL	11,967.2	645.5	5.4	13,046.7	818.0	6.3	15,073.6	867.2	5.8	n.a.	n.a.	n.a.

Source: 1. ECE Bulletin of Statistics on World Trade in Engineering Products 1972 - 1979
2. UN Yearbook of International Trade Statistics, Vol. II, 1976 - 1979, United Nations, New York.

*) Africa excluding South Africa and Zimbabwe
**) Data are for market economy countries only, world export figures refer to import figures.

Table 3. Development of shares of annual gross investment in different regions of Africa, 1975, 1980, 1990, 2000
(Scenario A)



Source: FAO study prepared for this Consultation - See footnote 24/ page 19.

Table 4. Characteristics of agricultural mechanization and

	Agricultural features										
		Land (in 1975)			Land man ratio	Main crops					Crop intensity
	Climate 1/	Arable (1000 ha)	Expansion 1975-2000 2/	Irrigated 1000 ha (Sh)		First	Second	Third	Share of first three	Share of cereals	
Northern Africa											
Morocco		7.990	107	887(11.1%)	2.45	Barley	Wheat	Pulses	73.6	75.1	0.75
Algeria		7.000	110	301(4.3%)	2.10	Wheat	Barley	Fruit	77.7	75.8	0.58
Tunisia		4.510	104	126(2.8%)	6.08	Wheat	Olives	Barley	78.4	44.3	0.81
Libya		2.518	107	171(6.8%)	6.39	Barley	Wheat	Fodder	80.7	62.1	0.37
Egypt		2.860	101	2.860(100%)	0.89	Fodder	Maize	Wheat	57.0	42.4	1.68
Sudan		14.290	143	1.672(11.7%)	1.62	Millet	Groundn.	Sisal	82.3	61.0	0.37
Total Northern Africa	ST	39.168		6.017(5.4%)							
Western and Central Sahel											
Mauritania		782	198	46(5.9%)	0.48	Millet	Pulses	-	89.4	68.2	0.23
Senegal		5.564	123	161(2.9%)	1.55	Groundn.	Millet	Pulses	91.8	45.6	0.46
Mali		11.720	110	152(1.3%)	0.67	Millet	Groundn.	Rice	86.2	79.7	0.13
Upper Volta		6.700	117	- -	1.08	Millet	Pulses	Groundn.	90.1	72.5	0.45
Niger		11.100	100	- -	3.09	Millet	Pulses	Groundn.	97.7	70.5	0.37
Chad		6.901	154	- -	1.21	Millet	Cotton	Pulses	86.8	62.9	0.24
Total Western and Central Sahel	TA/TS	42.767									
Other Western and Central Africa											
Gambia		421	109	32(7.6%)	0.97	Groundn.	Millet	Rice	90.2	41.1	0.51
Guinea		4.200	151	42(1%)	0.86	Cocoa	Root	Millet	68.8	23.2	0.35
Sierra Leone		1.814	110	- -	1.02	Rice	Palmtree	Cocoa	65.5	49.0	0.45
Liberia		1.331	170	- -	1.00	Rice	Rubber	Root	79.6	45.1	0.33
Ivory Coast		9.120	113	- -	1.20	Coffee	Root	Cocoa	58.3	26.8	0.37
Ghana		4.511	155	- -	1.79	Rice	Maize	Millet	75.5	75.5	0.82
Togo		1.919	104	- -	0.88	Millet	Maize	Pulses	60.6	50.3	0.32
Benin		2.950	139	- -	1.29	Maize	Root	Millet	64.8	50.2	0.30
Nigeria	TS/TH	32.306	127	- -	1.65	Millet	Pulses	Root	71.9	51.1	0.76
Cameroon		7.347	124	- -	1.05	Root	Maize	Millet	49.1	30.3	0.43
Central Afr.Rep.		5.910	123	- -	0.93	Root	Cotton	Groundn.	65.8	20.6	0.15
Gabon		350	100	- -	0.54	Root	Banana	Cocoa	90.0	5.0	0.31
Congo		662	157	- -	1.18	Root	Groundn.	-	61.8	14.2	0.32
Zaire		13.146	150	- -	0.57	Root	Maize	Rice	58.2	22.0	0.36
Total Western and Central Africa	TH	85.987									
Eastern and Southern Africa											
Ethiopia	HL/V	13.728	128	- -	0.75	Millet	Maize	Wheat	53.7	62.8	0.54
Somalia	TS	1.049	164	34(3.5%)	0.62	Millet	Maize	Sesam	88.8	78.5	0.60
Uganda	TS	5.251	134	- -	1.07	Millet	Pulses	Cotton	48.4	32.4	0.82
Kenya	HL/V	4.115	140	41(1%)	0.76	Maize	Pulses	Millet	75.0	60.5	0.78
Rwanda	TS	905	110	- -	0.43	Pulses	Banana	Root	67.9	24.1	0.95
Burundi	TS	993	118	- -	0.54	Pulses	Root	Millet	70.1	30.2	0.96
Tanzania	TS	6.810	162	- -	0.93	Maize	Root	Millet	50.7	37.3	0.74
Zambia	TS	5.000	128	- -	1.19	Maize	Millet	-	86.1	86.3	0.30
Malawi	TS	2.278	142	- -	0.94	Maize	Pulses	Groundn.	79.3	61.0	0.86
Angola	TS	4.500	138	- -	1.57	Maize	Coffee	Root	66.2	43.8	0.37
Zimbabwe	TS	2.480	135	- -	1.07	Millet	Maize	Groundn.	79.6	70.0	0.56
Mozambique	TS	5.000	160	- -	1.08	Maize	Root	Millet	52.2	37.8	0.54
Madagascar	TS	2.866	143	788(27.5%)	0.64	Rice	Root	Coffee	75.4	55.4	0.75
Mauritius	TH	100	105	15(15%)	1.0	Cane	-	-	84.2	-	0.95
Total Eastern and Southern Africa		55.075									
Total Africa		219.887	129	7.693(3.5%)	1.15	Millet	Maize	Pulses	47.9	51.6	0.53

1/ ST= Subtropical; TA= Tropical arid; TS= Tropical semi arid to sub-humid; TH= Tropical humid; HL= Tropical highlands; V= Varied

2/ 1975 = 100

3/ For scenario B of FAO

Source: FAO Study "Agricultural Mechanization and the Demand for Agricultural Machinery and Equipment in Africa up to the year 2000", UNIDO.ID/WG.365/2

demand by country and sub-region in 1975 and the year 2000.

	Existing patterns of mechanization (1975)						1975				2000 3/	
	Labour force		Draught animals		Tractors		Investment in agri-cultural machinery (mill.US$)	Demand for main products (units)			Investment in agricultural machinery	
	% of power requirement	People (mill.)	% of power requirement	in use (in 1,000)	% of power requirement	in use (in 1,000)		Hand tools (1000)	Animal draws (1000)	Tractors	Total (mill. US$ 1975)	Share of tractors %
Northern Africa												
Morocco	64.0	2.4	31.0	1.530	7.0	16	56	50	73.9	2.6	193	33.4
Algeria	46.4	1.9	17.4	342	36.2	51	94	40	15.4	7.6	328	52.1
Tunisia	44.1	0.6	13.7	208	30.4	29	50	10	9.2	4.1	166	53.8
Libya	27.6	0.1	12.8	50	59.6	25	56	0	3.1	3.5	95	49.2
Egypt	78.7	5.4	15.8	1.000	5.5	22	72	110	49.1	9.6	184	25.4
Sudan	65.6	3.3	26.6	1.000	7.8	9	50	80	52.3	1.6	352	31.8
Total Northern Africa		13.7		4.130		152	378	290	203.0	29	1.318	
Western and Central Sahel												
Mauritania	-	0.4	38.7	120	-	0	3	10	6.2	-	4	-
Senegal	91.0	1.7	7.5	147	1.5	1	7	30	9.2	0.1	17	9.2
Mali	89.2	2.3	10.0	245	0.8	1	13	60	18.5	0.1	29	3.1
Upper Volta	97.5	2.8	2.2	65	0.3	0	8	60	3.1	-	12	1.6
Niger	-	1.3	14.3	210	-	0	7	30	12.3	-	10	-
Chad	-	1.4	12.8	150	-	0	5	30	9.2	-	8	1.7
Total Western and Central Sahel		9.9		937		2	43	220	58.5		80	
Other Western and Central Africa												
Gambia	-	0.2	-	4	-	0	1	-	-	-	2	10.0
Guinea	-	1.7	1.2	16	-	0	4	30	-	-	6	1.3
Sierra Leone	-	0.8	-	3	2.0	0	2	20	-	-	4	5.6
Liberia	-	0.4	-	0	2.2	0	2	10	-	0.1	8	10.7
Ivory Coast	97.1	2.8	0.6	17	2.3	2	12	60	-	0.5	82	23.7
Ghana	95.3	2.0	1.6	36	3.1	3	9	40	3.1	0.4	31	11.8
Togo	-	0.7	-	3	2.3	0	2	10	-	0.1	9	18.9
Benin	-	0.7	2.8	23	-	0	2	10	-	-	4	2.0
Nigeria	92.9	14.9	5.2	949	1.9	12	70	300	52.3	2.1	257	19.3
Cameroon	98.1	3.0	1.6	50	0.3	0	8	60	3.1	-	12	1.8
Central Afr.Rep.	98.0	0.9	1.0	10	1.0	0	3	20	-	-	5	4.0
Gabon	-	0.2	-	0	7.0	0	1	-	-	0.1	15	75.0
Congo	-	0.2	0	0	4.0	0	1	-	-	0.1	12	41.4
Zaire	-	8.3	-	0	1.5	4	23	170	-	0.4	55	11.3
Total Western and Central Africa		46.7		2.048		23	188	950			582	
Eastern and Southern Africa												
Ethiopia	60.0	9.9	39.1	5.000	0.9	4	110	210	255.4	0.5	158	11.3
Somalia	56.7	1.0	40.0	350	3.3	1	9	20	18.4	0.2	22	19.4
Uganda	87.9	4.0	11.0	482	1.1	2	20	80	27.7	0.2	37	6.9
Kenya	79.3	4.2	15.5	800	5.2	6	34	90	43.1	1.0	203	42.8
Rwanda	-	2.0	5.8	100	-	0	6	40	6.2	-	10	2.6
Burundi	-	1.7	0.7	5	-	0	4	30	-	-	6	3.3
Tanzania	81.6	5.4	16.4	1.048	2.0	5	38	110	55.4	0.8	90	18.3
Zambia	81.4	1.3	12.2	186	6.4	4	11	30	9.2	0.5	30	21.2
Malawi	94.5	2.1	3.2	65	2.3	1	9	40	3.1	0.3	42	28.1
Angola	90.6	1.1	3.6	51	5.8	5	9	20	3.1	0.5	34	24.8
Zimbabwe	63.7	1.3	20.6	401	15.7	19	28	30	21.5	1.6	68	35.3
Mozambique	90.4	2.5	4.4	107	5.2	6	16	50	-	0.7	66	34.1
Madagascar	75.0	3.4	23.2	1.000	1.8	2	29	170	58.5	0.4	57	7.2
Mauritius	86.6	1.0	6.7	5	6.7	0	1	-	-	-	2	22.2
Total Eastern and Southern Africa		40.0		9.600		55	324	820			825	
Total Africa	82.9	101.3	13.3	15.777	3.8	232	880	2.110	824.6	36.6	2.174	25.6