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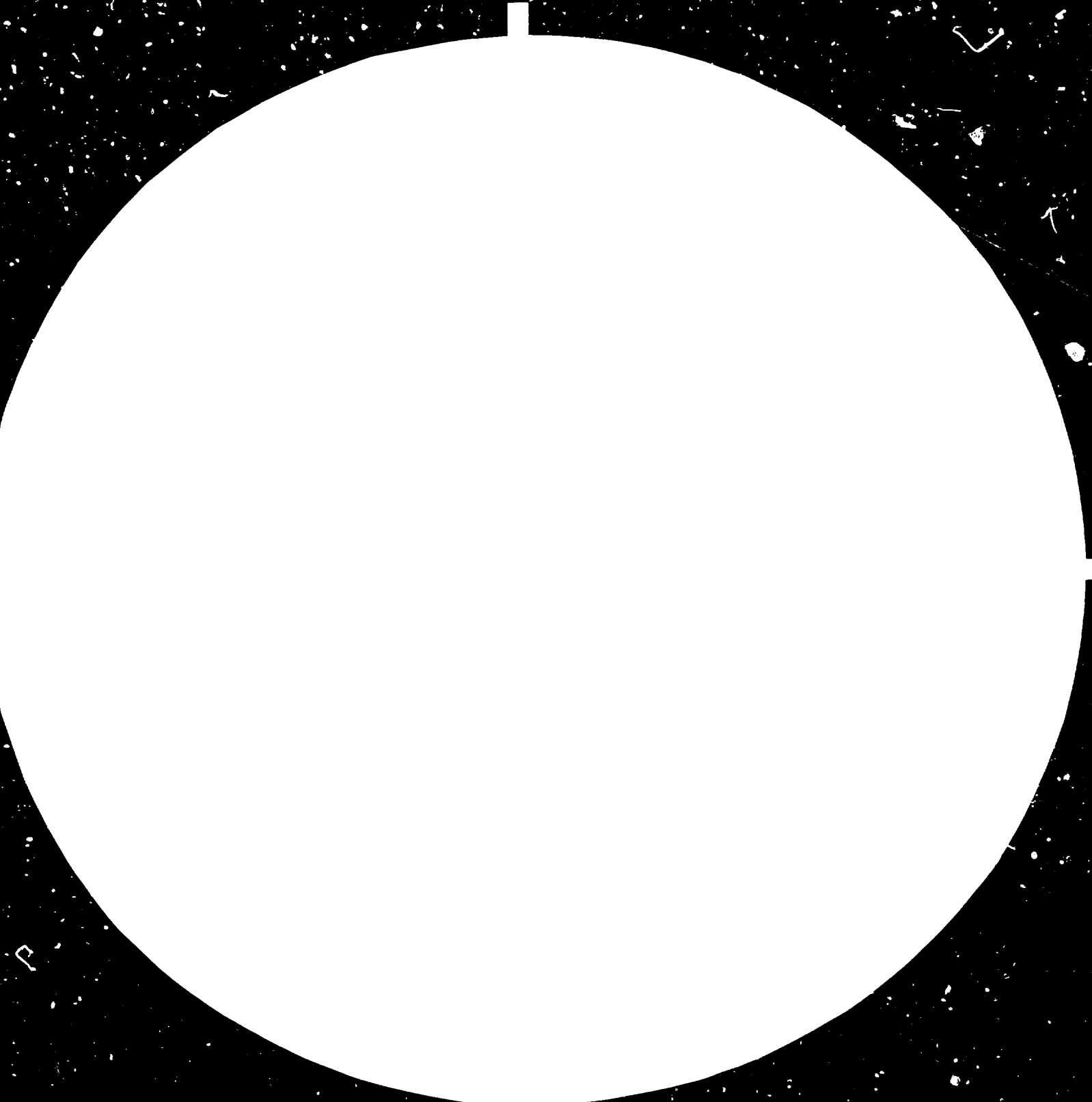

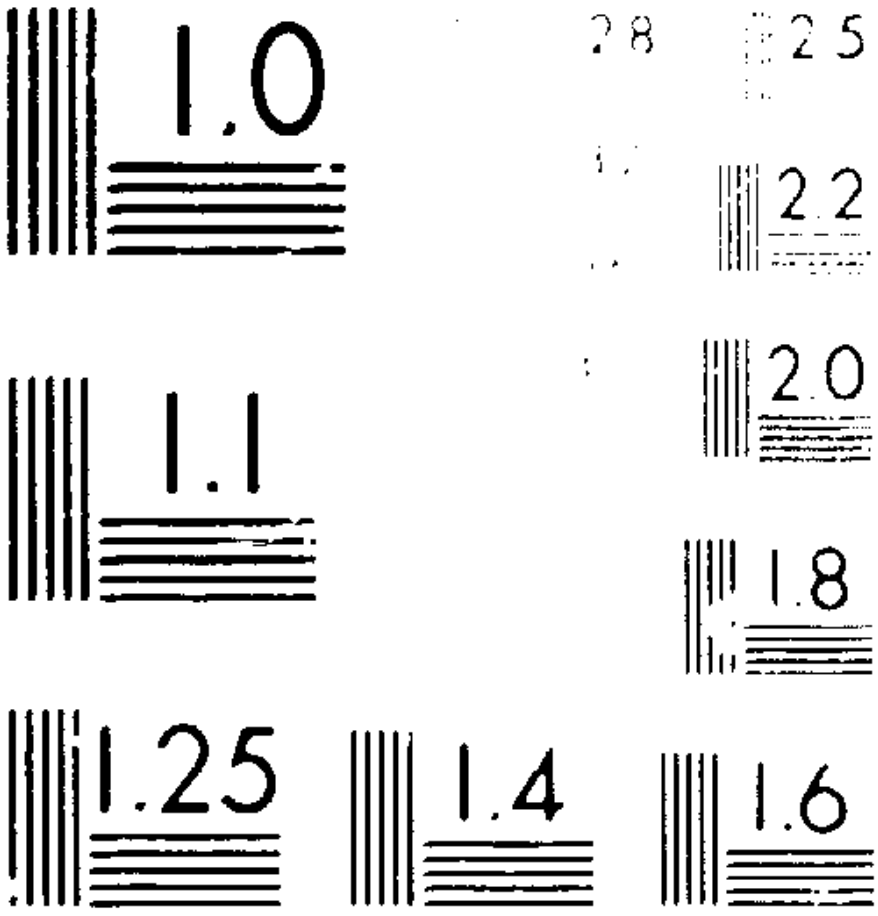
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TRENDS IN THE AGRICULTURAL MACHINERY INDUSTRY AND AGRICULTURAL MECHANIZATION(*)

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INTRODUCTION

This document is a background paper for the Meeting on Exchange of Experiences and Co-operation among Developing Countries in the Development of Agricultural Machinery Industry, organized by the United Nations Industrial Development Organization in co-operation with the Government of the People's Republic of China, Beijing, China, 20-27 October 1980. This meeting is being convened as a direct follow-up to one of the recommendations endorsed by the First Consultation Meeting on the Agricultural Machinery Industry convened by UNIDO in Stresa, Italy, 15-19 October 1979.

This document focuses on various recent trends in the agricultural machinery industry sector in developing countries. Analysis of such trends can pave the way for greater co-operation in specific areas related to the manufacture of agricultural machinery and implements through the exchange of experience between more advanced and less advanced developing countries.

The first section of this paper highlights the principal features of the present situation and recent trends in the agricultural machinery industry and agricultural mechanization. The second section attempts to identify major constraints upon the future of agricultural machinery and implements. The third section deals with the future of the agricultural machinery industry in developing countries and also touches upon areas where immediate international and regional co-operation can be extended to the manufacture of agricultural machinery and implements.

I. SITUATION AND RECENT TRENDS IN THE WORLD AGRICULTURAL MACHINERY INDUSTRY AND AGRICULTURAL MECHANIZATION 1/

1. In this paper, the term agricultural machinery and equipment is used to include all the tools, machines and equipment required in diverse agricultural operations, in particular stationary equipment for crop preservation, primary processing, etc. Agricultural machinery cannot simply be restricted to tractorization.

World production of agricultural machinery

2. Statistics on world production of agricultural machinery are inadequate: they cover tractors, but fail to take account of hand tools, most stationary equipment and, in general, the output of small-scale manufacturing units play an essential role in the developing countries.

3. In 1975, world production of agricultural machinery excluding hand tools and most stationary equipment was valued at about $ 36 billion 63 per cent of this output originated in market-economy developed countries, 31 per cent in the planned-economy developed countries and only about 6 per cent in the developing countries: the discrepancy between the latter share and the Lima target of 25 per cent for industry as a whole is considerable.

4. The two major producers, the United States and the USSR, account for nearly 46 per cent of total world production (about eight times the production of all developing countries), while the countries of the European Economic Community (EEC) account for 25 per cent.

5. Analysis of agricultural machinery production over a long period in terms of volume and value shows that production peaked during the period 1965-1970 (mainly in the market-economy developed countries)[1/]. Only the manufacture of tractors and thresher-harvesters continued to grow at a steady and appreciable rate up to 1976, whereafter production decreased or stagnated in most producer countries[2/]. These developments were often

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1/ Some of the analyses and facts have been extracted from "The First World-wide Study on Agricultural Machinery", UNIDO/ICIS.119, June 1979.

2/ See Table 2, "World production of selected main agricultural machinery products, 1960-1978"

marked by increased sales prices, by shifts towards more sophisticated and high-powered machines, and by specialized production of machines and stationary equipment.

6. The manufacture of tractors accounts for about 35 per cent of all agricultural machinery produced: this is equivalent to 2.1 million units in 1978 after a period of considerable growth (8 per cent per annum in the period 1971-1976)[3/].

7. In 1978, tractor production in the developing countries amounted to about 324,000 units, or 15.6 per cent of the world total. However, in reality, the developing countries contributed only some 11 per cent, in terms of value, to the world production of tractors, since tractor manufacture in those countries either involves countless components or sub-assemblies imported from major foreign manufacturers, or may in fact be limited to assembly operations. Furthermore, seven countries account for 90 per cent of the tractors produced in developing countries: Argentina, Brazil, China, India, Iran, Mexico and Turkey.

8. Agricultural machinery production in the developing countries increased in the period 1955-1975, the initial emphasis being on the manufacture of tractors[4/]. The following trends were to be observed:

(i) Establishment of a tractor-manufacturing industry on the basis of local assembly of components and groups of components imported from transnational corporations in developed countries;

(ii) Progressive local integration and indigenization of manufacturing units;

(iii) Diversification and increase in the production of other products, such as trailed and stationary equipment;

(iv) Improvement in the quality of production, expansion of export flows, and local design of indigenous products adapted to national requirements.

9. This past trend has been restricted to only a certain number of semi-industrialized countries. Local integration is still rather limited, while dependence on major transnational corporations remains high on

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3/ See Table 1, Geographical distribution of world production of tractors in 1978. UN Yearbook of Statistics.

4/ See Table 3, Production of tractors in the main producing developing countries.

account of the purchase of components or groups thereof, control of technological improvements, etc. This growth was to be observed mainly in relation to the production of modern machinery (especially tractors) in large units located in urban areas; it did not extend to the development of semi-industrial activities in rural areas.

10. In most countries, recent trends reveal a stagnation in production, frequent underutilization of existing capacities, and innumerable projects cancelled or delayed. In fact, local production based on adaptation and indigenous designs remains limited. Some examples are given below:

(i) Power tillers: China, India, Philippines, Republic of Korea, Thailand and Vietnam. The International Rice Research Institute (IRRI) has designed a cultivator which has been the subject of a technology transfer programme in Colombia, Indonesia, Malaysia, Pakistan and Sri Lanka;

(ii) Power threshers developed by IRRI have been adopted by several developing countries;

(iii) Small riding tractors (less than 18 hp): India (Punjab Tractor - Swaraj Model, HMT tractor) and Thailand (Iron Buffalo and subsequent model);

(iv) Tractors of 25 hp and above: based on joint ventures and licensing agreements with increased local manufacture of parts, for example in Brazil, India, Mexico, Pakistan and the Republic of Korea;

(v) Engines (automotive type, 15-50 hp): China, India, Republic of Korea and Thailand;

(vi) Engines (stationary, above 3 hp): China, India, Pakistan, Republic of Korea and Thailand;

(vii) Pumps (centrifugal, above 1 hp): Brazil, China, India, Mexico, Pakistan, Republic of Korea, Thailand, Zambia and Zimbabwe.

Recent trends in the agricultural machinery industry

11. Agricultural machinery manufacture forms an integral part of the engineering and allied metal working industries in both developing and developed countries. Being a sub-sector of the capital goods industries, agricultural machinery manufacture plays an important role in the over-all development of the engineering industries. The main structure of the

agricultural machinery industry comprises such units as foundry, forging, heat treatment and machine shop. Trends in the agricultural machinery industry are inseparably linked with those in engineering and allied metal-working industries in any country.

Developing countries

12. In developing countries the major trends in agricultural machinery manufacture can be attributed to different circumstances and divided into three categories:

Category I industries

13. At this level, hand tools and agricultural implements for soil cultivation and harvesting are manufactured by village blacksmiths and rural artisans. Almost all developing countries have these facilities: design and production techniques are traditional, the present trend being to manufacture animal-drawn implements. Production facilities are extremely limited, and machinery and equipment are locally fabricated. Governments in developing countries are endeavouring to upgrade these industries, whose contribution to industrial production is significant, particularly in the least developed countries. In Ethiopia, for instance, the consumption of metal at the blacksmith level (including co-operatives) is about 2000 tons per annum as against 500 tons per annum consumed by factories producing hand tools. It is important to note that more and more metal fabrication for various types of products is being undertaken at this most basic level.

Category II industries

14. At this level, the product is the result of a combination of agricultural hand tools and animal-drawn implements which are manufactured in small- scale or medium-scale production units. Industry at this level adapts local or foreign designs to the needs of the farmers. To a great extent, these industries consume imported hardware, tines, springs, etc. for their regular production. Significant co-operation exists at this level of industry through the adaptation of implements used in other regions. For example, a Zambian company has adopted Indian ox-drawn ploughs and produces 8,000 units per annum.

15. A major trend at this level is the rapid production of a wide range of implements, such as ox-drawn ploughs, cultivator-cum-seed drills, harrow and trailer/carts, supplemented by the production of other fabricated engineering products. Most of these industries are located in urban areas or on industrial estates.

Category III industries

16. At this level, industry is characterized by the assembly and limited production of tractor parts and selected power-operated implements, including the manufacture or assembly of trailers. These industries are generally medium- or large-size establishments and mostly linked to transnational corporations from industrialized countries. Design and manufacturing facilities are obtained under joint ventures or within the framework of co-operation or licensing agreements. The import content of the products is very high and, in many cases, the local value added is as low as 15 to 20 per cent. The major trend is towards the assembly of tractors or implements with a high import content. Most of these industries are controlled by transnational corporations from the developed countries. Very few countries, such as Brazil, China, India, Turkey and Yugoslavia are able to produce most, or all of the components. Another important trend in these industries is the development of ancillary industries with greater sub-contracting arrangements. This has only been achieved in selected countries in Asia and Latin America. In Africa, the trend is to import complete knock down (CKD) or partial knock down (PKD) parts for the assembly of tractors and implements. Only recently are countries such as Ethiopia, Kenya, Sudan and Tanzania endeavouring to establish plants manufacturing tractors and implements to meet domestic needs.

Developed countries

17. In developed market-economy countries, agricultural machinery manufacture is entirely controlled by transnational corporations, the emphasis being on mass production. Sub-contracting arrangements are provided for the procurement of ancillary parts and standardized accessories for final assembly of the products. Specialization increases in the field of product manufacture: for example, within the same company or group of companies, tractors and implements are manufactured in different plants, which themselves may be situated in different countries. Many transnational corporations have their own ancillary and accessory manufacturing

units: most parts and components are standardized. These companies tend to shift their outdated product lines to the developing countries owing to the demand for heavy and sophisticated machinery in the developed country markets. Product ranges vary widely and, in some transnational corporations, ten versions of one model are produced so as to cater to the different needs of the domestic and export markets, and the machinery manufactured by these companies covers all power-operated agricultural operations. Recently, major manufacturers of tractors and implements have been merging in order to expand their export market opportunities. The resultant trend in developed market economy countries has been towards market monopolies producing heavier machinery and equipment which requires enormous capital outlay, accelerated research and development activities, restricted spare parts manufacture, and sophisticated costly after-sales services.

World trade situation and trends in agricultural machinery

18. In 1978 world trade in agricultural machinery accounted for more than $ 10,4 billion.

19. The market-economy developed countries play a dominant role in world trade of agricultural machinery: they account for 80 per cent of the exports and 60 per cent of the imports. The most active exporting countries are those in the EEC, the United States (the major exporter accounting for 23 per cent of the world total),as well as Japan and the USSR.

20. The position of the developing countries in world trade is indicative of their constraints and problems. Whereas purchases by the developing countries account for 25 per cent of world imports, their exports account for only 1 per cent of world exports, the recipient of such exports being almost exclusively other developing countries. Furthermore, these exports come from a very restricted group of countries with Latin America, for example, accounting for nearly 75 per cent, (Argentina 33 per cent and Brazil 28 per cent).

21. Tractors account for about 55 per cent of the total value of trade. The "tractorization model" (tractor plus trailed equipment) alone accounts for more than 80 per cent of the trade in this industrial sector. Tables 4 and 5[5/] illustrate the evolution of international trade since 1970. Between 1969 and 1977, trade increased at an annual rate

5/ See Tables 4 and 5, Agricultural machinery imports and exports by region from 1970-1978, Yearbook of International Trade Statistics and ECE Bulletin of Statistics on World Trade in Engineering Products.

of about 20 per cent (at current prices), it being more than 25 per cent for stationary agricultural equipment. However, this evolution came to a sudden halt in 1975, and the volume of imported machinery dropped significantly.

Supply and demand for agricultural machinery and equipment

22. Manufacture and trading statistics provide insight into the world consumption of agricultural machinery. For example, in 1975 the market-economy and planned-economy developed countries and the developing countries accounted for 57, 31 and 12 per cent, respectively, of the agricultural machinery consumed in the world.

23. It is worth recalling how adjustment between supply and demand operates for the various groups of countries. In the developed countries, it can clearly be seen that the extraordinary development of agriculture since the Second World War and the growth of the agricultural machinery industry have developed in unison. By the seventies, this led to productive mechanized agricultural systems, to organized and powerful industrial structures, and to considerable commercial trading. At the same time, however, having reached a high level of equipment, and having to face other constraints or to move towards other choices, the agricultural systems in the developed countries have progressively ceased to constitute a sufficient pole of demand (at least for traditional mechanical models), whilst the immense requirements of the developing countries have emerged.

24. It was obviously suppliers from industrialized countries, in particular major transnational corporations, which met this emergent demand. In the initial stage, the companies exported exclusively, but in the subsequent stages they participated in the establishment of assembly and production units in the developing countries, or transferred the model of heavy mechanization, practically devoid of adaptation or design to meet the needs of the developed countries.

25. It would appear that a new stage has now been reached in the evolution of the world market. Investment in the industrialized countries is mainly limited to the renewal of existing equipment with a greater shift towards stationary equipment (the agro-food pole) or towards intermediate consumption (fertilizers, new seeds). However, a similar trend

towards the saturation of the demand is to be observed in the developing countries which account for only 12 per cent of world demand for modern agricultural machines, while the need for mechanization remains immense.

26. This situation, which is clearly revealed in statistics (in particular, those relating to production and external trading) and in the levelling off of the levels of investment in the agricultural systems of the developing countries, can be explained by three principal factors:

(i) Saturation of the purchasing capacity of the developing countries, mainly due to the low income levels of most farmers and the impossibility of creating a progressive accumulation of capital in agriculture;

(ii) Failure of developed country suppliers to adapt themselves to the specific and diverse needs of developing countries, and their imposition on those countries of a pattern of heavy motorization and costly sophisticated and specialized machines;

(iii) Existing high unemployment and underemployment, forms of organization of agriculture and social relations in rural areas as additional impediments to the rapid growth of agricultural production, mechanization and trade.

27. Supply from the industrialized countries has thus dominated demand in the developing countries, the result being a form of saturation which is prejudicial to both sides. It is essential that in the future supply should be induced by demand.

Agricultural mechanization in the developing countries

28. The general trend in agricultural mechanization in the developing countries seems highly complex. Mechanization throughout the developing countries ranges from the use of animal-drawn agricultural implements to combinations of sophisticated power-driven equipment. Over the last two decades, great emphasis has been given to mechanizing and reorienting the farming systems, due consideration being given to the relative costs of machinery, equipment, and labour as well as to the solvency of the farmers. 60 per cent of the farmers in the developing world use traditional hand tools. In vast areas, irrigation is contingent upon

seasonal rainfalls. When harvesting their crops, 90 per cent of the farmers still use traditional sickles and a wide range of machetes. In the developing countries, the over-all trend in mechanization can be divided into three distinct sectors:

(i) Manual systems

29. In this sector, farming operations (mainly cultivation and harvesting) are carried out on small farms (less than one hectare), with traditional designs of a wide variety of hand tools such as shovels, spades, forks, digging hooks, hoes and ploughs. The trend is towards the intensive use of labour drawn from the farmer's extended family. The output through this system provides only subsistence living without any market surplus. Some improvement is to be seen in cultivating rather than harvesting tools.

(ii) Mixed mechanization system

30. In this sector, farming operations are carried out partly by manual and partly by animal-drawn implements such as ox-drawn cultivator, animal-drawn ridger, simple walking-type planter, animal-drawn thresher, paddle or hand-operated winnower, and hand-operated sheller.

31. The present trend is towards improving animal-drawn mechanization for soil cultivation and seed-bed preparation rather than other farming operations such as crop protection, harvesting and crop processing. This trend is creating an over-all imbalance in farm mechanization in the developing countries. At present, animals are only used to reduce the drudgery of the farmers rather than to intensify food production. Moreover, the farmers take little care of their draught animals, most of which fail to produce the power needed during cultivation and seed-bed preparation. For instance, a pair of oxen should produce about 0.8 to 1 hp for cultivation, but in the African region, for example, the performance actually achieved is 0.05 to 0.4 hp.

32. This system of mechanization only caters for farms up to 3-4 hectares in size. Most of the output is consumed by the farmer's family and only a small part goes to the greater urban markets. At present, the developing countries can also be seen to be adopting animal-drawn soil cultivating implements originating from other developing countries: for instance, Iran, Kenya and Zambia have adopted Indian ox-driven ploughs.

(iii) Power-operated mechanization system

33. In this sector, farming operations are carried out by self-propelled machinery, such as tractors, combine-harvesters, and power threshers. None of the developing countries have yet been able to mechanize the whole spectrum of agricultural operations, such as cultivation, seed-bed preparation, water supply, crop protection, harvesting and post-harvesting by appropriate combinations of power-driven tools and implements. A new trend towards greater mechanization under co-operative arrangements has emerged. Crop production has been greatly intensified in selected regions by making maximum use of power-driven agricultural implements.

34. There is a recent trend in the developing countries to use low-power equipment, such as walking-type power tillers up to about 10 hp and four-wheel small rider tractors up to about 16 hp. South-East Asian countries offer the best examples. Although great efforts are being made by many developing countries to utilize power-operated machinery and equipment, mechanized forms of agriculture are still limited in the majority of the developing nations owing to ecological, agrarian and socio-economic constraints prevailing in many countries.

II. MAJOR CONSTRAINTS UPON THE FUTURE OF THE WORLD AGRICULTURAL INDUSTRY

35. Future developments in world agricultural machinery manufacture greatly depend on the development of engineering and allied metal-working industries in the majority of the developing countries. In physical terms, this development will be contingent upon the extent to which the transnational corporations engaged in machinery manufacture based in the developed countries and some of the advanced developing countries contribute to the transfer of their experience and know-how to the larger developing countries. Two important factors can be considered:

The prospects and performance of transnational corporations in the developed countries towards this contribution; and

The demand for appropriate agricultural machinery in developing countries and the prospects of local manufacture.

The prospects and performance of transnational corporations from the developed market-economy countries in the agricultural machinery industry

36. Current performance of the transnational corporations would indicate a moderate expansion of markets. "Future growth is expected to increase slightly, at a slower rate than previously, or remain static on a global basis. Developed-country markets will continue the present trend, and growth in the developing markets will probably begin to slow down".6/

37. Performance would also tend to confirm the hypothesis of market saturation, based on the following observations:

- Over the last decade, demand in the developed countries for tractors and trailed machinery has tended to decline. This is particularly noticeable in the United States and Western Europe. Although the number of units sold have declined, the sale of sophisticated types of agricultural machinery has increased appreciably.

- After a very rapid expansion, demand in the developing countries for tractors and trailed machinery is tending to stabilize. Under present demand and supply conditions, demand is approaching saturation point in some of the major developing-country markets such as Brazil, Pakistan and Turkey. In these latter countries, the trend is towards higher engine-power and product sophistication. Over the last ten years, growth of mechanization has been retarded by adverse financial and balance-of-payment situations in most of the developing countries.

- The present unsatisfactory sales situation should lend impetus to "rationalization" efforts. This would accentuate the trend towards concentrating manufacture (reorganization of industrial structures within individual companies; elimination of certain manufacturers) and towards diversification. The market slowdown is causing under-utilization of production capacities in the developed countries.

- In general, it can be observed that current production lines in developed countries are not appropriate to widespread use in the developing countries. A survey of transnational corporations undertaken by UNIDO did not reveal a radical change in present production lines.

6/ See Profiles of the major agricultural machinery manufacturers, UNIDO/ICIS.119/Add.1, page 8.

- The views indicated so far are not favourable towards the developing countries' endeavours to reduce their effective demand for agricultural machinery from the developed countries.

- The performance of the major transnational corporations engaged in manufacturing certain models indicates continued focus on the manufacture of high-powered tractors as priority items. For these large manufacturers, the tractor will continue to increase in both power and sophistication. In their view, development of tractors appropriate to farming conditions in the developing countries was a paying proposition. Conditions in the majority of developing countries are so different that they preclude the production of standard tractors. However, certain elements (cab, transmission, gear-box, etc.) could be simplified and the performance of current models improved (operation in humid conditions or replacement of present threshers by rotary threshers) in order to meet growing demand in the developing world.

The demand for appropriate agricultural machinery in developing countries

FAO forecasts up to the year 2000

38. Global estimates relating to food requirements, agricultural production and agricultural mechanization policies constitute the basic quantitative factors governing the demand for agricultural machinery. The following data have been elaborated by FAO, and extracted from the preliminary and final versions of the FAO study entitled "Agriculture: Toward 2000", (C79/24. FAO, Rome, 1979).

39. In 90 developing countries demand for food should increase by 3.7 per cent per year over the period 1980-2000 (2.9 per cent in 1953-1975). Consequently, agricultural production in developing countries should achieve an annual growth rate of 3.8 per cent up to the year 2000 (2.6 per cent over the period 1963-1975), with a higher rate for animal production (4.7 per cent as against 2.8 per cent). Table 6[7/] illustrates this global growth by region and category of agricultural production.

7/ Table 6.: "Agricultural production in developing countries"

40. On the basis of this forecast, investment in agricultural production will be appreciable having to increase by 3.6 per cent per year from 1980 to 2000, while investment in agricultural mechanization will have to increase yearly by 4.3 per cent[8/] (4.4 per cent in Africa, 5.9 per cent in Latin America, 2.9 per cent in the Middle East and 3.6 per cent in the Far East). The number of tractors in use would increase from 2,327,000 in 1980 to 9,860,000 by the year 2000 (1,056,000 in Africa, 4,217,000 in Latin America, 1,286,000 in the MIddle East countries, 3,299,000 in Far East countries), the corresponding annual growth rates being 8.6, 6.7, 3.6 and 10.1 per cent as compared to an historic global growth rate of 5.7 percent.

41. These data offer a precise indication of the market prospects for agricultural machinery in developing countries and show the tremendous potential open to manufacturers in both developed and developing countries.

42. This notwithstanding, FAO forecasts are based on global and national development plans as well as on normative policies considered essential to the solution of the problems of hunger, underemployment and over-population. In this respect, forecasts of this kind are very useful as they give detailed target features, but they fail to project the most probable picture of the future. For example, the most recent World Bank Development Report (August 1980) indicates that the average annual growth rates in agriculture in the periods 1960-1970 and 1970-1978 dropped from 2.5 to 2 per cent for the 36 low-income countries, from 3.4 to 3.1 per cent for middle-income countries and from 1.2 to 1 per cent for the industrialized countries. The highest rate of growth was achieved by oil exporting countries, 5.2 per cent in 1970-1978. These recent trends do not make for the envisaged annual growth rate of 3.8 per cent up to the year 2000 or even a gradual increase.

43. Moreover, FAO projections are based on a fundamental technological option: the reinforcement of the role of tractorization in the mechanization policies of developing countries. Thus, tractors and allied equipment accounted for 35 per cent of the investment in agricultural mechanization in 1975; according to FAO this figure will reach about

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8/ Agricultural mechanization accounts for about 30 per cent of the total investments, according to the FAO definition. Nevertheless, other categories of investment also call for equipment (irrigation, transport, processing) which fall within the broader concept of agricultural machinery and equipment.

73 per cent by the year 2000. At the same time investment in animal-drawn equipment and hand tools would drop from 50 and 13.4 per cent in 1975 to 20.6 and 6.2 per cent respectively, in 2000. This option needs further study.

44. Quantitative forecasts have to be matched by in-depth investigation of the structural factors related to the demand for agricultural machinery, in the main those factors arising out of the farming systems and the purchasing capacity of farmers in developing countries.

Farming systems in developing countries and their development

45. In certain developing countries richly endowed with farm land, the urgent need for food and the export orientation of food production can bring about modern large-scale farming and the application of power operated machinery and equipment on a broad scale.

46. On the other hand, in those countries where only a small part of the existing land is available for farming operations, the aim should be to strengthen small-scale multi-crop farming. This would induce diversification of equipment, particular emphasis being placed on stationary equipment, while priority could be given to the manufacture of certain types of equipment:

In respect of mobile equipment, priority could be given to the development of a simple and inexpensive tractor, to the improvement of self-propelled tillers, to the development of a multi-purpose engine for coupling to simple machines, and to the improvement of vegetable-treating equipment.

In respect of stationary equipment, priority could be given to the development of irrigation equipment, crop-protection equipment (storage, initial treatment of vegetable crops, preservation of animal products, etc.), waste-utilization equipment, and equipment designed to improve or introduce economical independent sources of energy.

47. As for systems based on animal-drawn technology, it will be necessary to improve not only animal-drawn mechanization for soil cultivation and seed-bed preparation, but also - and more particularly - the mechanization of other farming operations such as crop protection, harvesting and processing in order to reduce the existing imbalance in the mechanization process and, ultimately, to overcome the slow progress in the over-all intensification or agricultural production.

48. This problem also applies most significantly to the existing power-operated mechanization systems in developing countries. None of the developing countries have yet been able to mechanize the whole spectrum of agricultural operations: cultivation seed-bed preparation, water supply, crop protection, harvesting and post harvesting by appropriate combinations of power-driven tools and implements. Trends in countries such as Algeria, Argentina, Brazil, China, Egypt, India, Mexico, and Pakistan, are towards a limited degree of mechanization, particularly in major agricultural operations related to cultivation, irrigation and post-harvesting. The power utilized varies from 25 to 80 hp for tractors, up to 12 hp for power-tiller up to about 10 hp for irrigation and 2 to 7 hp for threshing and shelling. A new trend towards greater mechanization under co-operative arrangements has emerged. Crop production has been greatly intensified in selected regions through maximum use of power-driven agricultural implements as evidenced in India and Pakistan or in some regions of Latin America.

Discrepancy between potential needs and the farmers' purchasing capacity

49. Despite the considerable need for agricultural machinery and equipment experienced by most farmers in developing countries(and future generations), statistics would seem to indicate that demand has reached saturation point. This situation is also confirmed by major companies in their assessments of market opportunities in developing countries. This fact is of crucial importance not only for general humanitarian and social reasons (a very high per cent of future generations will have to face unemployment and malnutrition), but also in terms of developing a national agricultural machinery industry. Enterprises and industry will not be viable for want of basic needs and, above all,for lack of purchasing power. Most existing enterprises are already facing the reality of the farmers' limited purchasing power in developing countries. The main reasons for this are to be found in:

- The needs of large modern farms and large stretches of land which call for a high level of mechanization are met by large-scale machinery imports from developed countries (except in those few countries where local production can largely meet domestic demand, especially for tractors). Consequently, this sector of the market will, for the most part, require replacements, albeit on a more extensive scale than in developed countries owing to the shorter service life under developing country conditions.

- The needs of small farms and poor farmers cannot be met in the same way since the low incomes, insecurity of earnings, social habits and dependency status of the rural poor offer no financial leeway. Moreover, the machines offered on the local market (mainly imported) are often inappropriate to the real needs and conditions of work, frequently technically complex and costly to maintain and operate. This supply of inappropriate machinery and equipment contributes to a stagnation of demand which, in the final analysis, is also detrimental to the manufacturers. This situation is worsened by the absence of credit facilities and other banking amenities in rural areas.

- In most developing countries, domestic financial difficulties and constraints imposed by the balance of payments prohibit the provision, on an adequate scale, of loans and subsidies to farmers, co-operatives and rural development institutions. Furthermore, in some developing countries, the provision of loans and subsidies is not even accepted Government policy.

III. THE FUTURE OF THE AGRICULTURAL MACHINERY INDUSTRY AND INTERNATIONAL CO-OPERATION

Probable trends

The following trends are likely to prevail during the next two decades:

The least developed among the developing countries

50. Emphasis will probably be placed on products which involve upgrading establishments at the village blacksmith and artisan level to small-scale production using intermediate technology. More emphasis will probably be given to the local production of hand tools, simple hand-operated and animal-drawn implements with a high local component content. More information, on and assistance in, the manufacture of these items is expected to flow from more advanced developing countries to the least developed countries since most of the industrialized countries have long discontinued to produce hand-operated and animal-drawn tools and implements. The least developed among the developing countries are expected to continue importing tractors, engines, pumps and power equipment on a limited scale, while the future trend is expected to be towards the local assembly of such machinery from PKD and CKD imports.

The middle group of developing countries

51. In addition to hand tools, hand-operated and improved animal-drawn implements, emphasis will be on the local manufacture of the following

items: irrigation equipment such as pumps (up to 10 hp), pipes and fittings; crop-protection equipment (mainly manual); trailers (up to 1-2 ton capacity); hand reapers; threshers, mostly engine-driven (up to about 3-4 hp); limited quantities of power tillers (up to 12 hp); and such power-operated implements as disc ploughs and tillers (mostly assembled from CKD and PKD imports).

52. Imports of tractors and other power equipment are expected to continue. This group of developing countries will seek international co-operation in the manufacture of small engines and, in some cases, pumps. They will probably place emphasis on improving the existing metal-working industry and launching a diversified production programme for agricultural machinery and implements. Major efforts will probably be directed towards developing and upgrading foundry, forging, heat treatment and machine shop activities. This group of countries will continue to import steel, although small foundries with an output of 1-3 tons per hour will probably be set up for grey iron castings.

53. In their development, adaptation and prototype manufacture of hand-operated machinery, animal-drawn implements and simple tractor-drawn implements, these countries will probably encourage co-operatives the establishment of hiring stations for tractors and power-drawn machinery, with emphasis on repair and maintenance workshops, mobile servicing units and appropriate training facilities.

The more advanced developing countries

54. The importation of completely built machine units is expected to decrease gradually, except in the case of special machines and extra-powerful tractors for which demand in those countries is limited, and the domestic production of which would not be economically justified. It is expected that emphasis will be placed on the following items: local assembly and manufacture of two ranges of tractors, up to 50 hp for lowland farming and about 80-90 hp for highland farming; local assembly and manufacture of power-operated implements, such as 9-11 tine tillers, disc ploughs, harrows, seed drills, planters and mouldboard ploughs; local manufacture of irrigation equipment such as diesel and electric pumps up to 20 hp, sprinklers, pipes and fittings; manufacture of manual and portable crop-protection equipment, some engine-driven; manufacture of trailers with

a capacity of up to 5-6 tons; manufacture of threshers and shellers up to 5-7 hp; manufacture of large silos for grain storage up to 200 tons; manufacture of transport equipment and mechanical handling equipment; and large-scale manufacture of complex animal-drawn implements.

55. Although it can be expected that medium and large four-wheel standard tractors will be assembled and manufactured in co-operation with foreign partners, it is also likely that serious attention will be paid to the identification and development of small low-cost tractors for local manufacture. Some advanced developing countries are also expected to introduce tractor-driven or self-propelled combine harvesters (up to 60 hp). It is also possible that a number of developing countries may be able to introduce some form of land restructure as has happened in Ethiopia, Yugoslavia and in certain parts of India, in order to promote agricultural mechanization. It is quite likely that producer co-operatives and service co-operatives, in both the private and public sectors of the developing countries, will be expanded, thereby increasing the capacities of these countries to promote mechanized farming.

56. With regard to engineering and allied metal-working industries, it is anticipated that the majority of the developing countries will enhance their engineering capacity by expanding foundry, forging, heat treatment and machine shop activities.

Some guidelines for international and regional co-operation

57. The developing countries' present share of 8 per cent in the world agricultural machinery production (of which some 5 per cent are accounted for by the most advanced developing countries) is inadmissible, especially for an industrial sector that provides urgently needed tools, implements and machines to agriculture and thus helps to combat malnutrition in those countries. Furthermore, the agricultural machinery sector is an industrial sector of particular significance to the achievement of the Lima target. For obvious reasons, not all industrial branches in the developing countries can or will reach a share in world industrial production of exactly 25 per cent, the objective set in the Lima Declaration and Plan of Action: certain branches will exceed this level, others will remain below it. Moreover, for equally obvious reasons, the agricultural machinery industry is one of those industries in which the developing countries should acquire a share even greater than 25 per cent, if the acute food problem is to be solved.

58. At the same time, it is envisaged that developing countries will give priority to the manufacture of appropriate agricultural machinery, equipment and implements and to restructuring present production capacities in order to meet demand.

59. In the light of the present situation, trends and major constraints outlined in the previous section of this point, certain general guidelines for co-operation in the agricultural machinery industry can be brought forward.

International assistance programmes

60. Although such programmes vary depending on the development level of a country, they may be summarized in broad terms as follows:

Least developed countries

- Preparation of guidelines and sub-regional programmes for the production of hand tools, implements and simple machines:
- Assistance in the manufacture of hand tools, hand-operated and animal-drawn implements;
- Assistance in repair and maintenance activities at the national, regional and sub-regional levels;
- Promotion of training in the maintenance, repair and production of agricultural hand tools, implements and machinery.

Intermediate developing countries

- Assistance in expanding the production of hand tools, hand-operated and animal-drawn implements and simple machines;
- Assistance in establishing production units manufacturing pumps, threshers, crop-protection equipment and selected tractor-drawn implements and simple components:
- Promotion of licensing arrangements and foreign co-operation in the local manufacture of pumps and small engines.
- Reinforcing existing facilities for development, adaptation and testing, repair and maintenance, and commercialization.

More advanced developing countries

- Expansion of existing facilities manufacturing high-quality hand tools, pumps, engines, implements, crop-protection equipment, trailers and, in come cases, tractors and power tillers:

- Promotion of licensing arrangements and foreign co-operation in the local manufacture of tractors, power tillers, engines, combine harvesters, dryers, crop-handling equipment, transplanters and special implements for selected crops;

- Promotion of the manufacture of low-cost small tractors and power tillers;

- Development of ancillary industries;

- Assistance to design institutions, research and development institutes, prototype-fabrication centres, maintenance and repair centres, manufacturers associations, and professional agricultural engineering societies;

- Assistance at the plant level and management development;

- Development of steel manufacture for tractors, agricultural machinery and implements.

Potential areas of international co-operation between developing countries

61. In order to promote interregional and intra-regional co-operation between the developing countries on a bi-, tri- or multi-lateral basis with a view to developing the agricultural machinery industry and promoting agricultural mechanization, it is recommended that:

- Inter-country, sub-regional, regional and inter-regional committees be set up within existing institutions, international or regional organizations in order to develop concepts and undertake practical steps towards co-operation in the manufacture of agricultural machinery;

- Improved designs and agricultural machinery prototypes be transferred from one country to another in those cases where similarity in ecological and agrarian conditions justifies using the same types of machinery;

- Assistance be given through bilateral or other arrangements, in expanding and upgrading existing foundry, forging, heat treatment and machine shop facilities for the manufacture of agricultural machinery;

- Standardization be promoted throughout the agricultural machinery industry with particular respect to the design of agricultural equipment required by groups of developing countries with similar ecological and agrarian conditions;

- Pre-feasibility and feasibility studies, market and other surveys prepared by one country be made available to others intending to manufacture identical agricultural machinery and equipment;

- Facilities for training, prototype development, etc., be extended by industries and R and D centres in more advanced developing countries to other developing countries lacking such facilities;

- Study tours, seminars and workshops in more advanced developing countries be intensified at the sub-regional and regional levels in order to show development opportunities to the less developed countries;

- Large-scale multinational agricultural machinery projects be set up on a joint basis by several developing countries with a view to manufacturing appropriate items for consumption in those countries as well as for export;

- More sub-contracting arrangements be established for the manufacture of agricultural machinery parts and components at sub-regional and regional levels;

- Joint trade and marketing facilities be promoted among developing countries which use selected agricultural machinery and implements in common;

- Preferential tariff agreements (PTA) be established among interested developing countries in order to promote trade in both agricultural machinery and the raw materials required for that industry.

62. Continuous consultations and exchanges of experience are essential to the harmonization of agricultural mechanization policies in neighbouring countries which wish to bring about the better utilization of land areas and intensify crop production.

63. As stated earlier, the above proposals relate to only some of the potential areas for international co-operation in the agricultural machinery industry. The development of a precise plan of action requires thorough investigation and appropriate consultations among the governments and other decision-makers in the countries concerned. The list of possible areas for co-operation is only intended to serve as a basis for the exchange of views and experience at this Meeting on Exchange of Experience and Co-operation among Developing Countries in the Development of Agricultural Machinery Industry.

Table 1

Geographical distribution of world production of tractors of more than ten horse power in 1976

(in numbers)

	Number of tractors 1978	Percentage 1976	Ranking of 10 main producers 1978
Developed market economies	1,006,800	48.5	
USA	196,500	9.5	3
Japan	227,200	10.9	2
EEC	501,900	24.2	
of which			
- France 1/	165,000	8.0	4
- Italy	116,500	5.6	5
- Germany, Federal Republic of	108,480	5.2	8
- United Kingdom	111,900	5.4	7
Other European countries	74,100	3.6	
of which			
- Spain 2/	38,830	1.9	
- Sweden 3/	12,780	0.6	
Other developed market economies (Australia etc.)	7,100	0.3	
Developed centrally planned economies	744,500	35.9	
of which			
- USSR	576,110	27.8	1
- Romania	65,710	3.2	9
- Poland	59,510	2.9	10
Developing economies	323,700	15.6	
Latin America	93,000	4.5	
of which			
- Brazil 3/	53,700	2.6	
- Mexico	13,000	0.6	
- Argentina	6,000	0.3	
Asia	227,000	10.9	
of which			
- China	113,500	5.5	6
- India	53,100	2.6	
- Turkey 3/	31,700	1.5	
- Iran 3/	10,030	0.5	
Africa	3,700	0.2	
TOTAL WORLD	2,075,000	100.0	

Source: UN Yearbook of Industrial Statistics 1978, New York 1980

Figures are rounded, UNIDO estimates for countries not listed in the Yearbook of Industrial Statistics.

1/ Agricultural tractors of all sizes.

2/ Figures refer to 1976.

3/ Figures refer to 1977.

Table 2

World production of selected main agricultural machinery products (in numbers of units built) a/

1960 - 1978

Products \ Years	1960	1965	1970	1971	1972	1973	1974	1975	1976	1977	1978
Tractors of 10 HP and over	n.a.	1,292,406	1,552,499	1,489,310	1,556,308	1,730,291	1,902,998	2,028,673	2,174,350	2,151,076	2,074,649
Combine harvester-threshers	160,797	245,968	213,137	197,230	210,459	225,628	290,375	300,080	351,362	352,933	300,565
Ploughs	1,148,983	1,204,134	857,509	828,883	786,947	933,491	929,773	985,023	988,940	926,342	896,264
Rakes	——	117,020	143,867	117,639	116,377	139,046	139,908	140,735	136,381	128,277	141,293
Seeders, planters and transplanters	576,861	796,869	815,164	816,444	851,673	853,753	1,015,119	1,107,760	1,151,246	1,188,685	1,043,555
Fertilizer distributers	——	299,258	302,362	219,006	239,283	287,684	243,726	199,020	231,794	205,782	205,782
Milking machines	——	175,818	142,632	156,696	155,440	169,381	186,253	192,030	178,967	171,457	182,777

Source: Yearbook of Industrial Statistics, 1978, United Nations 1980 and previous editions.

Note: a/ This table only includes data reported to the UN Statistical Office in New York.

Table 3

Production of tractors of 10 hp and over
in the selected developing countries
(in number of units built)

Countries \ Years	1965	1970	1971	1972	1973	1974	1975	1976	1977	1978
Algeria	——	——	——	——	423	819	1,572	2,110	2,839	3,724
Argentina	13,648	10,642	13,268	14,408	21,460	24,505	18,397	24,098	25,631	5,997
Brazil	8,123	14,029	23,548	31,438	41,513	49,075	59,061	65,279	53,696	
China	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	99,300	113,500
India	6,312	19,931	16,545	18,308	23,537	29,097	32,445	36,675	34,675	53,088
Iran	n.a.	2,181	3,833	4,466	7,390	7,682	17,608	13,442	10,032	n.a.
Mexico	n.a.	3,596	5,079	6,229	5,830	7,539	10,082	11,574	10,489	13,005
Turkey	n.a.	7,709	15,693	23,178	32,818	25,653	28,023	39,357	31,658	n.a.

Source: UN Yearbook of Industrial Statistics 1974 and 1978, United Nations, New York 1976 and 1980.

Table 4

Agricultural machinery imports by regions during the period 1970 - 1978
(in million US $)

Regions	1970	1971	1972	1973	1974	1975	1976	1977	1978
Developed Market Economies	1,563.3	1,565.7	2,123.5	2,960.9	4,047.3	4,994.3	5,248.5	5,885.0	6,527.3
European Developed Market Economies	874.6	844.5	1,136.5	1,677.4	2,096.0	2,489.8	2,768.4	3,278.0	3,987.0
E E C	569.8	542.0	765.7	1,191.6	1,402.1	1,610.9	1,853.2	2,156.5	2,746.7
North America	481.2	569.2	765.0	993.8	1,489.0	1,865.8	1,914.3	1,944.7	1,983.9
Japan	39.5	39.5	43.9	60.6	93.1	88.3	75.7	89.7	128.7
Oceania (developed)	67.8	54.0	68.7	116.1	181.5	219.3	269.9	334.5	261.2
Centrally Planned Economies (incl. China)	508.5	556.4	748.6	1,035.7	1,138.1	1,536.9	1,563.9	1,136.4	1,454.7
Developing Market Economies	582.6	713.0	794.3	893.4	1,293.6	2,004.2	2,015.6	n.a.	2,417.1
Africa (exl. South Africa)	209.8	176.2	229.4	258.9	455.4	723.8	694.0	n.a.	569.5
Asia, Far East (exl. Japan)	240.8	246.6	n.a.	361.8	482.0	983.9	1,368.0	n.a.	581.1
Asia, Middle East	60.4	60.8	103.7	120.5	144.0	364.7	556.3	n.a.	406.4
Latin America	244.7	378.9	415.2	457.2	638.0	866.2	n.a.	n.a.	860.1
Statistical discrepancy	212.6	7.9	-305.6	111.3	284.5	531.9	469.6	1,036.9	47.1
Total World	2,867.1	2,848	3,360.8	5,001.3	6,763.5	9,067.4	9,297.6	10,350.6	10,446.2

Sources: - Yearbook of International Trade Statistics 1977, 1975, 1974, Vol. II, United Nations, New York.

- ECE Bulletin of Statistics on World Trade in Engineering Products, Editions 1970-1978, United Nations, New York.

Note: Due to the different structure as well as slightly different figures of the two statistical sources used for computing the tables "Agricultural machinery exports and imports by regions from 1970 - 1977", discrepancies in the data could not be avoided and are shown under "Statistical discrepancy".

Table 5

Agricultural machinery exports by regions from 1970 - 1978 a/

(in million US $)

	1970	1971	1972	1973	1974	1975	1976	1977	1978
Developed Market Economies	2,190.0	2,198.2	2,776.1	3,807.5	5,336.4	7,207.3	7,271.6	7,723.9	7,924.3
European Developed Market Economies	1,305.9	1,295.4	1,649.6	2,300.6	3,071.0	3,947.1	4,079.5	4,726.8	5,029.4
EEC	1,188.6	1,165.8	1,477.4	2,043.2	2,716.9	3,498.3	3,614.6	4,272.6	4,281.5
North America	782.2	778.7	973.2	1,268.4	1,793.7	2,631.8	2,648.9	2,392.6	2,643.6
Japan	71.8	91.8	114.7	184.2	391.7	534.5	449.7	516.0	782.0
Oceania (developed)	18.6	21.0	26.4	41.5	62.8	74.2	69.2	60.5	n.a.
Centrally Planned Economies	659.2	634.1	862.6	1,148.8	1,334.2	1,748.0	1,948.5	2,484.7	2,381.6
Developing Market Economies	17.9	15.7	22.1	45.0	92.9	112.1	79.5	142.0	141.2
Africa (excl. South Africa)	2.5	2.6	4.0	7.7	5.8	14.1	4.9	6.5	n.a.
Asia (excl. Japan)	6.9	2.4	4.5	6.2	21.6	19.0	16.1	n.a.	6.6
Middle East	0.8	0.6	1.0	1.2	6.3	3.2	n.a.	n.a.	n.a
Latin America	9.6	10.0	14.4	34.4	72.0	83.0	58.1	117.7	134.6
Total World	2,867.1	2,848.0	3,360.8	5,001.3	6,763.5	9,067.4	9,299.6	10,350.6	10,446.2

Source: Yearbook of International Trade Statistics, 1974, 1975 and 1977, Volume 2, United Nations, New York
ECE Bulletin of Statistics on World Trade in Engineering Products, edition 1970, 1977 and 1978

Table 6 Agricultural production in developing countries:

Growth Rates of Gross Agricultural Production

	Normative Scenario	
	1963*-75	1980-2000
	(per cent p.a.)	
90 Developing Countries	2.6	3.8
Africa	2.0	4.1
Far East	2.6	3.9
Latin America	2.8	4.1
Near East	3.1	4.0
Low Income Countries	2.1	3.8

Changes in the Composition of ross Output: 90 Developing Countries

($ billion 1975 prices)

	Percentage shares		Growth rate of production	
	1980	2000	1963*-75	1980-2000
			per cent p.a.	
Cereals	29	26	2.7	3.2
Other food crops	37	37	2.9	3.9
Non-food crops	13	13	1.2	3.7
Livestock	20	24	2.8	4.7
Total	100	100		

Source: FAO Summary and overview of the provisional report of Agriculture: toward 2000 - 25 July 1979