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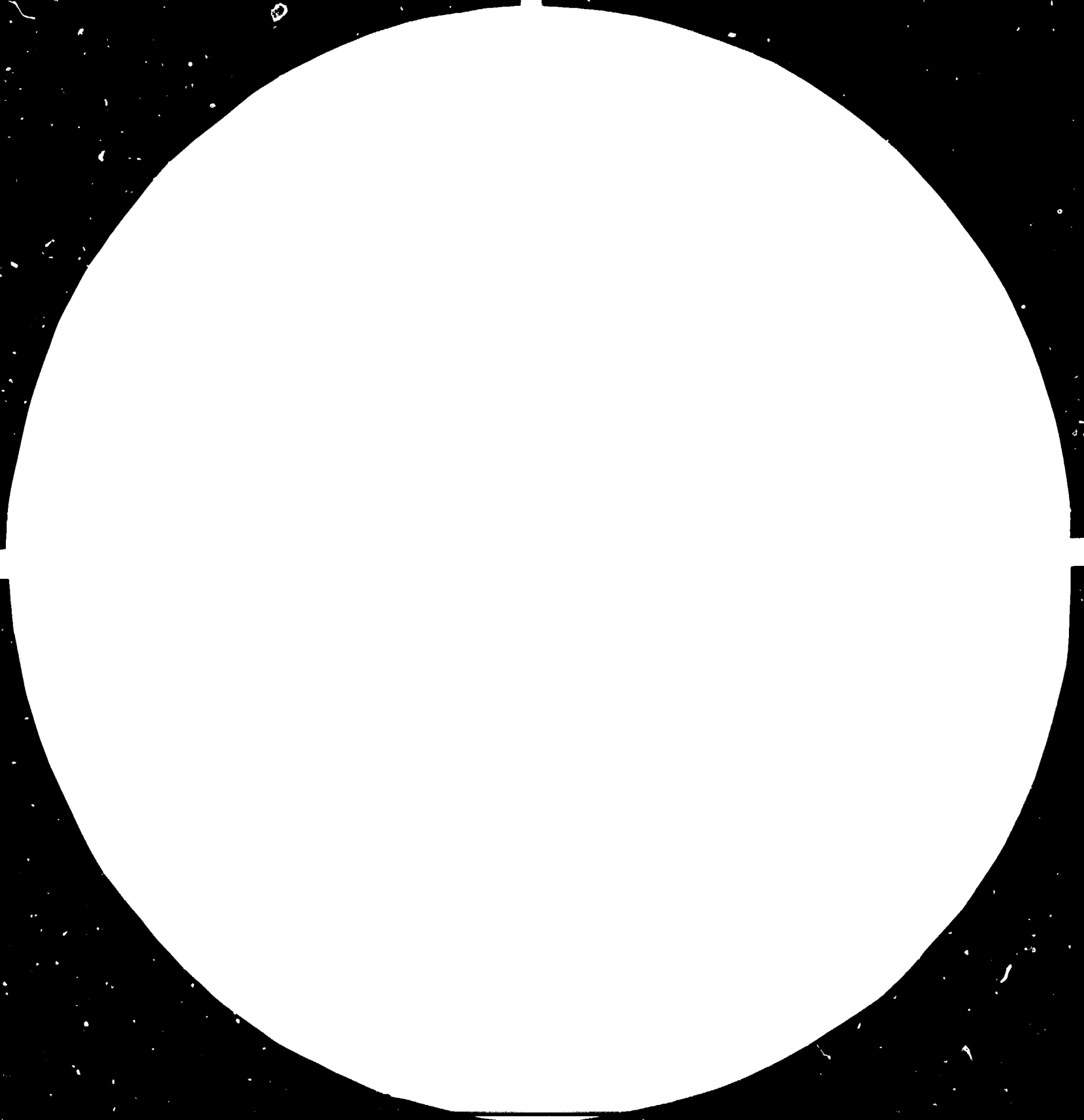

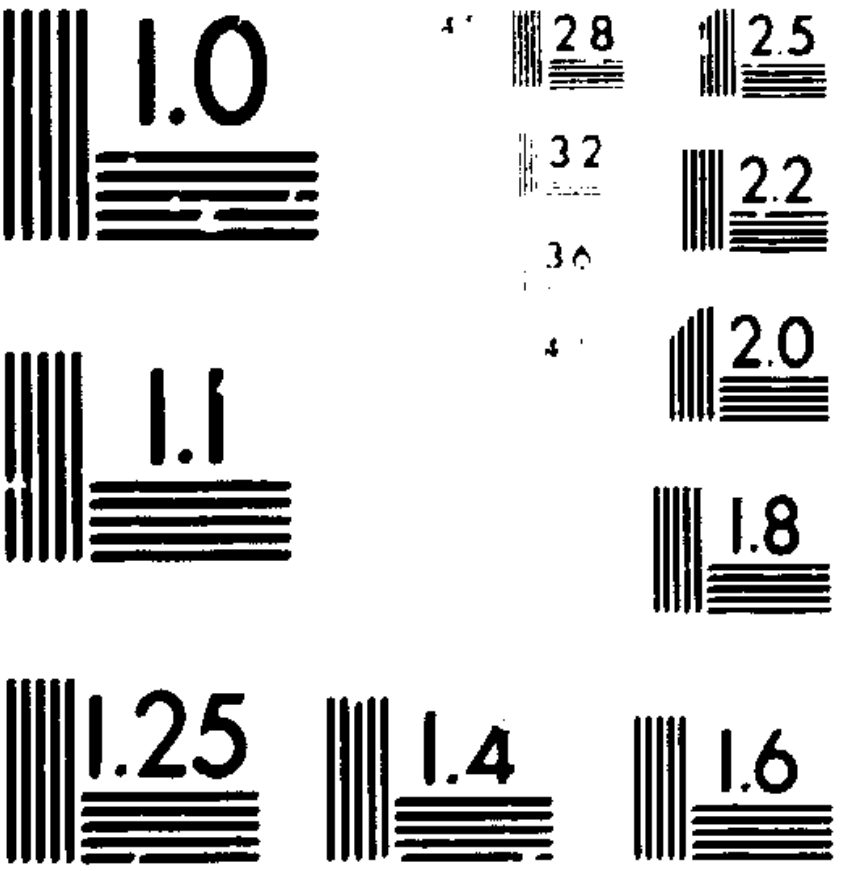

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THE AGRICULTURAL MACHINERY INDUSTRY: AN APPRAISAL OF THE CURRENT GLOBAL SITUATION PRODUCTION AND MARKET OUTLOOK

Sectoral Studies Series
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Main results of the study work on industrial sectors are presented in the Sectoral Studies Series. In addition a series of Sectoral Working Papers is issued.

This document presents major results of work under the element Studies on the Agricultural Machinery Industry in UNIDO's programme of Industrial Studies 1982/83.

Preface

This study has been prepared by UNIDO's Division for Industrial Studies, Sectoral Studies Branch. It presents an appraisal of the current production and market situation for the world's major producers of agricultural machinery. Specific emphasis is put on the situation in the developing countries.

The study will be a background document to the Second Consultation on the Agricultural Machinery Industry to be held in October 1983. The statistical material is issued in a separate statistical compendium in order to facilitate references. All reference to numbered tables refer to that statistical compendium (Volume II of this study).

The study draws on a number of input documents and external data sources. A special survey of the Latin American Region is issued simultaneously as another background document to the Consultation under the title "A Survey of the Latin American Agricultural Machinery Industry" (UNIDO/IS.407). Other background studies may be issued subsequently as Sectoral Working Papers.

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EXPLANATORY NOTES

References to dollars ($) are to United States dollars; constant dollars are expressed at 1975 pricess, obtained be deflating the current values by the geographically most appropriate export price index of agricultural machinery, published in the United Nations Monthly Bulletin of Statistics.

A billion is 1,000 million

A comma (,) is used to distinguish thousands and millions.

A full stop (.) is used to indicate decimals.

A slash between dates (e.g., 1980/81) indicates a crop year, financial year or academic year.

Use of a hyphen between dates (e.g., 1960-1965) indicates the full period involved, including the beginning and end years.

Metric tons have been used throughout.

The following forms have been used in tables:

Three dots (...) indicate that data is not available or is not separately reported.

A dash (-) indicates that the amount is nil or negligible.

A blank indicates that the item is not applicable.

Totals may not add up precisely because of rounding.

Besides the common abbreviations, symbols and terms and those accepted by the International System of Unites (SI), the following abbreviations and contractions have been used in this report:

Economic and technical abbreviations

GDP	Gross domestic product
GFCF	Gross fixed capital formacion
AMP	Agricultural Machinery Production, Gross
ISIC	International Standard Industrial Classification of all Economic Activities
MVA	Manufacturing value added
R and D	Research and Development
SITC	Standard International Trade Classification

Organizational abbreviations

ASEAN	Association of South East Asian Nations
UN	United Nations
UNIDO	United Nations Industrial Development Organization
FAO	Food and Agriculture Organization
UNCTAD	United Nations Conference on Trade and Development
ILO	International Labour Office
ECE	Economic Commission for Europe
IIASA	International Institute for Applied Systems Analysis
GATT	General Agreement on Tariffs and Trade
OECD	Organization for Economic Co-operation and Development
CEMA	Comité European des Groupement de Constructeurs du Machinisme Agricole

Introduction

The first global consultation meeting on the agricultural machinery industry organized by UNIDO in 1979 addressed the basic question on how agricultural mechanization in developing countries could contribute towards solving two fundamental problems:

(1) How to provide food for a world population that will reach 6.2 billion in the year 2000, 5 billion of which live in countries where the average food intake is already inadequate.

(2) How to employ this population and stabilize it in rural areas to prevent further anarchic growth of the major urban centres in the developing world.

In recognition of the fact that these problems have a special importance in the African countries, UNIDO in collaboration with FAO, organized a regional consultation meeting on the agricultural machinery industry in Addis Ababa in 1982. The documentation for the African consultation called for radically new policies and strategies and analyzed in depth the realities of the situation.[1/] New strategies and action programmes were developed and a basis for a plan of action was suggested.

The second global consultation on the agricultural machinery industry is convened at a time when the world industry is going through a critical phase. The production of modern agricultural equipment is massively concentrated in the industrialized countries with developing countries accounting for only about 8 per cent of total world production through a handful of countries. While the basic requirements of most developing countries for mechanization of their agricultural sector cannot be met, producers of machinery in the industrialized countries experience falling production levels, declining profits and increasing unemployment. Domestic production in developing countries faces grave difficulties and producers in industrialized countries have so far not responded to the special needs of developing countries.

1/ Agricultural machinery and rural equipment in Africa: A new approach to a growing crisis, UNIDO/IS.377, March 1983

The main objective of the second consultation is to explore practical ways of resolving the present situation and overcoming some of the difficulties through international co-operation. The first issue to be considered has been formulated as "The world agricultural machinery industry, prospects for international co-operation" (see document ID/WG.400/3 and the background paper "Agricultural machinery industry in the 1980s, factors for international co-operation", ID/WG.400/1). The impact of the strategies of main producers on the prospects for co-operation, the relation between the evolution of different agricultural mechanization models and the future of the agricultural machinery industry and the role of governments in co-operation are topics to be considered under this issue.

The second issue concerns "The integrated manufacture of agricultural machinery and capital goods" (ID/WG.400/5 and background paper ID/WG.400/6) and links the manufacture of agricultural machinery with the related manufacture of capital goods through multi-purpose units suitable for the development of the engineering industry. The third issue deals with "Items to be included in model contracts for the import, assembly and manufacture of agricultural equipment including training; model licencing agreement" (ID/WG.400/4 and background paper ID/WG.400/2).

The present appraisal of the current global situation of the agricultural machinery industry as well as the simultaneously issued survey of the Latin American agricultural machinery industry[2/] aim at giving a broad-brush background analysis of trade and production in different regions of the world as well as a factual background to the discussion of the above-mentioned issues on international co-operation which have been selected for the consultation. The global appraisal reviews the present situation in the world industry and the major factors behind this situation. It discusses the response of the producers and the principal considerations behind possible industrialization strategies of the developing countries. An overview of the global production and trade, including a tentative projection of the consumption of agricultural machinery in the years 1990 and 2000, is followed by regional summaries trying to highlight this specific situation and the main problems in each world region.

2/ A survey of the Latin American agricultural machinery industry, UNIDO/IS.407

1. An Appraisal of the World Situation

The world situation in the agricultural machinery industry is characterized by low production levels, declining profits, and increasing unemployment in the dominating producer countries. At the same time there exists a huge potential demand for agricultural machinery in the developing countries. To a large extent this potential demand does not become effective due to low purchasing power of farmers. Repetition of heavy mechanization patterns of developed countries and the uninterest of producers in those countries to adapt their production to the requirements of developing countries aggravate the situation. National policies to stimulate domestic production of agricultural machinery in developing countries have more often than not been unsuccessful.[3/]

1.1 The present situation in the industry

The world agricultural machinery industry[4/] has experienced a severe recession for several years running. This may have begun as early as 1977 or 1978 but became productionwise very serious around 1980-81 for most

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3/ See in this respect: UNIDO/IS.377, Agricultural Machinery and Rural Equipment in Africa - A New Approach to a Growing Crisis, and UNIDO/IS.407, A Survey of the Latin American Agricultural Machinery Industry.

4/ Throughout this study the agricultural machinery industry is defined as sectors belonging to the following groups of the International Standard for Industrial Classification (ISIC).

3811 Manufacture of agricultural handtools such as rates, hoes clippers, hand lawn movers.

3822 Manufacture of agricultural machinery and equipment, such as planting, seeding fertilizing, cultivating and harvesting equipment.

The corresponding trade statistics are reported under the headings listed in the SITC. Rev.1 as follows:

712.1 Agricultural machinery and appliances for preparing and cultivating the soil.

712.2 Agricultural machinery for harvesting, treshing and sorting.

712.5 Tractors, other than road tractors.

712.9 Agricultural machinery and appliances not elsewhere specified or included.

It is not possible to follow those definitions strictly and several deviations are indicated in the text and tables.

major producers. The decline in international trade generally lagged the reduction in production by one year. Of course, there has been individual deviations from this overall pattern both in terms of producers and products but mostly the market situation has been dismal. Very recently have some of the producers (mainly North American) began to show better profitability[5/] and the market outlook is expected to generally improve by 1984. One exception must be noted here. In 1981, Brazil managed to increase its exports to the other developing countries while other exporters started to experience heavy declines in their overseas sales. In fact, judging from the most recent available trade figures, no major slump in the trading performance of the developing countries occured in 1981 as compared to 1980. But, since the developing countries' share in trade (and production) of agricultural machinery is so small, their comparatively good performance did not substantially affect the global picture of the industry.

The world's agricultural machinery industry is heavily concentrated in the hands of a few countries and relatively few producers. The largest producer countries are the US, the USSR and Japan. In the developing countries, only Brazil, Argentina, India, Republic of Korea and China have significant domestic production of agricultural machinery (handtools and simple implements excepted). Mexico is emerging as a new important producer.

Because of the concentration of production in relation to the much more evenly spread demand, trade in agricultural machinery is substantial: approximately one third of the total world production is internationally traded. Therefore, too, production and exports are heavily correlated. Of the total exports, nearly 80 per cent originates from the developed market economies; five countries alone export two thirds of this total. Some

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5/ Massey-Ferguson's net losses during the second quarter of this year are down to $11.3 million compared to $87 million in the corresponding period last year. See Financial Times 1983-08-30, p.1. However, the improvement in profitability now is due to paying back of costs rather than to increased sales.

80 per cent of the developing countries' exports go to other developing countries, the majority of this being intra-regional trade from Brazil to other Latin American countries. The remaining 20 per cent is exported to the developed market economies. No exports to the centrally planned economies from the developing countries is registered.

The developing countries purchased one quarter of the world exports. More than 85 per cent of these imports came (in 1980) from the developed economies, 11 per cent from the centrally planned economies, and the remaining four per cent from other developing countries. Brazil is the only net exporter of agricultural machinery among the developing countries.

1.2 Major factors in the mechanization of agriculture

Since the 1950's the mechanization of agriculture has made rapid progress nearly everywhere. In the industrialized countries, the contributing factors to this development include:

- most available land is already in production;
- the value of farmland has increased;
- the average farm size has increased;
- the real cost of capital equipment in farming has increased;
- the availability of farm labour has declined;
- the development of agricultural machinery itself;
- agricultural policies that have made continuing overproduction financially feasible.
- technical evolution in the agricultural sector; and the development of the motor and automotive industries.

The implication of these factors is that the farmers have turned increasingly to an intensification of farming on their available lands as a primary strategy to increase the quantity and quality of agricultural production and thereby their incomes.

In the developing countries, the mechanization has proceeded much more slowly primarily due to:

- small farm sizes;
- topography and fragmentation of land;
- scarcity of skilled operators of mechanized farming equipment;
- population pressures;
- low effective demand for machinery;
- lack of appropriate machinery; and
- public policies intentionally or unintentionally biased against domestic agricultural production;
- lack of adequate infrastructure in the agricultural sector.

The implication of there factors is that while the farmers in the developing countries have realized the value of increased mechanization, their possibilities to purchase appropriate machinery have been very limited. Nonetheless, the need for an increased overall level of agricultural mechanization in the developing countries is strong and will have to be satisfied in order to reduce the so far widening gap between the growth in population and in food production.

1.3 Reasons for the current market situation

There are many important variables that argue for increased mechanization in the agriculture sector. Why, then, has the agricultural machinery industry experienced such a slow-down in the sales of its products?

In the developed market economies, the current market situation can be attributed to both domestic and international causes. On the domestic markets, major determinants are the worldwide recession, large crop production years further depressing already low farm commodity prices, increasing real prices for agricultural machinery, and an uncertain future of high interest rates and government support programmes. A prolongation of the usual machinery replacement cycle has not helped the machinery producers either but

this cause is probably related to the afore mentioned factors. In some of the smaller countries, a further development of collective utilization and leasing of equipment has reduced the rate of growth in the demand for agricultural machinery.

Since such a large portion of total agricultural machinery production in the developed market economies is exported, the external causes on the international markets are of great importance in this sector. Among the factors facing all, or nearly all, the exporting producers is foremost the worldwide recession which has caused total trade to languish and protectionist measures to proliferate to protect jobs at home. Other major common factors include the problems with distribution, service and parts supply which have not kept up with demand and caused some desillusion among potential buyers. The deteriorating balance of payment situation in many of the developed market economies is causing difficulties for not only the exporters but also for domestic producers who often rely on imported parts (often engines) to a varying degree.

Because of the recent large relative movements in the foreign exchange rates, the producers in different countries face different difficulties. The growing disparity between the dollar and the yen has had noticeable effects on the respective exports of USA and Japan. Italian and F.R. German producers have maintained their competiveness through currency adjustments and their traditional export orientation in specialized equipment. In fact, the smaller and more specialized manufacturers seem to have weathered the recession better than the giants in this industry. The producers in the UK have actually improved their international position through the lowering of the value of the pound and lower domestic inflation rate.

With respect to the markets in the developing countries, the major factors contributing to the depressed condition of the producers of agricultural machinery include:

- a deteriorating balance of payment situation making resources for the purchase of imports scarce;
- the increased debt burden in major importing countries making further credit very expensive, or even unavailable;

- continuing low incomes of farmers and fragmentation of available farm land;
- national policies intentionally or unintentionally biased agains domestic agricultural production.

An urban bias can be said to have characterized many national policies in the developing countries - more so in Africa and less so in Asia. This bias has clearly affected agricultural production and thereby the demand for agricultural machinery which, after all, is a derived demand. If the farmer does not experience an increased demand for this products, he has preciously little incentives to increase his production, i.e. to mechanize and improve productivity.6/

National policies have, by and large, failed in stimulating adequate domestic food production and in reducing the dependence on imports. Price structures and incentives have not been conducive to building up a profitable food producing sector.

In many developing countries, producer and consumer prices for basic foodstuff are controlled by the government. Dual objectives are pursued by these actions: adequate incentives for producers and protection of consumers are sought at the same time. In practice, the objective of ensuring adequate supplies of staples at "affordable" prices has been dominant. Thus, producer prices are fixed below market prices and imported foods are subsidized and encouraged when domestic food prices are increasing. Undoubtedly, this has a negative effect on domestic farmers and their willingness to produce and sell food on the local markets.

These policies have sometimes been attributed to an urban bias among policy makers in the developing countries.7/ Yet the bias against agriculture and in favour of urban activities has largely failed to benefit

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6/ Cf. in this context UNIDO IS/377, op.cit.

7/ See for example, The World Bank, Accelerated Development in Sub-Saharan Africa, Washington D.C., 1981, p.26, and Shankor Acharya, "Development Perspectives and Priorities in Sub-Saharan Africa", Finance and Development, March 1981, pp.16 - 19.

industrialization in the long run. Slow growth of rural incomes in the predominantly agricultural economies of the developing countries meant slow expansion of the domestic market for manufactures. In Africa, where these policies have been subscribed to most heavily, food production per capita declined by 7 per cent between 1967 and 1978 whereas it increased by 7 to 8 per cent in Latin America and Asia.[8/] However, those African countries where the bias against agriculture has been the least pronounced are also the ones where the industrial sector grew faster between the early 1970 and 1979.

Other causes for the slow development of the agricultural sector in the developing countries include marketing systems that are inefficient, uncompetitive, and uncertain, as well as irregular supplies of necessary inputs including seeds and fertilizers but also fuel and parts for agricultural machinery.

In addition, the transportation system for transferring product to market has severely limited the amount of product that could be effectively marketed outside the immediate growing region.

Finally, droughts and poor rainfall patterns in the 1970's in many parts of the developing world, rapid population growth pushing cultivation into less productive areas (and less conducive to mechanization), and wars and civil strife have caused severe disruptions in agricultural production and thereby demand for agricultural machinery.

1.4 The producers' response

In response to the general market situation, the producers of the developed market economies have been looking at their own cost, production, and distribution structure rather than attempting to increase sales by adaptation to shifting market requirements e.g. through catering for the needs of the developing countries. This has meant lowering wage and salary bills, reducing inventories, work on improved manufacturing methods and lay-outs, tighter financial controls and relationships with suppliers, and in general

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8/ Ibid. p.17.

various attempts at cutting costs by rationalization pf the production. Responsibility for quality control has been transferred more towards the suppliers of components. Research and development has been stepped up by at least some of the major producers. Many have been operating their plants at less than capacity and have consolidated their operations to increase operating efficiency and capital utilization. Many production facilities have been temporarily or permanently closed. Tractor production in North America in the last quarter of 1982 was probably at only a fraction of full production capacity.

The share of world-wide employment of major North American produc.rs employed in North America has steadily increased signalling a relative decline in overseas production. In fact, divestment of major interests in both European and Latin American subsidiaries have taken place recently.

The recession has forced the various manufacturers to further specialize their production and concentrate on the markets and products where they have a comparative advantage in terms of technology and foreign exchange rates.

North American firms are selling agricultural equipment to developing countries from their plants overseas to reduce the effect of the dollar's exchange value and bring the production closer to the markets. For example, John Deere manufactures its 55-59 HP tractor line in West Germany and markets to developing countries from there. Massey-Ferguson manufactures its medium and small (less than 100 HP) tractors in the United Kingdom and France. International Harvester manufactures in France, West Germany, and the United Kingdom, and assembles in New Zealand, Australia, and Mexico. J.I. Case acquired a British firm that manufactures small tractors to manufacture its 40-90 HP tractor line. Ford sells most of its tractors to customers outside North America from its European (France, Belgium, and the United Kingdom) and Brazilian plants. Not more than 5 per cent come from U.S. plants. As of now, there are few factories in the U.S. manufacturing tractors of less than 100 HP.

In the U.S., where the producers are hurt by increasing dollar values, leading producers in all sectors have increased their political pressure on the Administration to do something about the dollar/yen disparity in particular. Other responses of North American producers of agricultural

machinery to cushion against the effect of the high dollar and to reduce transportation costs include the selling of equipment to other countries directly from their overseas plants. Many firms have also increased their purchases of parts from overseas subsidiaries and licenses.

Many of the firms in the developed market economies are now entering into joint venture agreements with some developing countries and certain other innovative approaches, such as trade-and-barter schemes that accept counter-trade in exchange for exports, are tried out. In general, however, the developed countries' producers are not looking to solutions to their current problems with low demand that would involve the developing countries to any great extent. According to the industry itself, the product line produced in the developed countries for the developed country markets is so different from the machinery demanded in most developing countries that gearing up for those markets would involve major designing and re-tooling. This, it is argued, would require major investments which the industry is in no shape to undertake now and the resulting production series would be too short to achieve customary economies of scale. For example, for the European producers, the demand of the developing countries for agricultural machinery represents only some 10 per cent of total production. The Japanese manufacturers constitute an exception in this respect. Their production lines (compact tractors, combines and equipment suited for rice cultivation) find receptive markets among the developing countries. Japan is also eyeing the emerging huge Chinese markets and it is trying hard to increase its sales to the oil exporting Middle East countries with which it runs a constant trade deficit.

Political and other unrest in several traditional markets for the developed country producers of agricultural machinery have made them less attractive in the eyes of these manufacturers. Government interventions in the markets are also seen by these producers as uncertainty factors and thus have a negative effect on their perception of the markets in these developing countries. The response has been an abrupt withdrawal from these markets, except for in the case of direct sales of individual lots of machinery against guaranteed payment.

1.5 Policies for increased mechanization in the developing countries

Population growth is outstripping food production in many developing countries, in particular in Africa. Where output has increased, it is often due largely to an expansion of the areas under cultivation, except for the Indian subcontinent where much of the growth has come on irrigated lands. With the pressure of the growing populations on land, the traditional patterns of shifting cultivation, long fallow periods, manual farming using only primitive implements, and little use of fertilizers are becoming increasingly inappropriate. Over the past decade, it has been recognized that labour constraints are a key obstacle to agricultural progress but development strategies have not fully reflected this insight.[9/] Rather, the increase of the productivity of land through fertilizers and improved seeds has been stressed. Clearly, however, more emphasis should now be placed on increasing the productivity of labor through the greater use of farm implements, animal and machine powered cultivation, grain harvesting and processing equipment, and other equipment.

Although a great deal of agricultural machinery produced in the industrialized countries is sold or provided through development aid to the developing countries, we have seen that the companies strategies do not envision any expansion in this direction, with the notable exception of Japan. Thus, if the developing countries are to increase the level of mechanization of their agriculture, which they must, they will have to increase their own output of agricultural machinery.

To outline a detailed industrialization strategy for the manufacture of agricultural machinery is beyond the scope of this paper. Nonetheless, certain main elements deserve mentioning as a basis for discussions.

Principal considerations bearing on any such industrialization strategy are:

9/ Ibid., p.75.

(1) Market size. Although the farmers are numerous in the developing countries, their incomes are low and their holdings small and fragmented. Thus, the market in any given country or region tends to be small.

(2) Arable land. Many developing countries face a land constraint in the form of large areas being arid or semi-arid, mountainous, or covered by thick jungle. The cultivation of such lands requires specialized techniques and equipment that may not be easily transferrable. Soil conditions and the annual pattern of rainfall have similar effects.

(3) Wages and productivity. Wages in many developing countries, in particular in Africa, tend to be high in relation to productivity. This raises the cost of industrial production.

(4) Management costs. The industry in developing countries often rely heavily on expatriate management and technicians, less so in Latin America than in the other parts of the developing world. Such managers and technicians easily cost 2 or 3 times as much as in their home countries again adding significant amounts to relative costs of production.

(5) Capital and infrastructure costs. Due to higher transportation costs, risks and construction delays, industrial projects in developing countries typically require investment costs that are as much as 25 per cent higher than in developed countries.[10/]

Although not all developing countries are equally affected by the above considerations, they affect to a greater or lesser degree the options for increased production of agricultural machinery open to most of these countries. These options include:

(1) Import substitution. This can be a sound policy, in particular for the manufacture of relatively simple industrial goods where economies of scale are not very important. However, in the production of more mechanized equipment such as advanced tractors or harvestors there are considerable scale-problems.

10/ Ibid., p.93.

(2) Assembly. This offers an often used option to overcome problems associated with small markets and low labour and management skills. Tractors in particular are successfully assembled in many developing countries. Assembly offers an opportunity to gradually increase the local content in the production.

(3) Regional integration. Production for a regional market through some form of economic integration allows manufactuirng in larger series of more diversified equipment. Multi-purpose production is further facilitated. However, certain obstacles are associated with transportation cost, differing levels of development among the integrated markets, inefficient industries that eventually become a burden, and actual or potential political disputes.

(4) Manufacturing for exports. This option is attractive for the newly industrialized countries and the examples of several Latin American producers show that the strategy is feasible provided the factors mentioned above that contribute to relatively high production costs, can be effectively countered. Nonetheless, it must be realized that for most developing countries, producing for the domestic market will in the beginning be the most realistic target.

(5) Integrated approach to manufacturing. Promotion of indigeneous entrepreneurship and the building up of technological tradition is essential.[11/] And the opportunities in this respect are exceptionally good in the manufacturing of simple agricultural tools and implements. This can begin literally in rural blacksmith and small engineering workshops. This would improve agricultural production through the availability of appropriate agricultural implements and machinery and it would also provide an alternative source of income for the rural population. In this way, industrial and agricultural expansion can interact to boost both sectors simultaneously.

Regardless of which option for industrialization and mechanization of agriculture in the developing countries that is adopted, the common urban bias in price policies must be tackled. If the local farmer cannot sell his

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11/ This has been treated extensively in UNIDO/IS.377 op.cit.

production he will not be buying further machinery and hence such will not be produced either. This is not to deny in any way the fact that abundant experience worldwide certainly shows that the political risks of raising food prices can hardly be ignored. Furthermore, the concerns over the impact of such higher prices on real incomes and the nutritional well-being of the poor are genuine and very legitimate. Nonetheless, the agricultural pricing and distribution policies described above have hampered the growth of agricultural production in the developing countries and have thereby been self defeating.

Finally, the drive to increase the mechanization of agriculture in the developing countries must be accompanied by commensurable improvement in road infrastructure, marketing and input distribution, and transport equipment, including such simple means as animal drawn carts or small trucks (pick-ups). It is perhaps because of a lack of such coordinated rural development that the experience with ambitious tractorization schemes in some parts of the world has been, on balance, adverse.

2. Global Production and Trade

2.1 Production overview

Reliable production statistics are difficult to obtain and are often very fragmentary. Data in value terms are only available for the developed market economies, and for Brazil and Mexico. Production for the centrally planned economies and for most developing countries are only available in terms of units. The data in this section exclude handtools and fixed farming equipment due to lack of suitable information.

The agricultural machinery industry nearly everywhere has experienced a severe recession for the past few years. The decline in sales - and profits, where applicable - generally started in 1980, and was further deepened in 1981 and 1982. Where data are available for the early part of 1983, indications are that a recovery is gradually on the way.

In 1980, sales of agricultural machinery products in the developed market economies were estimated at $30 billion in current values or $20 billion at constant 1975 prices. Having been nearly $23 billion in 1975[12/], this represents a substantial decline in real terms. In the producer countries for which post-1980 data are available, sales declined further in 1981 and 1982 (see Table 1[13/]). The production of tractors in the centrally planned economies of Eastern Europe, in terms of units, increased steadily up to 1978 whereafter it has declined. The trend is similar for tractor drawn ploughs although the turning point came already around 1975. In contrast, the production of seeders, harvesters, and combines seem to have reached a plateau by 1981-1982.

Among the developing regions, Latin America is by far the most important one as far as production and assembly of agricultural machinery is concerned.

12/ First Global Study of the Capital Goods Industry: Strategies for Development, UNIDO/ID/WG. 342/3, p. 65.

13/ All numbered tables refer to those in the separate Statistical Compendium on Agricultural Machinery, UNIDO/IS.408/Add.1, Sept. 1983.

There, also, the global trend is evident. From 1960 to 1976, the production grew at a very fast rate but by 1982 it had fallen to levels only one half of those attained in 1976.[14/] As far as can be determined, the situation is similar in the developing countries of Asia and Africa. Overall production has probably fallen since 1977 or 1978 due to declining farmers' incomes, and persistent foreign exchange problems in many countries.

The world's agricultural machinery industry is heavily concentrated in the hands of relatively few producers, which are often transnational. The combined sales of 11 major manufacturers typically comprise some 70 per cent of total sales in the developed market economies. Among these 11 corporations, seven are based in the US, one each in Canada, Federal Republic of Germany, Italy, and Japan. And amongst these, three North American producers (John Deere, International Harvester, and Massey-Ferguson) account for nearly one third of all the developed market economies' sales.

The largest producer countries are the US, the USSR, and Japan. Amongst the OECD countries, the US and the EEC countries as a group each produce some 40 per cent (see Figure 1). Overall, the largest producer countries among the centrally planned economies are Romania and Poland, in addition to the USSR. But, due to planned specialization, the ranking varies by product group. Thus, Bulgaria is big on tractor-operated seeders and ensilage combines, and Czechoslovakia on tractors. The principal producers in the developing countries are Brazil, Argentina, India, Republic of Korea, and China.

The types of machinery produced varies from one country to another. Only the countries with very large domestic markets, such as the US and the USSR, or with fairly isolated but sizable markets, such as Australia, tend to produce a wide range of agricultural machinery. The structure of

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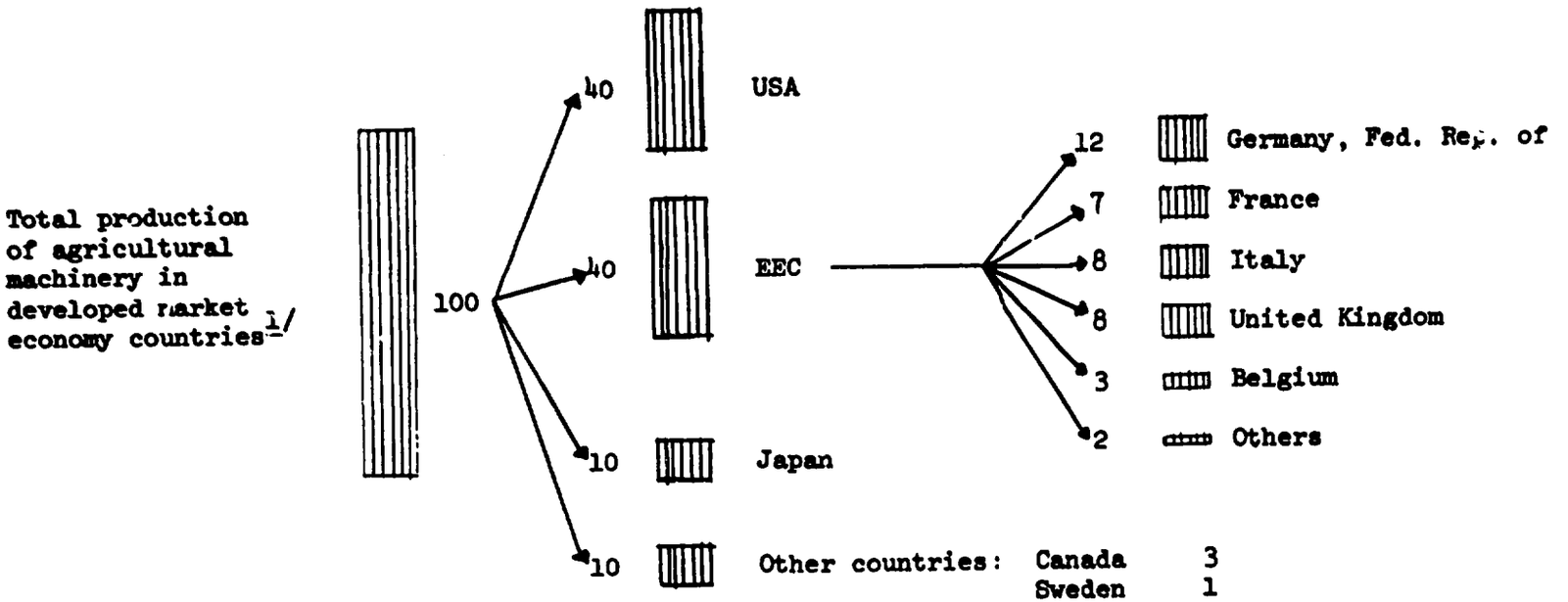
14/ The production of tractors in Mexico, which has begun only relatively recently, is an exception: there, production has been growing although the 1982 production is estimated to be lower than in 1980.

Figure 1: Production of Agricultural Machinery in Developed Market Economies in 1980 (Percentage Distribution)



1/ US $ million 30,000

Source: The Engineering Industries in OECD member countries, basic statistics, 1976 - 1978, OECD, Paris 1982 and UNIDO estimates.

production in a given country can be explained by various factors:

(a) the domestic agricultural productive system determines the type of machinery required,

(b) the demand for given types of machinery on accessible export markets afford possibilities to attain economies of scale in the domestic production, and

(c) the general stage of development: thus, the primary importance of the manufacture of tractors in the developing countries results from the weakness of the capital goods industry in producing a variety of machinery, lack in basic facilities, infrastructure, the versatility of the tractor as a 'general' agricultural machine, social symbolism of the tractor, etc.

In terms of value, as well as number of units, the most important products are the tractors. They represent about 40 per cent of total agricultural machinery sales. Harvesting and threshing machinery constitute the second most important product group with 25 per cent of total sales (see Table 2).

In 1980, world production of tractors of more than 10 HP amounted to over 2.1 million units (see Table 3). However, the maximum level of production in the past 10 years was reached in 1979, when the output of tractors was nearly 2.3 million units. In the first 5 years of the decade between 1971 and 1980, the annual average growth rate of tractors produced was much higher than in the later years when the level of production flattened out.

The world's largest producer of tractors is the USSR with an output of over half a million in 1980, thus providing over one quarter of total world's output. The planned economy countries as a group supply about 35 per cent of the world total. The US was the second largest producer of tractors in 1980 with an output of over 350,000 units. Japan was the third largest producer in 1980 (227,900 units). Japan had a peak in production in 1976 (almost 310,000 units). Beginning with 1972 Japan experienced an extremely rapid expansion. The number of tractors produced increased 3.6 times between 1971 and 1975.

Figures for China are only available from 1977 onwards. In 1980, tractor production slowed down (97,700 units) after it peaked in 1979 (125,600 units), but still occupies the fourth rank in world production.

The four EEC members France, Italy, Federal Republic of Germany and United Kingdom together account for over 20 per cent of total world production. The contribution of the developing countries (excluding China) to the world tractor production is estimated at about 175,000 units in 1980 or about 10 per cent and thus rather limited (Tables 3 and 4). No overall information is available on the extent to which tractors are only assembled or actually manufactured in the developing countries.

Other main types of agricultural machinery products include harvester-threshers, seeders and ploughs (see Tables 5, 6 and 7). Data on these products are of limited reliability since it is much more difficult-especially in the developing countries - to identify tractor or animal drawn and hand-operated machinery than tractors. However, some relationships between the number of units produced of the various types can be deduced (see Table 8). In 1980, for 10 tractors of 10 HP and over, the industry produced 3.7 tractors of less than 10 HP, 1.4 combine-harvesters, 5.3 ploughs and 4.8 seeders. These relationships have not changed significantly since 1971 and the slowdown in the agricultural machinery industry has affected all product groups, except for tractors with less than 10 HP.

The annual average growth of the number of the machines and equipment produced was much higher in the period 1971-1975 than in 1975-1980. Specially combine harvester-threshers, harrows and seeders and planters showed high growth rates from 1971 to 1975. Since then, the annual growth rates have remained positive only for tractors and harrows.

It is estimated that over 50 per cent of all farmers in the developing countries use only hand tools in their work, some of them as simple as wooden sticks to work the soil.[15/] Approximately 90 per cent make their own tools adapting them to tradition and local farming needs. Only limited specialization and trade in these products occur.

15/ UNIDO/ID/WG. 342/3 op.cit. p. 67.

In countries with important export crops such as coffee, tea, cocoa, groundnuts etc., a significant amount of machinery for cultivation and harvesting is produced domestically in medium sized enterprises (10-50 employees).

2.2 Trade

2.2.1 Evolution of international trade 1971-1980

Globally, trade grew in real terms very fast between 1971 and 1975, at 14.7 per cent annually, but since then the growth rate has decreased to only 1.5 per cent per annum, thus parallelling, although lagging, the decline in production (see Tables 9 and 10).

Regionwise, the developed market economies' share in the global trade has declined somewhat, the U.K. accounting for the largest relative drop in exports while both Italy and Japan significantly increased their relative export shares. The centrally planned economies more or less maintained their share in global trade with the gains of the USSR making up for the losses of exports from the Democratic Republic of Germany and the imports to Czechoslowakia. Relatively, the developing countries have increased their share in global exports the most, but absolutely the amounts are still modest. Imports have remained high in both relative and absolute terms although they declined towards the end of the decade.

2.2.2 The world situation in 1980 and developments in 1981

The global picture

World trade in agricultural machinery products[16/] was about US$ 14.4 billion in 1980 at current prices. Based on production data, it can be deduced that approximately one third of the total world production of

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16/ See footnote 2 above for definition in SITC terms.

agricultural machinery is internationally traded. The developed regions dominate the trade between developed and developing regions, (see Table 11). Of total world exports, 77 per cent originated from the developed market economies; five countries alone exported two thirds of this total, namely the US, which is the leading exporting country (21 per cent of world total), F.R. Germany, U.K., Italy and Japan. As a group, the EEC member countries accounted for 40 per cent of the world volume exported both outside and within the community.

All the above mentioned countries have a considerable export surplus in their trade in agricultural machinery. Among the leading exporting nations, Japan has the smallest imports in relation to exports. Therefore, it shows the most favourable export/import ratio, i.e. 5.83 as compared to US which, among the leading exporters, shows the least favourable export/import ratio, namely 2.58.

The centrally planned economies exported more than 20 per cent of the world total. Their exports exceeded their imports only slightly by 3 per cent. The leading 3 exporting countries, namely the USSR (8.5 per cent of world total), Democratic Republic of Germany (5.2 per cent) and Czechoslowakia (2.6 per cent) contributed almost 80 per cent of the centrally planned economies's exports.

The developing countries show a completely reverse picture. They exported only approximately 2 per cent of the world total in 1980; by contrast, they purchased one quarter of the world imports, thereby constituting a considerable market for the producers in the developed countries. They are the leading importing group and ahead of the EEC (21 per cent of world total).

For the developing regions as a whole, its coverage of imports by exports is only .076. When disaggregating the developing region into 3 sub-regions, the export/import ratio for Latin America is .170, for Asia it is .029 and for Africa it is almost nil or 0.001. This unbalanced situation, which is of

course also reflected in the trade in engineering products as a whole, aggravates the adverse balance of payments situation of most of these developing countries.

The developed market economies - trade in 1981

The 1981 export performance of the developed market economies as a group, compared to 1980, indicate a slowing down in the growth of their exports, i.e. exports decreased by 5.0 per cent in real terms (see Table 12). This decreasing trend is more marked in the EEC countries where exports went down by 14.7 per cent. The only two countries that registered a growth in exports were the US and Japan, the largest and fourth largest exporters, respectively.

The developed market economies also reduced their imports in 1981 quite substantially as compared to 1980. In 1981 they imported nearly 20 per cent less in real terms than in 1980 (see Table 13). This drop is sharper in the EEC countries, which imported on the average more than one quarter less than in 1980. Only Canada increased its imports.

Developing economies - trade by regions in 1980

In 1980, the exports of 13 selected developing countries totalled nearly US$ 163 million at constant 1975 prices representing almost 99 per cent of all developing countries' exports. The major exporters among these 13 countries belong to the group of newly industrializing countries (see Table 14).

Brazil is by far the leading exporting country accounting for about one third of total developing countries' exports. Argentina and Mexico come next in importance.

In 1980, approximately 80 per cent of the developing countries' exports went to other developing countries. The majority of this was intra-regional trade from Brazil to other Latin American countries. The remaining 20 per cent were exported to the developed market economies. No exports to the centrally planned economies were registered.

The breakdown of the developing countries' exports in 1980 was as follows:

- Latin America accounted for 88 per cent of total developing countries' exports of which 85 per cent came from Brazil alone, followed by Argentina, Mexico, Colombia and El Salvador;
- Asia's share in developing countries' exports was about 11 per cent. Singapore exported about one third of all Asian developing countries from output produced in off-shore plants;
- Africa's exports are almost negligible with less than one per cent of total developing countries' exports.

By 1981, the situation had not changed structurally, at least for the countries for which data are available (see Table 15). Notably, however, Brazil had managed to increase its exports to other developing countries.

On the import side the country concentration is less marked than on the export side. In 1980, the 23 major importing countries accounted for about 65 per cent of total developing countries' imports (see Table 16). In 1980, more than 85 per cent of the purchases of the developing countries came from the developed market economies, 11 per cent from the centrally planned economies and only 4 per cent from the developing economies. Thus, with the exception of three Latin American countries, namely Argentina, Colombia and Venezuela, where inter-regional trade is of some significance, world imports from developing countries are almost nil.

In 1980, the distribution of imports by developing regions was topped by Asia (40 per cent), followed by Latin America (38 per cent). Africa accounted for 22 per cent of total developing countries purchases.

In 1980, Brazil was the only net exporter of agricultural machinery among the developing countries. This situation seems to have continued in 1981 judged by the available 1981 trade figures. Selected major countries for which data are available show a more or less unchanged situation in 1981 (see Tables 16 and 17). Significantly, this seems to indicate that no major slump in the trading performance of the developing countries occurred in 1981 as compared to 1980.

Trade by groups of products

At the global level, trade in agricultural tractors was and remains the most important single trading item, accounting for over half of the total trade in agricultural machinery (see Table 18). Machinery for cultivating and harvesting comes second in the international trading list, amounting to 40 per cent of world exports in 1980. Both groups showed a slight increase of their share of total agricultural machinery trade between 1971 and 1980. Throughout the seventies, the export destination distribution has remained fairly stable although the share going to the developing countries was slightly higher in 1975 than at either the beginning, or the end of the decade (see Table 19).

The dominating position of tractors in the international agricultural machinery trade shows the importance which is given to tractorization in the development of the agriculture sector. This fact becomes even more clearly in when considering that tractor imports account on the average for over 60 per cent of total agricultural machinery imports by developing countries (see Table 20). In Africa they account for even more than 70 per cent.

2.3 Present and foreseeable trends in the mechanization of agriculture

2.3.1 A qualitative assessment

Since the 1950ies, mechanization of agriculture has made rapid progress everywhere, except for large areas of Africa where the typical smallholder still uses primarily simple hand tools and only occasionally animal drawn implements. The trends towards increased mechanization is illustrated as far as industrialized countries are concerned by the increasing numbers of tractors per unit of agricultural land in the ECE region (see Table 21). At the same time, average horse power per tractor also has increased steadily so that tractor horse power per unit of agriculture land went up even more quickly than the number of tractors.[17/] These developments have, in

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17/ "European Agriculture - A Very Old But Rapidly Changing Branch of the National Economies", Economic Bulletin for Europe, vol. 35, No. 2, pa. 159.

general, brought about an increased flexibility in operations and facilitated the execution of combined operations. The trend towards more machines and higher horse power per unit of land is expected to continue although at a slower rate than in the period 1960-1975.

Apart from tractors, many other types of agricultural machinery have been developed and introduced in the past two or three decades. Of great importance are the fully mechanized harvestors-treshers with their positive contribution to quality and low losses. The latest development in mechanization, now being implemented on the North American and European markets, is the application of microprocessors to many of the mechanized operations in agriculture. Primarily, these allow for greater efficiency in cultivating the soil, sowing and planting, applying of fertilizers and pesticides, harvesting, and usage of fuel. The importance of this development will increase as the cost of such inputs as seeds, fertilizers, labour and fuel increase. The absolute decline in the agricultural labour force (see Table 22) will also continue to exert pressure on increasing efficiency.

Finally, environmental considerations will emerge to require increased precision in tilling the soil and applying chemical inputs.

Taking rising yields per unit of land as an indicator of technical progress, it can be said that the mechanization of agriculture has led to very significant increases in productivity (see Table 23 for data for industrialized countries). Consequently, agricultural production has risen faster than total population in the developed countries and in many places lead to over-production. In most developing countries, however, the population growth has outstripped the gains in agricultural productivity leading to decreasing food supplies per capita. Although equilibrium could technically be achieved by continuing to over-produce in the developed countries and shipping the surplus to the deficiency countries, this is not generally seen as the long term solution. Rather, the population growth in the developing countries must slow down and the productivity of agriculture must be increased (especially since the agricultural land area cannot be much expanded without further ecological consequences such as disappearing

forest cover).[18/] This will entail an increasing demand for agricultural machinery in the developing countries. In the developed countries, especially in the market economies, the demand will increasingly take the form of replacement demand with an accent on higher efficiencies and safety and confort of the operators rather than more machines or greater power.

A considerable growth in capital invested per unit of labour can be observed in all countries for which data are available (see Table 24). Nonetheless, there are pronounced differences in the investment levels achieved and in some countries saturation levels may have been approached by the early 1980ies.[19/] But, as always, the question of optimal ratios of capital to other inputs must be seen in relation to the opportunity cost of capital and its marginal productivity in other sectors of the national economies. In some instances, productivity in agriculture may be increased more and more cheaply by irrigation, application of proper technique, pest and drought resistant seeds and plants, and weedkillers such as paraquat that hold out a promise of no-tillage cultivation, and improved crop storage facilities.

The technical requirements for agricultural machines in the coming years can be summarized as follows:[20/]

- more capacity per unit in countries with large farms (in particular the US and the centrally planned economies);
- small, flexible and inexpensive machines for small farms;
- increased reliability and less maintenance;
- less damages and losses resulting from use of machinery;

18/ See discussion in First Worldwide Study of the Wood and Wood Processing Industries, UNIDO/IS.398, Aug. 1983.

19/ ibid., p. 163.

20/ Much of the remainder of section 2.3.1 is based on document FAO/ECE/AGRI/WP.2/46, prepared in 1981 by the FAO/ECE Working Party on Mechanization of Agriculture, as reported in Economic Bulletin for Europe, Vol. 35, No. 2, pp. 213-222.

- special equipment for slopes and heavy or sandy soils;
- increased use of equipment suited for reduced tillage and non-tillage farming practices;
- improved transmissions and hydraulics to match engine and ground speeds to load;
- increased use of front wheel or four wheel drive to reduce tire slip and power loss, and to improve fuel economy;
- electronic or microprocessor controlled devices and sensors to permit more accurate control over implement precision;
- more comfort and safety for the operators;
- better machines for harvesting and handling of vulnerable crops;
- more standardization in components; and
- more attention to environmental damage.

The past trend towards larger agricultural machines seems to have slowed down in many countries, e.g. the US. The difficulty of transportation from one field to another, the limitations of the farm size and lay-out as well as other economic considerations (indivisibility of inputs) are setting limits in this respect. Instead, other possibilities for capacity increase, like higher working speed and a combination of several operations in one machine, are probed.

Where the agricultural production is too small to justify the use of a (large) machine, individual farmers will find proper forms for multi-farm machinery use provided they will find a profitable market for the resulting increased production. This development will result in a demand for larger and more sophisticated machinery than otherwise would be the case.

Human labour as a source of power in most agriculture of commercial importance is rapidly vanishing. Similarly, the use of draught animals, although still important in many regions of the developing countries, is being replaced by motor power. The expectation is that the growth in available power per hectare will slow down in the presently already highly motorized regions but in others it will continue with the same or even higher speed as in the past decade. Tractors will remain the most important power source but there will be a shift towards self-propelled machines and stationary electric

motors on the farm. Of course, the latter development is closely conncected to the progress in rural electicification.

The size of tractors, and other machinery, directly depends on the size of the farms. Thus, the machines are small in most developing countries but also in such industrialized countries as Switzerland, the Netherlands and even the Federal Republic of Germany whereas they are large in the US and Canada, the USSR and Hungary. In countries with a high tractor density, the total number of tractors will decline due to the diminishing number of small farms and increased power per tractor. Presently, the most common agricultural tractor on middle sized farms has a power between 40 to 80 HP. In many countries, there is a striking number of makes and types which causes problems with the supply of spare parts and maintenance. Thus, there are concerted attempts to reduce the variety of tractors on any given market and to standardize certain parts such as transmissions and tires.

The characteristics of tractors are expected to change in the following direction:

- more hydraulic and hydromechanical drives;
- transmissions enabling gear change on the go;
- new hydraulic systems with higher pressures;
- position and power regulation of coupled machines;
- on-board microprocessors for selecting optimum operations modes;
- automatic hitching devices for trailers and farm machinery;
- better working conditions for tractor operators;
- more front wheel and four wheel drives;
- increased reliability and durability;
- reduced daily maintenance requirements; and
- reduced specific fuel consumption.

Diesel oil will remain the main fuel for agricultural tractors for both economic and technological reasons. Use of alternative fuels (gas or gasohol) will be marginal and mainly only in cases of scarcitiy.

Mechanization of crop farming

Mechanization of almost all operations in crop farming is possible although no truly satisfactory solution has yet been found for the harvesting of some vegetable and perishable crops. No doubt, however, such solutions are forthcoming and then the distinction between arable crops and horticultural crops will disappear and the latter ones will be grown on a bigger scale with less need for manual labour. This will have obvious implications for the amount of agricultural machinery in demand. Where necessary, the capacity of the machinery (for soil loosening, for example) will be increased and self-propelled machines will gradually substitute tractor - machine combinations.

The size of ploughs and other implements will have to be adjusted to the gradually increasing size of tractors. Where the erosion of the top soil is severe, or threatens to become severe, emphasis on reduced tillage or no-tillage methods will receive priority. The necessity of reducing the number of passages on the field will promote the combination of several operations in one pass, i.e. by one machine. On heavy soils, sowing and planting machines can be combined with power harrows and on light soils with harrows using crumble rollers. Fertilization and application of herbicides and pesticides can also be included in combined operations.

No significant technological change in the existing design of drills and planters for arable crops are expected. However, they will become wider and can be equipped with electronic gear for regularity control. Sowing and planting machines will increasingly be combined with machines for soil tillage, fertilizing and crop protection. The introduction of more expensive hybrid plants and seeds may increase the demand for precision drills, especially in horticulture.

When spreading fertilizers in large quantities, there is a trend back towards more exact spreaders. These give higher yields and more even maturity with lesser amounts of fertilizers. The risk of leaching into the ground water is also minimized.

The use of organic manure instead of chemical fertilizers is expected to increase again. However, this will require the use of special vehicles for transport of liquid manure over fairly long distances. These transporters have special tires and wheel systems to enable driving on soft soils as well as on hard roads. New varieties of crops may in the future require less chemical protection and therefore also contribute to a possible reduction in the demand for fertilizer application equipment. The design of such equipment will take into account the working conditions of the machine operator during spraying.

Radically new harvesting machines can only be expected for fruit, berries and vegetables. Otherwise harvesting machines will only get bigger and better; they will require less and easier maintenance and repair, and the resulting quality of work will improve (less losses and damages). The increasing size of the machines will cause self-propelled machines to replace the trailed type unless larger tractors are used which have sufficient power to drive the combine harvesters without an assisting engine.

Combine - harvesters will undoubtedly do most commercial harvesting of grain, except for rice. On fields which are not suited for these machines, other crops will be grown. Harvesting of crop by-products will increase because the material will be important as fuel or as raw material for biotechnology.

Environment

The damage of modern agriculture to the environment will be controlled by technical means:

- noise from engines, ventilators, etc. will be prevented and dampened, and
- application techniques for fertilizers and pesticides will be improved to reduce the risk for water and soil pollution.

Energy

Increased tractorization and mechanization in general of the agricultural sector in developing countries may lead to a sharp increase of national consumption of petroleum products. For many developing countries which do not possess indigenous oil resources this would impose an additional pressure on the balance of payments situation and affect the industrialization process which also needs increasing supplies of petroleum products.

Although it is difficult to present specific figures for the current use of petroleum products by agricultural machinery in developing countries and corresponding predictions for the future, it is possible to give some order of magnitude informalities on the present situation. Thus, a five-fold increase in commercial energy use in crop and livestock production for 90 developing countries accounting for 97 per cent of population of the developing world outside China is predicted for the year 2000 (see Table 25). It should also be noted that the share in the energy use of farm machinery is expected to rise from 31 to 37 per cent.

Petroleum products are the most widely used source of commercial energy for agricultural machinery, therefore it is necessary to consider what could be done to avoid possible problems connected with meeting the petroleum requirements of a growing agricultural sector in developing countries. One possible solution that could become the most acceptable for developing countries and that attracts a lot of attention in many developed countries as well is ethanol from biomass. The production of fuel ethanol by fermentation has a long history but the availability of cheap oil during the 1950ies and 1960ies caused a decrease in interest in this source of energy. But the increase in the price of oil in the 1970ies made ethanol again attractive as an alternative type of fuel.

It should be noted that the possibility of ethanol production from biomass particularly from agricultural products and residues as well as production of energy from biomass in general raises the question of how such developments would affect production of food. This problem requires a thorough investigation and techno-economic feasibility studies for concrete cases.

At the same time there are technical problems connected with the substitution of petroleum based fuels for agricultural machines by fuels derived from biomass. Whereas existing automobile engines do not require any modifications to run on gasohol which is an alcohol/gasoline mixture of 20 per cent ethanol fluid, the case is different for diesel engines which are the main type of engine used in agricultural machinery. Straight ethanol is unsuitable as fuel in diesel because of its high flamability and inability to combust uniformly. According to the World Bank Study,[21/] Brazilian automobile industry and government institutes report that mixtures of various vegetables oils and ethanol(with or without gasoline blends) can be used as fuel in diesel engines. However, it is pointed out that though it is possible to identify technically satisfactory solutions in the near future, considerable doubts remain whether ethanol can economically replace diesel fuel in the immediate future, since most preliminary test results indicate specific ethanol consumption of between 1.6 - 1.8 times that of diesel.

Conclusion

The trend toward increased mechanization in agriculture will still be predominant in regions when the mechanization level is low. This will be done by applying present technologies at a wider scale. The further development in already highly mechanized areas will be characterized by increased automation and microprocessor control of operations, improved working conditions for operators, and more attention to environmental protection, and the quality of agricultural products.

Research, extension and education in agricultural engineering will be required continuously to keep up with changing circumstances both within and outside the agriculture sector.

Increased tractorization and mechanization of developing countries will result in a further increase in their use of commercial energy.

21/ Alcohol production from biomass in the developing countries, World Bank, September 1980, p.8.

2.3.2 Projected apparent consumption of agricultural machinery, 1990 and 2000

In order to obtain a quantitative assessment of the future consumption of agricultural machinery in the world, simple econometric models of apparent consumption have been estimated for those UNITAD regions[22/] for which reasonably complete time series data were available. The models are specified in equations expressing a hypothesized relationship between apparent consumption of agricultural machinery and a given set of determining variables, as follows:

Dependent variable: Apparent consumption of agricultural machinery production (Production + Imports - Exports)

Explanatory variables:
- Gross domestic product (GDP)
- Gross output[23/] ISIC 311 + ISIC 313 + ISIC 314
- Gross capital formation
- Tractors in use
- Harvesters in use
- Arable land

As estimated models, the equations represent only empirical relationships between apparent consumption and the explanatory variables. Thus, the estimated regression coefficients cannot be given strict economic interpretations[24/].

22/ For further reference see The UNITAD System, 1981 Report, UNIDO/IS.337, September 1982.

23/ ISIC 311 Food manufacturing
313 Beverage industries
314 Tobacco manufacturers

24/ The estimated coefficients are biased and have unduly large standard errors because of significant multicollinearity in the data. But the joint distribution of the coefficients in all the estimated models is tight and the coefficient of multiple determination (R^2) is without exception very high. Those are important characteristics of any forecasting model and, as long as the past multicollinearity in the data can be expected to continue, the possible "wrong" signs of the estimated coefficients and their large standard errors have little consequence for forecasting. Of course, the influence on the forecasts of individual variables cannot be determined without reference to the multi-correlated structure.

The absolute level of mechanization in agriculture is thought to exhibit an S-shaped form with respect to the main determining variables. That is, the level increases first at an increasing rate, thus slowing down to a constant rate (the inflection point) and finally decreasing to approach a fixed saturation level. Most countries and regions are still thought to be at the increasing rate portion of the curve (to the left of the inflection point); only North America is likely to be experiencing a decreasing rate of increase (to the right of the inflection point). The simplest functional form to handle both situations is the double log specification which is then chosen for all the regional models.

The regions correspond to those of the UNITAD model but because of lacking data do not always contain all the countries of the UNITAD regions. The use of the UNITAD model promotes consistency in the work of UNIDO in two ways: (1) the regional coverage for any two industrial sectors is always the same, and (2) the assumptions regarding future values for main determining variables such as GDP are the same for all sectors. For a balanced industrial strategy for any country or region, such consistency among sectors and studies is more important than absolute precision in individual assumptions or forecasts of future values.

Because of non-existent data, the models could be estimated only for a few regions, mainly those comprising the developed market economies[25/] and Latin America. Even then, great difficulties were experienced because of periodically lacking data for some countries and/or some years and a great deal of efforts had to be expanded to either locate or estimate the missing data. The resulting data base is now unique in its coverage and will therefore be fully presented--together with a detailed version of the model--in a separate document for further use by researchers in this field. However, the limited coverage of developing countries obviously reduces the applicability of the results. It is hoped that the coverage can be expanded in the future.

25/ The projections for Japan may be unduly high because of overly optimistic growth rates predicted for its GDP; they are therefore not presented for the time being.

Two alternative projections are presented. The first one is based on the full econometric formulations and assumptions concerning the future values of gross national product and gross fixed capital formation supplied by the Global and Conceptual Studies Branch of UNIDO's Industrial Studies Division and FAO predictions for arable land and number of tractors and harvesters. These forecasts are to be considered preferred over the second alternatives which are simple trend extrapolations of past apparent consumption in relation to time.

Both projections show an increase in consumption between 1980 and 2000 with the exception that the econometric model indicates an initial decrease for North-West Europe (see Table 26). Generally the trend extrapolation model gives much higher projected values. Non-linear trend extrapolations again would yield very unrealistic (unbelievable) results: for example, Latin America would exhibit drastic reductions in its apparent consumption of agricultural machinery.

The linear model shows decreasing rates of growth in all regions. The econometric model predicts an inital drop in apparent consumption from 1980 to 1990 for Norther West Europe and thereafter a stabilization.[26/] Otherwise, this model shows decreasing growth rates, too. These results indicate clearly that although the apparent consumption of agricultural machinery can be expected to increase strongly all over the world, the saturation process will reduce future growth rates especially in the more developed regions. Although the centrally planned economies and developing countries as a whole are not included in the model, we are safe to assume strong increases in the consumption of these regions.

The total consumption for all regions--excluding Japan--according to the econometric model shows annual growth rates of 1.2 per cent between 1980 and 1990 and 2.1 per cent between 1990 and 2000. The linear extrapolations yield aggregate growth rates of 3.3 per cent between 1980 and 1990, and 1.7 per cent from 1990 to the end of the century.

26/ The reduction in Western Europe can also be expected when the current overproduction in agriculture in many of the countries is brought under control.

Although mainly of indicative value, the above projections show clearly that the main markets for the industry will continue to be developed regions. This in its turn indicates that the problems of developing countries, having either a comparatively weak industry or importing ill-adapted machinery from other regions, will largely remain unchanged in the coming decades unless specific measures are taken to rectify the situation.

The estimations referred to above inso far consistent with the FAO projections of the use of agricultural machinery,[27/] as FAO data are used as explanatory variables in the UNIDO projections for the developing countries for the years 1990 and 2000. The objective of FAO scenarios was to identify issues, quantify and analyze them to the extent possible and then suggest policies for encouraging an adequate contribution of the agricultural sector to overall development. The above projections are more modest in scope. However, compared with the FAO data the UNIDO projection gives the following additional information:

- It attempts to cover the whole world and not only developing regions. The coverage of developing countries, however, is low.

- It gives apparent consumption in constant dollar values of 1975 whereas the FAO data give the use of various types of equipment in units.

- The concept of apparent consumption takes into account both domestic production and foreign trade. Improved projections will therefore allow analytical statements on these variables.

- The projection constitutes a link between the FAO forecasts and the global UNIDO projections for manufacturing industry and the economy as a whole.

27/ FAO, Agriculture Towards 2000, Rome 1979.

3. Regional Summaries[28/]

3.1 Developed market economies[29/]

3.1.1 An overview of the agricultural machinery sector

The agricultural machinery sector is characterized by a handful of multinational firms producing a range of tractors and implements, and by a multitude of smaller, more specialized firms. John Deere, International Harvester, and Massey-Ferguson account for some 30 per cent of total world output. Of total sales volume, Massey-Ferguson and John Deere derive 90 and 80 per cent, respectively, from the sale of agricultural machinery, whereas Ford is only 5 per cent product specialized. The North American manufacturers produce primarily for the domestic market although the transnational nature of most of the larger companies creates a significant amount of corporate interrelationships between manufacturing and marketing in a multitude of countries. (See Table 33).

The largest firms, Allis - Chalmers, J.I. Case, John Deere, Ford Motor Company, International Harvester, and Massey-Ferguson typically produce machinery in the US, Canada, one or more European countries and one or more large developing countries such as Brazil and Argentina. Several of the large companies also maintain assembly lines in smaller developing countries. However, total sector employment in the US as a percentage of the

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28/ The following are summaries of regional surveys of the world agricultural machinery industry, carried out for this study. The Latin America Survey is simultaneously issued as "A Survey of the Latin America Agricultural Machinery Industry" (UNIDO/IS. 407). The African Survey has been issued as "Agricultural Machinery and Rural Equipment in Africa. A new approach to a growing crisis" (UNIDO/IS. 377)

29/ The information base for this section comes primarily from a consultant report based on agricultural machinery producer's annual reports, US Department of Commerce statistics, and telephone interviews with company representatives and government officials. Much of the information was acquired through communication with manufacturers, associations of and discussions with market analysts. The supporting statistical tables are given in the separate Statistical Compendium, (UNIDO/IS.408. Add.1).

worldwide employment by four major North American producers have steadily increased from 53 per cent in 1978 to 87 per cent in 1982 signalling relative decline in overseas operations.

More than 50 per cent of the European production is manufactured in Germany Fed. Rep. (see Table 36), France (see Table 37), the United Kingdom (see Table 38) and Italy. A significant agricultural machinery industry is also located in Sweden, Spain, Finland, Austria and the Netherlands (see Table 39). However, the production in the latter two countries is mostly comprised of complementary parts that are added to tractors or other basic machines, to suit specific market demands.

The period after World War II, marked by a rapid expansion of the market, did not result in the establishment of Western European heavy machinery industries. The market demands was supplied by firms of U.S. origin. The exception is the Italian company Fiat, which has managed to secure a substantial market share both at home and abroad. Of the Western European market, 14 per cent was controlled by Fiat in 1981.

Only a few of the manufacturers produce a full line of agricultural machinery, the majority typically produce specialized machinery. Some multinationals have specialized in specific lines of the industry and control substantial shares of the market. That is the case for Allis Chalmers and Claas in combine harvesters and the Japanese Kubota in below 40 HP tractors.

With 450 main types of machines, the agricultural machinery industry employs in Western Europe 250,000 people in 4,000 production plants. The industry related labour force that is indirectly mobilized by this market is estimated to amount to 200,000 people. This force is mostly engaged in the retail business and the firms subcontracted for project basis work.

The production of tractors represents more than half of the total agricultural machinery output in Western Europe. The percentage of tractors in 1982 of the total production of agricultural machines was about 53 per cent in Germany Fed. Rep. (See Table 35), 40 per cent in France, 73 per cent in the United Kingdom, and 51 per cent in Italy. In contrast, tractors constitute only about one third of the value of agricultural machinery production in

North America. This is likely due to the larger share of harvesters and combines in the North American production.

Of the total turnover in the industry of agricultural machinery in Western Europe, an estimated 5 per cent is allocated for research and development. The most notable innovations in the technology of this industry are directed towards the improvement of comfort and security, the usage of electronics and the efficiency of production lines.

Japan is emerging as a major producer of agricultural machinery, especially of smaller sized (less than 50 HP) tractors. Today, Japan produces approximately 10 per cent of the total production of agricultural machinery in the developed market economies. In tractors, Japan, USSR and the US are the three largest producer countries in the world.

3.1.2. Current production and market situation

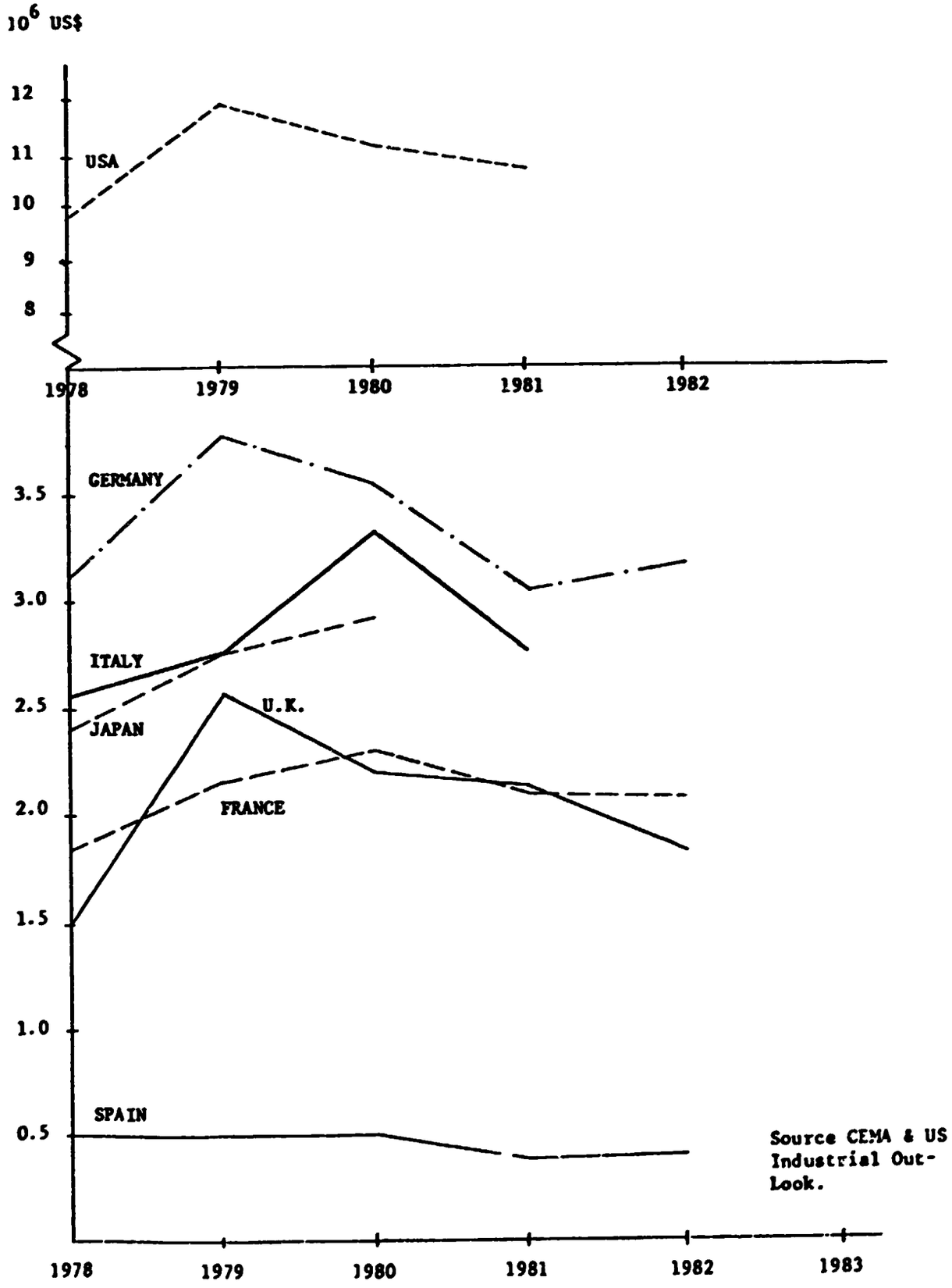
Industry sales in North America in real terms peaked in 1979 and were drastically down in 1982 (see Table 27). The industry turned from profitability to losses in 1980, including massive losses for 3 of the major 6 manufacturers. Only John Deere has shown continuing profits due to streamlined operations and a growing domestic demand for large tractors. The industry appears not to be in a financial position to make major investments. However, the prospects for 1983 are now improving.

Dealer inventories have remained steady but manufacturers have been drastically cutting inventories. Employment likewise has been severely curtailed, (see Table 28).

In response to the market situation, many North American manufacturers have been operating their plants at less than full capacity, reduced employment, cut wages, lowered their inventories, and consolidated their operations. Plants have been closed or downsized, and divestments have taken place. The data indicate that the conditions in the sector are fairly homogeneous over

Figure 2

Trends in products of agricultural machinery



the product categories. Real shipments peaked in 1979 for all categories but haying machinery and irrigation systems peaked a year later and the sales of crop preparation machines have been declining in real terms already since 1978. Although Massey-Ferguson and International Harvester have been the most severly hit, there are no indications that the smaller, more specialized firms have not suffered concordantly. Thus, the downturn has affected all firms regardless of size.

The recent recession has forced the agricultural machinery industry in Western Europe to specialize its production. This specialization has been congruent to the industry's comparative advantage in relation to domestic market demands, access to overseas markets, currency exchange advantages and technology.

The change in Western Europe production value and volume over the period 1976-1981 has not been uniform from one country to another. Whereas the volume has generally declined in the larger producing countries, except for Italy, nearly all the smaller producers have managed to maintain or even increase their production. Thus, the smaller and more specialized manufacturers in this industry appear to be less vulnerable in a recession.

In the United Kingdom, the number of farms have continued to decrease and the size of the remaining farms have increased through mergers. In 1978, the average farm size in the U.K. had risen to 66 ha, by far the highest figure for all of the EEC.[30/] Coupled with a simultaneous decrease in the farm labour force and increases in real farm wages, these developments have led to an increase in the demand for larger and more sophisticated agricultural machinery. This, in turn, has led to a fall-out of small producers and mergers of others to form larger production units capable of meeting the new demand. Thus, corresponding to the decline in the number of farms and the

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30/ Gego, Arno and Franz-Josef Pingen, Changing Regional Requirements in the Agricultural Machinery Industry in Western Europe (1950/80)--Reflection of the Development in Agricultural Mechanization, prepared for the UNIDO Second World-Wide Consultation Meeting on the Agricultural Machinery Industry, 1982/83, July 1981, Table 2.

increase in their size, we have a decrease in the number of firms and expansion in size of the firms producing agricultural machinery (see Table 48).

Whereas employment in the industry had been growing in the US steadily from 1978 to 1981, and then dropped drastically, in Western Europe, employment appears to have continuously declined from 1979 to 1982 without any noticably sharp change due to the recent recession (see Table 34).

Apparently, employment has decreased due to streamlined investments aimed at reducing production costs through labour substitution by technological development. The most critical decrease in employment has taken place in countries such as the U.K., where the industry is adapting its manufacturing to lesser total volume but larger size of units produced.

Some European transnational producers of agricultural machinery have increased their production of unassembled tractors in order to maintain their markets in countries where trade barriers have been raised against complete tractors.

Interestingly, Fiat Trattori and John Deere were the only two major agricultural machinery producers who made profits in 1981. The reasons are different for both companies:

- Fiat secured a larger share in world markets through its production of special tractor models for tropical crop production.
- John Deere was able to maintain its US domestic sales stable through streamlined investments that correspond to a growing demand for larger tractors.

Fiat exported 70 per cent of its total output (1981). The company has infiltrated the U.K., Greek, Irish and Spanish markets with much success, largely aided by beneficial currency exchange terms. It has consolidated its supply of tractors to the developing world where 3 per cent of its total sales in 1981 were absorbed.

Like in so many other industrial sectors, Japan's production of agricultural machinery has shown a spectacular increase since the end of World War II.[31/] The total sector output, in real values, was in 1980 nearly 3 times larger than what it was 15 years earlier. Especially in the beginning, the demand came primarily from the domestic markets when an increase in productivity was badly needed to make up for a conspicious labour shortage in rural areas. Also the type of machinery developed and manufactured in Japan - rice paddy machinery including rice planters and combines - was not in great demand on the export markets. Later, however, the advancement of domestic technology enabled Japan to produce high-performance tillers and tractors, also for export. The major export product is small tractors which account for nearly one half of all exports. However, as far as the North American export market is concerned, it is questionable whether these tractors should be considered agricultural machinery since they are primarily used for homes and estate maintenance and very small (non-commercial) farms, utility work and light industrial applications. But exports of rice culture related machinery to Southeast Asia has been increasing due to rising incomes and increased demand for higher productivity in those countries.

Generally, the developed market economies' imports have followed the developments on the domestic market. In the US, the export market downturn lagged the domestic downturn by 2 years thus coinciding with the dismal domestic market to exacerbate industry problems in 1982 (see Tables 30 and 32). Among tractors, US producers are only competing in the market for large (over 100 HP) tractors. Harvesting machinery exports remained strong in 1980 and 1981. Small Japanese tractors dominate the imports to the US (see Table 29).

Because of the worldwide recession, international trade has languished and protectionist measures have proliferated to protect jobs at home. 1982 was the sixth year of decline in worldwide farm and industrial machine sales.

31/ Much of this section is based on Yoshio Suyuki, "Current Trends in Agricultural Machinery Industry", Industrial Machinery Division, Machinery and Information, Industrial Bureau, MITI, Digest of Japanese Industry and Technology, No. 169, 1982.

In the US, real exports have declined for the past two years, with a drop of more than 5 per cent in 1982. The Common Market supports internal wheat prices--that are as much as 40 per cent higher than US and world market levels and compensates exporters in cash for the differential. The European farm programme outlays for domestic price supports and export subsidiaries could reach US$16 billion this year.[32/] Recessionary erosion of US exports has been exacerbated by the strong dollar. At the same time, the Japanese yen is comparatively weak. The resulting gap has been detrimental to the US based manufacturer or several export markets.

Farm machinery imports to Japan have always been rather small. It consists primarily of large-sized tractors and related implements as well as dry field farming machines and grass weeders developed for rice paddy use. In the future, imports are likely to remain small and consist primarily of large tractors and machines used in dry level farming and cattle raising. Imports might even decrease since domestic production of large tractors is gradually replacing current imports.

3.1.3 The market outlook

The demand for agricultural machinery is a derived demand: it is the demand for an increasingly essential input to the production of agricultural goods and services.[33/] Thus, the demand for farm machinery is highly dependent upon the primary demand for agricultural products. Additional very important variables are farmers' incomes, the available credit terms and most important, government agricultural support programs. Since these variables vary a great deal from country to country, the market outlook varies a great deal in individual countries.

32/ International Business Week, 1983-07-18.

33/ "Services" in the sense that there exist enterprises, farmers' organizations and cooperatives that are in the business of providing such services as tilling, harvesting etc. to independent farmers without own equipment. This is specially true where individual farm sizes are small such as in many parts of Western Europe.

Agricultural machinery is a capital intensive industry. As such it has been particularly hard hit by recent high interest rates. This has affected not only the domestic but also the export markets because interest rates have been high world-wide. Exports of agricultural machinery from the US is further severly hampered by the continuously strong dollar. To hold costs down, US manufacturers have to buy more components from foreign suppliers and shift production from US plants to overseas subsidiaries and licenses.

In North America, continuing low grain prices, substantial reduction in acreage, but uncertain future of still high interest rates despite a burgeoning recovery in the national economies, cause capital outlays for agricultural machinery to remain near the depressed levels of 1982. However, US retail sales of tractors are expected to increase later in 1983 and 1984.

In fact, now the latest information appears to indicate an unexpected upturn in all farm equipment sales.[34/] Paradoxically, behind this development is, in part, the US Department of Agriculture's new Payment-In-Kind (PIK) Programme, which is designed to remove some 23 million of acres from crop production but which has in fact improved many farmers' revenue outlook by guaranteeing quite a bit of income for leaving acres idle. Moreover, there is a lot of pent-up demand due to delayed replacement of farm equipment. The normal replacement cycle for heavy farm equipment is about eight to nine years long. Based upon that, a 'boom' was due in 1980 and 1981, and that has now been delayed.

Rather than expanding farm sizes, the farmers will turn to intensification of farming on present land. Although this will mean heavier fertilization, thicker planting, and more double cropping, it will also entail further increase in the use of agricultural machinery and equipment, especially spraying and irrigation equipment.

34/ The Wall Street Journal, 1983-05-06.

Technological innovation will continue to be important on the North American market. In part, this will protect the domestic producers from imports and maintain their competitiveness in the upper end of the market, even for exports despite the continuing disadvantage of a strong dollar.

In July 1982, the compounded annual rate of growth of US farm machinery industry from 1982 through 1987 was forecasted to be 4 per cent. Exports were expected to grow although at a decreasing rate because US manufacturers do not produce much of the small machinery required by the developing countries. This forecast is now believed to be too optimistic for the near term. The firm orders situation is now improving for all manufacturers with the exception of the Latin American markets where orders are decreasing.35/

North America is one of only a few areas in the world with the ability to supply both domestic demand and substantial exports. At the same time, population growth is outstripping the increases in food production in large areas of the world. One way or another, this is going to lead to continuing large, and perhaps even increasing exports of agricultural products from North America. Thus, for producers of agricultural machinery, this will mean a continuing large market in the long run in North America.

In the United Kingdom, the medium-term outlook is dependent on a sustained improvement in the agricultural commodities market. The first quarter of 1983 has seen a rise in tractor registrations of 15% compared to the same period in 1982. The rise in purchasing appears to be influenced by a continued expectation of falling prices of agricultural machinery. The recession period of 1976 to 1981 has encouraged competitive discounting to which the farmers have got accustomed. A maintained level of demand will be a reflection of farmers expectations, prices and interest rates. The present

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35/ The depressed situation on the Latin American market is as seen by the North American producers. Latin American producers may not concur with this view.

low level of commodity prices is showing improvement. Presently manufacturers are auctionning machinery to deploy stocks and selling at minimal margins. Large scale investment for plant modernization will take effect as credit interest rates moderate.

The Netherlands is a net importer of agricultural machinery, especially tractors. The domestically produced products consists mainly of attachment parts. The market is presently characterised by replacement demand, influenced by an expansion of farm sizes by reduction of units, through a process of mergers, and by replacements of older models by new machinery.

The expansion of farm sizes has been induced by market pressures to lower costs, as a result of increasing labor costs. The effect of this trend has been to increase the mechanization level, calling for machinery of higher horse power. Also, more security and comfort demanded by farm workers are factors influencing replacement. The increasing trend in replacement demand in the Netherlands is expected to maintain itself throughout the medium term.

Demand for agricultural machinery in France faces several difficulties in the short and medium terms. These factors can be summarized as follows:

- income stagnation since 1973 and a significant debt burden;

- the development of collective utilization of equipment; and

- deterioration of currency exchange rates in a market that has become gradually more dependent on imports.

On the other hand, several other factors can be expected to increase the demand for machinery:

- rise in labour costs pressuring for further labour substitution;

- number of farm units decreasing at approximately 3% per annum during the past 25 years, while the total level of arable land has increased, both factors contributing to a significant increase in average farm size;

- increased competitiveness of food production in France vis-a-vis the international markets, further boosted now by favourable exchange rates for export; and

- the intermediate need to replace much of the present machinery, especially tractors, which have become grossly outdated.

If the competitiveness in specialized agro-food production in foreign markets provides an improvement in farm cash flows, a trend to increase investment may also be expected. However, fiscal conditions in the form of lower interest rates for credit must accompany income increases to create the necessary financial conditions for structural changes in agricultural production. As deflationary programs seem to be improving the competitive position on potential markets and forecasts for more comfortable debt servicing schemes are in sight, a machinery replacement and upgrading market may be taking place.

Still, another factor that may help increase the demand for machinery is the labour substitution process that agro-food industries are apt to implement. This industry can be heavily mechanized and automatized. But given the powerful labour resistance that can be expected in the social context of France, labour cutting policies will be hard to implement.

The demand for new agricultural machinery in the Federal Republic of Germany has slightly increased in 1982 from its 1981 level. This improvement is limited to replacement of machinery and is restrained by the growth of second-hand machinery sales. This outlet comprises former rental equipment that dealers placed on the market through leasing arrangements as defensive measures against the market slump during the recession. The ratio of used to new tractors being sold in the market is:

	New models	Second-hand
1979	100	210
1980	100	224

As the stock of used equipment is absorbed and depreciated, new equipment sales will pick up a larger share of the market.

In the medium-term, if credit is facilitated by steady or lower interest rates, the agricultural sector may increase its replacement demand market. The tractor industry is experiencing an earlier recovery than the rest of the agricultural machinery sector. This is true for both internal demand and exports. The export orientation of the German market provides a stable and increasing assurance for the industry. For tractors, the first quarter of 1982 represented a boom market. However, the increase levelled off during the last quarter of the year. Still the years's increase in export was 10.2%, reflecting a record.

A declining home market and a limited international market for Nordic-style agricultural (and forestry) equipment has convinced the Swedish manufacturer Volvo to sharply reduce its production of such equipment. The production of combines has been halted, and the assembly of forestry equipment and tractor manufacture transferred to Valmet in Finland with Volvo supplying only tractor components.

The following Table A summarizes the market outlook in seven Western European producer countries.

The present currency gap between the over-valued US dollar and a relatively weak yen is creating a major comparative advantage for Japanese producers. This is in addition to a built-in cost disadvantage for US and Western European producers due to higher labour and materials cost.

The Japanese government is pushing for increased sale of manufactured goods, including agricultural machinery, to the Middle East oil producing countries because of Japan's heavily negative trade balance with those countries. The Japanese producers are also eyeing very closely the opening up of a potentially vast market in China.

Southeast and South Asia, together with certain markets in Europe will remain the most important export markets for Japanese agricultural machinery.

Table A. Market outlook agricultural machinery industry West Europe - summary table

COUNTRY	1983	Short term	Medium term	Comments
UNITED KINGDOM	- Tractor registration for the first 3 months: +15% - Combine harvesters: +10% in units - Other machinery: no clear expectations - Tractors: 26-27 000 units (26 118 in 1982)	- Overall equipt: increase of 2-4%		- Good competitiveness in foreign market due to weakness of pound and low rate of domestic inflation
FRANCE	- Tractor sales for the first 2 months: +22% - Combine harvesters: +140%	- Domestic market: +1% - Exports: 1-2%		- Total agricultural industry during the last 3 years: +1% - Domestic market: equipment replacement
FINLAND	- Orders: slightly expanding	- Steady market	- Sinking market	- Exports to western countries expanding - Exports to developing countries: small due to big distance between producers and market
DENMARK	- Demand for tractors: increases	- 50% of 1979 sales	- 50% of 1979 sales	- Record level in 1979 - 55% decrease in 1980 - Expected level of stability until 1987: 50% of 1979 sales - Tractor demand: < 50 HP: decrease 50-70 HP: stagnant > 70 HP: increase natural level: 40% of 1979
NETHERLANDS		- Soil preparation and cultivation machine: +10% year - Seeding + planting: +20% - harvesting machines: +8% - Transport equipt: +10% - Farm dairy equipt: +8% - Tractors: +5%		
SWITZERLAND	- Stagnation			
AUSTRIA	- Increase of 2-4% in nominal terms - Decrease of 0-2% in real terms			
SWEDEN	- No change, compared to 1982			- Bottom reached in 1980-1981

Source: Louis Berger, S.A.R.L., Paris, France.

Of course, small tractors will continue to be sold to North America in large quantities but as discussed earlier, it is doubtful whether these should be considered as agricultural machinery.

3.1.4 The situation in developing countries as it relates to the producers of agricultural equipment in the developed market economies

The manufacturers of agricultural machinery in the developed market economies have, during the recent recession, generally suffered severely in terms of very depressed sales and profit levels. At the same time, the rate of increase in food production is badly lagging behind the rate of increase in population in many developing countries. To close the gap, increased mechanization of agriculture in the developing countries is a must. It has therefore been asked whether the producers in the developed market economies see any solutions to their current problems that would (in some positive way) involve the developing countries. In general, the answer is no.

In this context, it is useful to classify the agricultural machines and equipment into broad groups:

(a) simple handtools
(b) tractors and their attachments, and
(c) self-propelled specialized equipment such as combines.

The producers in the developed market economies do not produce goods belonging to groups (a) and (b) only. But these latter machines are generally ill-suited to the typical smallholder, family type farming of the developing countries. This is so because in the developing countries the farms are mostly very small - only a few hectares - making the opportunity cost of using (family) labour less than that of applying capital extensive farming methods.[36/]

36/ For a detailed discussion of these problems, see "Agricultural Machinery and Rural Equipment in Africa. A new approach to a growing crisis", UNIDO IS/.377.

A possible exception are the tractors and their attachment when used jointly by several farmers as, for example, within the context of a co-operative. Machinery used in rice cultivation might also find an economic use within such multiple-user environments.

Notably, machinery for such joint use by many farmers is often supplied as part of official multilateral and bilateral development aid. Since such aid sometimes is "tied", producers in the donor countries may benefit from such programmes.

With respect to the developing countries, the market situation for North American manufacturers is aggravated by the following causes (in addition to the recession which is still continuing in most of the world, large crops and low farm commodity prices, and high interest rates):37/

(a) North American farm machinery manufacturers are not price competitive;

(b) North American manufacturers are not making what the developing countries want;

(c) problems with distribution, service, and parts supply; and

(d) other problems including red tape in getting US exports licenses, strict foreign corruption laws, and the expense of keeping salesmen abroad because of income tax laws.

To meet the demand for the type of equipment wanted in the developing countries, North American firms have developed new lines of tractors in the less than 100 HP range and typically manufacture them in Europe. Deere is also providing design and manufacturing technology to the People's Republic of China for the production of combines.

37/ These are the consensus views of industry representatives interviewed for this study. In response to queries on how the North American companies are viewing their current market situation and how selling to the developing countries might alleviate this situation.

In 1980, some 173,000 tractors were produced in the developing countries (see Table 4), while total imports were 143,000 units of which approximately 30% were supplied by Western European manufacturers.

Table B below shows the proportion of total production of major producers that takes place in developing countries. Roughly one quarter of the total production is undertaken in the developing countries. To a large extent, this takes place through local assembling of imported, and sometimes locally produced components.

For the European producers, the demand of the developing countries for agricultural machinery represents only some 10 per cent of total production. This amount is considered too small to influence the production trends of these manufacturers.

Political and other unrest in certain traditional markets for the Western European producers of agricultural machinery have made these markets less attractive in the eyes of these producers. Thus, for example, the imports of tractors by Egypt fell from 1,046 units in 1981 to only 48 in 1982; for Zimbabwe, the corresponding figures are equally telling: from 1,052 to 685.[38/] The variation in imports from country to country do not correspond to ordinary economic fluctuations but indicate exogenous intervention in the markets. These are seen by the Western European manufacturers as uncertainty factors and thus have a negative effect on their perception of the markets in the developing countries.

The major segment of the tractor markets for Kubota, as for most other Japanese manufacturers, is in the 20 to 30 HP bracket. As such, the Japanese are aiming their exports at countries with smaller farm sizes not requiring larger tractors. Such tractors, of course, are now also exported to North America, but less so for agricultural purposes.

The relatively weak yen especially compared to the strong dollar, coupled with the fact that Japan produces equipment such as compact tractors, combines and equipment more suited to the developing countries, has given it a definite edge over other developed country producers on these markets. Compact tractors, combines and equipment suited for rice culture constitute the major products aimed at the developing countries.

38/ FAO statistics.

Table B

World and developing countries production of tractors by major firms 1980

COMPANY	UNITS		PERCENTAGE	
	WORLD PRODUCTION	PRODUCTION IN DEVELOPING COUNTRIES	WORLD PRODUCTION	PRODUCTION IN DEVELOPING COUNTRIES
MASSEY FERGUSON	110 650	43 350	100	40,99
INTERNATIONAL HARVESTER	81 350	15 500	100	19,06
FORD	78 900	25 100	100	31,81
J.DEERE	77 200	3 000	100	3,89
FIAT	52 800	4 600	100	8,71
DEUTZ	27 300	6 000	100	21,98
D. BROWN/CASE	27 200	500	100	1,84
VALMET	17 500	14 300	100	81,71
EICHER	12 150	10 600	100	87,2
C.B.I.	7 150	7 150	100	100
EBRO	6 600	1 700	100	25,76
LEYLAND	5 050	1 650	100	32,67
OTHERS	58 400	37 350	100	63,95
TOTAL	662 000	172 800	100	

Source: Louis Berger, S.A.R.L., Paris, France.

3.2 European centrally planned economies

3.2.1 Production

In spite of significant increases in agricultural machinery production in the Eastern European centrally planned economies (CPE's), the domestic markets are not fully saturated either with tractors or other types of farming equipment. The variation in machinery intensity from one country to another is marked (see Tables 40 and 45).

The Council for Mutual Economic Assistance (CMEA) has taken an active interest in furthering the production of agricultural machinery in the region by encouraging a division of labour among the CPE countries.

The international society Agromash was set up in December 1965 in Budapest by the Governments of Bulgaria and of Hungary. In 1969, the Soviet Union joined, GDR in 1973, and Poland in 1976. Within the scope of acitivities of Agromash are problems concerning development, production and trade in agricultural machinery for fruit, vegetable and grape cultivation. In practical terms, Agromash performs intermediatery functions and works out recommendations on problems of co-ordination of plans for design activities, the development of production of agricultural machinery, the introduction of advanced technologies of growing, harvesting, and post-harvest processing of agricultural crops, the specialization and co-operation in the production of machinery, and so on.

The production of tractors in the CPE's of Eastern Europe increased steadily up to 1978. Between 1970 and 1978, the production in number of units grew at an average annual rate of 3.7%. Since then, however, total production has decreased. The production of tractor operated ploughs also shows an increasing trend until the mid-70's whereafter the trend has turned downward (see table 40). In contrast, the production of seeders, harvesters, and combines seems to have reached a plateau in the latter part of the past decade. The best known tractor makes in the region are Zetor (Czechoslovakia), Belorus (USSR), Universal (Romania), Ursus (Poland), and Fortschritt (GDR).

3.2.2 Trade

Both imports and exports of all agricultural machinery grew, in constant values, until 1977-78 whereafter there has been a decline to roughly the level of 1975 (see table 41). Besides engaging in considerable intra-region trade among themselves due to the aforementioned drive for internal specialization, the CPE countries also export tractors and other equipment to many developing countries as well as to some developed market economies.

3.2.3 Co-operation and product specialization by country

In accordance with the stipulants of the "Comprehensive Programme for the Further Extension of Co-operation and the Development of Socialist Economic Integration by the CMEA Member-Countries", the member countries have worked out proposals for extending and expanding the specialization and co-operation in the production of tractors, basic farm machinery, and complete technological lines and equipment. This should take place on the basis of an advanced international machine system for agricultural enterprises employing industrial methods of production. These proposals have been subsequently adopted as guidelines for the next years of the decade.

During 1971-1975, some new and improved types of tractors, farm machinery and machine systems were designed on the basis of the concerted effort of research and design organizations in CMEA member countries.

Bulgaria has specialized in 20 types of machinery. Significant progress has been made in design and production of machinery for soil cultivation in mountain areas. Versatile tractor "Murgash-45" has been used to operate 14 different kinds of machinery for land cultivation, harvesting and other applications.

In Czechoslovakia the production of tractor by the "Zetor" company belongs to the most developed subsectors of the industry. About 70 per cent of the production has been exported to the developing and developed market economy countries. In tractor manufacture Czechoslovakia has co-operated with Poland and Romania on the basis of bilateral agreements.

The sector in GDR has been playing a vital role in joint research and design with the other CMEA member countries.

The Hungarian industry has been able to solve many problems through both its CMEA and East-West co-operation. Examples are the utilization of complementary capacities by the Hungarian Company Komplex and FRG Company Claas in production of combines, harvesters and other types of machinery.

The sector in Poland has manufactured a large spectrum of machines and implements from very simple to technologically sophisticated ones. The wide range is required by the diversity of Poland's farms: from large co-operative or state-owned farms to numerous, frequently small private ones. During the last decade, the Polish industry co-operated both with CMEA countries as well as with Western partners e.g. International Harvester and Massey-Ferguson. The experience has not been altogether positive. Significant increase of production of machinery and implements for small farms are scheduled for 1982-1983.

The Romanian industry has specialized in manufacture and export of tractors. About 300,000 Romanian tractors have been purchased by 86 countries.

Agricultural machinery sector in the USSR is the largest in the region. The sector is scheduled to be expanded and modernized. For 1981-1985 new investments have been envisaged at about $8.8 billion. The investments should lead i.a. towards large scale manufacture of combines "Kolos" and "Niva".

3.3 Latin America[39/]

3.3.1. Characteristics of the Latin American production of agricultural machinery

From 1960 to 1976, the agricultural machinery and implements industry in Latin American countries experienced a self-sustained development with high levels of growth. Thus, from 1962 to 1976, the tractors industry increased

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39/ For a complete survey see "A Survey of the Latin American Machinery Industry", UNIDO/IS. 407.

its production from 18,567 units in the first year to 100,951 units in 1976, representing an average annual rate of growth of 12.9 per cent; similarly, the agricultural machinery and implements industry, other than tractors, grew at an average of 7.0 per cent yearly in the same period.

In 1974, the output of agricultural machinery in Latin America amounted to around one billion dollars. The figure refers to production in the three biggest countries in the region (Argentina, Brazil and Mexico) and in four countries of the Andean Pact (Colombia, Ecuador, Peru and Venezuela) covering 90 per cent of the agricultural machinery manufactured in Latin America.

In the last seven years (1976-1982) there has been a fall in the production as a consequence of international economic developments and in some countries also because of internal problems that hinder the local production. The production of tractors, measured by the physical units produced, decreased at an average rate of 10.8 per cent yearly, and the other branches of the industry decreased at an average of 9.2 per cent yearly (see Table 46).

The tractor industry represents the most important component of the agricultural machinery and implements output in Latin America. Tractors accounted for 57 per cent of the agricultural machinery produced in Argentina, 64 per cent in Brazil and in Mexico 69 per cent. Although the information on production of other agricultural machinery is very weak, it can be ascertained that almost all countries in the region manufacture some agricultural equipment, such as simple handtools and some animal-drawn equipment.

The production of tractors over 10 HP grew steadily at an average annual rate of growth of 23.6 per cent between 1970 and 1976 (See Table 47). In 1977 the production decreased to 89,816 and in 1982 to only 50,663 units, equalling the output manufactured ten years before.

Other agricultural machinery and implements are manufactured in limited quantities by medium and small enterprises and by craftsmen, often in rural repair shops. The relatively simple manufacture of many tools and the advantages of being located near the market have meant that the greater part of these small manufacturers are established in agricultural areas, and accordingly more widely scattered than is usual in other branches of

industry. Products of this type are made not only in Argentina, Brazil and Mexico, but also in Chile, Colombia, Ecuador, Peru, Uruguay and Venezuela.

The economic difficulties during the last two years (1981-1982) were responsible for the decrease in the production and sale levels of the agricultural machinery sector. The economies of the situation is exacerbated by the fact that the Latin American tractor industry is working at a very low level of capacity utilization, only 30 per cent. However, the outlook is improving. In 1983, the tractor production in Argentina, Brazil and Mexico has increased compared to the 1982 production and sales. Thus, Argentina increased its production by 75 per cent in the first quarter of 1983 compared to the same period of 1982.

In 1982, the total tractor fleet in Latin America was 874,189 units. The big countries of the region (Argentina, Brazil and Mexico) had 70.5 per cent of the tractor stock of the region's total of 616,700 units.

As far as harvesting equipment is concerned, the situation is rather different, because the technology is more complex. The main producer of self-propelled harvesters is Argentina, but Brazil also produces this type of machinery. Chile, Colombia and Mexico have some stationery threshing machines. The harvester-threshers fleet in Latin America was 128,723 units of which Argentina, Brazil and Mexico had 95,000 units, or 73.8 per cent of the region total: 44,000 units in Argentina, 36,000 units in Brazil and 15,000 units in Mexico.

3.3.2 International trade of agricultural machinery in Latin America

Import value of current prices agricultural machinery in Latin America increased between 1971 and 1981, but its share in the world imports does not show any significant change.

The import share of tractors is higher than those of other product categories - around 10 per cent. The import share of harvesting machinery shows fluctuations over the years. The share of cultivating machinery has lately decreased reaching in 1981 the level of 1975, around 7.1 per cent (see Table 48).

The export shares show a very different pattern from those of imports. In fact, the global export share of agricultural machinery increased from 0.4 per cent in 1971 to 2.4 per cent in 1981. Tractors have been the most dynamic product: In 1971, Latin America exported 0.3 per cent of the world trade, increasing constantly until 1975 and reached a share of 3.5 per cent of the world tractor exports in 1981. The second item in importance is cultivating machinery which increased its share in world exports from 0.8 per cent in 1971 to 1.8 per cent in 1977 and 1.5 per cent in 1981. In the case of harvesting machinery, the share of around 1% has not undergone substantial changes in recent years.

Total Latin American imports of agricultural machinery reached $650 million in 1981 at constant 1975 prices, up from $445 million in 1971 (see Table 48). This represents an annual real growth rate of 3.9%. Total exports rose to $146 million in 1981, up from $15 million ten years earlier, representing an annual real growth rate of 25.8 per cent. Thus, although imports still exceed exports by a factor of early 4.5, exports grew at a much faster pace than imports. Even more remarkable is the indication that the recent recession appears to have affected imports much more severely than exports which remained in 1981 at about the 1980 levels, or even increased slightly for some product groups, whereas imports in all product categories decreased dramatically (see Table 48).

The importance of export promotion of manufacturers by the most developed countries of the region is evident in the evolution of the import and export figures for agricultural machinery. The ratio of imports to exports dropped from 30.1 in 1971 to 4.4 ten years later. Among the product groups, the change in imports in relation to exports is most significant in the case of tractors: the ratio declined from 49.9 in 1971 to 12.5 in 1975 and to 3.4 in 1981.

3.3.3. Prospects for expanding the Latin American agricultural machinery and implements industry

In Argentina, farm machinery sales increased nearly 50 per cent in 1982 from the very depressed level of 1981. In Brazil, despite the government's

Strategic Development Plan, farm machinery sales in 1983 are likely to remain near depressed 1982 levels. In Mexico, severe national financial problems will continue to limit farm machinery sales in 1983.

In the medium term, there are potentials for the further development of the agricultural machinery and implements industry in Latin America due to the following main reasons:

(1) There is a serious crisis in the availability of food products, in many developing countries.

(2) Latin America, having large areas of underutilized or not yet utilized land, is the biggest land based world reserve for food production.

(3) Latin America can reach a substantial improvement in its agriculture productivity through an intensive process of agricultural mechanization[40/].

(4) The rate of use of animal drawn power is decreasing sharply, specially in the more developed countries of the region.

(5) Governmental institutions have granted a high priority to the development of the agro-industry sector.

(6) There are in the more developed countries a high technological level, experience and capacity to export and transfer technology to the less developed countries.

(7) Regional and sub-regional agreements will promote interregional trade and horizontal integration.

(8) Packages of promotion measures, giving incentives to industrial development, exist in the Latin American countries.

40/ In the Federal Republic of Germany, labour productivity increased 5.5-fold from 1950 to 1974 due to increased mechanization. This example illustrates the magnitude of the potentials.

(9) The institutional facilities for financing of both production and exports are good.

(10) The most promising cost-reducing policy in the agricultural economy is through an intensive use of agricultural machinery and implements.

In order to accelerate the development of the agricultural machinery and implements industry in Latin America, it will be necessary:

(1) to standardize the production of agricultural machinery and implements through adequate national, regional and international co-operation; (national and regional institutions for technical standardization together with similar institutions of the developed countries can help the sector reach the necessary standardization);

(2) to raise the presently very low level of capacity ilization to improve true economic viability;

(3) to promote co-operation of manufacturers of agricultural machinery at national levels in order to reduce marketing costs and to have a competitive export package;

(4) to establish a Latin American network of technical and commercial information on agricultural machinery and implements industry in order to improve production and sales;

(5) to promote an adequate technology transfer to the less developed countries through international co-operation;

(6) to improve the horizontal integration through regional agreements and international co-operation; (sectoral meetings of manufacturers can help this purpose);

(7) to promote national and regional seminars and training courses with participation of users or potential users of agricultural machinery and implements, specially in the less developed countries;

(8) to promote in the less developed countries national institutions of technical assistance in agricultural machinery, similar to those existing in the more developed countries of the region; and

(9) to make farming itself more profitable thus encouraging increased productivity through higher levels of mechanization. This can take place through a variety of schemes such as long-term tax incentives and buy-back schemes, subsidized loans, export incentives, etc.

3.4 Asia[41/]

3.4.1 The ECWA region

Information concerning the ECWA region (Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Yemen Arabic Republic, People's Democratic Yemen Republic) has been given by the ECWA secretariat. Available fragmentary data indicates that the agricultural machinery industry, as far as ECWA is concerned, can be considered significant in Iraq and Syria and there are some possibilities for expanding the fleet of agricultural machinery and equipment in Saudi Arabia and Jordan. (See Table 49 for the number of tractors in use in the countries of the region from 1965 to 1980).

The Council of Arab Economic Unity has taken an active role in co-ordinating and integrating the AMI in the Arab world. A project protocol was prepared in 1982, which among other things, calls for the co-ordination and integration of production programmes as well as co-ordination of plans for establishing new production units or expansion of existing ones through joint venture companies.

In both Iraq and Syria, the manufacturing of simple equipment and tractor assembly have started. In Saudi Arabia, the development of this industry is based on national components but most of the inputs such as spare parts and production equipment have to be imported.

41/ Excluding Japan which is discussed under Developed Market Economies.

In Iraq, a great number of the machinery is idle due to poor maintenance and lack of spare parts. In order to reduce the number of idle machines, extensive steps have been taken to build workshops equipped with spare parts all over the country. Furthermore, mobile workshops have been purchased to provide service at sites in isolated areas.

The State Company for Mechanical Industries in Iraq started in 1970 assembling Russian implements such a ploughs, harrows, planters and other. Tractors assembly started in 1977 with the Czechoslovakian Zetor (renamed Antor). The period 1981-1985 is considered by Iraqi authorities as an advance mechanization stage. During this stage, all grain crops as well as a reasonable percentage of other crops are supposed to be mechanized. By 1995, Iraq is aiming of completing full mechanization of all cereals as well as a very high percentage of industrial crops, fodder and vegetables. If the targets are achieved, 0,8 HP/hectare may be exceeded. With regard to manufacturing, the intent is to manufacture all implements required and to meet the local demand of 70 HP tractors. This size of tractor represents more than 80 per cent of all types.

Steps have been taken to enlarge the production capacity of tractors in Iraq to reach 5000 units per year. The local content is aimed at reaching 55 per cent of the cost of a tractor. This may be achieved easily when the new premises for assembly and manufacturing of tractors are completed. The local content in manufacturing implements is in advanced stages and it is intended to reach a 95-100 per cent local content in the near future.

With regard to import policy, it is intended to minimize makes and models. In 1968, there were more than 60 different makes of tractors in Iraq. This has been reduced to about 30 by 1978. More efforts are made to reduce the models to a minimum.

The only local production unit for tractors and agricultural implements in Syria is the Al-Furat factory in Aleppo. This is a joint venture between Motor IBERICA S.A. of Spain (25 per cent) and the Syrian Government (75 per cent). The Al-Furat factory was established in 1973 and the assembly

started using imported 60 HP engines. Later, other models were introduced but since 1980, the production has been rationalized to a single 70 HP tractor. Annual output of traders was raised from 217 units in 1974 to 3,000 units in 1982.

The Al-Furat factory started assembling imported units from Spain. Now it is claimed that about 50 per cent of the cost of a tractor is manufactured locally through the four workshops that have recently been completed. The planned local manufacturing programme is aimed at 4,500 tractors, i.e. about 50 per cent than what was planned. Steps are also taken to increase local content to reach at least 55 per cent.

There exist private plants to manufacture implements such as planters, threshers, sprayers, spreaders and others. The operation in these plants is artisanal and the production is to order.

The newly established State Organization for Agricultural Mechanization intends to act as a co-ordinating body and to achieve the level of mechanization required by the development programmes including the co-ordination of demand and supply. But presently, the organization is implementing projects related to repair and maintenance centres and the projects related to the mechanization of certain crop fields. The tractor utilization is aimed at 85 hectares per tractor by the year 2000. This appears to be an ambitious target.

Available data for the ECWA Region do not distinguish between domestically produced and imported machinery (see Table 49). However, FAO data indicate that the majority of at least Iraqi tractors, and probably most of the other machinery as well, is imported. The number of tractors have increased nearly 3-fold between 1971 and 1980. The increases in harvesters, combines and weeders are also significant.

Turkey and Iran both had substantial markets until present financial and political problems suspended production and trade. However, in Turkey, farm machinery sales increased significantly in 1981 and 1982 and should be stable or slightly higher in 1983. The situation in Iran remains depressed.

The assembly plant capacity in Turkey is about 40,000 units (Fiat, Massey-Ferguson, Ford, International Harvester, and Leyland) and Iran 12,000 units (Universal/Massey-Ferguson, and John Deere).[42/]

For Turkey, the following additional data for tractors are available:

	Park	Output	Sales
1970	104,640	7.709	...
1975	220,000	34.281	52,000
1977	300,000	43.560	60,000

The Middle East oil producing countries are expected to remain a relatively strong market for agricultural tractors. However, government priorities are likely to affect sales level. The present war between Iran and Iraq is creating major uncertainties and is siphoning off resources, affecting all industrial operations in those countries.

Lowered income from oil dampened both actual sales and planned acquisitions of agricultural machinery in the whole region. The prospect for an increase in oil revenues in real terms over the near and middle term is slim at best.

3.4.2 The East Asian Region

The information contained in this summary has been provided by the ESCAP Secretariat. ESCAP has established an inter-country project entitled "Regional Network for Agricultural Machinery" (RNAM) which has had a far reaching effect and impact on the agricultural mechanization programme in the participating countries. Particular attention has been paid to the strengthening of manufacturing capabilities of the developing countries.

42/ "Tractors in Use and Markets Worldwide", Agricultural Machinery Journal, May 1979.

India

There are 700 manufacturers in large and medium-scale, 1,500 in small-scale and about a million village artisans and blacksmiths. The products range from four-wheel tractors to hand tools. No implement or machinery is now imported, as the required technology, equipment and raw materials are available locally. To promote local manufacturing, District Industry centres provide technical guidance, shed land and other facilities. State financial corporations provide loans at subsidized rates, particularly for backward areas. Some of the important materials are provided by Government agencies to small-scale industries. Most of the other materials are freely available from the open market. Marketing by bigger manufacturers and urban-based units is through dealer network and the medium and small-scale manufacturers through their own efforts. The larger units and their dealers have adequate competent staff for after-sales services while smaller ones usually attend to complaints at their own workshops. The large industries have adequate quality control methods while the smaller ones also apply quality control to some extent. There are many research organizations working for research and development of agricultural implements and machinery. Indian Standards Institution has already laid standards for a large number of agricultural implements and machinery.

Contrary to the commonly hold belief that very long series are essential because of economies of scale, Indian plants are all set for productive levels between 3,000 to 7,000 units of equipment per year. This set-up is better suited to India's low wage cost structure and small regional markets than the pattern with high capital intensity and high degree of automation typical of the production in the industrialized countries.

Indonesia

The growth of manufacturing industries in the country is increasing due to positive Government programmes and policies in promoting agricultural mechanization, support from universities and scientific organizations, increasing national rice production, which create big demands for agricultural machinery, and steps to control imported machines through an import tax and duty for agricultural machinery which is differentiated by the level of manufacturing.

Pakistan

All the tractors and farm machines were imported in the first decade of Pakistan's creation. Since then the imports have gradually given way to local production. A variety of implements is also imported from Europe and the US. Five makes of tractors, i.e. Massey-Ferguson, Fiat, IMT, Belorus and Ford are being imported and assembled by two firms in the public sector and three private firms using some local parts. The Government has laid down a strict deletion programme for all the firms engaged in tractor manufacturing to gradually increase the volume of local parts,. They are to achieve 85 per cent deletion in these tractors by 1985-1986.

There are nearly 400 manufacturers of agricultural machinery in Pakistan. Of these, about 10 can be considered as large, 100 as medium and the rest as small-scale manufacturers. There is a large variety of farm machinery being produced in the country. Only cultivators and threshers are produced in large quantities.

There are two Agricultural Engineering Institutes, exclusively engaged in the development of agricultural machinery and farm implements in the country.

The Government of Pakistan has provided several incentives to the manufacturers of agricultural machinery such as exemption from income tax, refund of custom duty for raw materials used for farm machinery production. These incentives have had a positive impact on the local manufacture of farm machines.

Philippines

Sales of agricultural machinery and equipment totalled $74 million in 1979, $40 million in 1980 and $61 million in 1981. Locally produced agricultural machinery had a share of 10 million in 1979, $7.4 million in 1980 and $9.0 million in 1981. The Philippines imported $32 million worth of agricultural machinery and tools in 1979, $26 million in 1980 and $29 million in 1981. The United Kingdom and the US were the main suppliers of standard four-wheel semi-knockdown condition tractors, while Japan almost monopolized

the supply of four-wheel compact tractors. The US was the major source of gasoline engines, while Japan and Italy shared the bulk of diesel engines imported from 1979 to 1981. Japan and China were the main suppliers of rice mills.

Most of the agricultural machinery manufacturers have shops equipped with the basic metal forming, cutting, welding and machining equipment. There is paucity of heat treatment facilities for special materials like spring tines for multiweeders. There are about 80 manufacturers and assemblers of agricultural machinery and equipment. The industry employed about 6,200 people in 1980 and produced about $26 million worth of agricultural machinery.

The Government through the Board of Investments and other government agencies formulated policies, programmes and incentives towards local manufacturing. An Executive Order creating the National Agricultural Mechanization Council has been drafted. The Bureau of Standards has started setting minimum standards for farm machinery and equipment. Already, standards have been set for threshers, rice mills, grain driers, and corn shellers.

Though a big number of gasoline engines are imported, the share of the diesel-powered equipment is now increasing.

Sri Lanka

Endeavours are being made to instruct the farmers on the use of modern farm machinery and implements. Most of the farmers have small holding and so their financial capacities are limited. High prices for fuel and spare parts are constraints in the popularization of power machinery. Therefore manual and animal-drawn implements will have to be improved and popularized.

There is a liberalized import policy in Sri Lanka. Four-wheel tractors and power tillers are imported mostly in built-up stage. Some implements for the above are imported as accessories while other implements for tractors, power tillers and animal-drawn implements are manufactured locally. Hand tools are manufactured at the rural level. Transplanters are in the R & D stage. Rotary weeders are in use. Gasoline, diesel engines and two stroke

engines are imported and used on water pumps and sprayers. Mini-axial flow threshers are manufactured in small numbers. Machines imported which compete with some locally manufactured farm machinery and implements have a high (protective) tariff. Prices are closely watched by officials of concerned ministries.

The liberalized import policy is a challenge to local manufacturers to upgrade their products in quality and finish. However there is the ever prevailing problem of importers and aid giving organizations bringing in cheap, unsuitable type of machinery and equipment with no after-sales service facilities. This has adverse effects on local manufacture. There is growing linkage between manufacturers and research institutes. Moves are being made to establish an Agricultural Machinery Manufacturers Association.

Thailand

The significant locally manufactured agricultural machinery in Thailand are (i) power tillers, (ii) mini tractors, (iii) low lift irrigation pumps, (iv) farm trucks, (v) rice threshers, and (vi) rice mills. Important items imported are: (i) farm tractors from U.K, (ii) mini tractors and power tiller from China and Japan, and (iii) small diesel engines and water pumps from Japan.

Republic of Korea

Although a significant producer of certain agricultural machinery, specific statistical and other information is lacking at this point.

3.4.3 Common problems in Asian countries

Common problems facing more than one Asian Country are:

1. Facilities for providing information on modified designs and prototypes are inadequate.

2. Lack of experience in the marketing field for some (mostly small) manufacturers.

3. Strong impact of imported agricultural machinery on consumers.

4. Raw materials are often hard to get which make the price go up.

5. Difficulties in obtaining credits for financing.

6. The alloys of steel, aluminium and copper of reliable composition and physical properties in all commercial shapes and forms are not readily available on the open market. The availablitiy of sub-standard, raw materials imported by traders at cheap rate has retarded the growth of steel industry.

7. Shortage of trained engineers and technicians in the country due to draining out of these essential personnel to Middle Eastern countries because of better wages.

8. Deterioration of technical education standards at the educational institutes.

9. Inconsistent and seasonal demand for the farm machines which discourages investors to enter this industry.

10. Farmers are not quality conscious. They prefer to purchase implements at the lowest price even if they are of inferior quality. This is a serious drawback in improving the quality of farm machines produced locally.

11. Lack of sufficient marketing and export outlet organizations.

12. Higher production costs caused by low productivity, wastage and inferior production techniques, partly due to minimal production planning and control.

13. Difficulty in marketing of farm implements due to poor knowledge about use and maintenance of farm machines produced by the manufacturers of the farm machines.

14. Lack of co-ordination among the training institutes to train farmers, operators, mechanics, artisans, and middle level technical supervisors and engineers to utilize the existing training facilities to their best possible potentials.

15. The manufacturers have been encountering problems with foreign competition since tariffs for imported finished farm machinery and equipment are kept low but tariffs for raw materials for the manufacture of the same implements are kept high.

16. Lack of after-sale service.

3.5 Africa

3.5.1 General outlook[43/]

Industrial producers of agricultural machinery in Africa[44/] are few in number, mostly small in size and able to make only a correspondingly small contribution to total supply. In all developing Africa, there are only about 100 industrial or semi-industrial companies, even including those for which agricultural machinery and equipment are not the main products. As a rough estimate, they employ 15,500 workers to manufacture equipment valued at $150 million and with a value added on only $50 million annually.[45/] Adding $150 million to the estimated value of imports, $850 million, (average annual value in the period 1978-80), gives a market estimate of around $1 billion.

The local producers' share (the rate of self-sufficiency) is thus 15 per cent based on final value and only 5 per cent based on added value. The situation is, of course, worse if the sub-Saharan countries are considered

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43/ This summary report is largely based on the survey "Agricultural Machinery and Rural Equipment in Africa. A new approach to a growing crisis". UNIDO/IS. 377.

44/ As a developed country, South Africa was not included in the study.

45/ Because of the paucity of available data, it is only possible to make rough estimates based on average added value per worker. The quoted figures nevertheless indicate the general order of magnitude.

alone, e.g. excluding Algeria and Egypt, respectively Nos. 1 and 2 in African agricultural machinery production.

Generally, each of the small and medium-sized countries has only one industrial producer,[46/] that evolved in response to a wide variety of local conditions. Because of history, local environment and national policies, industrial producers therefore show strong national traits and focus almost entirely on local or national markets. Exports of finished products or components of agricultural machinery between the countries are virtually unknown.

Nearly all the industrial units in the sector were set up during the period 1950-1972, some even earlier. In many cases their equipment is old. In recent years only a few new units have been established; at the same time many either disappeared, amalgamated with others or abandoned production of agricultural equipment in their manufacturing programmes. Today, only about one third of the companies produce exclusively agricultural equipment. The others can be divided into two groups:

(1) Producers whose dominant activity is still agricultural machinery but that have diversified production by adding one or more product lines offering higher profitability. The range of equipment may include stationary equipment for the agricultural and other sectors, wheelbases and other transportation equipment, and metal furniture. The non-agricultural machinery products often account for a significant part of the turnover.

(2) Producers coming from outside the sector. Examples are industrial groups in metal working (foundries such as Chanimetal in Zaire), in engineering (Sonacome in Algeria, Acmefon in Zaire, Sidema in Madagascar), in vehicle production (Nasco in Egypt), and importing companies such as

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46/ Despite the distinction made here between industrial and artisan production, a rigorous classification is not possible in practice because of the wide diversity in the types of production unit. The co-operatives of artisans that have evolved in Western Africa have clear industrial characteristics, for example. With that proviso, countries apparently without any industrial-scale capacity for agricultural machinery production are Burundi, Cape Verde, The Central African Republic, the Congo, Gabon, Guinea-Bissau, Mauritania, Rwanda, Somalia and the Sudan.

Fiat-Zaire. Such groups are often of considerable size and influence for the country. They are linked either to state interests, or (as private companies) linked to transnational corporations. Table C presents the main characteristics and limitations on agricultural mechanization in Africa.

Whether or not it is agricultural machinery or other goods that dominate, the range of equipment produced is nearly always very broad due to the limitations of the market for each product in most African countries. Each manufacturing enterprise has had to diversify production into other products.

The situation of Africa's agricultural machinery producers has worsened by the effects of the world recession since 1980 and the deterioration of many African economies. The rising cost of imports, which represent up to 70 per cent of the total cost of many products, increased the overall cost of African-made agricultural machinery and was the source of the sector's falling local added-value component. If producers tried to pass on these costs, they exceeded their customers willingness to pay. If their selling prices were frozen, there was a corresponding reduction in their own margins and therefore in their own investment capability. Lack of investment meant foregoing not only new capacity but also the many small items necessary for immediate improvements in productivity.

These trends are aggravated, depending on location, by falling or stagnating farmers' incomes, by reduction or cancellation of state aid to industry and by increased competition from companies in developed countries---especially the world's large producers confronted with recessions in their other makets.
The fall in farmers' incomes often reflected a parallel crisis in the agricultural sector--the results of drought and government policy measures (e.g. stagnation in agricultural product prices). Some governments also had to reduce their aid to industry because they in turn were confronted with high indebtedness. They may also have had to reduce credits because of cuts in bilateral and multilateral aid.

To these difficulties outside the industrial producers' direct control are added the deficiencies specific to indivudual firms--in particular their low technical ability, their low productivity and systematic errors at the management level. The economic recession exacerbates such internal

Characteristics	Hand farming	Animal-draught farming	Tractorization
System basis	Man-dependent, using human energy to accomplish all tasks, either directly or with the aid of simple traditional tools	Use of animals to carry out all or part of the agricultural work. Implies complementary agriculture, husbandry system and use of animal-drawn equipment	Use of motors and tractors to carry out all or part of the agricultural work Requires corresponding environmental and other changes to permit operation of machines and heavy equipment
Machines used	Simple tools (machettes hoes) Simple machinery to be carried (back-pack sprayers), pushed (carts, hoes) or stationary (shellers, pumps)	Simple machines (carts swing-ploughs, harrows) More sophisticated machinery-ploughs, sowers, multi-cultivators)	Tractors with heavy equipment (ploughs, disc harrows, sowers, drills, trailers) Motorized fixed machinery (threshers, motorized pumps) Self-propelled machines
Initial investment	$10/labourer/5years for simple handtools; less than $100/labourer/5 years for simple machinery	$325/decade plus rearing and training of animals; $400/animal for purchase	Equipment cost (including one 45 hp tractor) estimated at $11,000/8 years; $16,000 if thresher is included
Positive aspects	Low level of investment with direct supply from local blacksmiths System is adapted to the agro-ecological environment (e.g. cultivation on ridges with several types of plants on the same plot) Conditioning of land confined to contol of water No training needed	Animal-draught farming eases bottlenecks in soil preparation transportation Low investment cost; investments made profitable by increases in production Land conditioning made feasible (grubbing and land clearing) Maintenance by local artisans and blacksmiths Production by craftsmen or local industry does not need major investments in equipment The low degree of complexity requires little supervision The system adapts to the agro-ecological environment without disturbin it	Introducing heavy mechanization raises value of waste land production, increases output by expanding arable land, carries out arduous work such as deep tillage and raises the value of inputs by introducing modern farming techniques Very high appeal of tractors, as symbol of modernity Can compensate for a lack or absence of farm labourers.
Agricultural operations performed (role of equipment)	Partial clearing Light preparation of soil (surface only) Crop maintenance and plant protection Aid to harvesting and products transformation	Light preparation of soil; sowing; upkeep of cultures; light transportation	Preparation of soil, sowing, light tilling, transportation. Via accesories: threshing, irrigation
Types of crops affected	Food crops: cereals, roots or fruit; cash crops: annual (cotton, groundnut); perennials: palm trees, sugar cane; export crops: coffee, cocoa, citrus fruit	Cereals: rice, corn, millet, wheat; annual cash crops: cotton, groundnut, tobacco	Cereals: rice, corn, wheat; cash crops: annual (cotton, soya); pluriannuals: (sugar cane, bananas); perennials: (palm trees, coffee, cocoa)
Disadvantages	Low productivity	Because of the limited strength of the animals and the present technological limits, only a few farming techniques and crop types can profit from mechanization, especially among tuberous food crops	Some operations, e.g. transportation, easily mechanized; others require treatment of land (land clearing, anti-erosion terrassing) or a change of farming technique (e.g. flat instead of line culture) Some harvesting operations mechanized only with difficulty
Type of farmers and farming units	Small individual family-type farming (less than 5 ha), medium and large plantations where much work is still manual	Individual medium-size family plots (less than 20 ha) usually based on cereal	Medium or large size farming of cereals or industrial crops: . family farms of more than 20 ha . large private farms . private, mixed or state agro-industrial units . state farms . production co-operatives
Problems		All non-mechanized work still done by hand; some deep tilling is motorized	Mechanization rarely 100% - in general limited to a few operations; the remainder require human labour
Present limits and bottlenecks	Simple handtools mean low productivity and no progress beyond subsistence level; Young people refuse to continue working with traditional methods (arduous and demeaning tasks); General lack of equipment especially for harvesting, storing, processing and transport	Low productivity level reflects strength of animals; several operations (e.g. tuber farming cannot be mechanized) Stock raising requires grazing areas or fodder crops Credit to purchase animals and equipment granted only to co-operatives and in framework of development programmes Need to set up supply systems for spare parts and maintenance Low level of interest shown by young people whose ambition is modernization through motorization Geographical limits: animal-draught farming is limited to areas of traditional animal husbandry, flat regions with only slight infestation of parasites, a few types of farming (harvesting constitutes a particular bottleneck) In densely populated areas, competition between husbandry and crop growing	Lack of local manufacturing; import problems for poor countries; Weak infrastructure (maintenance and distribution networks hard to establish) Badly prepared territory: lack of land clearing and anti-erosive terrasing Little adaptation of equipment and techniques farming for Africa conditions particularly for food crop farming Farm credit systems not adapted to purchase of equipment Low productivity due to farm size and plot distribution (in particular with food crop farming) Low income of family production units Increasing divergence between equipment cost and prices of agricultural products Low level of training and competence of technicians who use and maintain equipment High operating costs

Source: UNIDO/ID/WG.365/1.

deficiencies in areas of employment and wage levels. This leads to short-term decision making and management strategies that move production and marketing in entirely the wrong direction. For example, many of the companies are seeking solutions to their problems by developing exports, the fruits of which are often illusory.

3.5.2 Imports

Although they provide only an incomplete record of current trends in imports, import statistics for agricultural machinery in Africa confirm that the continent is a relatively small buyer on a global scale, (see Table 52). Furthermore, the general trend seems to be down rather than up, with most countries spending progressively less on imported equipment. In world terms there are differences too in the pattern of imports--with Africa showing a greater than average emphasis on tractors (see Table 54). At the same time most African countries continue to purchase large quantities of foodstuffs (e.g. commodities such as cereals) and non-machinery agricultural inputs such as fertilizers. The overall picture, therefore, is that agricultural machinery receives low priority in external spending.

Import data for agricultural machinery and handtools (Table 51) for the period 1973 to 1979 shows a rapid increase in volume up to 1975 followed by a series of erratic moves in the second half of the decade. The huge drop in 1979, over 33 per cent, brought the value of imports below 1975 levels and, because of inflation in between, reflected an even larger drop in volume.[47/] This is in line with the reports of domestic suppliers for the same period, i.e. the market plunged for importers and local manufacturers alike.

As a market for the world's agricultural machinery suppliers Africa's 5 per cent share (Table 52) is small in relation to its population. Handtools aside, the major suppliers are European countries (with 72 per cent) followed by the United States (with 15 per cent) (Table 53). Intra-African trade (6 per cent) is small by comparison and South-South suppliers (2 per cent) are almost negligible.

47/ Later estimates from UNECE (Geneva) and the Comité Européen du Mechinisme Agricole (CEMA, Paris) indicate a modest recovery in import demand in 1980 and 1981.

Within Africa, the North Africa subregion accounts for 50 per cent of the developing countries' demand. This is followed by Eastern and Southern African with 23 per cent and West Africa with 20 per cent. Central Africa accounts for only 8 per cent of total imports. Individual countries accounting for a significant share of total imports include Algeria (around 6 per cent), the United Republic of Cameroon, Sudan and Kenya (4.5 per cent) and the United Republic of Tanzania (4 per cent).48/

Case studies for 16 countries selected for special study49/ confirm three things:

(1) The levels of production is low in all countries and declining in certain countries;

(2) Changes in imports, in particular of tractors are erratic: the trend is generally downward, reflecting disorganization and external disruption of markets;

(3) Motorized equipments--tractors and their associated equipment, in some cases also combine harvesters--dominates the volume of imports of each country.

3.5.4 Short-term prospects

Only a few African countries have so far recognized the important role of domestic producers by supporting expansions of existing capacity and/or plans for new production units. The result of 16 countries studies, are summarized in Table D.

48/ Unless otherwise stated, statistics and other references to Africa in this report should be understood as "developing Africa". In this context, the continents' main importer is South Africa whose $214 million purchases in 1979 equalled 44 per cent of those by developing Africa.

49/ See Annex II of Agricultural Machinery and Rural Equipment in Africa, op.cit.

TABLE D. PLANS FOR NEW INVESTMENT
(as of mid-1981)

Countries investing in existing plants	Notes
Algeria Togo Zambia	Algeria plans to extend the Constantine complex to a capacity of 1,000 tractors per year and 4,000 motors/year. The Sidi Bel Abbes complex will be expanded by 500 combine harvesters per year. In Togo, Uproma, created in 1980, will be further developed. Tropic in Cameroon is considering adding a foundry. In Zambia, Northland Engineering is considering an expansion that would include production of animal-drawn equipment, handtools and tractor equipment. In addition a feasibility study has been made for a tractor assembly unit.
Countries planning new production units	
Mali Nigeria United Republic of Tanzania United Republic of Cameroon	In Cameroon the enterprise Anghu in Bermanda is building a new workshop for stationary equipment. Mali is considering a small unit for assembling threshers and other stationary equipment. Nigeria is planning to add tractor assembly at its plants for vehicle assembly. Tanzania plans a 4,000 t/a unit for handtools, equipment for animal-drawn cultivation and tractor equipment at Mbeya: the finance comes from Holland the technology from India. A similar mixed product project at Mwanza, built with help from Bulgaria, will have a capacity of 6,700 t/a. A tractor assembly unit with a capacity of 1,500 units/year is being built in conjunction with Valmet company (Finland); the UFI company is expanding capacity to 1,000 t/year.
Countries with no known new projects	
Burundi Chad Egypt Ethiopia Kenya Senegal Sudan Uganda Zaire	In Senegal, Sismar, which ceased operations in September 1980, resumed production in early 1982. In Burundi, a handtools plant at Bujumbura has not operated after being built in 1972. In Uganda, two modern handtools plants ceased operation due to the war situation. The Somat unit in Chad has not started up for similar reasons. In Sudan, the Masudan assembly project to make 4,000 tractors/year, first considered in 1974 is blocked for lack of finance.

Source: UNIDO/IS. 377.

This information, although fragmentary, permits four broad conclusions.

(1) Eight countries out of sixteen studied have no known project for agricultural machinery.

(2) The creation of sizable new industrial units seems to be confined to Nigeria and the United Republic of Tanzania. In this context, Tanzania, one of the least developed countries, joins a restricted group of more advanced African developing countries (Algeria, Nigeria and the United Republic of Cameroon), all of which anticipate substantial investment in the agricultural machinery sector.

(3) All new or expanded projects are to some extent multiproduct. Tractor assembly, for example, is usually associated with the assembly of other heavily--motorized equipment (e.g. passenger vehicles and trucks, military vehicles). Finally, no project is exclusively devoted to industrial manufacture of handtools, apart from the scheduled restart of an existing unit in Burundi.50/

The picture provided by these individual national projects is partly explained by the economic difficulties outlined earlier. The number of projects recently abandoned has been extremely high. Today there are more firms, whose sole objective is to ensure their own survival, than companies envisaging investments, not to mention those whose existing units are inactive.

In summary what has happened is that the industrial basis of agricultural machinery production in Africa, which was created and developed between 1950 and 1974, has experienced a break in rhythm and direction. Instead of helping satisfy basic food needs and make the African countries self-sufficient in agricultural machinery, the trend is in precisely the opposite direction.

50/ In Sudan a project drawn up in collaboration with China has been abandoned.

It is clear that the agricultural machinery sector labours under a number of heavy constraints. Overcoming them has to become a priority task for national governments.

Local industrial scale production is generally limited to one or two producers per country and in many countries does not exist at all. These producers, moreover, are medium or small size (rarely more than 200 employees) whose output is either confined to simple technical operations, or constitutes only part of a multiproduct range. In many cases there is only minimal contact with the existing industrial environment and the resulting difficulties in obtaining local supplies of raw materials and semi-finished goods means continuing dependence on overseas supplies. In turn, this means transport difficulties, late deliveries, long lead times and a general inability to compete with imports of finished goods.

Craft producers are also suffering from increasing imports but there is growing competition from higher quality industrial products made locally as well. Furthermore, the contribution made by local blacksmiths in rural areas, although high, has never been quantified and as a result tends to be ignored by central authorities responsible for finance and agro-industrial development.

In addition to these individual problems both groups operate in an economic environment that hinders rather than supports their development. Imports, competition from local industry and farmer credit geared to purchases of industrial products undermine the precarious existence of artisans and blacksmiths. Competition from imports, supply difficulties and declining farmers' incomes have markedly reduced the turnover and output of the smaller industrial producers.

Given the apparent overcapacity, there has been little interest in developing new industrial projects. Similarly, private investors find little encouragement in the weakness and irrationality of the market as a whole. On the other hand, development of this sector in each African country is vital not only to supply equipment and maintenance services to agriculture, but also to minimize dependence on overseas supplies.

3.5.4 Mid-term prospects[51/]

In 1978, African cereal imports had already reached 13.4 million tons, a level that was not supposed to be reached until 1990.[52/] According to an FAO study,[53/] in the year 2000, Africa will need 39 million more tons of rice and coarse grains than in 1980. Consequently, cereal production has to be intensified urgently. Here industry has a vital role to play, particularly since it provides industrial inputs into increasing production and reducing food losses. However, given the broad potential contribution of industry to agriculture and in view of the limited industrial capacity, coverage is highly selective: specific choices would depend on each country.

The manufacture of simple hand tools is fairly well established in most African countries at the village blacksmith level and, in some countries, higher engineering levels have been achieved. However, in most African countries, the local manufacture of animal-drawn and power-operated implements is still virtually non-existent. The same situation exists in respect of such inputs as storage and processing equipment, and industrial machinery and equipment.

Agricultural tools

Total imports of agricultural tools in the African region were of the order of 40,000 tons in 1976, and it is estimated that they will increase to 139,000 tons and 207,000 tons by 1990 and 2000, respectively. Current annual production capacity is about 18 million hand tools and 60,000 implements. By 1990, the Eastern and Southern African subregion will require over 7 million hand tools. The corresponding figures are over 10 million hand tools for Western Africa, and 3 to 4 million hand tools for North Africa. The Central African subregion will most likely be able to manage by upgrading existing and planned establishments.

51/ Based on United Nations, A Programme for the Industrial Development Decade for Africa, New York 1982.

52/ FAO, Regional Food Plan for Africa, Rome 1980.

53/ FAO, Agriculture: Towards 2000 (C79/24), Rome 1979.

Hand-operated and animal-drawn implements

Total demand for 1990 and 2000 is estimated at over 25,000 tons and 38,000 tons respectively. About 10 per cent of these requirements are for Central African countries and 30 per cent each for the other three subregions.

Power-operated agricultural implements and machinery

Total regional requirements for these implements and machinery are estimated at 75,000 tons and 100,000 tons for the years 1990 and 2000, respectively. Their distribution would be similar to that for hand-operated and animal-drawn implements. Very few African countries have manufacturing facilities for these implements and machinery, whereas about a dozen countries have facilities for assembling power-operated implements.

Agricultural tractors

In 1977, a total of 83,433 tons of agricultural tractors were imported into the region. It is estimated that this will increase to 687,000 tons in 1990 and 1,750,000 tons in 2000.

The following are among the activities that need to be undertaken:

(a) The formulation of an agricultural modernization and phased mechanization policy and strategy based on self-reliance, taking into account the changes in the farmer's income levels, farm sizes, power requirements and energy needs as a basis for a farm input development programme;

(b) Design and formulation of an appropriate farm inputs development programme and identification of major changes in demand for inputs, including standardization, so as to extend the domestic market and develop maintenance services and the production of spare parts;

(c) Support for and upgrading of indigenous agricultural agents and rationalization of production;

(d) Preparation of fertilizer and pesticide programmes, including manpower profiles.

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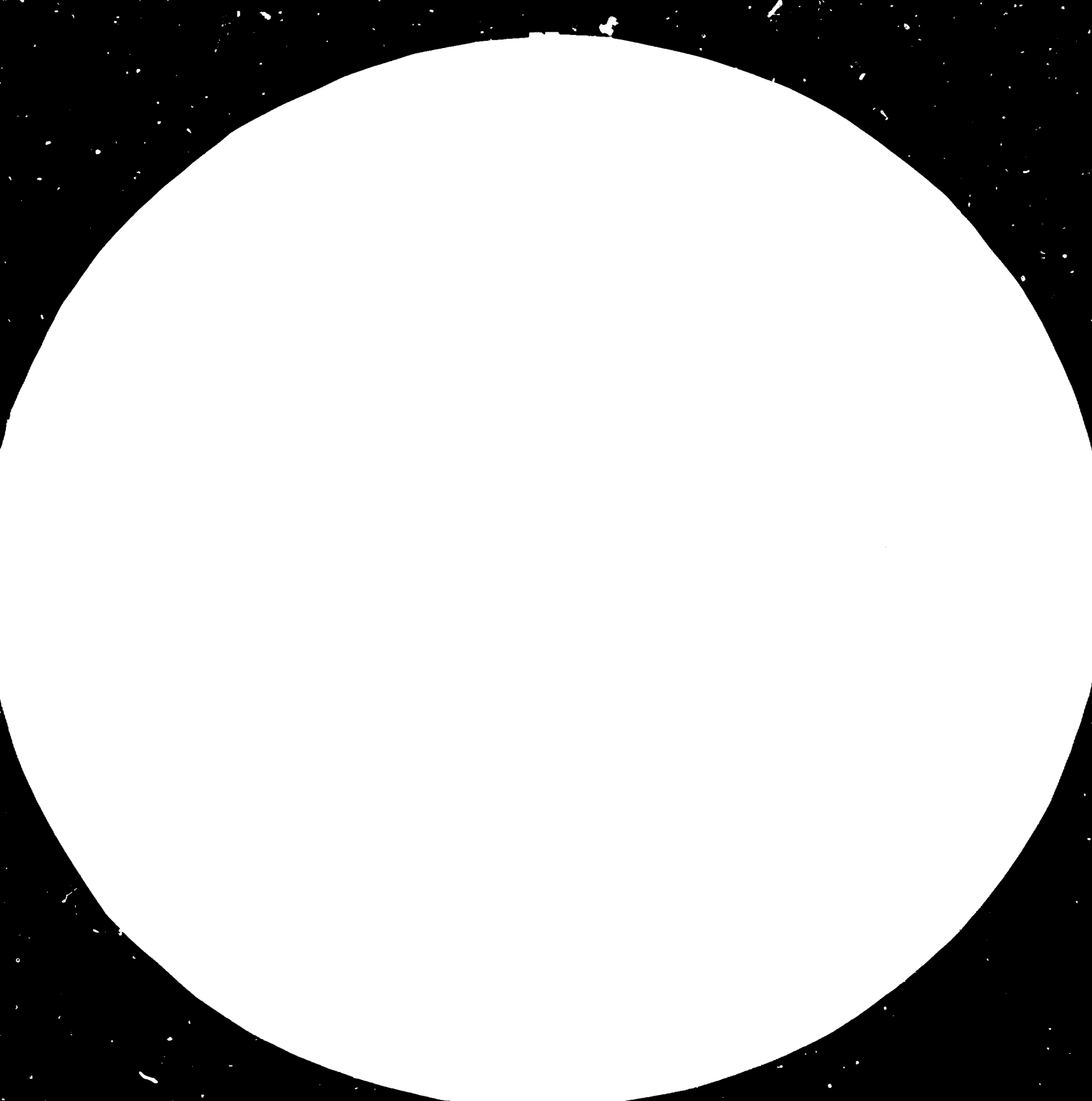

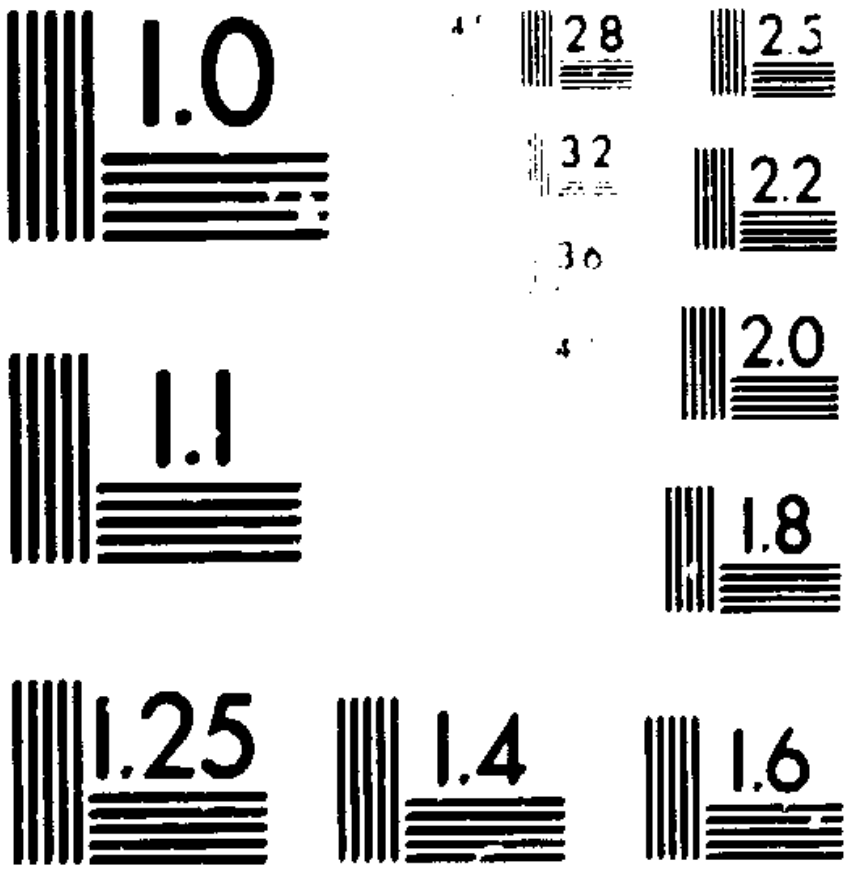

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THE AGRICULTURAL MACHINERY INDUSTRY: AN APPRAISAL OF THE CURRENT GLOBAL SITUATION PRODUCTION AND MARKET OUTLOOK

STATISTICAL COMPENDIUM

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This document presents major results of work under the element Studies on the Agricultural Machinery Industry in UNIDO's programme of Industrial Studies 1982/83.

Preface

This statistical compendium contains the detailed data supporting the Volume 1 of the study entitled "The agricultural machinery industry: An appraisal of the current global situation, production and market outlook", Sectoral Study Series No. 5 (UNIDO/IS.408).

Section A of the statistical compendium contains the statistical tables referred to in chapters 1 and 2 of the study. Section B contains the tables referred to in chapter 3. They comprise mainly individual country as well as company data which were made available by consultants. Section C contains data for individual developing countries collected in the course of the study work. In order to improve this data base, comments and observations are invited on the situation of the agricultural machinery industry and more specifically, on the level of mechanization in the individual countries as described in the last two columns of each table.

STATISTICAL COMPENDIUM

Section A

Tables referring to global appraisal and analysis of production and trade

Table 1. Sales of agricultural machinery in selected major developed market economies 1972 - 1981

(US $ million, constant 1975 prices)

	1972	1975	1979	1980	1981	1982
Austria	183.7	152.0	210.3	..	..	..
Australia	269.5	342.9	249.2	..	..	..
Belgium	342.2	476.9	557.2	..	..	..
Finland	80.9	130.5	112.5	130.6	136.5	..
France	1,185.5	1,679.0	1,512.9	1,424.8	1,249.9	..
Germany, Fed.Rep.	1,556.4	2,184.3	2,569.6	2,250.4	1,861.1	..
Italy	1,055.4	1,528.0	1,638.3	2,054.3	1,545.1	..
Japan	1,242.1	2,365.0	2,189.6[a/]	1,839.2	..	..
Norway	46.9	76.4	59.0	..	..	..
Sweden	270.6	432.4	355.4	218.9	88.9	..
United Kingdom	1,377.2	1,490.0	1,832.2	1,205.9	1,008.2	..
U.S.A.	7,890.9	9,371.6	9,535.9	8,674.0	8,684.6	6,369.7

Source: The Engineering Industries in OECD Member Countries, Basic Statistics, 1972-1975 and 1976-1979, OECD, Paris, 1977 and 1982.

Comité Européen des Groupements de Constructeurs du Machinisme Agricole (CEMA).

David M. Dornbusch and Co., San Francisco, U.S.A. Data comprise 6 major manufacturers in U.S.A.

a/ 1978.

Table 2. Sales of agricultural machinery by product groups in 10 selected market economies in 1979
(percentage distribution)

	Machinery for cultivating and preparing the soil	Harvesting, threshing and sorting machines	Milking machines and dairy equipment	Tractors	Others	Total per cent
Australia	30	35	1	20	14	100
Austria	10	30	-	60	-	100
Belgium	65	35	-	-	-	100
Denmark	30	50	20	-	-	100
Finland	23	23	5	45	3	100
France	20	22	1	27	30	100
Germany, Fed. Rep.	10	20	5	50	15	100
Norway[a/]	70	25	5	-	-	100
Sweden	10	15	25	50	-	100
USA[b/]	10	30	3	30	27	100
All above countries	15	25	5	40	15	100

Source: The Engineering Industries in OECD Member Countries, Basic Statistics, 1976-1979, OECD, Paris, 1982, and UNIDO estimates

a/ 1978

b/ 1977

Table 3: World production of tractors of more than 10 HP 1971 - 1980
(units)

ISIC-BASED CODE - 382261A

COUNTRY OR AREA	Footnotes	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Annual average growth 1971-1975
AFRICA		89	7	423	842a/	1605a/	2153a/	2882a/	3767a/	4926a/	4249a/	106.0
Algeria		-	-	389	799	1562	2110	2839	3724	4883	4206	
Angola		89	7	34	...	...	...	...	...	...	...	
AMERICA, NORTH		191311	224442	242774	241364	241950	226728	215774	209461	416439	374953	6.0
Mexico		5079	6229	5830	7539	10082	11574	10489	13005	15595	17893	
United States	1/	186232	218213	236944	233825	231868	213154	205285	196456	400844	357060	
AMERICA, SOUTH		37131a/	46161a/	63288a/	73674	77995	89692a/	79637a/	55786a/	67634a/	70501a/	20.4
Argentina	2/	13268	14408	21460	24505	18397	24098	25631	5997	10901	3618	
Brazil		23548	31438	41513	49075	59061	65279	53691	49474	56418	...	
Peru	3/	...	...	...	94	537	...	...	...	...	...	
ASIA (EXCL. USSR)		211135a/	240547a/	317971a/	379700a/	418108a/	509170a/	467177a/	435345a/	499892a/	447084a/	18.6
Burma	4/	657	594	1019	426	410	882	844	700	...	...	
China		...	...	...	...	...	...	99300	113500	125600	97700	
India		16545	18308	23537	29097	32445	36675	34675	52368	60094	67528	
Iran		3833	4466	7390	7682	12608	13442	10032	6796	...	...	
Iraq		592	2166	1735	1279	2269	...	...	...	...	...	
Japan	5/	64790	82810	142447	206538	235245	309909	288073	227196	266141	227932	
Turkey		15693	23178	32818	25653	26106	36889	31658	31963	32097	...	
EUROPE (EXCL. USSR)		570991	562296a/	600741a/	670720a/	726164a/	777786a/	806356a/	724254a/	709676a/	679985a/	6.2
European Econ. Comm.		413680	396442a/	423335a/	470593a/	512658a/	556575a/	578780a/	501766a/	504527a/	466809a/	5.5
Denmark		6	...	...	...	...	...	...	...	...	...	
France	5/	112800	109300	117900	130400	140500	166700	162300	165000	157200	123500	
Germany, Fed. Rep		83767	84237	99856	116111	114064	125152	128727	108480	110646	94587	
Italy		65607	68604	86292	104476	116388	128217	140547	116380	115775	127023	
United Kingdom	7/	151500	134295a/	119283	119600	141700	136500	147200	111900	120900	...	
EFTA		21807	22293	24407	25500	25327	25866	25638	22278	20694	24821a/	3.8
Austria		9200	9233	9209	10167	9583	9000	9251	9241	8281	10049	
Finland		2479	3183	4290	3306	3143	2629	3727	3433	3399	...	
Sweden		10128	9877	10908	12027	12601	14237	12660	9604	9014	...	
EASTERN EUROPE		117155	117916	121839	135669	146831	154624	160340	166616	158181	168656	5.5
Bulgaria		4668	4094	3958	4241	5112	5919	6258	7675	5944	6767	
Czechoslovakia		21794	22253	23975	27065	29585	31458	35040	33317	35370	33359	
German Dem. Rep.		15172	8295	3885	4045	4027	4018	...	...	...	...	
Hungary		1611	1175	1065	730	551	513	658	400	142	108	
Poland		43510	47216	50156	55038	57553	58805	59078	59509	54231	57549	
Romania	8/	30400	34883	38800	44550	50083	53911	59306	65715	62494	70873	
OTHER EUROPE		18349	25645	31160	38558	41348	40721	41598	33596	26274	19699a/	22.5
Greece		370	695	1135	2852	2728	1689	1879	1571	-	...	
Spain		17450	24382	29650	35786	38258	38830	39596	31709	25954	18012	
Yugoslavia		529	568	375	340	362	202	125	314	320	129	
USSR		472013	477822	499582	531094	550432	562175	569145	576113	557415	554916	3.9
USSR		472013	477822	499582	531094	550432	562175	569145	576113	557415	554916	
Belorussian SSR		(81050)	(81790)	(82950)	(84085)	(85861)	(86526)	(87126)	(87835)	(89145)	(89550)	
Ukrainian SSR		(149192)	(125485)	(126894)	(136551)	(143059)	(140794)	(141331)	(141752)	(142039)	(135630)	
OCEANIA		8468a/	7637	8273a/	8388a/	8296a/	8837a/	8637a/	7792a/	6508a/	6932a/	- 0.5
Australia	9/	...	5536	6312	6427	6335	6876	6676	5831	4547	4971	
New Zealand	8/ 9/ 10	1822	2101	...	...	...	...	...	...	...	...	
TOTAL		1491138	1558912	1733052	1905782	2024550	2174541	2149608	2012518	2262490	2138620	

3822-6 1A Tractors of 10 HP and over, other than industrial and road tractors.

Vehicles constructed essentially for hauling or pushing another vehicle, appliance or load, whether or not they contain subsidiary provision for the transport, in connexion with the main use of the tractor, of tools, seeds, fertilizers or other goods, etc, irrespective of their mode of propulsion (internal combustion engine, steam engine, etc.). This heading includes agricultural as well as other tractors, for example for use in forestry or in construction. Road tractors for tractor-trailer combinations and industrial tractors are, however, excluded. Walking tractors, equipped with a single driving axle carried on one or two wheels, the steering of which is effected by means of two handles, used like normal tractors and possibly with interchangeable implements, are also included.

1/ Shipments. 2/ Agricultural tractors only. 3/ Data refer to assembly. 4/ Twelve months ending 30 September of year stated.
5/ Including bulldozers. 6/ Agricultural tractors of all sizes. 7/ Deliveries of wheeled and half-track tractors.
8/ Including road tractors. 9/ Including tractors of less than 10 HP. 10/ Twelve months beginning 1 April of year stated.

Source: Yearbook of Industrial Statistics, Vol. II, 1980 Edition. United Nations, New York, 1982. Data shown include those reported to the UNSO as well as estimates by the UNSO.

a/ estimate.

Table 4. Number of tractors assembled and/or manufactured in developing countries, 1980

	India	Brazil	Mexico	Turkey	Pakistan	Argentina	Algeria	Iran	Syria	Thailand
Massey Ferguson	7,800	18,800	5,600	2,800	5,500	1,250	-	3,000	-	600
Intern. Harvester	11,600	-	2,700	1,200	1,000	-	-	-	-	-
Ford	3,500	13,500	5,600	900	-	-	-	-	-	600
J. Deere	-	-	2,000	-	-	1,000	-	-	-	-
Fiat	-	-	-	4,200	-	400	-	-	-	-
Deutz	1,000	-	-	-	-	1,200	3,800	-	-	-
D. Brown/Case	-	500	-	-	-	-	-	-	-	-
Valmet	-	14,300	-	-	-	-	-	-	-	-
Eicher	10,600	-	-	-	-	-	-	-	-	-
C.B.I.	-	7,150	-	-	-	-	-	-	-	-
Ebro	-	-	-	-	-	-	-	-	1,700	-
Leyland	..	-	-	1,650	-	-	-	-	-	-
Others	32,700	4,650	-	-	-	-	-	-	-	-
Total	67,200	58,900	15,900	10,750	6,500	3,850	3,800	3,000	1,700	1,200

Source: Louis Berger, S.A.R.L., Paris, France.

Table 5. Production of ploughs in major manufacturing countries 1971-1980

(Percentage distribution of units produced)

Country/year	1971	1975	1980
USA	8.8	15.5	20.6[a/]
USSR	25.6	19.1	18.1
France	14.1	15.5	13.4
Brazil	15.1[a/]	12.1	11.6
Yugoslavia	3.3	4.4	5.6
Japan	5.7	4.7[a/]	5.4[a/]
Poland	8.3	7.6	4.1
Germany, FR	2.8	2.4	1.5
Other countries (estimate)	16.3	18.7	19.7
Total world (estimate)	100.0	100.0	100.0

Source: Yearbook of Industrial Statistics, Vol.II, 1980 Edition, United Nations, New York, 1982.

Note: Countries ranked in descending order according to 1980 data.

a/ UNIDO estimates.

Table 6. Production of seeders in major manufacturing countries 1971-1980

(Percentage distribution of units produced)

Country/year	1971	1975	1980
USA	11.8	20.1	30.8
USSR	19.7	17.9	19.7
Germany, FR	12.9	8.5	6.7
France	9.0	6.8	5.8
Brazil	4.8[a/]	3.4[a/]	3.3[a/]
Bulgaria	3.5	2.4	2.0
Poland	6.4	4.3	2.0
Romania	2.0	2.5	1.9
Other countries (estimate)	29.9	34.1	27.8
Total world (estimate)	100.0	100.0	100.0

Source: Yearbook of Industrial Statistics, Vol.II, 1980 Edition, United Nations, New York, 1982.

Note: Countries ranked in descending order according to 1980 data.

a/ UNIDO estimates.

Table 7. Production of combine harvester-threshers in major manufacturing countries 1971-1980

(Percentage distribution of units produced)

Country/year	1971	1975	1980
USSR	51.9	32.1	40.3
Japan	19.4	41.9	36.2
USA	10.8	10.3	9.8
Germany, FR	6.1	5.3	4.3
Other countries (estimate)	11.8	10.4	9.4
Total world (estimate)	100.0	100.0	100.0

Source: Yearbook of Industrial Statistics, Vol.II, 1980 Edition, United Nations, New York, 1982.

Note 1: Countries ranked in descending order according to 1980 data.

Table 8. World production of selected agricultural machinery products, 1971 - 1980
(Numbers of units built)

Products \ Years	1971	1975	Annual average growth rate (%) 1971-1975	1980	Annual average growth rate (%) 1975-1980
Tractors of 10 HP and over	1,491,138	2,024,550	7.9	2,138,620	1.1
Tractors of less than 10 HP (garden tractors)	811,576	706,428	-3.4	787,433	2.2
Cultivators, scarifiers, hoes, weeders, etc.	712,957	920,265	6.6	851,755	-1.5
Combine harvester-threshers	196,990	303,580	11.4	291,443	-0.8
Harrows, rotary, animal or tractor operated	386,184	834,641	21.2	1,051,492	4.7
Ploughs	861,408	1,072,894	5.6	1,117,588	0.8
Rakes, animal or tractor operated and self-propelled	149,028	166,335	2.8	172,608	0.7
Seeders, planters and transplanters	711,857	1,004,726	9.0	1,018,686	0.3
Threshing machines[a/]	207,925	192,611	-1.9	148,028	-5.1
Fertilizer distributors	215,926	198,742	-2.0	191,954	-0.7

Source: Yearbook of Industrial Statistics, Vol. II, 1980 Edition, United Nations, New York, 1982.

a/ No figures reported for North America.

Table 9. Exports of agricultural machinery by regions and selected countries, 1971 - 1980
(US$ million, constant 1975 prices)

Regions	1971	1975	1980	Percentage distribution 1971	1975	1980
Developed market economies	3,359	6,807	7,018	79.1	80.8	77.2
of which:						
-- USA	962	2,066	1,927	22.7	24.5	21.2
-- Germany, FR	477	1,032	1,135	11.2	12.2	12.5
-- United Kingdom	685	876	873	16.1	10.4	9.6
-- Italy	197	481	678	4.6	5.7	7.5
-- Japan	138	521	531	3.2	6.2	5.8
Centrally planned economies	862	1,517	1,902	20.3	18.0	20.9
of which:						
-- USSR	261	569	771	6.1	6.7	8.5
-- Germany, DR	262	379	473	6.2	4.5	5.2
-- Czechoslovakia	125	166	237	2.9	2.0	2.6
Developing economies	23	103	173	0.5	1.2	1.9
-- Latin America	15	82	146	0.3	1.0	1.6
-- Asia	5	12	27	0.1	0.1	0.3
-- Africa	3	9	0.6	0.1	0.1	-
World	4,244	8,427	9,093	100.0	100.0	100.0

Source: UNSO Trade Tapes, ECE Bulletin of Statistics on World Trade in Engineering Products 1971, 1975 and 1980, United Nations 1973, 1977 and 1982.

Table 10. Imports of agricultural machinery by regions and selected countries 1971 - 1980
(US$ million, constant 1975 prices)

Regions	1971	1975	1980	Percentage distribution 1971	1975	1980
Developed market economies	2,487	4,591	5,225	58.6	54.5	57.5
of which:						
-- USA	379	708	746	8.9	8.4	8.2
-- Germany, FR	143	261	311	3.4	3.1	3.4
-- United Kingdom	84	187	277	2.0	2.2	3.0
-- Italy	98	122	189	2.3	1.4	2.1
-- Japan	59	78	91	1.4	0.9	1.0
Centrally planned economies	757	1,437	1,589	17.8	17.0	17.5
of which:						
-- USSR	300	498	406	7.1	5.9	4.5
-- Germany, DR	56	132	147	1.3	1.6	
-- Czechoslovakia	177	248	143	4.2	2.9	
Developing economies	1,000	2,399	2,280	23.6	28.5	25.1
-- Latin America	393	916	856	9.3	10.9	9.4
-- Asia	364	953	822	8.6	11.3	10.1
-- Africa	243	530	501	5.7	6.3	5.5
World	4,244	8,427	9,093	100.0	100.0	100.0

Source: UNSO Trade Tapes, ECE Bulletin of Statistics on World Trade in Engineering Products 1971, 1975 and 1980, United Nations 1973, 1977 and 1982.

Table 11. Exports and imports of agricultural machinery by regions and selected countries in 1980
(US$ millions, constant 1975 prices and per cent)

Region/Country	Exports		Imports		Export/import ratio
	mill US$	% of total world	mill US$	% of total world	
Developed market economies	7,018	77.2	5,225	57.4	1.34
of which:					
- USA	1,927	21.2	225	8.2	2.58
- Germany, F.R.	1,135	12.5	746	3.4	3.65
- United Kingdom	873	9.6	311	3.0	3.16
- Italy	678	7.5	277	2.1	3.58
- Japan	531	5.8	189	1.0	5.83
EEC	3,626	39.9	91	21.4	1.86
Centrally planned economies	1,902	20.9	1,947	17.5	1.20
of which:					
- USSR	771	8.5	1,589	4.5	1.90
- GDR	473	5.2	406	1.6	3.22
- Czechoslovakia	237	2.6	147	1.6	1.65
Developing economies	173	1.9	2,280	25.1	0.08
of which:					
- Latin America	146	1.6	856	9.4	0.17
- Asia and Oceania	27	0.3	922	10.2	0.03
- Africa	0.6	- a/	501	5.5	0.001
World	9,093	100.0	9,093	100.0	1.00

Source: UNSO Trade Tapes, ECE Bulletin of Statistics on World Trade in Engineering Products 1980, United Nations, 1982.

Note 1: For reporting reasons the imports of the listed developed market economies do not include imports from the centrally planned economies. However, such imports are not large in magnitude.

Note 2: The table comprises SITC (Rev. 1) 712.1, 712.2, 712.5 and 712.9.

a/ negligible

Table 12. Developed market economies: exports of agricultural machinery in 1980 and 1981

(US$ million, constant 1975 prices)

Regions/countries	1980	1981	percentage change 1980-1981
Developed market economies	7,018.3	6,665.7	- 5.0
of which 11 major exporters			
- USA	1,926.7	2,144.8	+ 11.3
- Germany, FR	1,135.0	996.6	- 12.2
- United Kingdom	873.4	698.1	- 20.0
- Italy	678.8	5,988.8	- 11.8
- Japan	530.8	623.2	- 17.4
- France	384.0	349.4	- 9.0
- Canada	360.3	315.7	- 12.4
- Belgium - Luxembourg	267.0	196.7	- 26.3
- Netherlands	158.1	144.1	- 8.9
- Denmark	116.5	97.5	- 16.3
- Sweden	103.8	81.5	- 15.7
EEC	3,626.0	3,093.1	- 14.7

Source: UNSO Trade Tapes, OECD microtables

Note: Countries are ranked in descending order according to 1980 data. The data do no include trade with the centrally planned economies.

Table 13. Developed market economies: imports of agricultural machinery in 1980 and 1981

(US$ million, constant 1975 prices)

Regions/countries	1980	1981	percentage change 1980-1981
Developed market economies	4,993.7	4,022.2	- 19.5
of which 11 major exporters			
- Canada	804.4	871.7	-18.4
- USA	746.2	603.9	-19.1
- France	609.2	510.9	-16.1
- Germany, FR	311.1	262.7	-15.6
- Australia	279.2	251.0	-10.1
- United Kingdom	276.3	232.5	-15.9
- South Africa	247.4	198.1	-19.9
- Italy	189.3	117.4	-38.0
- Netherlands	158.1	102.0	-35.5
- Belgium - Luxembourg	150.8	100.1	-33.6
- Sweden	140.9	97.3	-30.9
EEC	1,933.1	1,404.9	-27.3

Source: UNSO Trade Tapes, ECE Bulletin of Statistics on World Trade in Engineering Products 1980, United Nations, 1982.

Note: Countries are ranked in descending order according to 1980 data. The data do not include trade with the centrally planned economies.

Table 14. Developing countries - major exporters of agricultural machinery in 1980
(US$ million, constant 1975 prices)

Exporters	Destination of exports: Developed market economies $	Developed market economies %	Developing countries $	Developing countries %	Total exports $	Total exports %
Latin America						
Argentina	5.3	46.1	6.2	53.9	11.5	100
Brazil	24.0	18.9	103.3	81.1	127.3	100
Colombia	-	-	2.2	100.0	2.2	100
El Salvador	0.02	-	1.5	100.0	1.5	100
Mexico	...	...	...	...	6.8	100
Asia						
India (1979)	0.4	16.7	2.0	83.3	2.4	100
Republic of Korea	0.7	24.1	2.2	75.9	2.9	100
Philippines	1.0	83.3	0.2	16.7	1.2	100
Saudi Arabia	0.3	6.0	4.7	94.0	5.0	100
Singapore	0.3	4.9	5.8	95.1	6.1	100
Turkey	0.3	18.7	1.3	81.3	1.6	100
Africa						
Ivory Coast (1979)	0.1	12.5	0.7	87.5	0.8	100
Senegal	0.01	- a/	0.3	100.0	0.3	100
United Republic of Cameroon	0.1	100.0	-	-	0.1	100
Total of selected countries	32.5 b/	20.0	130.4 b/	80.0	169.7	100

Source: UNSO Trade Tapes.

a/ insignificant
b/ excluding Mexico

Table 15. Developing countries - major exporters of agricultural machinery in 1981
(US$ million, constant 1975 prices)

Exporters \ Destination of exports	Developed market economies		Developing countries		Total exports	
	$	%	$	%	$	%
Latin America						
Brazil	25.4	17.8	117.4	82.2	142.8	100.0
Colombia	-	-	2.7	100.0	2.7	100.0
Asia						
Saudi Arabia	0.2	7.1	2.6	92.9	2.7	100.0
Singapore	0.3	8.9	3.1	91.0	3.4	100.0
Thailand	-	-	0.6	100.0	0.6	100.0
Turkey	0.2	2.7	6.7	97.3	6.9	100.0
Africa						
Ivory Coast	0.4	33.3	0.8	66.7	1.2	100.0
Senegal	0.01	- a/	0.3	100.0	0.3	100.0
Total selected countries	26.5	16.5	134.2	83.5	160.7	100.0

Source: UNSO Trade Tapes.

Note: a/ insignificant.

Table 16. Developing countries - major importers of agricultural machinery in 1980
(US$ million, constant 1975 prices)

Origin of imports / Importers	Developed market economies $	Developed market economies %	Centrally planned economies $	Centrally planned economies %	Developing countries $	Developing countries %	Total imports $	Total imports %
Latin America								
Argentina	53.5	74.1	0.1	0.2	18.6	25.7	72.2	100
Brazil	23.3	94.7	1.1	4.5	0.2	0.8	24.6	100
Colombia	28.9	78.5	0.6	1.6	7.3	19.8	36.8	100
Cuba	11.1	10.2	97.3	89.8	0.01	-	108.4	100
Mexico	291.9	99.3	0.4	0.1	1.6	0.6	293.9	100
Venezuela	59.4	88.0	0.1	0.1	8.0	11.9	67.5	100
Asia								
China	15.6	49.2	16.1	50.8	0.03	-	31.7	100
India	22.1	90.6	1.7	8.0	0.6	2.5	24.4	100
Iraq	155.3	91.5	12.5	8.4	1.9	1.1	169.7	100
Republic of Korea	19.0	98.4	0.3	1.6	0.002	-	19.3	100
Pakistan	50.4	76.9	15.1	23.1	0.03	-	65.5	100
Philippines	22.7	99.6	-	-	0.1	0.4	22.8	100
Saudi Arabia	116.5	96.6	-	-	4.1	3.4	120.6	100
Singapore	45.2	98.7	-	-	0.6	1.3	45.8	100
Thailand	40.3	96.9	0.8	1.9	0.5	1.2	41.6	100
Turkey	19.5	99.5	0.1	0.5	-	-	19.6	100
Africa								
Algeria	75.8	91.1	5.2	6.2	2.2	2.6	83.2	100
Egypt	28.6	75.1	9.3	24.4	0.2	0.5	38.1	100
Kenya	16.7	99.4	-	-	0.1	0.6	16.8	100
Libya Arab. Jam.	49.3	100.0	-	-	0.02	-	49.3	100
Morocco	21.8	99.1	0.2	0.9	-	-	22.0	100
Nigeria	72.8	98.0	-	-	1.5	2.0	74.3	100
Tunisia	33.2	99.1	0.3	0.9	0.002	-	33.5	100
Total of selected countries	1,272.9	85.9	161.2	10.9	47.6	3.2	1,481.8	100

Source: UNSO Trade Tapes, UN Bulletin of Statistics on World Trade in Engineering Products, 1980, United Nations 1982.

Table 17. Developing countries - major importers of agricultural machinery in 1981
(US$ million, constant 1975 prices)

Importers	Origin of imports: Developed market economies $	Developed market economies %	Developing countries $	Developing countries %	Total exports $	Total exports %
Latin America:						
Argentina	28.5	86.1	4.6	14.0	33.1	100
Brazil	9.6	100.0	-	-	9.6	100
Colombia	29.1	81.5	6.6	18.5	35.7	100
Cuba	9.0	100.0	-	-	9.0	100
Mexico	271.4	98.5	4.1	1.5	275.5	100
Venezuela	76.2	87.8	10.6	12.2	86.8	100
Asia:						
China	4.7	94.0	0.3	6.0	5.0	100
India	11.5	99.3	0.06	0.7	11.6	100
Iraq	166.3	97.1	4.9	2.9	171.2	100
Republic of Korea	23.8	99.7	0.06	0.3	23.9	100
Pakistan	29.9	94.6	1.7	5.4	31.6	100
Philippines	14.7	97.4	0.4	2.6	15.1	100
Saudi Arabia	179.9	99.5	1.0	0.6	180.9	100
Singapore	18.9	99.5	0.1	0.5	19.0	100
Thailand	22.8	72.6	8.6	27.4	31.4	100
Turkey	35.1	100.0	-	-	35.1	100
Africa:						
Algeria	71.0	90.2	7.7	9.8	78.7	100
Egypt	65.7	98.6	0.9	1.4	66.6	100
Kenya	8.9	92.7	0.7	7.3	9.6	100
Libyan Arab. Jam.	96.4	99.8	0.2	0.2	96.6	100
Morocco	16.8	96.6	0.6	3.4	17.4	100
Nigeria	103.0	94.8	5.7	5.2	108.7	100
Tunisia	30.9	100.0	-	-	30.8	100
Total of selected countries	1,324.0	95.7	58.8	4.3	1,382.8	100

Source: UNSO Trade Tapes, UN Bulletin of Statistics on World Trade in Engineering Products, 1980, United Nations 1982.

Table 18. Structure of world exports of agricultural machinery by major product types in 1971, 1975, and 1980
(US$ million at constant 1975 prices and percentage distribution)

Years	1971		1975		1980	
Product types	$	%	$	%	$	%
Total agricultural machinery[a/]	4,244	100.0	8,427	100.0	9,093	100.0
of which						
Machinery for cultivating soil and harvesting[b/]	1,570	37.0	3,450	41.0	3,637	40.0
Tractors[c/]	2,131	50.0	4,404	52.0	4,723	52.0
Others[d/]	543	13.0	573	7.0	733	8.0

Source: UNSO Trade Tapes, ECE Bulletin of Statistics on World Trade in Engineering Products 1971, 1975 and 1980, United Nations 1973, 1977 and 1982.

a/ SITC's 712.1, 712.2, 712.5 & 712.9 Rev.I
b/ SITC 712.1 and 712.2 Rev.I.
c/ SITC 712.5 Rev.I.
d/ SITC 712.9 Rev.I.

Table 19. Exports of agricultural machinery by product group and destination, 1971 - 1975 - 1980
(percentage distribution)

Destination \ Product group	Agricultural machinery Total a/			Agricultural machinery for cultivating soil b/			Tractors c/		
	1971	1975	1980	1971	1975	1980	1971	1975	1980
Developed market economies	58	55	57	67	59	59	58	53	55
of which:									
- USA	8	8	8	15	12	10	5	6	7
- Germany, F.R.	3	3	3	4	4	4	3	3	2
- United Kingdom	2	2	3	4	4	4	1	1	2
- Italy	2	1	2	3	2	2	2	1	2
- Japan	1	1	1	1	1	1	2	1	1
Centrally planned economies	17	17	18	21	24	23	11	8	10
of which:									
- USSR	7	6	5	6	5	10	2	3	1
- Germany, DR	1	2	2	1	2	0.1	2	1	2
- Czechoslovakia	4	3	2	5	4	2	3	1	2
Developing economies	25	28	25	12	17	18	31	39	31
of which:									
- Latin America	10	11	9	7	9	7	13	14	11
- Asia and Oceania	9	11	10	2	4	6	11	17	12
- Africa	6	6	6	3	4	4	7	8	8
World	100	100	100	100	100	100	100	100	100

Source: UNSO Trade Tapes, ECE Bulletin of Statistics on World Trade in Engineering Products 1971, 1975 and 1980, United Nations 1973, 1977 and 1982.

a/ SITC 712.1, 2, 5, 9, Rev. 1.

b/ SITC 712.2 and 712.2 Rev. 1.

c/ SITC 712.5 Rev. 1.

Table 20. Share of major product groups within total agricultural machinery imports by developing regions 1971 and 1980
(percentage distribution)

1971

Products / Regions	Total agricultural machinery (712.1,2,5+9)	Machinery for cultivating soil and harvesting (712.1,2)	Tractors (712.5)	Others (712.9)
Latin America	100.0	26.7	69.6	3.7
Asia	100.0	10.8	66.7	22.5
Africa	100.0	19.6	58.8	21.6
Total developing countries	100.0	19.2	65.9	14.9

1980

Products / Regions	Total agricultural machinery (712.1,2,5+9)	Machinery for cultivating soil and harvesting (712.1,2)	Tractors (712.5)	Others (712.9)
Latin America	100.0	31.6	62.7	5.7
Asia	100.0	25.9	60.3	13.8
Africa	100.0	26.3	71.3	2.4
Total developing countries	100.0	28.1	63.7	8.2

Source: UNSO Trade Tapes, ECE Bulletin of Statistics on World Trade in Engineering Products 1971 and 1980, United Nations 1973 and 1982.

Note: Code numbers in table heading refer to SITC (Rev. 1).

Table 21. Tractors per agricultural land and per arable land 1961-1965, 1969-1971, 1980
(Units per 1,000 hectares, annual average)

	Tractors per agricultural land			Tractors per arable land		
	1961-65	1969-71	1980	1961-65	1969-71	1980
Developed market economies	7.6	9.3	11.4	26.6	31.6	38.3
North America	10.5	11.4	11.0	24.1	24.6	23.4
West Europe	21.6	31.1	43.8	41.7	61.9	87.9
Oceania	0.8	0.8	0.8	10.8	10.2	9.5
Other developed market economies	1.5	4.4	12.9	9.0	25.6	74.9
Developing countries	0.3	0.6	1.1	1.3	2.1	3.8
Africa	0.1	0.2	0.3	o.6	1.2	1.6
Latin America	0.7	0.9	1.3	4.8	5.2	6.5
Near East	0.4	0.5	1.6	1.4	2.4	7.6
Far East	0.2	0.6	1.9	0.3	0.8	2.3
Other developing	1.6	2.4	3.1	6.1	10.6	13.4
Centrally planned economies	1.8	2.5	0.8	5.0	7.5	2.3
Asian CPE	0.2	0.4	0.1	0.7	1.5	0.3
Europe USSR	2.1	4.1	1.3	7.0	10.0	3.2

Source: 1976 FAO Production Yearbook, FAO, Rome 1977.
1980 FAO Production Yearbook, FAO, Rome 1981.

Table 22: Labour force in agriculture (in absolute numbers) and as a percentage of total labour force, 1950 to 2000 (millions and per cent)

Year	Western Europe		Eastern Europe including USSR	
	millions	%	millions	%
1950	42,096	31.1	76,842	54.8
1960	33,146	23.5	67,616	42.4
1970	22,626	15.4	49,362	28.7
1975	19,393	12.7	44,026	23.9
1980	16,445	10.4	38,622	19.8
1985	13,955	8.4	33,720	16.7
1990	11,608	6.8	28,589	13.8
1995	9,617	5.5	24,226	11.5
2000	7,982	4.5	20,999	9.6

Source: UN/ECE; Present and Foreseeable trends in mechanization of agriculture (horizon 1990), FAO/ECE/AGRI/WP.2/46, New York 1981, p. 14. From Economic Bulletin for Europe Vol. 35, No. 2.

Table 23: Average Wheat Yields, 1948-50 to 1978-80
(kg per hectare)

Country	1948-50	1958-60	1968-70	1978-80
Austria	1,577	2,145	3,227	3,930
Belgium	3,143	3,710	3,972	4,999
Denmark	3,587	3,850	4,554	5,039
Finland	1,613	1,670	2,280	2,351
France	1,830	2,340	3,566	4,993
Germany, FR	2,470	3,105	4,013	4,810
Ireland	2,243	2,655	4,325	4,994
Netherlands	3,530	3,860	4,442	6,236
Norway	2,190	2,125	3,104	4,133
Sweden	2,223	1,590	3,805	4,292
Switzerland	2,647	2,137	3,578	4,591
United Kingdom	2,687	3,350	3,926	5,456
Greece	997	1,565	1,662	2,707
Italy	1,490	1,925	2,290	2,659
Portugal	657	870	976	949
Spain	800	1,050	1,217	1,842
Yugoslavia	1,220	1,585	2,218	3,149
Bulgaria	...	1,680	2,621	3,729
Czechoslovakia	1,840	2,055	3,068	4,008
German Democratic Republic	1,897	3,125	3,761	4,450
Hungary	1,280	1,480	2,456	4,104
Poland	1,213	1,655	2,455	2,851
Romania	...	1,160	1,753	2,606
USSR	...	1,125	1,425	1,694

Source: FAO Production Yearbook, various years: from Economic Bulletin for Europe, Vol. 35, No. 2.

Table 24. Total capital invested per labour unit in agriculture, 1961 to 1973
(000 US$)

	1961	1964	1967	1970	1973
Austria	...	7	10	20	30
Belgium	26	37	...	60	81
Denmark	16	23	33	41	75
Finland	5	7	7	10	14
France	...	...	...	26	41
Germany, F.R. of	...	12	16	21	26
Iceland	...	...	...	16	32
Norway	5	6	7	8	12
Sweden	8	10	16	29	37
Switzerland	8	10	10	15	21
United Kingdom	...	...	...	27	62
Greece	0.5	1	1	2	5
Spain	...	...	5	11	17
Yugoslavia	0.5	1	1	1	3
Czechoslovakia (000 Kcs)	56	70	94	112	146
Hungary (000 Forints)	46	63	56	88	193
Poland (000 Zlotys)	141	153	119	136	155

Source: Economic Bulletin for Europe, vol. 35, No. 2, p. 171

Note: Labour units in Western European countries are man-years; in Czechoslovakia, Hungary and Poland the number of persons employed in agriculture. The main purpose of this table is to show the increasing investments per labour unit overtime. Comparisons between countries are impossible owing to different coverage of data (e.g. incl. or excl. land values) and also to different valuations used (e.g. market or taxation values).

Table 25: Commercial energy use in crop and livestock production in developing countries
1980 and projections for 2000

	Total (mill.tons oil equivalent)		Share of cost of each input (per cent)							
			Fertilizers		Farm machinery		Irrigation		Pesticides	
	1980	2000	1980	2000	1980	2000	1980	2000	1980	2000
Africa	1.9	12.1	36	44	48	50	7	2	9	4
Far East	16.4	93.1	63	69	15	25	19	5	3	1
Latin America	12.4	48.7	48	39	45	58	4	1	3	2
Near East	6.1	20.6	43	49	36	41	19	8	2	2
Developing countries a/	36.8	174.5	54	57	31	37	12	4	3	2

a/ 90 countries accounting for 97% of population of developing world outside China.

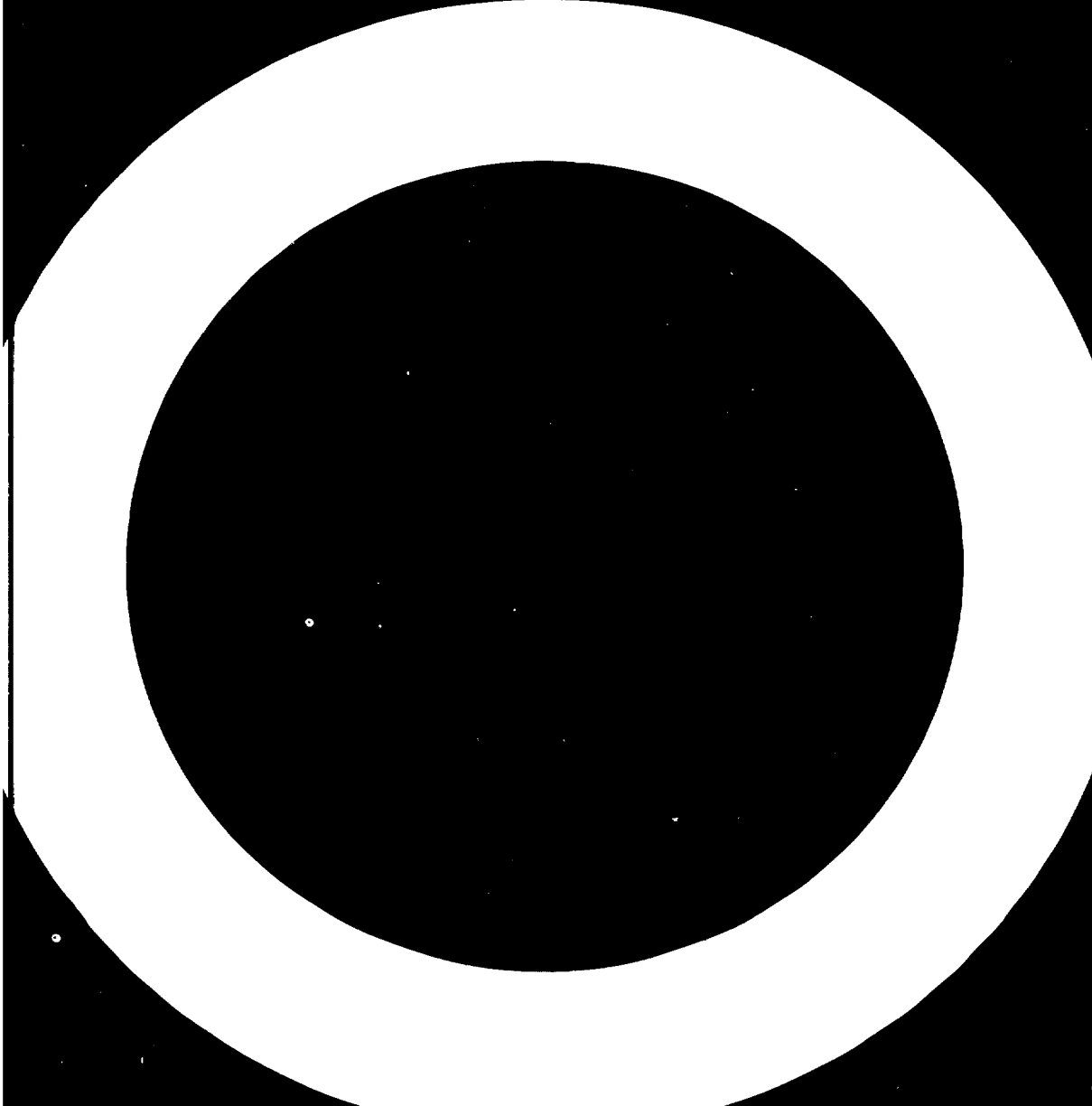
Source: Energy in agriculture and rural development, FAO, c81/25, August 1981.
Based on data from revised normative high scenario of FAO's study of Agriculture: Toward 2000

Table 26. Apparent consumption of agricultural machinery 1980 and projections 1990 and 2000

Region	Year	Full econometric model		Linear trend extrapolation	
		US$ million[a/]	Annual growth rate %	US$ million[a/]	Annual growth rate %
Latin America[b/]	1980	559		559	
			8.5		9.8
	1990	1,265		1,521	
			3.9		2.9
	2000	1,862		2,028	
North America	1980	7,684		7,684	
			3.6		2.0
	1990	10,913		9,346	
			2.0		0.8
	2000	13,306		10,157	
Other developed market economies	1980	619		619	
			-0.2		4.9
	1990	608		1,000	
			3.2		2.9
	2000	836		1,333	
West Europe (North)	1980	7,038		7,038	
			-4.2		3.7
	1990	4,580		10,113	
			0.03		2.1
	2000	4,696		12,470	
West Europe (South)	1980	503		503	
			7.4		4.7
	1990	1,030		800	
			6.8		2.9
	2000	1,991		1,067	

Note: Data and details of the estimated model will be separately issued by UNIDO.

a/ at constant 1975 prices.
b/ represented by Mexico and Brazil.



STATISTICAL COMPENDIUM

Section B

Tables referring to regional surveys

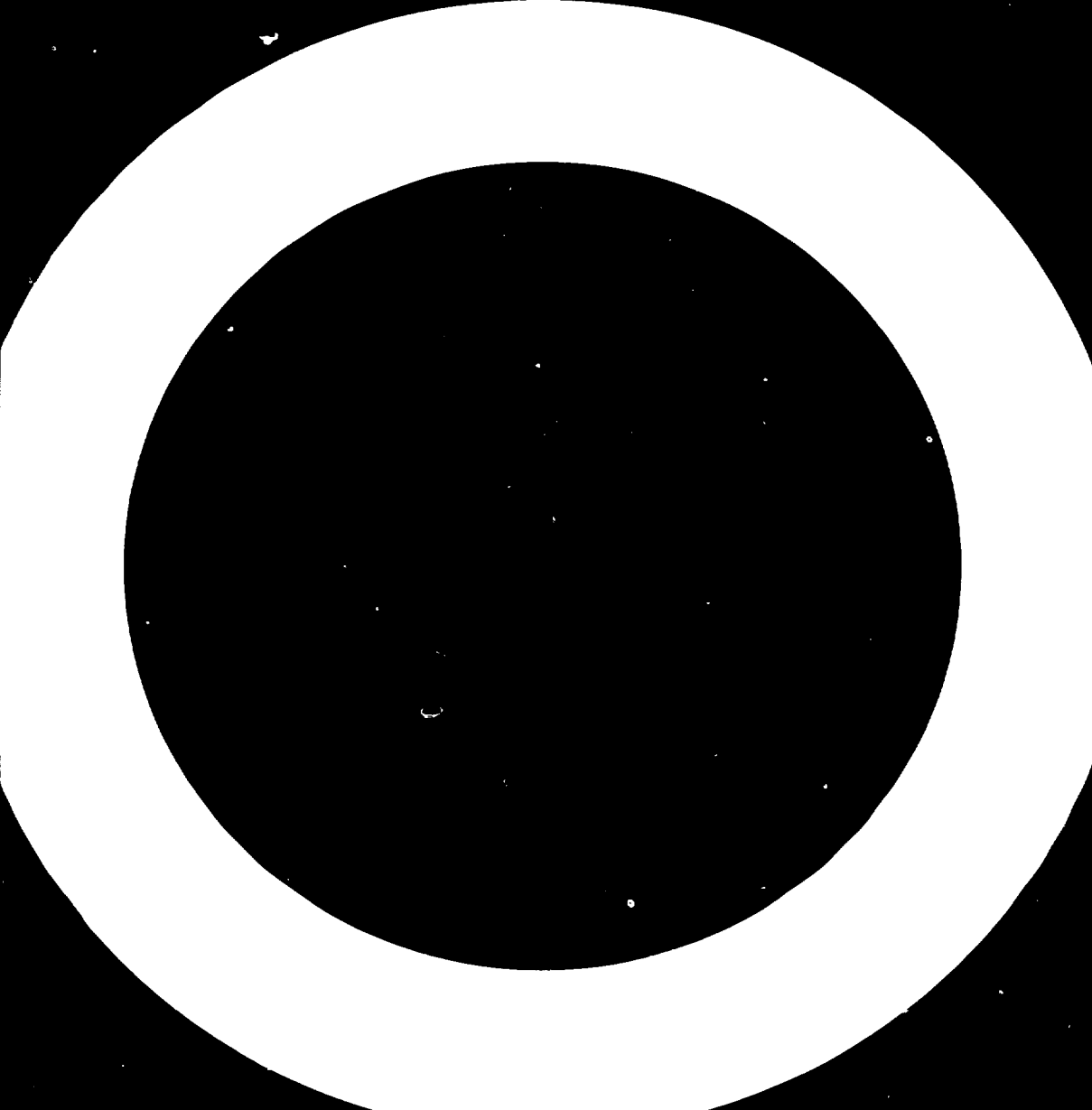


Table 27. Six major North American agricultural machinery producers sales and income (US$ million)

Company / Year	1977	1978	1979	1980	1981	1982
Allis-Chalmers						
- Sales in current dollars (a)	545	580	679	684	700	...
- Sales in constant 1982 dollars	856	846	910	820	732	...
- Profit in current dollars	40	33	38	4	-85	...
- Profit in 1982 dollars	63	48	51	5	-89	...
J.I. Case						
- Sales in current dollars	...	1,386	1,674	1,671	1,798	1,458
- Sales in constant 1982 dollars	...	2,022	2,242	2,004	1,880	1,458
- Profit in current dollars	...	41	37	0	19	-3
- Profit in 1982 dollars	...	60	50	0	20	-3
John Deere						
- Sales in constant dollars (b)	2,933	3,297	3,936	4,489	4,665	4,033
- Sales in constant 1982 dollars	4,608	4,810	5,272	5,384	4,878	4,033
- Profit in current dollars	256	265	311	228	251	53
- Profit in 1982 dollars	402	387	417	273	262	53
Ford Motor						
- Sales in current dollars (b)(c)	1,246	979	1,496	1,222	1,280	1,097
- Sales in constant 1982 dollars	1,958	1,429	2,004	1,466	1,339	1,097
- Profit in current dollars	1,673	1,589	1,169	-1,543	-1,060	-658
- Profit in 1982 dollars	2,628	2,318	1,566	-1,851	-1,108	-658
International Harvester						
- Sales in current dollars (b)	...	2,348	3,069	2,507	2,980	1,864
- Sales in constant 1982 dollars	...	3,426	4,111	3,007	3,116	1,864
- Profit in current dollars	...	187	370	-397	-393	-1,638
- Profit in 1982 dollars	...	273	496	-476	-411	-1,638
Massey-Ferguson						
- Sales in current dollars	2,861	2,631	2,973	3,132	2,646	2,058
- Sales in constant 1982 dollars	4,495	3,838	3,982	3,757	2,767	2,058
- Profit in current dollars	32	-262	37	-225	-195	-413
- Profit in 1982 dollars	50	-382	50	-270	-204	-413
Total six companies						
- Sales in current dollars	7,585	11,221	13,827	13,705	14,069	10,510
- Sales in constant 1982 dollars	11,916	16,371	18,522	16,438	14,713	10,510
- Profit in current dollars	2,001	1,853	1,962	-1,933	-1,463	-2,659
- Profit in 1982 dollars	3,144	2,703	2,628	-2,319	-1,530	-2,659

Source: David M. Dornbusch and Co., San Francisco, U.S.A.
Note: Producer price index for agricultural machinery and equipment, code 11-1, as published by U.S. Department of Labor, Bureau of Labor Statistics.

(a) Sales and profits pertain only to the agricultural machinery segment of the company.
(b) Sales pertain only to agricultural machinery, profits are company-wide.
(c) Sales are estimated by multiplying unit tractor sales by $15,000 per tractor.

Table 28. U.S. agricultural machinery producers (SIC 352)
Shipments and employment
(US$ million and thousands of employees)

Category	1978	1979	1980	1981	1982	Jan 83	Feb 83
Farm tractors[a/]	2,264	2,902	2,761	3,066	2,339	145	...
Farm machinery ex tractors[b/]	5,479	6,711	6,651	6,896	...	...	...
Total farm machinery	7,743	9,613	9,412	9,962	...	...	...
Total sector shipments[c/]	11,197	13,258	13,699	14,769	11,816	907	789
Sector employment (thousands)[d/]	120.9	143.1	142.3	149.9	118.4	...	...
Total farm machinery (1982 US$)	11,297	12,877	11,289	10,418	2,339	...	...
Total sector shipments (1982 US$)	16,336	17,759	16,431	15,445	11,816	877	761

Source: David M. Dornbusch and Co., San Francisco, U.S.A.

a/ Wheeled tractors for agricultural use.
b/ Excludes lawn and garden equipment and commercial turf equipment.
c/ This row includes all goods and services produced by the farm machinery sector ISIC 352).
d/ Scaled to match sector shipment data in this table.

Table 29. US imports of agricultural machinery with detail on tractors by size (US$ million)

Product groups / years	1978	1979	1980	1981	1982
Tractors					
< 40 HP	128	205	146	155	129
40 HP to 100 HP	91	271	323	241	200
> 100 HP	40	52	65	56	57
used or HP non spec.	212	144	130	160	142
Total tractors	471	672	664	612	528
Other farm machinery	489	698	685	639	485
Total farm machinery (current US$)	960	1,370	1,349	1,251	1,013
Total farm machinery (1982 US$)	1,401	1,835	1,618	1,308	1,013

Source: David M. Dornbusch and Co., San Francisco, U.S.A.

Table 30. US exports of agricultural machinery with detail on tractors by size (US$ million)

Product groups / years	1978	1979	1980	1981	1982
Tractors					
< 40 HP	15	22	18	14	6
40 HP to 100 HP	87	69	59	79	45
> 100 HP	322	407	498	623	495
used or HP non spec.	119	158	160	184	93
Total tractors	543	656	735	900	639
Other farm machinery	844	1,088	1,295	1,420	1,127
Total farm machinery (current US$)	1,387	1,744	2,030	2,320	1,766
Total farm machinery (1982 US$)	2,024	2,336	2,435	2,426	1,766

Source: David M. Dornbusch and Co., San Francisco, U.S.A.

Table 31. US shipments of agricultural machinery except tractors by product groups
(US$ million)

Product groups / years		1978	1979	1980	1981
Planting, seeding and fertilizing machinery	Current $	522	653	681	770
	1982 $	762	875	817	805
Harrows, rollers, pulverizers and stalk cutters	Current $	462	601	555	524
	1982 $	674	805	666	548
Plows	Current $	204	273	246	234
	1982 $	298	366	295	245
Harvesting machinery	Current $	1,816	2,134	2,207	2,579
	1982 $	2,649	2,859	2,647	2,697
Haying machinery	Current $	534	675	778	715
	1982 $	779	904	933	748
Farm dairy machines and equipment	Current $	109	134	144	160
	1982 $	159	179	173	167
Sprayers and dusters	Current $	198	245	254	249
	1982 $	289	328	305	260
Farm elevators and blowers	Current $	157	173	141	118
	1982 $	229	232	169	123
Cultivators and weeders	Current $	206	276	276	240
	1982 $	301	370	331	251
Crop preparation machines	Current $	356	385	340	312
	1982 $	519	516	408	326
Farm poultry equipment	Current $	159	223	175	145
	1982 $	232	299	210	152
Hog equipment	Current $	95	121	64	42
	1982 $	139	162	77	44
Other barn & barnyard equipment	Current $	252	307	274	257
	1982	368	411	329	269
Farm wagons & other transportation	Current $	248	277	207	199
	1982 $	362	371	248	208
Irrigation systems	Current $	161	234	309	352
	1982 $	235	313	371	368
TOTAL FARM MACHINERY EXCEPT TRACTORS	Current $	5,479	6,711	6,651	6,896
	1982 $	7,994	8,989	7,978	7,211

Source: David M Dornbusch and Co., San Francisco, U.S.A.

Table 32. U.S. imports and exports of agricultural machinery except tractors
(US$ million)

Import Category		1978	1979	1980	1981	1982
Machinery for soil preparation and cultivation	Current $	97	125	132	129	89
	1982 $	142	167	158	135	89
Harvesting machinery	Current $	330	471	467	416	322
	1982 $	481	631	560	435	322
Dairy machinery and other	Current $	63	103	86	95	74
	1982 $	92	138	103	99	74
TOTAL AGRICULTURAL MACHINERY IMPORTS EXCEPT TRACTORS	Current $	490	699	685	640	485
	1982 $	715	936	822	669	485

Export Category		1978	1979	1980	1981	1982
Machinery for soil preparation and cultivation	Current $	210	262	262	299	218
	1982 $	306	351	314	313	218
Harvesting machinery	Current $	497	645	846	909	744
	1982 $	725	864	1,015	951	744
Dairy machinery and other	Current $	138	181	187	212	165
	1982 $	201	242	224	222	165
TOTAL AGRICULTURAL MACHINERY EXPORTS EXCEPT TRACTORS	Current $	845	1,088	1,295	1,420	1,127
	1982 $	1,233	1,457	1,553	1,485	1,127

Source: David M Dornbusch and Co., San Francisco, U.S.A.

Table 33. Sales of major O.E.C.D. manufacturers of agricultural machinery in 1981
(in million US$)

Company	Country of registration of the parent company	Sales (mill. US$)
John Deere	USA	4,665
International Harvester	USA	2,979
Massey-Ferguson (USA)	Canada	2,646
Massey-Ferguson (Canada)	Canada	1,587
Case	USA	1,798
Fiat	Italy	1,174
Ford	USA	1,280
New Holland (Agricultural machinery division of the Sperry Rand Corporation)	USA	1,087
Kubota	Japan	951
Allis-Chalmer	USA	700
K.H.D.	Germany, Fed. Rep.	505
Renault-DMA	France	314
Claas	Germany, Fed. Rep.	309

Source: Louis Berger, S.A.R.L., Paris, France.
a) estimate

Table 34. Employment in the agricultural machinery industry in selected Western European countries
(Numbers of persons employed)

Country / year	Machinery Industry			
	1979	1980	1981	1982
Germany, Fed. Rep.	60,863	57,690	55,738	54,487
France	38,759	35,994	35,562	34,700
U.K.	...	26,100	20,600	19,200
Italy	...	...	...	...
Netherlands	5,000	4,900	4,500	...
Finland	...	5,600	5,400	5,300
Switzerland	...	...	...	3,000
Belgium	...	7,654	7,182	6,404
Sweden	2,703	2,359	2,308	2,200

Source: Louis Berger, S.A.R.L., Paris, France.

Table 35. Production of tractors in the Federal Republic of Germany, 1981-82

(in numbers of units)

Manufacturers	(ranking in 1981)	1982		1981		1982/1981	
		Units	Market share %	Units	Market share %	Units change	% change
1. KHD	(2)	7,836	18.9	7,310	17.8	+ 526	+ 7.2
2. FENDT	(3)	7,813	18.9	7,182	17.5	+ 631	+ 8.8
3. IHC	(1)	7,018	17.0	8,130	19.8	- 1,112	- 13.7
4. J. DEERE	(4)	3,675	8.9	3,055	7.4	+ 620	+ 20.3
5. DAIMLER BENZ	(5)	2,639	6.4	2,781	6.8	- 142	- 5.1
6. MAS. FERGUSSON	(6)	2,743	6.2	2,743	6.7	- 174	- 6.3
7. FIAT	(7)	1,627	3.9	1,418	3.5	+ 209	+ 14.7
8. SAME	(10)	1,026	2.5	882	2.1	+ 144	+ 16.3
9. EICHER	(8)	1,013	2.4	1,327	3.2	- 314	- 23.7
10. RENAULT	(9)	885	2.1	971	2.4	- 86	- 8.9
11. HOLDER	(11)	488	1.2	522	1.3	- 34	- 6.5
12. SCHLOTER	(12)	488	1.1	492	1.2	- 44	- 8.9
13. STEYR	(13)	432	1.0	443	1.1	- 11	- 2.5
14. ZETOR	(15)	423	1.0	342	0.8	+ 81	+ 23.7
15. FORD	(14)	382	0.9	343	0.8	+ 39	+ 11.4
16. LAMBORGHINI	(16)	299	0.7	305	0.7	- 6	- 2.0
17. D. BROWN	(17)	152	0.4	219	0.5	- 67	- 30.6
18. UTB	(18)	60	0.2	97	0.2	- 37	- 38.1
Others		2,595	6.3	2,536	6.2	+ 59	+ 2.3
TOTAL		41,380	100.0	41,098	100.0	+ 282	+ 0.7

Source: Louis Berger, S.A.R.L., Paris, France.

Table 36. Agricultural machinery production in the Federal Republic of Germany, 1979 - 1981
(US$ million, constant 1975 prices)

Product group / year	1979	1980	1981
Machinery for soil cultivation	98.4	78.4	85.5
Planting, seeding and fertilizing machinery	93.4	71.4	72.1
Sprayers and dusters	41.2	32.4	32.9
Irrigation equipment	8.4	6.5	10.8
Harvesting machines	505.5	406.0	444.2
Crop preparation machines	12.4	9.2	8.6
Farm equipment	54.2	38.8	32.4
Other agricultural machinery	102.3	79.5	83.5
Accessories and parts	199.9	163.6	169.5
Handling equipment	62.6	48.6	42.0
Farm wagons	123.7	101.6	96.0
Accessories and parts for transportation and handling equipment	15.8	11.8	11.1
Farm dairy equipment	108.5	91.4	96.3
Total agricultural machinery	1,426.4	1,139.2	1,185.1
Cultivators	32.5	24.6	20.7
Tractors 34 HP	27.1	23.9	11.9
35 HP 50 HP	131.2	65.7	72.2
50 HP	202.9	711.2	724.9
Accessories and parts	236.1	169.8	177.3
Total tractors	1,329.7	995.1	1,007.0
Total production of all machinery	2,756.2	2,134.3	2,102.1

Source: Louis Berger, S.A.R.L., Paris, France.

Table 37. Agricultural machinery production in France, 1979 - 82
(in numbers of units)

Product / year	1979	1980	1981	1982[a/]
Machines for soil cultivation	39,563	32,784	34,434	40,600
Planting, seeding, & fertilizing machinery	78,246	70,584	63,416	56,900
Sprayers and dusters	279,510	290,755	311,169	280,200
Harvesting machines	46,958	43,094	32,612	28,670
Other agricultural machinery	13,539	11,347	10,261	10,000
Vintage machines	291	520	847	1,380
Handling equipment	13,826	13,609	13,090	17,000
Farm wagons	17,771	21,449	18,865	17,000
Cultivators	110,673	84,526	74,590	77,900
Tractors: 34 HP	78	55	30	73
35 - 50 HP	8,714	7,104	5,504	4,206
50 HP	37,658	31,845	32,833	35,821

Source: Louis Berger, S.A.R.L., Paris, France.

a/ Estimate.

Table 38. Sales of agricultural machinery (excluding tractors) and number of enterprises in the U.K., 1979 - 1982
(US$ million, constant 1975 prices)

Product group / year	1979		1980	1981		1982	
	a	b	b	a	b	a	b
Soil preparation and cultivation machinery							
- ploughs		8,215	8,449	11	8,301	11	9,548
- cultivators and hoes	12	19,399	13,483	9	8,805		9,736
- disc harrows	11	4,134	4,100	6	3,199	5	3,518
- drills	14	10,381	10,011	10	5,955	7	9,531
- fertilizing and spreading machines		5,454	8,556	9	5,232		9,748
- plombers, rollers	12	7,313	5,019	7	3,873	7	1,546
- parts	24	29,809	29,287	15	19,483	13	22,208
Harvesting and threshing machinery							
- harvesters			15,750		9,949		6,106
- balers	6	31,127	24,208	5	16,217		8,860
- mowers		9,812	7,739		3,127		3,534
- feed processing silage making		14,181	11,199		7,942		4,944
- others			21,530	18	20,008	14	17,251
- parts	26	19,146	24,180	25	13,316	17	10,153
Farm dairy equipment		28,432	23,927		21,212		20,274
Miscellaneous agricultural machinery			21,657	21	16,224	14	13,013
Elevators and conveyors		11,500	8,308	14	6,563	12	5,242
Other handling equipment						26	24,590
Parts	54	40,383	41,621	33	2,246	35	20,618
Unclassified sales		4,661	4,752		2,652		3,528
Total		243,947	283,776		174,304		203,984

Source: Louis Berger, S.A.R.L., Paris, France.

a) Number of enterprises.
b) Sales in 000US$.

Table 39. Agricultural machinery production in the Netherlands 1978-1981
(US$ million, constant 1975 prices)

Produced groups/year	1978	1979	1980	1981
- Ploughs	2.37	1.65	1.28	1.37
- Harrows, cultivators, hoeing machines and weeding implements	16.77	13.09	13.34	15.15
- Other equipment for cultivation	3.91	2.46	1.64	1.65
- Fertilizer distributors and liquid manure spreaders	21.67	22.13	17.45	19.13
- Equipment for sowing and planting	0.51	0.66	0.44	0.48
- Spraying machines	10.27	6.15	5.14	6.16
- Haying machines	8.66	7.51	6.81	9.11
- Digger harvesters for potatoes and sugar beets	4.24	3.12	2.86	2.38
- Other machinery for threshing and harvesting; balers for straw and raw food	36.79	38.14	36.71	37.50
- Grading machines	24.99	21.00	17.70	20.34
- Other agricultural machines	45.27	55.92	40.47	40.52
- Parts and special equipment	36.14	37.11	28.35	27.44
- Agricultural trailers	8.55	8.21	6.17	...
Total agricultural machinery	220.14	217.18	178.37	181.02

Source: Louis Berger, S.A.R.L., Paris, France

Note: Figures are provisional

Table 40. Agricultural machinery and implements production in European centrally planned economies, 1970 and 1975-1980
(in units)

Tractors

Country / year	1970	1975	1976	1977	1978	1979	1980
Bulgaria	4,405	5,112	5,919	6,258	7,675	5,644	6,767
Czechoslovakia	18,480	29,585	31,458	35,040	33,317	35,370	33,359
Hungary	1,930	551	513	658	400	142	108
Poland	40,998	57,553	58,805	59,078	59,078	54,231	57,445
Romania	29,287	50,003	53,911	65,715	65,715	62,494	70,873
U.S.S.R.	458,525	550,432	562,175	575,113	576,113	557,415	554,916
Total	553,625	693,236	712,781	742,729	742,729	715,296	723,468

Ploughs (tractor-operated)

Country / year	1970	1975	1976	1977	1978	1979	1980
Bulgaria	3,871	3,221	3,624	711	1,166	1,650	2,145
Czechoslovakia	3,238	3,235	1,876	1,365	1,001	1,100	1,212
German Dem. Rep.	4,916	2,552	2,343	2,567	3,432	2,695	2,616
Hungary	2,096	3,073	4,616	2,583	1,590	707	301
Poland	28,099	41,434	38,180	33,349	33,052	34,653	3,0024
Romania	11,414	19,883	23,250	15,677	14,756	9,597	12,818
U.S.S.R.	211,657	205,391	202,321	184,940	216,117	210,851	202,246
Total	265,291	278,789	276,210	251,252	271,114	261,253	251,362

Seeders (tractor-operated)

Country / year	1970	1975	1976	1977	1978	1979	1980
Bulgaria	22,427	21,863	23,201	23,948	22,045	21,125	19,446
Czechoslovakia	5,173	4,955	5,090	5,325	3,547	2,492	4,178
German Dem. Rep.	3,320	3,140	2,902	2,556	2,262	2,334	3,022
Hungary	1,456	1,055	2,526	1,344	989	1,202	960
Poland	3,221	1,030	3,538	6,897	10,721	13,400	13,434
Romania	11,721	25,448	18,620	27,054	23,204	22,436	19,351
U.S.S.R.	163,453	180,015	191,051	196,891	198,781	202,008	201,181
Total	210,771	237,506	246,982	264,015	261,549	264,997	261,572

Note: Seeders and potato transplanters together.

Table 40 (cont'd)

Harvester-combines

Country / year	1970	1975	1976	1977	1978	1979	1980
Poland	2,155	3,591	3,956	4,003	4,301	4,268	4593
Romania	1,179	5,659	5,198	5,365	3,887	3,016	4890
U.S.S.R.	99,247	97,503	101,700	105,510	113,002	14,759	11,7365
Total	102,581	106,753	110,854	114,878	121,190	122,043	126,848

Ensilage combines

Country / year	1970	1975	1976	1977	1978	1979	1980
Bulgaria	20,330	30,000	28,482	31,968	33,770	35,978	35,503
Czechoslovakia	920	1,097	...	...	...	...	...
German Dem. Rep.	4,670	5,772	4,011	4,502	4,425	4,500	4,810
Hungary	1,004	1,073	520	204	-	-	-
Poland	6,000	1,501	-	-	-	610	1,663
Romania	-	45	...	...	...	...	...
U.S.S.R.	34,335	70,895	56,039	56,645	47,985	45,585	46,689
Total	67,259	110,383	89,052	93,319	86,180	86,673	88,665

Source: J. Jelenkowski, Warsaw, Poland.

Table 41. European centrally planned economies: Trade in agricultural machinery by country
(US$ million, constant 1975 prices)

Bulgaria

	1970	1975	1976	1977	1978	1979	1980
Tractors and related machinery							
Exports	138.1	198.0	171.7	177.9	138.0	174.3	181.4
Imports	83.4	191.0	180.9	194.3	167.1	154.3	162.0
Agricultural machinery and equipment							
Exports	119.5	165.8	129.2	147.2	142.9	143.2	153.9
Imports	32.2	121.9	104.4	107.6	96.8	108.1	90.9

Czechoslovakia

	1970	1975	1976	1977	1978	1979	1980
Tractors and related machinery							
Exports	113.0	201.0	277.5	281.7	279.7	272.0	255.7
Imports	187.1	322.0	360.0	369.0	282.0	234.3	226.2
Agricultural machinery and equipment							
Exports	35.6	85.2	113.3	111.9	129.5	122.1	117.1
Imports	120.3	236.7	246.7	235.9	186.5	165.5	152.8

Table 41 (cont'd)

Germany, Democratic Republic

	1970	1975	1976	1977	1978	1979	1980
Tractors and related machinery							
Exports	278.5	479.8	571.9	616.2	562.9	566.3	543.1
Imports	98.0	188.3	208.6	264.6	216.7	217.7	228.2
Agricultural machinery and equipment							
Exports	165.9	460.0	644.2	591.3	547.1	550.8	520.7
Imports	28.8	84.5	84.2	140.2	102.9	101.7	114.1

Hungary

	1970	1975	1976	1977	1978	1979	1980
Tractors and related machinery							
Exports	43.6	134.9	177.9	202.6	184.0	213.2	229.3
Imports	114.1	243.1	305.2	326.2	347.4	300.9	232.3
Agricultural machinery and equipment							
Exports	29.7	122.7	151.5	191.6	178.0	197.7	210.9
Imports	68.3	181.9	213.1	217.9	230.0	209.9	160.0

Table 41 (cont'd)

Poland

	1970	1975	1976	1977	1978	1979	1980
Tractors and related machinery							
Exports	67.8	193.2	216.2	208.2	202.2	187.7	175.2
Imports	130.7	307.5	387.9	412.2	408.0	365.3	334.2
Agricultural machinery and equipment							
Exports	44.1	114.8	135.8	132.2	134.4	125.4	129.4
Imports	54.6	188.4	174.8	190.2	163.4	195.4	164.9

USSR

	1970	1975	1976	1977	1978	1979	1980
Tractors and related machinery							
Exports	158.5	214.1	280.2	340.1	319.5	302.0	268.2

Total imports and exports of agricultural machinery and implements by the centrally planned economies of Eastern Europe, 1975-1980,[a/]
(US$ million, constant 1975 prices)

	1975	1976	1977	1978	1979	1980
Total						
Imports	2,065.3	2,265.7	2,458.1	2,200.7	2,053.2	1,865.7
Exports	2,155.4	2,589.3	2,660.7	2,498.7	2,552.7	2,609.8
Tractors						
Imports	1,251.9	1,442.6	1,566.3	1,421.2	1,272.5	1,183.0
Exports	1,206.9	1,415.2	1,486.6	1,366.8	1,413.5	1,477.8
Agricultural Machinery Other than tractors						
Imports	813.4	823.1	891.8	779.5	780.7	682.7
Exports	948.5	1174.1	1174.1	1131.9	1139.2	1132.0

a/ excluding USSR

Source: J. Jelenkowski, Warsaw, Poland.

Table 42. European centrally planned economies
Cultivated land per tractor, 1970, 1975 and 1977
(in hectares)

Country/Year	1970	1975	1977
Bulgaria	112	92	96
Czechoslovakia	52	49	50
Germany, Dem. Rep.	42	45	46
Hungary	100	109	113
Poland	85	47	40
Romania	140	125	108
USSR	276	235	225

Source: J. Jelenkowski, Warsaw, Poland.

Table 43. European centrally planned economies:
Crop area per complete harvester or harvester thresher, 1970, 1975 and 1977
(in hectares)

Country/Year	1970	1975	1977
Bulgaria	232	219	213
Czechoslovakia	160	137	141
Germany, Dem. Rep.	128	228	368
Hungary	254	215	204
Poland	562	344	277
Romania	130	164	144
USSR	183	180	181

Source: J. Jelenkowski, Warsaw, Poland.

Table 44. European centrally planned economies:
Production of tractors per 10,000 inhabitants, 1970 - 1978
(in numbers)

Country/Year	1970	1975	1977	1978
Bulgaria	4.1	5.6	7.1	8.7
Czechoslovakia	12.9	20.0	23.3	23.3
Hungary	1.9	0.5	0.6	0.4
Poland	12.6	16.9	17.0	17.0
Romania	14.5	23.5	27.4	30.1
USSR	18.2	20.8	21.1	21.2

Source: J. Jelenkowski, Warsaw, Poland.

Table 45. Specific agricultural machinery and equipment produced in centrally planned economies

Bulgaria

(in units)

Items	1970	1975	1976	1977	1978	1979	1980
Cultivators, tractor-drawn	3,204	2,810	1,560	1,286	354	116	120
Fertilizer distributors, tractor-drawn	2,223	2,531	2,636	2,590	1,940	1,094	313
Crushers (pre-cutters) of the feeding for animals	18,059	23,250	24,777	25,997	9,542	2,263	2,434
Water distributors	2,106	900	1,000	533	440	618	597

Czechoslovakia

(in units)

Items	1970	1975	1976	1977	1978	1979	1980
Beet harvesters, tractor-drawn	915	989	900	770	633	721	685
Cultivators	50	75	90	10	-	100	-
Potato planters	-	4,820	4,830	5,275	3,447	2,392	4,128
Seeders		135	260	50	100	100	50
Milking machines	2,055	1,340	1,322	1,439	1,587	1,734	1,942
Pesticides distributors	1,023	200	1,050				

Table 45 (cont'd)

German Democratic Republic

(in units)

Items	1970	1975	1976	1977	1978
Potato harvesters	3,222	5,327	5,000	3,845	2,230
Hay and straw-press	5,743	11,630	9,352	10,200	9,743

Hungary

(in units)

Items	1970	1975	1979	1980
Disc tillers	3,309	3,649	1,620	1,025
Machine pulled and suspended tractor cultivators	700	4,488	9,115	12,307
Harrows	5,737	9,884	10,417	6,550
Mechanized irrigators and pulverizers	1,984	4,046	3,362	3,043
Seed-dressing machines	2,484	1,064	2,050	1,384
Self-propelled chaff-cutter machines	1,004	1,073	-	2
Mechanized shellers	1,862	3	504	-
Mechanized crushing mills	887	29,006	39,568	37,629

Tractors	1970	1975	1980	1981
Production	1,930	551	108	224
Imports	4,855	6,373	4,460	3,120

Table 45 (cont'd)

Poland

(in 000 units)

Items	1970	1975	1978	1980	1981
Ploughs[a/], animal-drawn	50.2	40.4	9.1	15.8	19.1
Cultivators					
tractor-drawn	6.8	15.7	14.2	11.3	12.6
animal-drawn	8.5	5.0	1.4	-	-
Seeders[a/], animal-drawn	29.0	42.0	6.0	7.0	11.2
Mowers					
tractor-drawn	8.0	14.0	9.8	11.0	14.6
animal-drawn	50.7	41.9	18.3	16.1	10.8
Harvesters	7.2	6.0	6.4	6.8	9.7
Threshing machines	9.7	14.1	11.5	12.1	11.4
Complete harvesters	2.2	3.6	4.3	4.6	4.3
Potato-harvesters					
tractor-drawn	11.6	17.9	11.7	18.8	16.9
animal-drawn	48.0	20.0	7.3	7.5	11.6

Romania

(in units)

Items	1970	1975	1976	1977	1978	1979	1980
Cultivators							
tractor-drawn	2,992	800	3,509	4,033	2,603	3,738	3,073

a/ Ploughs, tractor-drawn see Table 40.
Seeders, tractor-drawn see Table 40.

Table 45 (cont'd)

U.S.S.R.
Production data in physical units. (in 000 units)

Items	1970	1975	1976	1977	1978	1979	1980
Paring ploughs, tractor-drawn	38.3	32.6	30.5	33.3	31.8	25.4	27.0
Disc-harrows, tractor-drawn	22.8	32.1	32.1	33.3	29.6	31.9	35.6
Potato-planters, tractor-drawn	18.0	9.1	10.5	11.0	11.5	13.1	13.4
Cultivators, tractor-drawn	219.0	188.0	180.0	187.0	193.0	204.0	218.0
Pesticide distributors	31.2	33.1	37.1	37.4	41.7	45.6	45.9
Harvesters	47.7	92.1	93.6	92.7	95.9	98.1	99.7
Complete harvesters	99.2	97.5	[illegible]	106	113	117	106
Potato harvesters	7.0	9.4	9.9	9.9	9.9	10.0	10.3
Beet harvesters	9.1	17.1	14.4	14.6	14.9	9.5	9.3
Corn harvesters	5.1	10.3	11.2	11.3	10.0	0.7	1.2
Drenchers	5.9	7.6	8.0	8.7	8.8	9.1	9.6
Mowers, tractor-drawn	12.3	27.1	28.4	27.5	26.0	18.0	17.1
Rakes, tractor-drawn	144.0	83.9	89.4	97.2	109	86.2	84.2
Pick-up presses	61.7	46.1	42.5	46.7	48.3	53.1	48.9
Ensilage harvesters	15.8	28.1	30.2	28.7	28.7	31.0	32.0
Multi-purpose loaders	34.4	70.9	56.0	56.7	48.0	46.7	40.8
Crushers (pre-cutters)	78.2	90.1	94.7	96.2	93.2	95.5	95.8
of the feeding for animals	14.2	33.2	35.1	36.6	32.2	27.1	26.7
Self-acting equipment for watering of animals	5,305.0	5,169.0	4,960.0	4,869.0	4,880.0	5,233.0	4,943.0
Milking machines	39.2	53.3	53.1	54.9	53.4	56.7	62.6

Source: J. Jelenkowski, Warsaw, Poland.

Table 46. Production of agricultural machinery and implements in Latin America, various years
(in units)

Items	1962	1967	1970	1976	1980	1982[a/]
1. Tractors[b/] of which	18,567	19,475	28,787	100,951	78,128	50,663
- Argentina	10,981	9,664	10,642	24,098	3,658	3,889
- Brazil	7,586	6,219	14,029	65,279	57,975	32,246
- Mexico		3,592	4,116	11,574	16,496	14,528
2. Agricultural machinery and implements other than tractors[c/]	137,960	212,812	469,328	354,612	217,025	198,000

Sources: 1962-1980 Yearbook of Industrial Statistics-Commodity Production Data, New York, various issues.

a/ 1982: figures for tractors from national sources, for other machinery UNIDO estimates.

b/ Tractors of 10 HP and over, other than industrial and road tractors.

c/ Cultivators, scarifiers, weeders, hoes, etc., harrows, ploughs, seeders, planters and transplanters, combine harvester-threshers, mowers (animal, tractor operated and self propelled), rakes and threshing machines.

Table 47. Latin America: Production of agricultural tractors of more than 10 horsepowers, 1970-1982
(in units)

Year	Totals	Argentina	Brazil	Mexico
1970	28,267	10,642	14,029	4,116
1971	41,895	13,268	23,548	5,079
1972	52,075	14,408	31,438	6,229
1973	68,803	21,460	41,513	5,830
1974	81,119	24,505	49,075	7,539
1975	86,540	18,397	58,061	10,082
1976	100,951	24,098	65,279	11,574
1977	89,816	25,631	53,696	10,489
1978	68,476	5,997	49,474	13,005
1979	82,819a/	10,901	56,418	15,500a/
1980	78,128	3,658	57,975	16,795
1981	62,832	1,378	42,474	18,980
1982	50,663	3,889	32,246	14,528b/

Source: Years 1970-1979: United Nations Yearbook of Industrial Statistics, Vol. II, 1978. Years 1980-1982: Argentina, Ministerio de Economía, Información Económica de la Argentina, No. 126, January-February 1983. Brazil: ANFAVEA, Planejamento Económico o Estadístico, April 1983. Mexico: Secretaría de Programación y Presupuesto, Estadística Industrial Mensual.

a/ Estimates.

b/ From January-October.

Table 48. Latin American imports and exports of agricultural machinery and implements
Share of the region in world trade 1971 and 1975-1981 (US $mill., constant 1975 prices)

SITC Rev. I	Description	1971	1975	1976	1977	1978	1979	1980	1981
7121/2/5/9	Agricultural Machinery and Implements - Total								
	- Imports (US $mill)	444.8	916.2	654.4	690.1	646.8	682.4	871.6	650.1
	Share in world imports (%)	10.2	10.9	7.8	8.9	8.5	8.2	10.2	10.5
	- Exports (US $mill)	14.8	82.0	55.1	94.4	113.5	130.0	145.6	146.4
	Share in world exports (%)	0.4	1.0	0.6	1.2	1.5	1.5	1.8	2.4
7121	Cultivating Machinery								
	- Imports (US $mill)	26.9	51.0	41.6	35.6	39.6	47.3	57.0	48.1
	Share in world imports (%)	8.4	7.2	6.2	5.3	6.0	6.4	7.6	7.1
	- Exports (US $mill)	2.4	11.9	9.0	11.8	9.6	11.7	13.9	10.1
	Share in world exports (%)	0.8	1.7	1.4	1.8	1.5	1.6	1.6	1.5
7122	Harvesting Machinery								
	- Imports (US $mill)	94.8	231.1	125.4	132.2	116.6	116.8	214.1	176.8
	Share in world imports (%)	7.7	8.4	5.1	6.3	5.3	4.8	7.3	9.6
	- Exports (US $mill)	5.6	19.9	18.1	16.3	14.6	12.0	14.4	17.4
	Share in world exports (%)	0.4	0.7	0.7	0.8	0.7	0.5	0.5	1.0
7125	Tractors non-road								
	- Imports (US $mill)	302.6	603.4	442.2	484.7	455.6	467.5	536.4	396.9
	Share in world imports (%)	13.2	13.7	9.9	10.9	9.7	10.9	11.6	11.9
	- Exports (US $mill)	6.1	48.4	26.0	63.5	84.4	104.0	114.6	116.8
	Share in world exports (%)	0.3	1.1	0.3	1.4	1.8	2.4	2.5	3.5
7129	Agricultural Machinery and Appliances NES								
	- Imports (US $mill)	20.5	30.7	45.2	37.6	35.0	55.8	64.1	28.3
	Share in world imports (%)	7.0	8.3	6.7	8.6	7.4	7.7	9.5	7.8
	- Exports (US $mill)	0.7	1.8	2.0	2.8	4.9	2.3	2.7	2.1
	Share in world exports (%)	0.3	0.5	0.5	0.7	1.2	0.5	0.4	0.6

Source: UNSO Trade Tapes

Table 49. ECWA Region: Tractors in use, 1965 - 1980
(in units)

Year / Country	Bahrain	Iran	Iraq	Jordan	Kuwait	Lebanon
1965	-		6,500	3,608	-	1,900
1966	-	16,000	7,700	2,168	-	2,080
1967	-	17,500	8,922	2,808	-	2,176
1968	-	20,000	9,500	3,044	-	2,250
1969	-	21,000	10,400	3,127	-	2,350
1970	-	20,000	10,800	2,758	-	2,500
1971	-	21,500	11,300	2,856	-	2,700
1972	-	23,000	12,000	2,950	-	2,850
1973	-	25,000	18,000	3,200	9	3,000
1974	-	27,000	19,000	3,547	18	3,000
1975	-	29,000	20,222	3,748	14	3,000
1976	-	45,000	21,000	3,914	20	3,000
1977	-	50,000	21,500	4,074	25	3,000
1978	-	55,000	21,800	4,223	30	3,000
1979	-	57,000	22,000	4,370	,32	3,000
1980	-	58,000	22,200	4,520	35	3,000

Year / Country	Oman	Qatar	Saudi Arabia	Syrian Arab Rep.	United Arab Emirates	Yemen Arab Rep.	Yemen Dem. Rep.
1965	-	-	400	7,675	-		660
1966	-	-	313	7,424	-		820
1967	-	-	374	7,204	-		880
1968	-	-	396	8,115	-		-
1969	-	-	451	8,756	-		-
1970	-	-	700	9,031	-		1,050
1971	-	-	750	9,606	-		1,100
1972	-	-	800	10,374	-		1,150
1973	-	-	850	11,574	-	674	1,150
1974	-	-	770	12,864	-	750	1,180
1975	-	-	800	15,303	-	850	1,190
1976	75	-	830	18,567	-	1,500	1,200
1977	84	-	900	20,672	-	1,600	1,200
1978	100	-	1,000	23,329	-	1,800	1,250
1979	92	-	1,100	25,340	-	1,900	1,260
1980	93	-	1,200	27,544	-	2,000	1,260

Source: FAO Production Yearbook, various issues, FAO, Rome.

Table 50. Syria: Agricultural machinery used in cultivation

(in units)

Year	Tractors	Harvesters		Combined Harvester + Threshers		Fixed Threshers	Seeders	Disc Harrow + Pulvizers	Dusters		Sprayers		a) Ploughs
		by animals	tractors	self-powered	by tractors				by motor	by hand	by motor	by hand	
1971	9,606	-	52	1,368	65	531	1,929	1,117	7,455	14,967	1,010	2,099	96,247
1972	10,374	2	49	1,294	86	657	1,660	1,105	6,788	12,095	899	1,787	120,855
1973	11,574	23	77	1,587	122	814	1,656	1,557	7,587	11,815	831	2,761	131,995
1974	12,864	3	92	1,657	87	1,103	1,702	1,782	17,316	12,738	846	2,832	144,100
1975	15,303	-	60	1,607	57	1,367	1,903	2,012	8,706	12,614	1,325	3,031	133,996
1976	18,567	5	59	2,088	58	1,448	2,020	2,486	9,406	13,632	1,337	2,866	137,197
1977	20,672	23	48	2,254	105	1,512	2,087	2,687	11,735	15,085	1,153	3,222	134,611
1978	23,329	4	51	2,106	83	1,966	2,343	3,405	11,681	15,966	824	3,587	132,030
1979	25,340	10	82	2,206	123	2,064	3,137	3,139	12,863	16,545	784	3,717	133,526
1980	27,544	28	85	2,244	114	2,301	3,483	3,628	14,806	19,053	1,081	3,788	134,950

Source: The Annual Agricultural Statistical Abstract 1980, Syria.

a) The modern ploughs represent about 26% of total.

Table 51. Developing Africa's imports of agricultural machinery, 1973 -1979
(US$ thousands, constant 1975 prices)

Year	Group	Handtools[a/]	Tractors[b/]	Others[c/]	Total
1973	All developing Africa	19,413	192,016	104,800	316,385
	of which:				
	Sub-Saharan countries	15,120	125,201	48,880	190,201
	LDCs	4,692	34,607	19,146	58,445
1974	All developing Africa	23,007	261,167	118,074	402,247
	of which:				
	Sub-Saharan countries	18,747	148,723	58,053	225,523
	LDCs	5,969	41,992	22,049	70,010
1975	All developing Africa	28,934	366,026	166,723	561,583
	of which:				
	Sub-Saharan countries	25,644	224,632	83,983	334,259
	LDCs	10,113	50,354	32,026	92,493
1976	All developing Africa	27,185	332,392	128,073	487,950
	of which:				
	Sub-Saharan countries	24,269	224,065	70,271	318,605
	LDCs	8,589	39,505	25,049	73,142
1977	All developing Africa	29,989	381,020	144,257	555,175
	of which:				
	Sub-Saharan countries	24,924	255,856	92,387	373,167
	LDCs	8,689	43,201	25,897	77,786
1978	All developing Africa	31,789	384,832	160,611	587,228
	of which:				
	Sub-Saharan countries	27,891	203,741	101,981	333,613
	LDCs	11,151	34,650	31,084	76,874
1979	All developing Africa	22,170	202,401	133,533	358,006
	of which:				
	Sub-Saharan countries	17,580	118,166	69,966	205,620
	LDCs	5,632	41,459	30,539	77,630

Source: UNSO Trade Tapes.

a/ SITC 695.1. Rev.1
b/ SITC 712.5. Rev.1
c/ SITC 712 less 7,2,5. Rev.1.

Table 52. Developing Africa's imports of agricultural machinery[a/] by subregions, 1973 to 1979

(US$ thousands, constant 1975 prices)

Year	World trade[b/]	Developing Africa's imports: Total thousands of dollars	Developing Africa's imports: As share of world trade[b/] (%)	Sub-Saharan African imports as share of African imports: Total	Sub-Saharan African imports as share of African imports: (%)	Africa LDC's imports as share of African imports: Total	Africa LDC's imports as share of African imports: (%)
1973	5.870,130	296,874	5.1	175,081	37.2	53,753	11.4
1974	6.893,708	379,240	5.5	206,776	32.9	64,041	10.2
1975	7.979,778	523,749	6.7	308,615	34.4	82,380	9.2
1976	7.626,415	460,466	6.0	294,336	44.7	64,553	9.8
1977	7.635,850	525,277	6.9	348,243	50.1	69,097	9.9
1978	7.319,312	555,443	7.6	305,722	42.5	65,723	9.1
1979	8.193,012	335,934	4.1	188,031	41.9	71,998	16.0

Source: United Nations Statistical Office; Yearbook of International Trade Statistics, various editions, United Nations, New York.

a/ SITC 712. Rev.1.

b/ Trade in agricultural machinery between market economy countries.

Table 53. Africa's sources of imported agricultural machinery, a/ 1979
(000 US $, 1979 prices)

Importers / Subregion/ country	Exporters: Western Europe b/	United States and Canada	Other developed countries	CMEA c/	Developing countries d/	Africa developing countries	South Africa	Other	World
North Africa	200 595	14 195	5 361	11 833	2 603	352	-	1 230	236 172
of which:									
Algeria	32 772	3 247	1 485	3 340	763	283	-	-	41 891
Egypt	10 144	1 441	360	6 948	163	-	-	10	19 069
Sudan	14 028	5 689	37	285	1 654	18	-	-	21 713
West Africa	56 337	24 632	10 763	740	3 963	705	-	1 087	97 731
of which:									
Ivory Coast	14 647	10 939	2 623	-	569	63	-	1 087	29 931
Mali	2 663	188	17	-	-	16	-	1 087	2 885
Nigeria	19 009	6 263	2 900	-	982	2	-	-	29 158
Senegal	2 781	750	34	-	51	-	-	-	3 618
Togo	1 357	166	4	-	-	5	-	-	1 534
Central Africa	18 757	17 304	632	104	91	931	-	329	38 150
of which:									
Burundi	465	239	-	-	-	1	-	-	706
United Republic of Cameroon	11 789	9 316	348	93	91	597	-	329	22 566
Zaire	3 456	778	140	-	-	2	-	-	4 377
East and Southern Africa	74 047	19 019	10 366	5 744	3 195	893	1 780	-	115 040
of which:									
Ethiopia	7 868	382	1 885	5 658	102	-	-	-	15 897
Kenya	15 340	1 540	2 686	-	688	-	-	-	20 257
Madagascar	6 049	2 517	590	85	62	105	-	-	9 411
United Republic of Tanzania	12 684	2 537	2 767	-	689	11	-	-	18 690
Zambia	6 531	760	132	-	-	468	-	-	7 892
Total Sub-Saharan Africa	163 170	66 645	21 800	6 374	8 905	2 549	1 780	1 417	272 645
All developing Africa	349 737	75 151	27 124	17 922	9 855	2 882	1 780	2 647	487 104
Africa LDCs	66 174	16 623	6 535	6 184	3 974	1 182	1 720	-	104 397
Total Africa	442 634	122 484	38 138	17 922	22 004	2 882	1 780	2 647	650 496
Total World	6 343 628	3 567 153	765 [illegible]	930 990	228 679	4 522	10 708	28 200	11 879 868

Source: UNSO Trade Tapes.

a/ Data excludes handtools, i.e. SITC 712 only.
b/ EEC plus EFTA countries.
c/ European CMEA countries only.
d/ Excluding Africa.

Table 54. Africa's tractors imports[a/] 1976-79
(in numbers and thousands US$ at 1975 constant prices)

	1976		1977		1978		1979	
	Number	Value US$	Number	Value US$	Number	Value US$	Number	Value US$
Algeria	450	4,776	2,565	19,297	5,400	36,678	1,300	8,581
Angola	830	7,143	840	6,897	850	549	770	5,517
Benin	60	667	75	647	60	564	60	524
Botswana	...	...	170	1,466	170	1,371	185	1,401
Burundi	15	83	33	172	175	844	75	330
Cameroun	1,300	12,697	1,800	16,566	2,000	16,856	2,050	16,552
Cape Verde	2	19	1	9	6	65	3	34
Cent.Afr.Rep.	6	63	12	110	12	102	90	757
Chad	45	476	47	474	47	436	46	414
Congo	65	876	110	1,377	85	977	90	966
Egypt	1,849	11,604	3,498	26,935	6,000	40,967	2,850	12,352
Ethiopia	380	3,696	534	4,750	210	1,032	670	4,419
Gabon	500	7,315	500	6,446	535	6,165	350	3,772
Gambia	26	145	45	289	46	263	47	262
Ghana	890	11,886	1,000	12,714	760	8,271	1,000	10,345
Guinea Bissau	30	279	15	105	15	113	16	117
Ivory Coast	7,209	35,051	1,683	47,118	1,150	17,157	630	8,881
Kenya	1,341	11,440	2,801	24,165	2,830	26,374	885	9,683
Lesotho	100	1,007	130	1,121	120	955	122	931
Liberia	90	2,503	169	2,791	140	1,522	168	1,724
Libya	2,291	15,917	2,737	18,560	5,643	34,916	4,700	27,586
Madagascar	186	2,151	135	1,415	329	2,477	285	2,069
Malawi	432	3,182	248	1,297	380	3,261	580	4,793
Mali	20	184	195	1,693	220	1,654	190	1,379
Mauritania	100	472	363	1,561	280	1,128	320	1,284
Mauritius	145	2,366	132	1,352	165	1,504	182	1,586
Morocco	2,317	18,139	3,163	19,591	2,543	15,480	2,524	14,739
Mozambique	111	669	150	862	215	1,128	240	1,241
Niger	1,000	4,175	780	3,017	800	3,008	760	2,897
Nigeria	4,397	74,316	4,431	71,372	4,200	60,157	4,250	57,241
Reunion	150	1,434	145	1,260	140	1,102	150	1,124
Rwanda	19	181	19	172	20	168	27	217
Sao Tomè	6	29	6	28	6	26	6	26
Senegal	290	3,333	380	6,943	236	5,114	180	3,241
Seychelles	...	...	10	33	10	27	7	23
Sierra Leone	219	335	50	195	85	451	105	552
Somalia	155	1,457	590	5,114	290	2,295	320	2,414
South Africa	15,585	113,812	13,567	94,741	13,966	94,344	8,012	71,468
Sudan	2,813	15,394	985	3,151	1,033	4,112	1,150	4,828
Swaziland	70	696	100	862	140	1,054	220	1,595
Tanzania	491	4,305	383	3,453	560	4,887	700	5,517
Togo	480	4,883	355	3,314	450	3,759	480	3,793
Tunisia	2,453	15,215	1,895	12,234	1,781	11,205	1,437	9,488
Uganda	635	3,903	650	3,707	642	3,383	530	2,759
Upper Volta	130	1,905	143	3,083	150	2,256	200	2,787
Zaire	568	7,100	281	4,184	330	4,511	375	4,828
Zambia	811	3,833	692	3,803	860	4,398	900	4,483
Zimbabwe	...		702	5,172	543	3,637	741	4,925
Total Africa[a/]	51,062	411,094	49,315	445,613	56,628	438,538	40,978	326,446
Total World	763,414	3,963,720	833,754	4,031,760	824,544	3,926,165	850,846	3,935,861
of which:								
Africa[b/c/]	28,524	254,367	28,528	302,226	29,986	264,189	24,266	210,212
Latin America	41,443	470,394	45,297	461,997	50,862	471,907	51,973	388,583
Near East[b/c/]	61,655	407,848	58,546	342,924	50,322	271,756	24,781	138,330
Far East[b/c/]	36,765	197,158	37,810	214,296	43,708	210,044	39,902	194,981

Source: FAO Trade Yearbook, 34, 1980; FAO, Rome.

a/ Total imports including intra-Africa trade.

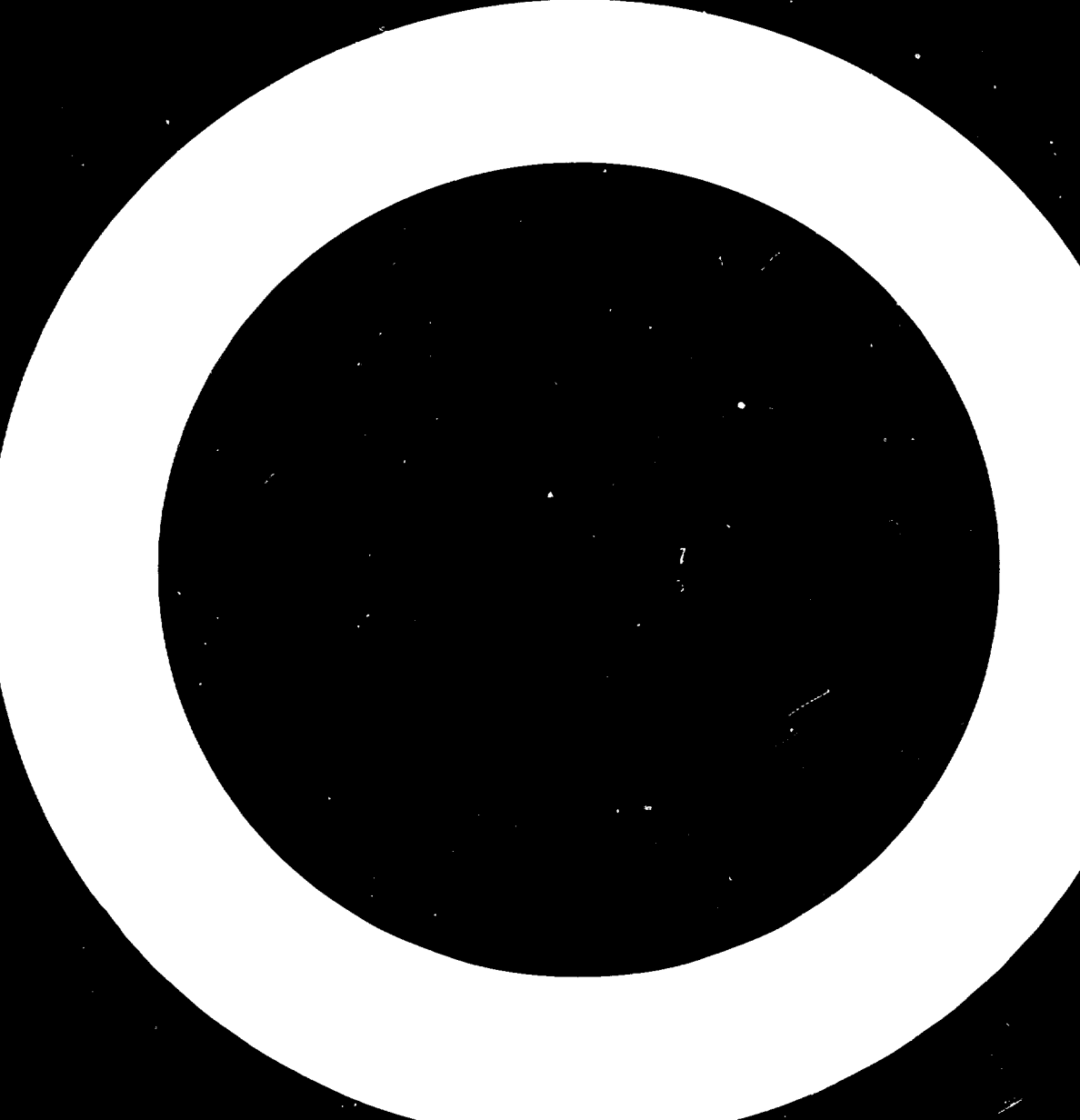
b/ Market economy developing countries only.

c/ Excluding intra-regional trade.

STATISTICAL COMPENDIUM

Section C

Selected data relevant to the agricultural machinery industry of the developing countries



SECTION C

Selected Data of the Developing Countries

Year: 1980

Country	Total land area Km^2	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Afghanistan	647,500	16,347	77	8,050	4.0	0.49	92	N.A.	790	10,190	1.9	Manual and animal drawn implements farming	Some hand tools and animal-drawn implements and pumps
Algeria	2.381,740	19.590	49	7.509	12.2	0.38	1,081	6.1 <5 69%	43,693	172	3.6	Holding within the self-managing are quite mechanized	Tractors and other implements all manufactured locally
Angola	1,246,700	7,262	57	3,500	17.2	0.48	381	N.A.	10,300	340	3.3	N.A.	N.A.
Argentina	2.766,890	27,369	13	35,200	10.1	1.29	2.622	<5 82%	166,700	211	26.3	0.3HP/HA. Most of land is well mechanized with tractor and combines	Tractors are produced - 10,000 unit per year. 180 factories manufacture all implements
Bahamas	13,940	248	N.A.	16	5.6	0.06	2,500	N.A.	72	222	N.A.	N.A.	N.A.
Bangladesh	144,000	90,693	84	9,145	0.2	0.10	142	0.62 <4 98%	4,100	2,230	0.36	Mainly animale drawn implements farming except irrigation and rice procession use machine	All tractors implements and animal-drawn implements are locally made

a/ Figures refer to 1970

b/ The data on average size of holding are the most recent available, generally from 1970 - 1977.

Table (Cont'd)

Country	Total land area Km2	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Benin	112 620	3,640	46	1,795	3.1	0.49	157	N.A.	105	17.095	2.4	Mainly hand tools farming	Not existing
Bhutan	47.000	1,325	93	93	3.6	0.07	70 b/	N.A.	N.A.	N.A.	0.2	Traditional farming	Not existing
Botswana	600,370	832	79	1,360	72.2	1,63	819	4.5 <4 66%	2,150	633	4.5	Drawn animals are mainly used	Nearly all implements are imported
Burundi	27,830	4,348	83	1,305	0.64	0.30	122	N.A.	50	26,100	0.8	Manual and animal drawn implements farming	Some of hand tools can be made
Bolivia	1,098,580	5,720	49	3,250	19.2	0.57	504	<5 59%	750	4,333	3.6	Agriculture has traditionally been produced	Not existing
Brazil	8,511 970	125,220	37	61,950	6.8	0.49	1,347	5.8 <5 63%	330,000	188	1.6	0.3HP/HA. Most of land is well mechanized with tractor and combines	Most of agricultura machines including tractors - 5,000 unit/year are manufactured
Burma	676,550	36,166	51	9,573	1.9	0.26	110	4.1 <4 59%	9,273	1,032	1.3	Farms use hand-tools and animal-drawn implements. Sugar cane farmers use tractor for cultivation	Nearly all of the tractors and implements are locally made

b/ 1977

Table (Cont'd)

Country	Total land area Km2	Total population 1000	Agricultural population in % of total populat	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Cameroon	475,440	8,650	80	6.930	5.5	0.80	461	<4 94%	500	13,860	2.2	N.A.	Hand tools can be made
Central Africa	622,980	2,349	87	1,945	26,5	0.83	190	<5 97%	155	12,548	1.8	Mainly hand tools animal-drawn implements are not popularized	Not existing
Chad	1,284,000	4,547	83	3. 5,150	28,2	0.69	129	<5 89%	160	19,687	2.2	Mainly hand tools animal-drawn implements are beginning to be used	Not existing
China	9.596.960	1,007,750	59	99,200	1.0	0.10	380 b/	1.0	740,000	134	0.4	Some state farms are highly mechanized. Most communes use power machinery for cultivating, but animal-drawn implements still existed. Power machine cultivated area 42% (in 1979)	There are a lot of factories which make all kinds of agricultural machinery. They produced tractors: 126,000 units and walking tractors: 316,000 units in 1979

b/ 1977

Table (Cont'd)

Country	Total land area Km²	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Chile	756,950	11,294	18	5,530	6.7	0.49	1,397	7.1 <5 66%	34,600	160	8.2	Small or medium sized tractors are most commonly used	Hand-tools and animal implements can be produced
Colombia	1.138.910	26,355	27	5.650	4.3	0.21	633	<5 51%	28,423	199	2.7	60-70% land is well mechanized with tractors and combines 0.3HP/HA	Category I, II are manufactured. Tractors are not manufactured due to market limit
Comoros	2,170	369	63	91	0.59	0.25	202	N.A.	N.A.	N.A.	1.1	N.A.	N.A.
Congo	342.000	1,578	33	669	21.7	0.42	538	1.4 <2 84%	670	999	3.7	Hand-tools are used	Hand-tools are produced
Costa Rica	50.700	2.266	34	490	2.2	0.22	1.080	<5 49%	5,950	82	1.9	Plantation are mechanized. Small farms use hand tools and animal-drawn implement	Mainly produce hand tools
Cuba	114.520	9,791	25	3,200	1.2	0.33	800 b/	<5 86%	68.300	47	4.6	N.A.	N.A.
Cyprus	9.250	623	34	432	1.5	0.69	1,971	N.A.	10.800	40	4.7	N.A.	N.A.
Dominican Republic	48.730	6,095	57	1,230	0.8	0.20	775	<5 77%	3.150	390	1.4	N.A.	N.A.

b/ 1977

Table (Cont'd)

Country	Total land area Km^2	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
East Timor	14.930	772	58	80	1.9	0.10	130 b/	N.A.	114	702	0.6	N.A.	N.A.
Ecuador	283.560	8,275	44	2,620	3,4	0.32	702	11 <5 74%	5,750	456	2.3	Most farmers use manual and animal drawn implements	All machines are imported except hand tools which are locally made
Egypt	1.001.450	43,101	50	2,855	2.3	0.07	493	0.9 <2.1 94%	25,000	114	0.5	30% of work is mechanized, small farms use animal drawn implements	Tractors assembling 20,000 unit/year. Other implements are manufactured
El Salvador	21,040	4,938	50	725	0.43	0.15	365	<5 86%	3,300	220	1.0	High power input for large scale cotton and sugar cane farms. Hand labour and animal drawn implements for small farms	Not existing
Equatorial Guinea	28,050	372	74	230	7.5	0.62	109	N.A.	98	2.347	2.9	N.A.	N.A.

b/ 1977

Table (Cont'd)

Country	Total land area Km2	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Ethiopia	1.221.900	32,158	79	13,880	3.8	0.43	108	1.5	3.950	3,514	1.4	Except state farm (2% area) using machinery, all farms use animal-drawn implement for cultivation and manual harvesting	90% hand tools and some animal-drawn implements can be produced
Fiji	18.270	641	39	148	2.9	0.23	1,314	7.3 4.4 55%	1,560	95	1.8	Most farmers use manual and animal-drawn implements, only 5,000 farms of sugar cane own tractors	Not existing
Gabon	267,670	555	76	452	48.2	0.81	4,037	N.A.	1,250	362	2.3	Hand tools are mainly used	Not existing
Gambia	11,300	619	78	270	1.8	0.44	423	N.A.	75	3,600	1.2	Mainly hand tools some use animal-drawn implements	Hand tools made locally
Ghana	238,540	12,063	50	2.760	2.0	0.23	356	3.2 <4. 86%	3,500	789	1.3	Mainly hand-tools and animal-drawn implements are used but mechanized land preparation is widespread	Two firms are assembling (FMD) tractors. One firm produces hand-tools and animal-drawn implements

Table (Cont'd)

Country	Total land area Km²	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Guatemala	108,890	7,481	54	1,834	1.5	0.25	658	<4 78%	4,000	459	1.5	Plantations are mechanized; small farms use hand tools and animal-drawn implements	Mainly produced hand tools
Guinea	245,860	5 147	80	1,570	4.8	0.31	262	N.A.	140	11.214	2.9	Most farms use hand tools and animal-drawn implements are not popularized	Firms producing hand tools are existing
Guinea Bissau	36.120	583	82	285	6.2	0.49	191	<5 87%	25	11.400	2.0	N.A.	N.A.
Guyana	214.970	903	21	380	23.8	0.42	498	N.A.	3,460	110	6.1	Rice cultivation is highly mechanized. Hand-tools are used for other	Not existing
Haiti	27,750	5 954	66	890	0.47	0.15	147	<4 95%	520	1,712	0.5	Mainly hand tools and animal implement are used	Hand tools are locally made
Honduras	111.209	3.822	62	1,757	2.9	0.46	385	<4 60%	3.250	541	2.6	Plantations are mechanized; small farms use hand tools and animal-drawn implements	Mainly produced hand tools

Table (Cont'd)

Country	Total land area Km^2	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
India	3,287,590	697,974	62	169,130	0.47	0.24	154	2.6 <2 62%	418,116	405	1.0	Most medium farms use power machinery for cultivating. Small farms (<3Ha) are still using animal-drawn implements. Total draft power is 0.36 HP/HA of cultivated land	There are 3000 factories making all kinds of agricultural machinery and implements, of which 11 tractor firms manufactured 60,000 units in 1979
Indonesia	1,904,350	150,520	58	19,500	1.3	0.13	267	1.14 <5 98%	13,000	1,500	0.7	The mechanization has been low level, the farms still use hand tool and animal-drawn implements	Some hundred tractors are assembled and other implements are manufactured
Iran	1,648.000	39,320	38	15,950	4.2	0.41	952	7 <5 35%	58,000	275	3.9	Most of the area are mechanized	Local assembly of tractors, power tiller and implements
Iraq	434,920	13.527	40	5.450	3.2	0.40	1,462	9.6 <5 41%	22,200	246	4.2	Most of the area are mechanized	Local assembly of tractors (2 firms 20,000 units/year) and manufacture of agricultural implements

Table (Cont'd)

Country	Total land area Km²	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Ivory Coast	322.460	8.298	79	3,880	3.9	0.47	663	<5 64%	3.100	1.252	1.2	N.A.	Not existing
Jamaica	10.990	2,220	20	265	0.5	0.12	1,028	<4 89%	2.800	95	1.7	N.A.	N.A.
Jordan	97,740	3.364	25	1.380	2.9	0.41	625	<5 64%	4,520	305	6.9	Machinery farming 32%, manual and animal-drawn implements for others	Small workshop made threshers, trailers disc harrows and deep-well components
Kampuchea DM	181.040	6 828	74	3,046	2.7	0.45	90 b/	N.A.	1.350	2,256	1.6	Hand tools and animal-drawn implements are used	Hand tools can be made
Kenya	582,650	17,148	77	2,275	3.4	0.13	250	<4 83%	6.750	377	0.5	Large farms and plantations are well mechanized. Most farms use animal-drawn implements	8 factories are making animal-drawn implements and implements for tractors
Korea, DPR	120,540	18.317	45	2,240	0.7	0.12	450 b/	N.A.	30,000	75	0.6	Most farms use tractors	A few firms manufacture small farm machinery, most implements and tractors are manufactured

b/ 1977

Table (Cont'd)

Country	Total land area Km^2	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Korea, Rep.	98.480	39,110	37	2,196	0.3	0.06	761	0.87 <3 99%	2,664	824	0.4	Mainly power tillers (122,079 units in 1976) for farming. Total machine power is 0.9 HP per HA	Local manufacture of tractors with some imported parts. All other machines are completely locally made
Kuwait	17.820	1,426	2	1	1.3	0.001	12,563	N.A.	35	29	0.2	N.A.	N.A.
Lao	236.800	3.811	73	880	6.2	0.23	85 b/	N.A.	464	1,897	0.7	Hand tools and animal-drawn implements are used	Hand tools can be made
Lebanon	10.400	2.685	9	348	0.39	0.13	779 c/	N.A.	3,000	116	5.1	Mainly power machinery farming. Hand tools and animal-drawn implements are used	Animal-drawn implements and hand tools are locally made
Lesotho	30.350	1.374	83	292	2.2	0.21	321	2 <4 91%	640	456	0.5	Mainly animal-drawn implements. Only 15% land area cultivated by machinery	Not existing
Liberia	111.370	2 038	69	371	5.5	0.18	428	N.A.	300	1.237	0.7	N.A.	Hand tools can be produced

Table (Cont'd)

Country	Total land area Km^2	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Libya	1,759 540	3,098	15	2,080	56,8	0.67	5,799	26 <5 33%	14,000	149	17.8	Agriculture is coming close to being completely mechanized	A joint venture company is to assemble and later part manufacture the tractors
Madagascar	587.040	8,982	83	3,000	6.5	0.33	231	N.A.	2.650	1.132	0.8	Few state farm with machinery farming most farms use animal-drawn implements	Some of hand tool and animal-drawn implements can be produced
Malawi	118 480	6,369	83	2,320	1.9	0.36	140	1.5	1,200	1.933	0.7	Most farms use hand tools; some farms use animal-drawn implements	Hand tools and some animal-drawn implements can be made locally
Malaysia	329 750	14.415	47	4,310	2.3	0.30	1,004	2.0 <4 90%	8.050	535	1.9	Tree crops make up 82% of agricultural land it is mechanized. In the rice growing area 60 to 90% of farms are mechanized	A few firms manufacture small-farm machinery and tractor assembly
Mali	1.240.000	7.136	86	2.050	17.4	0.29	83	4.4 <4 63%	700	2.929	0.6	Manual and animal drawn implements farming	Hand tools and some animal-drawn implements can be made

Table (Cont'd)

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Mauritania	1.030,700	1.681	82	195	61.3	0.12	277	N.A.	290	672	0.5	N.A.	N.A.
Mauritius	1,860	976	28	107	0.2	0.11	861	N. A.	325	329	1.1	Agriculture (main crop sugar cane) is highly mechanized. Hand tools are used for other	Part of hand tools are locally made
Mexico	1.972.550	71.814	35	23,330	2,8	0.32	1,458	<5 51%	120.000	194	3.2	Except 30% small farms all land is well mechanized with tractors	Most agricultural machines are manufactured. Tractor production 10,000 units per year
Mongolia	1.565 000	1.716	48	1,182	91.2	0.69	750 b/	N.A.	9,700	122	3.9	N.A.	N.A.
Morocco	446.550	20.971	51	7,719	2.1	0.37	561	5.8 <5 66%	24.500	315	2.8	Mainly manual and animal-drawn implement farming. Machinery 11%	Some hand tools and animal-drawn implements can be produced. For tractor 50% assembly and 50% imported
Mozambique	801.590	10.757	63	3,080	7.5	0.29	294	<5 97%	5,750	536	1.2	N.A.	N.A.
Nepal	140,800	14,617	92	2,330	1.0	0.16	121	1.3 <3 83%	520	4,481	0.4	Manual and animal drawn implements farming	A factory produces implements and tools

Table (Con'd)

Country	Total land area Km2	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Nicaragua	130.000	2,824	42	1,516	4.6	0.54	494	3.5 32%	2,200	689	4.4	Plantations are mechanized; small farms use hand tools and animal-drawn implement	Mainly produce hand tools
Niger	1 267.000	5,479	87	3,350	23.1	0.61	208	6 <5 56%	180	18.611	2.3	Mainly manual farming	Not existing
Nigeria	923.770	79,680	52	30,385	1.16	0.38	685	<4 90% without state farms	8,600	3,533	2.0	N.A.	Animal implements are manufactured. tractors are assembled locally
Oman	212 460	919	61	41	23.1	0.04	2,400 b	N.A.	93	N.A.	0.3	N.A.	N.A.
Panama	77 080	1,970	34	574	3.9	0.29	1.202	<4 48%	4,000	144	2.6	N.A.	N.A.
Pakistan	803 940	89,416	53	20,320	0.9	0.23	231	5.2 <5 68%	46,000	442	1.6	Large and medium size farms own tractors (60% of farms)	Tractor assembly, other machines and implements are produced
Papua New Guinea	461 690	3,241	82	366	14.2	0.11	505	N.A.	1,350	271	0.3	Mainly hand tools farming	Not existing

b/ 1977. later data not available

Table (Cont'd)

Country	Total land area Km²	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Paraguay	406,750	3.269	49	1,920	12,4	0.59	808	<5 46%	3,200	600	3.9	N.A.	Hand tools can be produced
Peru	1.285,220	18,119	37	3,400	7.1	0.19	907	<4 72%	13,900	245	1.8	Large farms mechanized; small farms use animal-drawn implements	No tractor manufacturing. Animal-drawn implements are produced
Philippines	300,000	50.525	45	9,920	0.59	0.20	419	3.6 <5 85%	17,000	584	1.3	Animals are widely employed on farms	1,200 tractors/year are assembled. Some firms produce animal-drawn and other implements. Total 60 firms
Qatar	11.000	248	N.A.	2	4.4	0.01	9,000 b/	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Rwanda	26 340	4,950	89	975	0.53	0.20	150	N.A.	84	11,607	0.4	Mainly manual farming	Some of hand tools can be made
Samoa	2,860	158	N.A.	122	1.8	0.77	320	N.A.	30	4,067	N.A.	N.A.	N.A.
Sao Tome	960	86	N.A.	36	1.1	0.42	450	N.A.	123	293	N.A.	N.A.	N.A.

b/ 1977

Country	Total land area Km2	Total population 1000	Agricultural population in % of total populat.	Total arable land area 1000 HA	Specific land area per person HA	Specific arable land area per person HA	National income per capita US $ a/	Average size of holding HA	Total No. of tractors	Arable area per tractor HA	Arable land/agricultural labor force	Level of agricultural mechanization	Agricultural machinery industry
Saudi Arabia	2.149 690	9.319	60	1.105	23.1	0.12	6.657	6.7 <5 77%	1.200	921	0.8	Most of small holding (50%) use traditional tools and implements. The Government farm machinery hire service provides farm equipments	No manufacture of agricultural machines and implements
Senegal	196 190	5.811	74	5,225	3.4	0.90	302	<4 70%	460	11,359	3.0	Mainly hand tool and animal drawn implements	Animal drawn implements are manufactured under licence
Sierra Leone	71.740	3.571	64	1.766	2.0	0.49	212	<4 90%	317	5.571	2.1	Hand tools and animal drawn implements	Not existing
Singapore	580	2.420	2	8	0.024	0.003	3.502	N.A.	44	182	0.4	N.A.	Tractors are assembly locally

Table (Cont'd)

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Solomon Is.	28.450	237	N.A.	52	12.0	0.22	300 b/	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Somalia	637.660	4 895	80	1,066	13.0	0.22	157	<5 97%	1.650	646	0.8	Some commercial farms are mechanized, small farms are traditional	Some of hand tools can be made
Sri Lanka	65.610	15.109	53	2.147	0,43	0.14	353	1.6 <4 95%	24,263	88	0.8	Most farms use animal-drawn implements. Only large farms use tractors	Animal drawn implements and tractor implements are made locally
Surinam	163 270	397	17	52	41.3	0.13	1.592	<5 74%	1.400	37	3.1	N.A.	N.A.
Sudan	2.505.810	18.901	76	12,417	13.3	0.66	379	4.1 60%	11.000	1,129	2.8	Some project are power mechanized. Seed bed preparation and wheat harvesting is mainly mechanized	Tractors are assembled (PKD). (610 units in 1975). Other implements are also made locally
Swaziland	17 360	574	72	204	3.02	0.36	932	3 <5 .8%	2.650	77	1.1	Mainly animal-drawn implements are used.	Small scale production of small tractors
Syria	185 180	9.331	47	5 684	1.98	0.61	869	N.A.	27.544	206	5.2	Half of cultivated area is mechanized	Tractors are assembled locally. (25-35 units per day)

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Tanzania	945.090	18.510	80	5 160	5.1	0.28	186	N.A.	18,600	277	0.9	90% of small farms use hand-tools and animal-drawn implement	Hand-tool are locally made
Thailand	514.000	48.125	75	17,970	1.1	0.37	438	5.2 <5 60%	37.000	486	1.1	Sugar cane plants use power machinery, most small farmers use animal-drawn implements	Local assembly of tractors with mostly locally made components(3,000 units per year) other implements are produced
Togo	56 790	2.705	67	1,420	2.1	0.52	229	<5 94%	200	7,100	1.9	N.A.	Hand tools can be made locally
Trinidad and Tobago	5,130	1.185	16	158	0.4	0.13	2,944	5.9 <5 46%	2.350	67	2.2	N.A.	N.A.
Tunisia	163.610	6 513	40	4,700	2.5	0.72	952	N.A.	34.000	138	7.6	N.A.	Tractors are assembled locally. A factory produced implements and tools
Turkey	780.580	46 375	53	28,479	1.7	0.61	1.052	5.5 <5 73%	435.281	65	2.8	Except 15% of small farms all land is well mechanized with tractors	Most agricultural machines are manufactured. Tractor produced 40,000 units per year

Table (Cont'd)

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U.A. Emirates	83 600	762	N.A.	13	11.0	0.017	11.000 b/	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Uganda	236.040	13.620	80	5 680	1.7	0.42	230	<4 72%	2,180	2,606	1.3	Manual and animal-drawn implement farming	Hand-tools and some animal-drawn implement can be produced
Upper Volta	274.200	7.094	81	2,563	3.9	0.36	90	N.A.	68	37.691	0.9	N.A.	N.A.
Uruguay	176 220	2.945	12	1.910	6.0	0.65	1.519	N.A.	28.200	68	14.3	N.A.	Hand-tools and animal drawn implement can be made
Venezuela	912.050	16.156	17	3.755	5,7	0.23	2,027	<5 43%	38.000	99	4.4	N.A.	Tractors and other implement manufactury all locally
Vietnam	329,560	54,968	70	6.055	0.6	0.11	160	1.3 <5 95%	24.500	247	0.4	Mainly animal-drawn implements for farming	Animal-drawn implements and hand tools are manufactured
West Sahara	266.000	N.A.	N.A.	2	N.A.	N.A.	900	N.A.	11	182	N.A.	N.A.	N.A.
Yemen Arab R	195.000	5,940	75	2.790	3.3	0.47	230	N.A.	2 000	1,395	2.3	Manual and animal drawn implements farming	Some hand tools and implements can be produced

Table (Cont'd)

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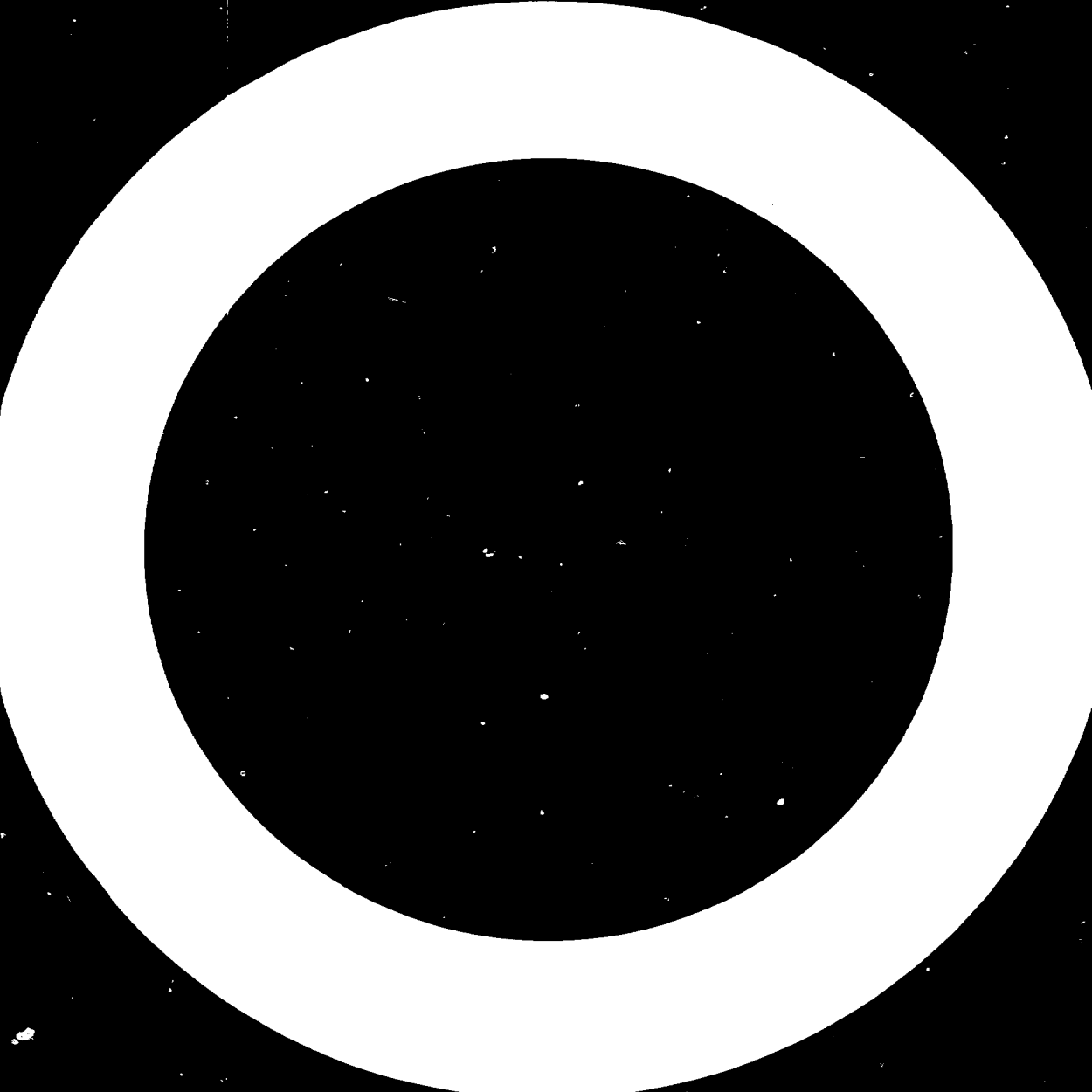
Yemen Demo.	332 970	1.906	58	207	17.5	0.11	200 b/	N.A.	1,260	164	0.7	Mainly manual and animal-drawn implements farming	Hand tools can be produced
Zaire	2.345.410	29 104	74	6,314	8.1	0.22	94	2.3 (1.5 64%)	1.900	3,323	0.7	Hand-tools and animal-drawn implements mainly used. State farms are mechanized	There are firms to assemble tractors and manufacture hand tools
Zambia	752.610	5 961	66	5 108	12.6	0.96	434	3.7 90%	4,600	1.110	3.7	90% crop-land use hand method, 10% crop land use tractors	Just started manufacturing hand-tools and animal-drawn implements
Zimbabwe	390 580	7.656	58	2 521	5.1	0.33	395	N.A.	20.200	125	1.8	N.A.	N.A.

Source: 1) 1981 FAO Production Yearbook Vol. 32
2) The world in figures (1976) - Editorial information compiled by the Economist and 1870 World Census of Agriculture. Analysis and Internal and Comparison of the results FAO
3) UNIDO data base

Note: The percentages hown in item "Average size of holding" represent the percentage of holdings with less than or more than indicated number of hectares of the total number of holdings.



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The Agricultural Machinery Industry: An appraisal of the current global situation production and market outlook, Statistical Compendium

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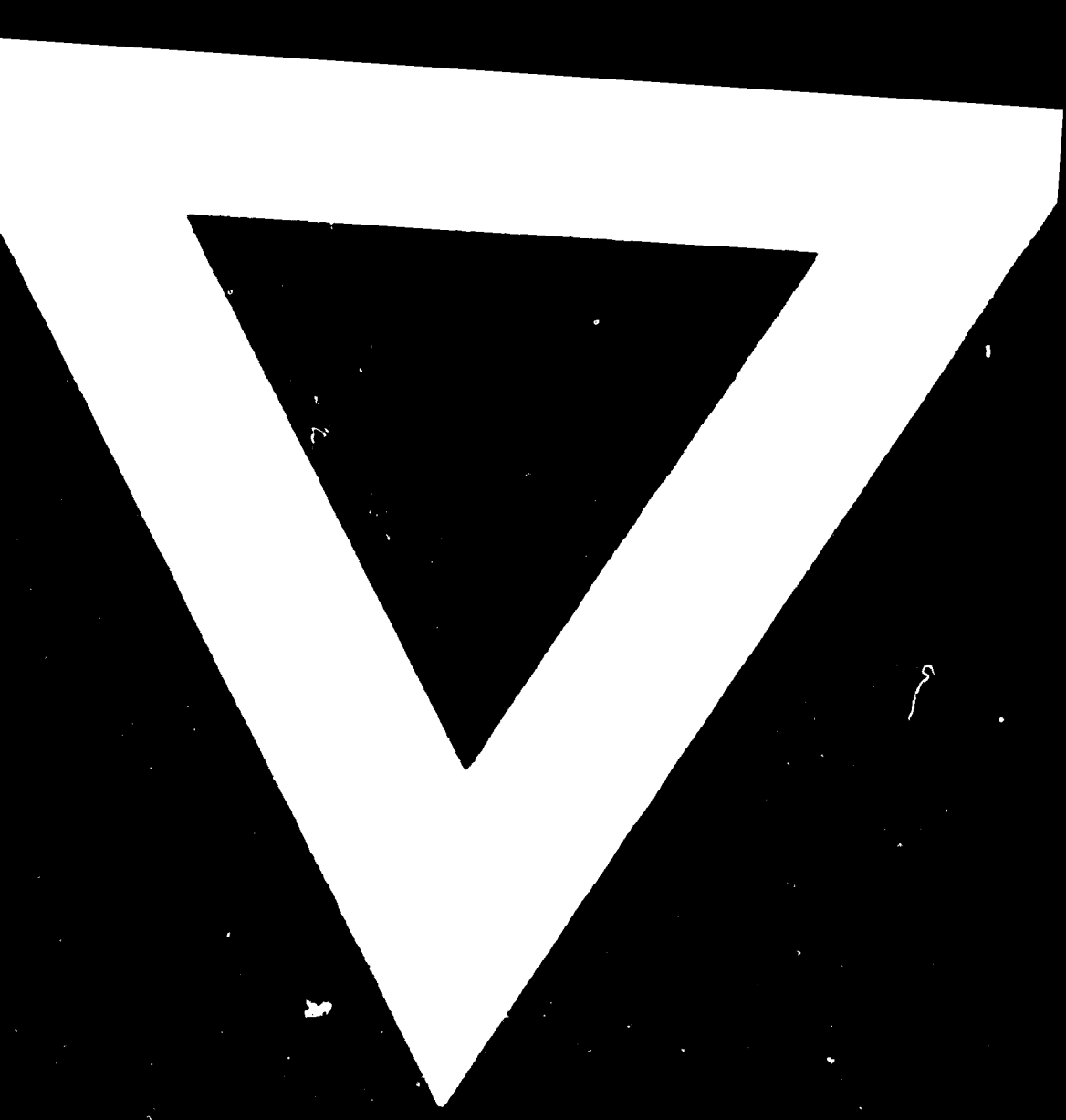

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