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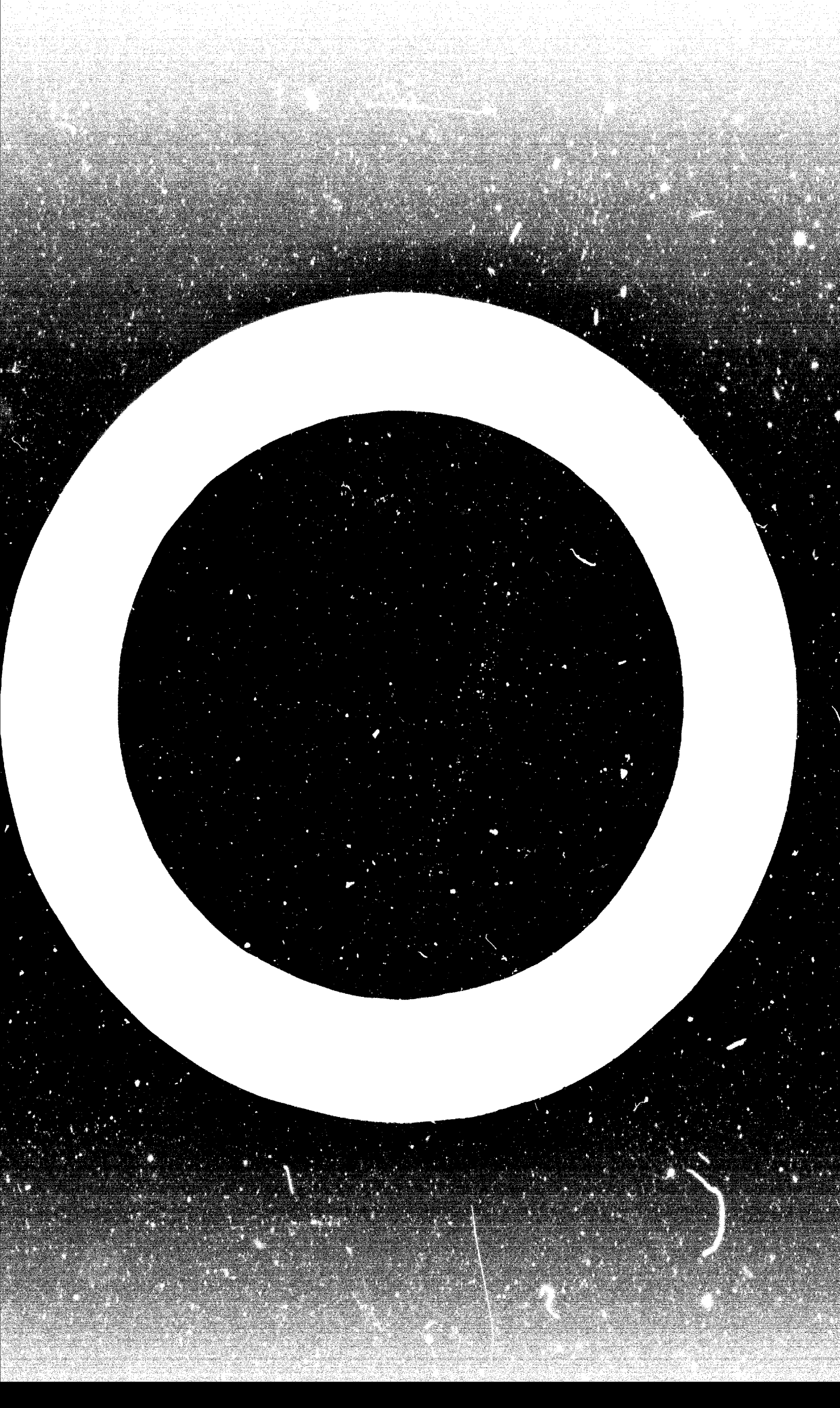
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REPORT OF THE UNITED NATIONS ECAFE/AIDC-UNIDO FACT-FINDING
TEAM ON INDUSTRIES MANUFACTURING AGRICULTURAL MACHINERY ^{1/}

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ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

ASIAN INDUSTRIAL DEVELOPMENT COUNCIL

Fifth session
15-21 January 1970
Bangkok, Thailand

REPORT OF THE UNITED NATIONS ECAFE/AIDC-UNIDO FACT-FINDING
TEAM ON INDUSTRIES MANUFACTURING AGRICULTURAL MACHINERY

The views expressed in this report are those of the Team and do not necessarily reflect those of the Council or of the ECAFE secretariat.

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LETTER OF TRANSMITTAL

24 February 1969

Dear Sir,

We have the honour to present to you the report of the United Nations ECAFE, AIDC-UNIDO Fact-Finding Team on Industries Manufacturing Agricultural Machinery.

This report is composed of two parts - part I presenting the recommendations and the summary and part II comprising the general findings. The annex consists of selected individual country statistics for each of the countries visited.

The Team visited thirteen countries of this region including Japan from 3 November 1968 to 18 January 1969 for purposes of observation. While in these countries, the Team collected the necessary information and also met the parties concerned - private and government - to ascertain their interest in the establishment and enhancement of manufacturing plants for agricultural machinery. The Team was greatly assisted by the counterparts designated by their respective Governments, who prepared in advance country reports and programmes of activities.

The Team wishes to express its deep appreciation to the officials of the Governments concerned and especially to the counterparts, to the officials of UNDP and other United Nations specialized agencies, and to the various


/representatives

The Executive Secretary
Economic Commission for Asia and the Far East
Bangkok, Thailand



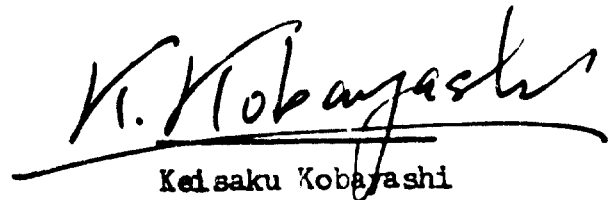
representatives of manufacturing firms. The Team is also grateful to the ECAFE secretariat for its assistance.

Yours truly,


~~Robert Viteau~~
Team Leader



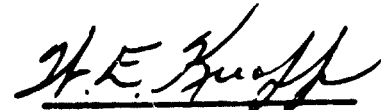
Swamy Rao A.A.
Member-Secretary



Keisaku Kobayashi
Member



Hector L. Fajardo
ECAFE Representative



William E. Knapp
UNIDO Adviser



I. INTRODUCTION.

As directed during the third session of the Asian Industrial Development Council, a Fact-Finding Team on Industries Manufacturing Agricultural Machinery was constituted to visit interested countries in the ECAFE region with the following terms of reference:

1. To gather information and consult private and government authorities in order to ascertain the depth of their interest in erecting/expanding manufacturing plants for agricultural machinery;
2. If the Team found it justified, to send afterwards a detailed survey mission; to set up the terms of reference on probable projects that could be considered for establishment preferably by means of the pooling of country resources.

The Fact-Finding Team consisted of three experts contributed by the governments of India, Italy and Japan and a representative each from ECAFE and UNIDO. The members of the Team were as follows:

- (i) Mr. Robert Vitou (Team Leader)
Chief Engineer
Product Development and Experimental Dept.
Somaca Division
FFSA (FIAT FRANCE)
(Expert contributed by the Government of Italy)
- (ii) Mr. Swamyate N.A. (Member-Secretary)
Marketing Manager
International Tractor Co. of India Ltd.
Bombay 67 (3B), India
(Expert contributed by the Government of India)
- (iii) Mr. Keisaku Kobayashi (Member)
Deputy Chief
General Plan & Control Dept.
Iseki Agricultural Mfg. Co.
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/(iv)

- (iv) Mr. Hector L. Lagarde (ECAFE representative)
Associate Economic Affairs Officer
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UN ECAFE, Bangkok
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- (v) Mr. Wilhelm E. Knapp (UNIDU representative)
Adviser
UNIDU, Vienna
Austria

The team visited thirteen countries of the region including Japan from 3 November 1968 to 18 January 1969, for purposes of observation. The developing countries visited were China (Taiwan), the Republic of Korea, the Philippines, Indonesia, Singapore, Malaysia, Ceylon, Thailand, Iran, Pakistan (East and West), India and Nepal. While in these countries, the team collected the necessary information and also met the parties concerned - private and government - to ascertain their interest in the establishment and enhancement of manufacturing plants for agricultural machinery. The team found a deep interest in farm mechanization in those countries where the governments were giving priority to agriculture and where efforts were being rewarded with increased agricultural production. Such increased production would lead to self-sufficiency within the near future. Owing to the introduction of improved varieties of seed, multicropping, irrigation, fertilizers, pesticides, and generally improved farm techniques, these countries had made a significant start in the use of farm machinery and a number of them were actively developing their facilities to manufacture farm machinery.

Some interest in regional co-operation in research and manufacture of farm machinery was shown. Although the terms of reference of the team emphasized the field of manufacture of farm machinery, it was felt that additional studies should be undertaken in other aspects of farm mechanization, namely field application, research and extension. The team therefore included recommendations relating to such aspects.

/RECOMMENDATIONS

PART I

RECOMMENDATIONS

As an outcome of its findings during the visits to the twelve developing ECAFE countries, the Fact-Finding Team presented the following recommendations:

1. The sending of pre-investment survey missions to investigate the feasibility of manufacturing the following types of farm machinery in the countries mentioned:
 - (a) Four-wheel riding tractors - Ceylon, India, Iran, Malaysia, Pakistan, the Philippines and Thailand.
 - (b) Power tillers (hand tractors) - Ceylon, India, Indonesia, Malaysia, Pakistan, the Philippines, Singapore and Thailand.
 - (c) Small engines - (through specialized teams)
 - (i) 1-2 hp gasoline-fed engines - a plant at Singapore to supply the regional requirements
 - (ii) 3-5 hp gasoline-fed engines - Indonesia
 - (iii) 3-15 hp diesel-fed engines - Ceylon, Indonesia, Malaysia, the Philippines, Singapore and Thailand
2. The organization of technical study teams for the following purposes:
 - (a) riding paddy tractors - to introduce such equipment in interested rice-growing countries.
 - (b) Improved power paddy threshers - to investigate the existing types of power paddy threshers in countries such as Ceylon, China (Taiwan), India, Japan, the Philippines and Thailand and to recommend an appropriate design suited to the needs of the region.

/(c)

- (c) Power wheat threshers - To investigate existing models of threshers in countries such as India, Iran, Nepal and Pakistan, and to recommend an appropriate design suited for the region.
- (d) Bullock-drawn implements and hand tools - To investigate their development in the countries of the region and to recommend measures for the manufacture and wider use of suitable implements and hand tools.

3. The provision of technical assistance on the following areas:

- (a) Pumps - Assistance to be rendered to the pump manufacturers in the interested countries of the region so as to improve their production techniques particularly in foundry practices.
- (b) Paddy propeller pumps - The Governments of the Philippines and Thailand to consider providing expert assistance to the interested countries of the region in the design and manufacture of paddy propeller pumps.
- (c) Sprayers and dusters - To assist interested countries in the region in the selection and standardization of appropriate types of sprayers and dusters intended for manufacture.
- (d) Power-operated and simple power threshers - To co-ordinate the national small-scale industries of interested countries of the region in the manufacture and spread of such machinery.
- (e) Hand tools and bullock-drawn implements - To render assistance to the Government of Nepal in evolving an improved method for the construction of hand tools and bullock-drawn implements taking into consideration the possibilities for the Governments of Ceylon and India to provide the experts.

/(f)

- (f) Supporting industries - A foundry specialist to visit interested countries of the region and advise the parties concerned regarding the adoption of better techniques for producing castings for agricultural purposes.
- (g) Technical training programmes - To devise training programmes to improve the skills of mechanics and service personnel engaged in the repair and maintenance of farm machinery.

4. Miscellaneous:

- (a) The convening of a seminar to discuss problems on paddy tillage and the desirability of producing riding paddy tractors specially designed to suit the conditions in Asian countries.
- (b) The organization of an Asian fair to demonstrate farm machinery for paddy; the first to start preferably in 1971 or 1972. The fair should be participated in by leading manufacturers of farm equipment so as to create an interest in farm mechanization of rice in Asia and to promote the creation/improvement of machinery best suited to the needs of the region.
- (c) The organization of a meeting of representatives from interested countries for purposes of investigating, developing and promoting the use of an improved design of thresher in India, Iran, Nepal and Pakistan.
- (d) The creation of a regional organization - a development agency for farm mechanization in Asia.

A. SUMMARY OF FINDINGS

Four-wheel riding tractors

1. The level of consumption of tractors in Ceylon, India, Iran, Malaysia, Pakistan, the Philippines and Thailand appeared to justify their manufacture in those countries. In 1968 the total number of tractors in the countries visited was around 176,300. The total sales for the same year were around 33,000, of which tractors within the range of 35-45 hp were highest. It was expected that in 1970, the annual sales as compared to 1968 would increase by 70 per cent and in 1975 by 250 per cent. In 1968 the number of tractors manufactured was 22,000 of which about 12,000 were manufactured in India under a progressive scheme for substituting imported tractors with locally-made ones. Another 6,700 were assembled but with limited local parts in India, Iran, Pakistan, and Thailand. The rest were assembled in Ceylon, the Philippines and Thailand from parts which were almost totally imported in the form of CKD components. Manufacturing machinery was being installed to produce 30,000 tractors by 1970 and 74,500 by 1975. The number of assembled units estimated for 1970 was around 15,000.
2. It was estimated that the output of tractor manufacturing plants which would be installed and/or expanded in the near future would not be able to cope with the projected consumption requirements by 1975. A regional production deficiency therefore would justify the economic manufacture of tractors of various sizes. For tractors within the 35-50 hp range, the collective demand was expected to be around 32,000 of which India and Pakistan would both absorb about 80 per cent. The manufacturing capacities of both countries for 1970 in the given range of tractor sizes were expected to be approximately adequate. For tractors within the 55-65 hp range, the collective demand was expected to be around 15,000 of which 13,600 represented the combined demand in India, Iran, the Philippines, and Thailand. In Iran, there was a plan to install a tractor manufacturing plant with an annual installed capacity of about 4,000 units.

3. It was proposed to send a survey mission to study the feasibility of manufacturing tractors in Ceylon, India, Iran, Pakistan, the Philippines and Thailand. The proposed mission would study in detail the level of tractor manufacture in the countries mentioned, the availability of ancillary and supporting industries and the possibilities of establishing or expanding plants for tractor manufacture with a view to regional co-operation.

Power tillers (hand tractors)

4. Power tillers were found to have already been introduced in nearly all the rice-producing countries visited. However, they were not able to replace the work of animal and farm labour in the agriculturally oriented countries because only a short period of time had elapsed since their introduction and the majority of the farmers were still unable to afford them. Still, there was a growing acceptance of the dependability of power tillers in certain regions of the countries visited where crop productions were high and multi-cropping was practised. In quite a few cases, the owners of power tillers by engaging in contract cultivation of other agricultural lands, earned additional incomes larger even than the net proceeds from the outputs of their farm holdings.

5. In 1968, the total population of power tillers in the twelve countries visited was reported to be around 70,000. The total consumption was around 21,500. The annual demand was expected to increase to 38,000 by 1970 and to around 100,000 by 1975. Out of an installed combined annual capacity of 20,600, about 14,000 power tillers were manufactured with various amounts of local parts in Ceylon, China (Taiwan), India, Iran, and the Republic of Korea. In most of those countries, a substantial proportion of the components were made locally, except the engines and transmissions or their main parts which were still imported, principally from Japan. Plans were underway in the countries visited to increase by 1970 the combined annual installed capacity to about 34,000.

6. It was expected that the aggregate annual demand for power tillers in the countries visited would increase by about 65 per cent in 1970, as compared to 1968. The number of manufacturing plants available by that time would be adequate for producing approximately 90 per cent of the aggregate demand. Because of the increasing demand for power tillers however, it was necessary to expand the manufacturing plants available. Furthermore, it appeared that there would be a bigger market in the future should a less expensive, more rugged and simpler power tiller be developed and mass-produced for the needs of developing ECAFE countries where agricultural conditions especially in rice producing areas were nearly identical.

7. It was proposed to send a pre-investment survey mission to countries such as Ceylon, India, Indonesia, Malaysia, Pakistan, the Philippines and Thailand to study the feasibility of manufacturing power tillers and attachments with a high degree of local components and to promote regional co-operation particularly in the specialization of manufacturing vital power tiller components.

Small riding paddy tractor

8. In many rice-producing countries, the need was expressed for a small compact and economical riding paddy tractor with a suitable matching wetland tillage system, preferably with a rotary tiller, in the 20 hp range. The production of such a tractor, if it could be offered at a lower price than that ones normally available, would greatly increase the demand for such tractors especially for wetland cultivation. With the interests expressed by the parties in the rice-growing countries for such a type of tractor, it would be necessary to investigate the possibilities of manufacturing such a paddy tractor.

9. A study team composed of leading experts from industry and representatives from UNIDO and AIDC/ECAFE was suggested for visiting interested ECAFE countries. The team would study the existing pattern of wetland cultivation

/taking into

taking into account the use of both animal and mechanical power and the design and performance capabilities of existing models of small tractors and also of power tillers. The team would also gather all technical information necessary to establish the design parameter for a small riding paddy tractor. A study of the market would also have to be undertaken to determine the demand for and price of the paddy tractor after considering the scope of regional co-operation available in production and marketing.

Small engines for agricultural use

10. Manufacturing plants to produce small engines were found in China (Taiwan), India, Indonesia, Iran, Pakistan and the Republic of Korea. The production of small engines of various types (including the engines for tractors and power tillers) in the twelve ECARE countries visited was about 277,000 in 1968, of which India produced about 90 per cent. Small engines for agricultural purposes, being composed of various sizes and makes, needed to be categorized, however, according to the purpose of their specialized manufacture, as follows:

- (a) 1-2 hp, gasoline-fed micro-engines - for knapsack sprayers and dusters. In India where such engines were manufactured, the production in 1968 was around 18,000 from a plant having an installed capacity of around 36,000. The demand for 1970 of such engines in the twelve ECARE developing countries visited was estimated to be 90,000 and it would likely increase two-fold by 1975. It was therefore necessary to explore the possibilities of setting up a mass producing manufacturing plant to supply at a competitive price, all the requirements of the countries within the far-eastern sub-region. At the same time, India should find ways of utilizing more of its installed unused manufacturing capacity.

/(b)

- (b) 3-5 hp, gasoline-fed engine - for light agricultural applications. The aggregate production in 1968 was around 24,000. The increasing demand for 1970 was estimated to be about 80,000 and for 1975 about 160,000. These estimates took into consideration the competition from diesel engines for similar agricultural applications. To overcome demand, it seemed necessary to explore the possibilities of setting up a new plant in the Far East, preferably in Indonesia, where the purchase price of gasoline was comparatively low and where the future demand for small gasoline-fed engines was increasing rapidly.
- (c) 3-15 hp, diesel engines - for power tillers and stationary agricultural applications. In 1968, the combined production of such a category of small engines from plants in China (Taiwan), India, Iran, South Korea and Pakistan was around 140,000. The demand was increasing rapidly and would reach an estimated annual volume of 330,000 by 1970, in pace with the increasing demand for power tillers and pumps. In plants located in China (Taiwan), India, Iran, South Korea and Pakistan, the respective productions would have to be increased in steps with the proportionate demands. Steps would have to be undertaken by countries such as Ceylon, Indonesia, Malaysia, the Philippines and Thailand to manufacture such engines.
- (d) 12-30 hp, diesel-fed engines - for medium-duty agricultural applications. Except in India and Pakistan, the demand for such engines, mostly of the horizontal type, was relatively small. With the increasing rural electrification, the need for such engines was decreasing, except for irrigation purposes and deep well installations at places where electricity was not economical. There were manufacturing plants for such engines

/in Iran,

in Iran, South Korea, and Pakistan although the quality of production needed to be further improved.

- (e) 30-75 hp diesel engines - for riding tractors. In 1968, about 18,000 such engines were manufactured in India. It was estimated that the collective annual demand for 1970 of the twelve ECAFE countries visited would be 57,000.

11. A pre-investment survey mission composed of specialized teams was suggested to ascertain the demand for engines in interested ECAFE countries, to undertake feasibility studies and explore the possibilities for regional co-operation. The specialized teams would consider the feasibility of establishing a plant in the far eastern sub-region, preferably in Indonesia, for producing 3-5 hp gasoline-fed engines, a plant in Singapore preferably to produce 1-2 hp gasoline-fed engines, and individual plants in Ceylon, Indonesia, Malaysia, the Philippines, Singapore and Thailand for producing 3-15 hp diesel-fed engines. It was further proposed that AIDC provide technical assistance to engine manufacturers in China (Taiwan), Indonesia, Pakistan, South Korea, and other countries offering such assistance, especially if 12-30 hp diesel stationary engines were being produced.

Power-operated pumps

12. Centrifugal pumps were the ones widely used for agriculture in the twelve ECAFE countries visited. Propeller paddy pumps which were employed to transfer water between low head areas, such as between irrigation canals and paddy fields, were used mostly in the Philippines and Thailand. Deepwell water pumps were used quite extensively in India, Iran, Nepal and West Pakistan. The total demand for 1970 of all types of pumps in the countries visited was estimated to be 440,000. All the countries were nearly able to produce their respective requirements of conventional pumps for agricultural purposes. The technology requirements for the manufacture of such pumps were relatively simple, although, however, there was a need to improve the manufacturing

/techniques,

techniques, particularly in foundry practices. The aggregate production of power-operated pumps which was estimated to be around 375,000 in 1968 needed to be rapidly increased to cope with the demand which was roughly estimated to be about 750,000 by 1975.

Plant protection equipment - sprayers and dusters

13. In all the countries visited, there was a growing awareness of the need to protect crops from pests and other forms of plant diseases. Hand-operated sprayers were already used substantially while power-operated knapsack dusters and sprayers were still in the introductory stages. The estimated demand for 1970 of hand-operated sprayers and dusters was 330,000 while the production for 1968 was around 240,000. In the case of power-operated knapsack sprayers and dusters, the aggregate production for 1968 was around 27,000 whereas the estimated demand for 1970 was 80,000. Hand-operated knapsack sprayers being relatively simple to manufacture at low cost could be manufactured in every country. However, small 1-2 hp gasoline-fed engines for knapsack sprayers needed to be procured initially as their manufacture to be economical would have to be done on a large scale. Countries such as Indonesia, Iran, Malaysia, the Philippines and Thailand on account of the increasing national demands would be justified in going ahead with the full scale manufacture of power knapsack sprayers, excluding initially the small engines that would have to be imported together perhaps with the nozzles. It was proposed that a technical team be sent to interested countries to assist the parties concerned in the manufacture of standardized models of sprayers and dusters proven to be reliable and economical in use.

Paddy threshers

14. Almost all the paddy produced, in all the countries of the region, was threshed in the traditional way except in China (Taiwan) and the Republic of Korea. Mechanical threshing was becoming more important because of the exigencies of multi-cropping, of increases in crop production, and of new

/varieties of

varieties of paddy which could not easily be threshed according to existing techniques. The different types of mechanical threshers were: (a) the pedal-operated simple thresher, which only threshed; (b) the power-operated simple thresher, which threshed only with a prime mover; (c) the power thresher/winnower with hand feeding, which threshed, winnowed and sieved; and (d) the automatic power thresher, which fed, threshed, winnowed, sieved and performed *chaff* re-feeding. The simple thresher was the type that was popularly used and the power thresher/winnower had apparently just been introduced.

15. The demand estimated for 1970 of pedal-operated paddy threshers of the simple type was about 60,000. The total production in 1968 was around 30,000. Pedal threshers could easily be produced in all ECAFE countries since they were simple to manufacture and the amount of investment necessary was small. The demand estimated for 1970 of power-operated paddy threshers of the simple type was about 50,000 and for 1975 about 150,000. In none of the countries was there found an organized effort to produce an efficient type of power paddy thresher. However, appreciable efforts were being made to design and evolve improved models. Efforts were being made in the Philippines by the International Rice Research Institute and in Thailand by the Engineering Division of the Rice Department. In countries such as Ceylon, Indonesia, Nepal, Pakistan and Thailand, assistance should be provided to local industries in the design of threshers and in the manufacture of improved threshers.

16. In collaboration with the national small-scale industries or their equivalents in interested countries, ECAFE/AIDC should co-ordinate the introduction and eventual manufacture of paddy threshers. It was further recommended that a technical study team be formed consisting of technical representatives preferably from Ceylon, China (Taiwan), India, Japan, Pakistan, the Philippines, Thailand and interested organizations, to investigate the existing new designs and models of power paddy threshers, to co-ordinate their testing in different countries, and to recommend a proven design for manufacture.

/Power wheat

Power wheat threshers

17. With the introduction of high-yielding varieties of wheat and multi-cropping patterns, the demand for power wheat threshers in wheat-producing countries such as India, Iran, and Pakistan was expected to go up. The demand for 1970 of power wheat threshers was estimated to be about 26,000. The production in 1968 was only 11,000. In many major wheat-producing countries, combine harvesters mainly the self-propelled combines were widely used although their introduction in Asian countries such as Iran and (West) Pakistan was only recent. Until recently, in India, no significant attempts to introduce them had been made. The local designs of wheat threshers found in the Asian wheat-producing countries needed considerable maintenance improvements. However, the ones introduced and manufactured in West Pakistan appeared to be the best suited for the requirements of the region. Hence, it was proposed that technical representatives from India, Iran, Nepal and Pakistan be appointed to develop a suitable power wheat thresher for the region. It was also recommended that the technical team meet in Pakistan where there existed models of improved threshers.

Hand tools and bullock-drawn implements

18. There was a need to improve the technique of manufacture of hand tools and bullock-drawn implements as well as their design and quality. No country seemed to have given much attention to their manufacture. Besides the drawbacks in the implements, the low capability of bullocks to produce adequate draft power had hindered production. Other factors were the diversity of models of tools and implements in use within the region, the current dearth of quality manufacture in small shops and above all, the difficulty of making available quality implements at economical prices. State-run plants in Ceylon and Nepal were producing hand tools and bullock-drawn implements at outputs below the rated manufacturing capacities. To increase production, the market in these two countries needed to be expanded to nearby countries and the products needed

/to be

to be broadened. Since emphasis was apparently given to the production of simple tillage implements only, attempts should be made in all the countries visited to diversify the production so that other much-needed bullock-drawn seed drills, fertilizer distributors, mowers and reapers, and improved rubber-tired bullock carts might be included. With that in view, it was proposed that a technical study team be constituted to undertake in collaboration with the national small-scale bodies of different countries, investigations regarding the development and manufacture of bullock-drawn implements and hand tools. Furthermore, ECARL/AIDC and UNIA in collaboration possibly with the governments of Ceylon and India should render technical assistance to the Government of Nepal in evolving new product models for Nepal's implement factory, taking into account the future market trends and export possibilities.

Tractor and power tiller implements

19. Small-scale producers or tractor/power tiller manufacturers and assemblers themselves fabricate the matching basic implements in accordance with the original specifications. Although accepted and widely used in the countries visited, the implements manufactured need to be improved both as regards their material composition and the techniques of manufacture. Disc ploughs, mould board ploughs, tillers, seeding and fertilizer distributor, crop protection equipment, and in particular, specialized components such as tines, discs, bearings, shares, mouldboards and bar points needed to be manufactured with regional collaboration in mind. The Government of countries deficient in specialized farm implements should import appropriate amounts for purposes of farm demonstration and extension work. Thereafter suitable types should be selected and their local manufacture promoted or enhanced.

Rice processing machinery

20. The introduction of new high-yielding varieties of rice pointed to the need for improved machinery and techniques for rice processing. Improved drying, hulling, milling, storage, and transport facilities should be adopted to avoid the substantial losses resulting from the traditional harvesting

/methods.

methods. Technical solutions were available, but a judicious choice should be made of the size and type of equipment to be promoted, considering all the factors involved such as location, facilities, etc. It was felt that medium-sized (2-3 ton/hour) rice mills may be more economical for private contractors or co-operatives. As the existing farm marketing practices in most of the countries were in terms of paddy rather than brown rice, farmer-owned small rice hullers might be used only for limited contract work. Moreover, they were expensive. Big rice mills (4-6 ton/hr) would be economical only in areas where the means of communication made them accessible to wider areas. With that in view, it was recommended that ECAFE/AIDC and UNIDO, with the possible co-operation of the Asian Development Bank should organize a technical survey team to investigate exhaustively the conditions of rice processing in the interested countries and such factors as drying, storage, handling and transport and to recommend the appropriate rice processing equipment to be adopted.

Automotive, tractor ancillary and supporting industries

21. A number of the components of tractors, power tillers and agricultural engines were similar to those for automobiles. The manufacture of these components to be economical had to be done on a large scale. India now had plants to produce certain components enough for its domestic needs and perhaps, for other countries within the region as well. The expansion or the establishment of factories for casting, forging, etc. should be encouraged in countries deficient in these supporting industries. Moreover, foundry techniques needed to be improved. Many countries had no facilities for malleable casting and a few had only limited capacities for forging and heat treatment. The physical and chemical laboratories of foundries and forging shops would have to be improved as regards facilities and inspection techniques streamlined. With that in view, it was recommended that ECAFE/AIDC and UNIDO send a pre-investment survey team to the interested and to propose a suitable manufacturing programme for important ancillary components. Furthermore, a foundry specialist should be sent to the interested countries of the ECAFE region to study suitable foundry

/techniques

techniques applicable to the production of casting for farm machinery and to give needed advice.

Service and training

22. Despite the efforts of the government authorities concerned and of the dealers and manufacturers of farm machinery, facilities for the repair and maintenance of agricultural equipment in the countries visited were very poor. The equipment used was sometimes outmoded and unsuited, and insufficient. Management and workshops needed improvement. Experienced and well-trained mechanics and technicians were scarce. Farmers and operators themselves lacked experience and training to run agricultural machines efficiently and to maintain them properly. Moreover, farmers and mechanics themselves found difficulty in obtaining in time reasonably-priced spare parts. Those factors resulted in making the use of farm machinery costly and less productive. To help overcome difficulties in the procurement of service equipment, financial institutions should grant loans easily to dealers of farm machinery. Governments should provide facilities for the specialized training of agricultural extension officers who would assist farmers in acquiring mechanized equipment. The governments should also make it easy to procure spare parts of agricultural machinery. It was recommended that a technical study team be organized with the assistance of international organizations, UNIDO and leading farm equipment manufacturers, to devise programmes for training mechanics and service personnel.

Development and the promotion of farm mechanization in Asia

23. As the need to mechanize was being appreciated in all the countries of the region, the governments concerned in collaboration with private, national and international organizations had given priority to farm mechanization. Rice was the basic crop and vital for the progress of nearly all the developing countries of the region, yet its cultivation was left almost entirely to human hands and to draft animals. The introduction of new high-yielding strains of paddy and multicropping patterns necessitated the completion of cultivating and harvesting the crops in a short period of time. Moreover, larger volumes of crops

/had to

had to be handled. These problems posed an engineering and a technological challenge. Such endeavour at research for development had been performed on a modest scale by certain institutions, but such endeavours appeared to be inadequate and sometimes to be duplicated by other institutions. Lack of funds and technical personnel, the absence of precise problems and above all, the lack of co-ordination in the exchange of information were some of the major reasons why there seemed to be a lack of proper perspective towards the development of farm mechanization. It was therefore necessary that governments promote the effective approach to technical research thereby encouraging the creation/improvement of machinery best suited to the needs of the region. Industry should find ways of expanding its output preferably in collaboration with leading farm equipment manufacturers. Farmers should receive assistance to ascertain the performance of farm machinery.

24. With that in view, it was recommended that ECARF/AIDC, possibly UNIDO and other interested international organizations, governments and international research institutions and leading farm equipment manufacturers, create at an early date a permanent Development Agency for Farm Mechanization in Asia with the following objectives, as arranged in the order of priority:

- (a) To perform technical liaison functions among all existing national research and development institutions and other organizations devoted to farm mechanization, industry and governments.
- (b) In collaboration with the International Standards Organization, to assist national institutions in member countries in the standardization of farm machinery and to study and formulate Asian regional standards for components of major farm machinery.
- (c) To assist in the development of farm implements for the needs of the region.

/(d)

- (d) To perform other activities for the promotion of farm mechanization, particularly pertaining to rice cultivation.

With that in view, it was further proposed that ECAFE organize an "Asian fair to demonstrate equipment for paddy" to be held in 1971 or 1972 at a suitable place with participants coming from industry, to demonstrate their equipment for rice cultivation. Special awards could be given to the firms excelling in the manufacture of machinery best suited for tillage in small and wet paddy fields, transplanting and/or seeding and harvesting and/or threshing.

Scope for regional co-operation

25. It was evident from the visits that there was a need for regional co-operation in the solution of common problems in farm mechanization. Various governmental and private agencies emphasized the need for the exchange of information about farm mechanization and its dissemination among the appropriate bodies. International agencies can be called upon to co-ordinate such exchange of information and to execute regional activities in research and development, standardization, technical assistance on manufacturing techniques, marketing research and training. Developed countries in the ECAFE region such as Australia, Japan and New Zealand could provide technical assistance to developing countries upon request. India could also possibly provide assistance in certain areas of farm mechanization. Developing countries themselves are desirous of rendering technical assistance to other countries in areas where they relatively excel. Some examples of such co-operative areas are as follows:

- | | |
|----------------|---|
| Ceylon | - manufacture of hand tools and implements and farm machinery testing. |
| China (Taiwan) | - manufacture and use of pedal and power threshers, power tillers and hand tools, extension service, agricultural engineering education and farm machinery testing. |

/India

- | | |
|-------------|---|
| India | - ancillary and supporting industries, operation of rice mills, engines especially small gasoline, medium and high horsepower diesel, pumps both centrifugal and submergible deep well, tractors, agricultural implements, crop protection equipment, manufacturing techniques, management, training, agricultural engineering education, machinery testing and engineering design. |
| Indonesia | - farm machinery operator training. |
| Iran | - training of industrial operators, manufacture of power tillers and agricultural engineering education. |
| South Korea | - power tiller manufacture and agricultural engineering education. |
| Malaysia | - training of tractor operators and agricultural engineering education. |
| Nepal | - manufacture of farm tools and implements. |
| Pakistan | - diesel engines, power wheat threshers, training, agricultural engineering education and machinery testing. |
| Philippines | - paddy propeller pumps and agricultural engineering education. |
| Singapore | - training of industrial mechanics. |
| Thailand | - rice mills, propeller paddy pumps, and engineering design. |

/PART II

PART II

B. GENERAL PATTERNS OF AGRICULTURE

Geographical conditions

26. The twelve developing countries visited extended geographically from the outer fringes of Indonesia to West Iran. The countries visited had wide differences in climatic conditions, soil, terrain, etc. although all had basic points of similarities from the point of view of agricultural development. Large-scale farming was done in commercial crops designed mostly for export which contributed substantially to the country's national income. The amount of agricultural land and manpower for such purpose was, however, small compared to the overall land mass composed of fragmented small farm holdings operated by large farm populations engaged in the subsistence type of farming. Except in China (Taiwan) where the level of agriculture was relatively advanced and in Singapore, where on account of its small agricultural land area (13,000 hectares) the contribution of its agricultural sector to the gross national output was relatively less significant, all the other countries were still in various stages of improving their agricultural conditions and achieving self-sufficiency in food.

Population

27. All the countries (excluding Singapore) had more than one-half of the national-employed population engaged mostly in self-subsisting types of farming. Nepal had about 92 per cent of its employed population engaged in agriculture. India, Pakistan and Thailand were within the 70-80 per cent range; the others range from 50-70 per cent. A substantial degree of under employment existed and that was one of the reasons for the disproportionate contribution of agriculture to the overall output of the respective countries concerned.

28. Population densities ranged from 1-13 persons for every hectare of cultivated land. and the number was likely to increase in the future should

/the rate

rate of crop production and, to an extent, the amount of tillage land for cultivation, fall below the generally high rate (2½ per cent) of population growth. Thailand with a density of about 1.7 persons per hectare of cultivated land had its agricultural holdings spread quite extensively over the country's plain fields, except in the undeveloped areas of the northeastern region. In Indonesia over 60 per cent of the population was concentrated in West Java which had a land mass representing a mere 7 per cent of the country's total area. The vast undeveloped areas of Sumatra, Kalimantan, and West Irian could serve as the future migratory areas when the government achieved substantial gains in infrastructural development, including the Bimas resettlement schemes. High population densities of about 14.5 persons per hectare of cultivated area were found in South Korea and China (Taiwan), and yet both countries had no other substantial available areas remaining for further cultivation.

Land distribution

29. The total land mass of the countries under study was about 920 million hectares of which less than one-third was cultivated. Another one-third was reported to be forested land from which timber in commercially exploitable quantities was obtained in Indonesia, Malaysia, the Philippines and Thailand. The remaining third was accounted for by the vast desert lands and mountains of Iran, the wastelands of India, the snow-capped mountain ranges of Nepal, and the idle cultivable lands of the Philippines estimated to be about one million hectares.

30. The governments of nearly all the countries visited were undertaking various programmes to expand irrigation facilities but it would take however a considerable length of time, however, before all cultivated lands could be irrigated, since financial resources to undertake such extensive irrigation schemes were limited. China (Taiwan) and South Korea led the other countries in having a high percentage of cultivated lands irrigated. The lands being mostly paddy fields accounted for the fairly-high yield of rice. In China

/(Taiwan),

(Taiwan), irrigated lands made it possible to engage in multi-cropping and furthermore, intra-cropping, where two rice crops and two intermediary cash crops were planted within a year. India, Malaysia, the Philippines and Thailand had 30-40 per cent of their respective paddy fields irrigated.

31. Rice being the staple food was the main crop particularly in the countries within the Far East sub-region. The combined production of India, Indonesia, Japan, Pakistan, the Philippines and Thailand was equivalent to about 70 per cent of the total world production. The low production figure however was due to the use of large tracts of low yield-producing paddy field operated mostly on a self-subsistence basis by farmers. In Thailand, about 73 per cent of the total cultivated land was rice, in India about 66 per cent, in Indonesia about 59 per cent, and in Nepal about 56 per cent. As already experienced in China (Taiwan), it was expected that rice yields in Asia would significantly increase in the years to come (from the present levels of 1200-1500 Kg/hectare of paddy), with the introduction of improved irrigation facilities, high-yielding rice seedlings, multi-cropping practices, and better farming techniques. Such an expectation was not altogether far from realization since countries like India, Pakistan and the Philippines were already deriving high yields from expanding pilot farms. To cope with the high yields, improved and economical rice processing equipment was needed. There was also need for proper storage and disposal of the milled output to the grain-consuming areas.

32. Other major grain crops were wheat and maize. Wheat was planted extensively in India, Iran and Pakistan. Yields however needed to be improved to achieve self-sufficiency. Maize was extensively grown in India, Indonesia, the Philippines and Thailand which exported it to Japan. The average yield varied from as low as 660 kgs/hectare of maize in the Philippines to 2,240 kg in Thailand and 2,320 kgs in China (Taiwan). Other crops, mostly for export, produced by commercially-operated estates and plantations were tea and coconut in Ceylon,

/sugarcane and

sugarcane and bananas in China (Taiwan), jute in India and Pakistan, sugarcane in Indonesia, rubber and oil palm in Malaysia, sugarcane, coconut and abaca (Manila hemp) in the Philippines, and sorghum, and rubber in Thailand.

33. The size of holdings was small, ranging from one hectare in China (Taiwan) to 5.9 hectares in Malaysia. In China (Taiwan) about 60 per cent of the estimated 854,000 holdings were below one hectare in size and there were hardly any holdings beyond five hectares. South Korea had a similar situation. In India, nearly three-fourths of the estimated 50.7 million holdings was three hectares in size. About 4.5 million holdings were within 5-10 hectares and another 2.3 million over 10 hectares. In Indonesia about 73 per cent of all holdings was below one hectare and another 23 per cent was within the 1-3 hectare range of sizes. With land reform, China (Taiwan) had made tremendous progress in the equitable distribution of holdings through the progressive reduction of land tenancy. The percentage of tenant-operated farms was reduced from about 56 per cent of all holdings during the implementation of land reform in 1946 to about 10 per cent in 1963. In Thailand, tenancy was fairly low since a high 82 per cent of all holdings was under owner-cultivation. In the Philippines, the operation of holdings was divided between the tenant and the farmer. To correct the imbalance the Government of the Philippines had launched its land reform programme in 1963, but the implementation was yet limited owing to lack of funds to support the "packaged" approach. In South Korea, the government was cautious in the implementation of its land reform scheme which called for expropriating land over three hectares per holding for distribution to land-deficient tillers. It had been accepted that unexpropriated holdings over three hectares in size apart from being more productive were contributory to the government-sponsored farm mechanization programmes. Other countries that still had high rates of tenancy were Iran, 75 per cent of all holdings, Ceylon 33 per cent, and Nepal 27 per cent.

Cattle population

34. Except in China (Taiwan) where the draft animal population was progressively declining as the level of farm mechanization increased, the small

/holdings in

holdings in the other countries were still dependent to a high degree on predominantly oxen and bullock power for farm cultivation. In Ceylon, India, Iran and Thailand, on the average there were four animals employable for draft in each holding. In China (Taiwan), South Korea and Malaysia the relatively high costs of maintaining and acquiring draft animals supported the change to mechanized farming. In the Philippines, the number of draft animals, particularly bullocks, was relatively low and so to increase the number the government had discouraged the slaughter of bullocks. The existence of employable work animals in the farm showed that there was inexpensive draft power adequate to cope conveniently with traditional work load in the farm. The substitution of mechanized power for animal power would be justified not only on the supposition that the resulting increased farm earnings would surpass the expenditure incurred in the acquisition of the farm equipment but also from the fact that the displaced work animal could otherwise be gainfully utilized elsewhere and its upkeep and maintenance ensured.

Farm income

35. The income of rice farmers in Asia was generally in the range of U.S.\$200-300 per hectare. That might be considered to be the gross annual income for the majority of the farms operating holdings below one hectare in size. In China (Taiwan), however, where the yield of paddy was high the annual income was about four times more. Generally, Asian farmers earned little and it would inevitably take a considerable length of time before they could supplement their income from sources other than agriculture. The prospects, however, of higher incomes in the near future would be bright if farmers adopted modern techniques in farming and the governments made available the use of more agricultural inputs and infrastructures were developed.

Farming practices and agricultural development

36. Almost all the varieties of paddy grown in the region belonged to the "Indica" type which differed in many respects from the "Japonica" type found in Japan, Korea and Taiwan. Most "Indica" varieties possessed such a high capacity

/for absorbing

for absorbing nutriment that they could very actively grow without the application of fertilizers. Another variety found in the region was known as floating paddy since it thrived in areas around rivers and marshes where the water level was high. That was the result of a long history of paddy cultivation in which the paddy survived the severe struggle with deep water and rapidly growing weeds and soils low in nutriment. The majority of paddy-growing areas in the region were rain-fed; the sources of water supply were monsoon rains and flooding rivers and in some areas, artificial irrigation. Korea and China (Taiwan) were proceeding with extensive mechanization of paddy fields. Other developing countries were still in the very early stages of mechanization.

37. The paddy of the region generally exhibited wider differences. In every country of the region, rice breeding work had been conducted for many years. Such work had proved that the "Indica" variety also had the generic potential of a very high yield, which had long been believed to be the characteristic only of the "Japonica" paddy. In every country in the region the breeding of new varieties with improved fertilizer response and resistance to disease and insect pests was being tried. The International Rice Commission of FAO had organized an international co-operative project for the hybridization of the "Indica" variety, having the generic factors responsible for the high fertility response and the "Japonica" type. As a result, several improved varieties like "Malinja" and "Mahsuri" had been successfully bred. The International Rice Research Institute had bred high-yielding improved varieties such as IR-8 and IR-5. Those varieties were considered, however, to be still imperfect since their production required more application of fertilizers and the paddy yielded was more difficult to thresh by conventional means and the taste of the cooked grains was noticeably different from that accepted. It was estimated that from ten to thirty per cent of the total area of paddy fields in the countries visited had now been planted with improved seed varieties.

38. In tropical regions, paddy could be grown during the entire year as long as an adequate water supply was available, but in the majority of paddy-growing areas only a single crop was planted in the year owing to the lack of irrigation. The planting cycles for paddy-growing in the countries visited were illustrated in a table appearing in the annex. The double cropping of paddy was practised only in limited areas of Ceylon, Indonesia, Malaysia (West), India, Japan, the Philippines, Pakistan (East), Thailand and Taiwan. In the deltaic areas of the continental countries, the pumping of perennial river water was being done. Tube-wells were another important means of water supply. Paddy fields were normally shifted to double cropping as soon as irrigation was made available. The interval between the harvesting of the preceding crop and the transplanting of the second crop was short, usually lasting about one month, and it was during that time that the harvesting, drying and threshing of paddy took place, the paddy fields were prepared, the seedlings transplanted and the seed beds managed. It was during that short critical period that the need for mechanization was apparent.

Plant diseases and pests

39. Plant protection was inadequately applied in Asian fields. It deserved greater importance and attention. Many types of pest plagued paddy fields. The stemborer was the most destructive and was common to all countries of the region. The damage caused by stemborers was estimated to be about 10-20 per cent of the yield. The species of stemborers observed in the region had different life cycles and behaviour patterns. Another predominant rice disease was the rice blast. Rodents and sparrows continued to plague farm lands causing substantial damage to crops.

40. The stages of land preparation for paddy growing were usually ploughing, harrowing, puddling and levelling, in that order. Ploughing by means of animal power could normally be carried out only when the fields were irrigated. Harrowing, puddling and levelling were performed afterwards with the use of wooden or iron-made harrows. In Japan where the majority of farmers owned power tillers, land cultivation was done quite conveniently with the use of rotary cultivators and cage wheel attachments to the power tillers. By that method, land cultivation could be performed in either dry or wet fields. The transplanting and

/harvesting

harvesting operations were two labour-intensive activities performed normally by the traditional Asian farmer with the aid of a single hand tool like a sickle. In Japan, the harvesting of paddy was simplified by the use of harvesting machines such as reapers mounted on power tillers, automatic binders and walking-type combines. The adoption of such harvesting machines by the farmers in the developing countries in the ECAFE region, was being done on a limited introductory scale. That would undoubtedly increase the rate of harvesting, provided that such machines were adjusted to process efficiently the "Indica" type of rice, the variety predominantly employed in the region. Moreover, a change from the traditional foot or animal-tramping method of paddy threshing to the employment of automatic threshers, as was practised in China (Taiwan) and Japan should be made. Care should be taken that the machine processed economically the high-yielding paddy with the least incidence of broken grains. As had been experienced in China (Taiwan) and South Korea, the use of the simple pedal-operated drum-type paddy thresher had resulted in a tremendous gain in threshing efficiency, which otherwise would not have resulted if the farmers had continued to rely upon the traditional labour-intensive methods.

/Table 1

Table 1: The paddy growing cycles as practised in Asian countries

Country	Growing period	Remarks
Ceylon	Yala crop: Feb., June-July to Nov. Maha crop: July-Nov. to Feb.-May. The Maha crop came in between the above mentioned growing period. In the southwestern part of the country, there was enough rain for both the Yala and Maha crops; thus, the raising of two crops during the year was possible. But in the northern dry zone areas there was only enough rain for the Yala crop.	The Yala cropping used the rain that came with the southwest monsoon (May to Sept.) and the Maha cropping used the rain that came with the northeast monsoon (Nov. to Mar.).
China (Taiwan)	First crop: Feb.-Mar. to June Second crop: July-Aug. to Oct.-June	Japonica type of paddy was used.
India	The main period began with rain that came in June. 1) Aus. (autumn rice): Apr.-June to Sept. 2) Aman (winter rice): May-June to Dec. 3) Boro (summer rice): Nov. to Apr.	The rainy season came during May-June through Sept.-Oct.
Indonesia	Since there was considerable rain even during the dry season, all stages (from seed bed preparation to harvesting) of rice cultivation could be observed any time of the year, but the main period could be considered to be from Nov.-Jan. to Mar.-May.	In most regions, the rainy season was from Nov. to Apr., and the dry season from May to Nov., but the distinction was not precise. There were two types of rice planted, Bulu and Tjereh, but there was no difference in their rice growing periods. In eastern Indonesia, the rainy and the dry seasons were reversed.
Iran	Apr.-May to Sept.-Oct. Northern part: Apr.-May to Sept.-Oct. Southern part: Mar.-Apr. to Oct.-Nov.	Middle of June to middle of July was the rainy season.
Korea	Apr.-May to Sept.-Oct.	Japonica type of paddy was used.

/Malaysia

Table 1 (contd.)

Country	Growing period	Remarks
Malaysia	The main planting period occurred between May-Aug. and Jan.-Feb. but in some regions paddy was grown from Apr. to Aug. In the northwestern region: May-July to Jan.-Feb; central & southern region: July-Aug. to Jan.-Feb.; northeastern region: Aug.-Sept. to Feb.-Mar.; northwestern double cropping region: main season, Sept. to Feb.-Mar., off season, Apr.-Aug. East Malaysia: June-July to Nov.-Dec.	The distinction between the dry and wet season was not clear, but generally more rain prevailed from Sept. to Dec. In the northeastern region, rain was concentrated in Nov. and Dec.
Pakistan	In East Pakistan: Aug. (autumn paddy): May-June to Aug.-Sept.; Aman (winter paddy): Apr.-May to Nov.-Jan.; and Boro (summer paddy): Dec. to Mar.-Apr. Since there was little rain in West Pakistan, only the Aus paddy was raised. Aus: May-June to Aug.-Sept.	In East Pakistan, May-Sept. was the rainy season. Rain was plenty in East Pakistan and the main crops were paddy and jute, whereas in West Pakistan, the climate being dry, the main crops were wheat and cotton.
Thailand	The main growing period was from May to Sept. That was the same as the rainy season. In the north and northeastern regions: Apr.-May to Nov.-Dec; central region: Apr.-May to Nov.-Dec.; southern region: Sept. to Mar.-Apr.	From May to Sept. was the rainy season and from June to Sept. the rainfall was the heaviest. In the southern regions, because they were near the sea, the distinction between the dry and wet season was not too clear, and rainfall heaviest from Oct. to Dec. There was also a spring variety (second crop) that was raised from Feb. to May-June.
Philippines	In the central Luzon region, the main paddy producing district, May-June to Nov. was the main paddy growing period. In regards where there were irrigation facilities, paddy was raised from Feb. to May.	May-June to Oct. was the rainy season.

C. GENERAL PATTERN OF FARM MECHANIZATION

Paddy was the main crop in nearly all the countries visited. China (Taiwan), Indonesia, Nepal, South Korea and Thailand had more than 50 per cent of their respective cultivated land areas planted with paddy. The large amount of agricultural land and the number of people employed on it called for a consideration in brief of the types of farm tools and equipment employed and what improvements or innovations were deemed necessary.

Hand tools and animal-drawn implements

41. Simple hand tools like hoes and spades were still used especially in small farms or in areas where there was a scarcity of draft animals. In the majority of cases however, draft animals were used together with ploughs, harrows, land levellers and puddlers. The implements were made of wood with pieces of metal attached as the soil-working parts. Entirely wooden ploughs were still used by millions of farmers in India, Indonesia and other countries. Improved types with very small iron mouldboards that were made locally were becoming popular because of their low cost and their proven performance. Locally-made ploughs entirely of iron did not seem to have been very successful since their selling prices were considerably high and they were heavy, thus being burdensome for the farmer to carry to the field and for the animal to handle efficiently. Harrows, levellers and puddlers consisted mainly of wooden frames. Harrows had a few teeth (six to ten) made of wood or iron.

Power implements

42. Power implements comprised power tillers or tractor tillage implements, ploughs, rotary cultivators, tine cultivators, harrows and levellers etc. In countries like Japan, China (Taiwan) and South Korea, the rotary cultivators were almost generally used as an attachment to the power tiller. Ploughing with the mouldboard was occasionally done after harvesting. For soil preparation, one pass of the rotary cultivator was made in the soft or dry field. Some 10-15 cm. of water was allowed into the paddy field and a

/few days

few days afterwards, a second pass of the rotary tiller took the place of puddling. Levelling was done with a levelling wooden board just before transplanting. In countries where tractors were used as in India, Ceylon and Thailand, the tillage was performed through disc ploughs in Thailand, tine cultivators in Ceylon, and cage wheels and disc harrows in India. Tillage was normally done at the beginning of the rainy season with the aid of tractors equipped with cage wheels. The working conditions during tillage operations in wet paddy fields were the most severe that could be encountered by the power tiller or the tractor. Power tillers made in Japan numbering more than three million and now in use had been proven to perform quite successfully. They were light, well-protected against water intrusion and were especially designed for power transmission to the rotary tiller. Rotary tillers had been known for more than forty years and the Japanese engineers had improved and redesigned them to make them suitable for wet land cultivation. Rotary tillers were very suitable and convenient for small farms. Four-wheel riding tractors, were relatively few and were concentrated in Ceylon, India and Thailand. In Thailand, contractors who owned most of the tractors used them to plough dry or semi-dry fields using implements such as disc ploughs and cultivators. Tractors in general were very difficult to use because the paddy fields in most countries (except Thailand and some parts of India) were very small in size and were very swampy. Owing to the conditions of wet paddy cultivation and the smallness of the paddy fields, tractors were not really suitable and much development work needed to be done in that respect.

Seeding and transplanting

43. Paddy was generally transplanted by hand without using any device such as wheel markers, except in China (Taiwan), Japan, Korea. However, there were land transplanters used to some extent in China (Taiwan) and they were being tested and improved in countries like Ceylon. The transplanters were very light, since most of them were made of wood. Though they were sturdy they were not easy to operate. In Japan, mechanical transplanters were becoming popular.

/Weeding and

Weeding and plant protection

44. Weeding was generally done by hand or with small weeding tools which were found to be very popular in Ceylon, China (Taiwan), India, Nepal, South Korea, etc. In Japan, farmers used chemical weeders. Hand sprayers - the hudson and the Japanese types - were commonly used in all the countries. Knapsack power sprayers were becoming popular and were of the mist type operated by micro engines. They could also be used as dusters. Their great advantage, apart from being engine-operated, was that they covered a much greater surface of the field for a given amount of liquid. Another type of duster being used was the portable trolley and boom type consisting of a small 2-3 hp engine with a mist fan and a powder tank mounted upon a frame. The equipment was carried by one man to the field and when in use was connected to a perforated plastic film distribution tube supported at the other end by another man.

Harvesting

45. Except in Japan, harvesting was done by hand and mostly by women using knives or sickles. In Indonesia where Indica rice was grown, only the heads of the paddy were cut and collected. In other countries, the straw was normally collected with the heads and quite often the ensuing bundles of paddy were stacked outdoors for purposes of sun-drying. As a first step towards increasing the efficiency of manual harvesting, the use of scythes having light wooden frames could be recommended as was practised in Europe many years ago for harvesting wheat. Asian workers, however, were not accustomed to reaping in a standing position. In Japan, reapers and binders were commonly used. Reapers being simple attachments for power tillers could be introduced as a first stage of mechanizing harvesting in many Asian countries. Binders being also attachments to power tillers may be integrated to the harvesting machines.

Japanese combine harvesters

46. The harvestors were very small machines especially designed for the combined operation of harvesting and threshing paddy in the typically small

/and wet

and wet Asian paddy fields. About five years ago, major Japanese makers had developed a smaller size of the Western type of combine with 1.5-2.0 meters harvesting width. But unfortunately, all the models had been unsuccessful in operation owing to the high moisture content (more than 60 per cent) of paddy straws, the high humidity and the smallness of the paddy fields. To solve these problems, special types of combines were developed. All were self-propelled, mounted on tracks, and were designed either as a walking or a riding type. They could harvest two rows (depending upon the model) up to an accumulated weight of paddy of around 600 kg - 1300 kg. The harvesting rate was about 3-5 ha per hour. They operated perfectly in good harvesting conditions. Although only recently introduced, Japanese combines were in great demand in Japan where 15,000 were supplied in 1968 and 30,000 were expected to be sold in 1969. However, the relatively high cost of such combines and the differences in agricultural conditions in Asian countries where they were to be introduced were considerations which needed to be further examined before such combines were manufactured on a large scale.

Western type combine harvesters

47. Such combines were basically of the same models as those used for processing wheat or other cereals. The only differences were in the threshing drum (peg type instead of standard raspbar type) in the carriage system, (half tracks replacing the front wheels) and in minor changes in size. The combines proved very successful in all western countries even in Italy, France and the United States of America where they were used for processing paddy. Apart from their high cost, they appeared to be too bulky and too heavy for use in small and wet paddy fields. The smaller models with 1.6-2.0 meters harvesting width were being tested in Asia by western makers on a very small scale. Such machines needed to be improved to fit the conditions encountered in Asian countries in wet paddy fields.

/Rice processing

Rice processing machinery

48. The conditions for rice milling varied from country to country. Rice mills were found to be owned mostly by private investors. In certain countries co-operatives and the government handled substantial proportions of the national milling capacity. Larger rice mills mainly handled paddy purchased by the government and as a rule, such mills having capacities ranging from 10 to 50 tons of paddy per day in one shift were under utilized. The number of small mills, some of which were provided merely with hulling machines, had increased in rural areas. The capacities of those mills range from 0.5 to 5 tons of paddy per day based on one shift operation. Hand-pounding of brown rice was practically quite extensive in the Asian countries. In Ceylon hand-pounded rice was preferred to milled rice which was processed through parboiling. Depending upon the type of milling equipment used, the recovery rate varied from 55-70 per cent. New types of milling equipment increased the yield by about 10 per cent. In countries where "Indica" paddy was produced, much broken rice was found in the milled rice. More than 30 per cent of the milled rice produced in some countries was broken rice. To reduce the incidence of broken rice, parboiling was adopted as in the case of Ceylon and Pakistan but such type of processing needed to be carefully controlled. Except for China (Taiwan) and South Korea, the other countries of the region required technical assistance for the improvement of rice milling and the storage of paddy. In Thailand where nearly all the rice mills that were efficiently operating were owned by private millers, the Government still continued to show a keen interest in the improvement of the quality of rice for export.

Forms of mechanization employed in raising selected crops

49. Wheat, barley and other grain were mainly popular in Iran, West Pakistan, India, Nepal and South Korea. For some crops the land needed to be partly irrigated. But in most cases there was no irrigation, and so tilling and harvesting presented difficulties but not of the same magnitude as those prevailing

/in the

in the paddy fields. Ploughing was still done mostly by traditional ploughs and draft animals operating at poor efficiency and turning soil at shallow depths. As experienced in India, Iran and Pakistan, tractors were being employed to prepare and clear wide agricultural areas which otherwise would have remained idle or less productive on account of the prevailing dry conditions which made the soil difficult to till by traditional means. Such tractors had to be powerful enough. In India and Pakistan, they were mostly in the power range of 35 to 45 hp; in Iran, 50-60 hp. Mounted disc ploughs (2 or 3 discs) and to some extent mouldboard ploughs were used. After ploughing, the soil was harrowed with a disc harrow or a tine cultivator. Spine harrows were not apparently widely used. Sowing was done mostly by hand except in Iran where common in line seed drills were popular. In India, tractor-drawn seed drills or combined seed-fertilizer drills were used together with bullock-drawn seed drills. Harvesting was commonly done by hand with the use of sickles. In Iran, self-propelled combines were used, and the tendency was towards an increasing use of almost 300 a year. In Pakistan, 300 pull-type combines were being imported as a first test batch. India is thinking of employing combines also.

50. In India as in Pakistan, some attempts had been made towards the use of reapers as a first step towards mechanization, because of the relatively-high cost of combines and their inability to gather straw and chaff (busa) used for cattle feed. It had been suggested to the local manufacturers to introduce in India the type of reapers formerly made in Europe and to test a small binder used in small farms in Europe after World War II. But the final solution it seemed would be to use standard self-propelled combines when farmers could afford to purchase them. Meanwhile, it was proposed that the government allow sufficient import of combines for demonstration purposes and evaluation and for the training of operators. Threshing was done in South Korea by small, pedal-operated threshers or by simple threshing combs, and in Nepal, India, Pakistan, Iran by draft animals. There was a great need in Pakistan and India for good power threshers able to thresh the new varieties

/of Mexican

of Mexican wheat and also to chop the straw. The former European models did not seem to be suitable for that purpose. It appeared that it was necessary to improve and develop the manufacture and use of the Pakistan-type model which could be described as a light power thresher with a peg drum. It threshed efficiently without too much broken grain, winnowed and cleaned the grain. Much care should be taken to improve its efficiency and design so that it could be manufactured at low cost.

51. Hybrid maize was being introduced under various stages in many of the countries visited. The preparation of the soil for maize was similar to that for other cereals. Sowing by hand was commonly practised but precision planters would be needed in the future. Harvesting by hand was convenient in those countries owing to the abundance of farm labour. It was suggested that the corn attachment for combines be used rather than corn pickers or corn huskers which were costly machines and the use of which was decreasing even in the United States. Husking of corn was done by small hand huskers. The introduction of more improved power husker was to be encouraged.

52. Sugar cane was grown mostly in private or state-owned estates in Ceylon, China (Taiwan), Indonesia and the Philippines, and by individually-owned farms in India, Iran and Nepal. In the first case, mechanization had been achieved significantly through the use of crawlers or four-wheel tractors for ploughing and preparing the soil. Planting and inter crop cultivation were done by hand. A few mechanical harvesters were used in the two state-owned sugar estates of Ceylon. But those machines were costly and were not entirely efficient. There seemed to be dependence on man-labour in place of harvesting machines.

Trend of preference the major forms of farm machinery

53. Four-wheel riding tractors. The most popular models were in the range of 35-45 hp and were known to be light medium tractors with unit

/weights of

weights of around 1600 kg. A few specific technical features were required as modern tractors were used successfully in their original design. They needed to be very strong, in the rear axle, the front axle and the steering mechanism because of the use of cage wheels used in wet or dry paddy fields. Hydraulic lift should be very powerful and good draft control was necessary. For work in paddy fields a good protection against water and mud was needed for all parts and mainly for the braking system and for the oil seal rings in the front and the rear axle. Air cleaners had to be highly efficient likewise fuel filters because of probable use of polluted fuel oil and tropical-proof electrical equipment was also necessary. There was a big demand for more powerful tractors in the large power range of 60/70 in Iran, Thailand and Philippines. The trend was certain to extend to other countries especially to India where there was already a demand for higher horse power. A few very powerful units of more than 80 hp were going to be needed in Iran and India for extensive cultivation in dry lands and also in the Philippines for use in sugar cane estates.

54. It would be advantageous to manufacture a riding paddy tractor in the small horsepower range. A two cylinder diesel engine of 20/25 hp would perhaps be suitable. A one cylinder engine with its usual cylinder capacity and speed would be limited to a maximum of 15 hp and that would be too small for the requirements of rotary tillage. For making a significant difference with the big power - tillers - it would not be more costly to give more power ability and 25 hp would be better than 20. Other characteristics desired would be a simple mechanical transmission with 6 gears and a differential lock. A low gear at around 1.5 km/hr was necessary for rotary tillage. Other desirable features were:

Small wheel base for short turning radius (around 1.6 meters).

Light weight, around 800 kg with more than 40% of weight upon front axle.

Simple and powerful hydraulic lift.

/Especially

Especially-designed rear hitch and driving mechanism for rotary tillers.

High ground clearance (more than 40 cm)

Sturdy rear and front axle.

Few accessories and gadgets for the low priced models.

With that in view, it was proposed that the research of a design for such a riding paddy tractor be made. As most of the tractor models in the market were in the medium range of 35-45 hp, there appeared to be a need for a cheap dryland tractor of around 25-30 hp. Tractors for the region should be as simple and cheap as possible as costly accessories such as power shift transmission were not necessary. There was a small demand for tractors with power shift transmission as such tractors used only for reclamation work and to a small extent for deep ploughing in estates. For land reclamation work, there was need for powerful tractors of 80 hp, which were considered to be the minimum size useable. The trend was to use larger models of 120-180 hp. In extensive land development work, there was also a need for 120-180 hp tractors which were found to be the most efficient and popular models. For light earthmoving jobs a good number of small crawler tractors of 45-55 hp sizes were needed.

56. Power tillers. The most popular models of power tillers as found in the ECARFE countries were in the range of 6 to 12 hp. Such models were used for paddy cultivation whereas smaller power tillers in the range of 3 to 5 hp were used in the cultivation of vegetable areas. Generally however, power tillers were used by farmers mainly for paddy cultivation since they were found to be of light weight, simple in structure, requiring only a small initial investment and of low operational cost. Power tillers were suitable for farmers who had small holdings that were characteristically soft and swampy. In Japan farmers used power tillers as a means of power transportation (trailer), for irrigation (pump) and plant protection (sprayer and duster), for harvesting (reaper and binder), threshing (thresher), hulling (huller) and cutting

/(straw cutter)

(straw cutter) and recently even for transplanting. Considering the performance of the existing models of power tillers marketed within the ECAFE countries and their cost, it would be good to develop a model that would be simpler in structure, lower in cost and stronger in design and performance. Such a model might incorporate the following basic parameters of design:

One cylinder, four-cycle, air-cooled diesel engine rated at around 8-10 hp.

Weight, less than 300 kg including engine.

Simple mechanical transmission with 4 gears: 3 gears forward and one reverse.

Power take-off; belt drive with engine pulley and tilling upper shaft.

Tyres: 6'/12 or 6'/14, high road clearance.

Tilling width and depth; 600-650 mm, 150-200 mm.

Few accessories; pipe frame body and simple design.

57. The various types of small engines used in agriculture were as follows:

(a) Micro gasoline-fed engines From 1-2½ hp for knapsack sprayers and dusters.

(b) Small gasoline-fed engines From 2-6 hp engine, equipped normally with one vertical cylinder, used for stationary applications in power threshers, rice hullers and to a limited extent, as motive source of power for power tillers. Some of them were water-cooled but most were air-cooled.

(c) Small diesel engines From 5-15 hp used for power tillers and for stationary purposes. They were used mostly for driving irrigation pumps, threshers, rice processing equipment, electrical generating sets, etc. The common design employed popularly for Japanese-made power tillers was the one-cylinder, water-cooled engine. That engine could easily be demounted from the power tiller and used afterwards like a stationary engine. There was a tendency towards the use of lighter, high-speed (2000 rpm),

/one vertical

one vertical cylinder, air-cooled engines which were sold at low prices.

- (d) Medium diesel engines Those engines in the range of 12-30 hp were used for driving big irrigation pumps, tractors and electric generating sets. They were with one or two horizontal cylinders, water-cooled, operated at low speeds from 350 to 600 rpm, heavy in weight and especially designed for stationary uses. There was a tendency to use lighter-weight engines operating at higher speeds (from 1500 to 2500 rpm).
- (e) Diesel engines for tractors Air-cooled diesel engines had not been successfully used within the ECAFE countries because of the difficulty in obtaining the desired cooling effect. Almost all tractors were fitted with water-cooled engines, of the direct injection types with a speed of from 2000 to 2500 rpm and with 2 to 4 cylinders depending upon the horse power ratings. The engines were similar to the ones used in automotive vehicles and hence the ensuing cost for such engines was considerably low owing to their production on a large scale.

Pumps

58. Pumps were used mostly for irrigation and the demand in the future was expected to increase in keeping with the over-all infrastructural development in agriculture. The centrifugal-type of pump from 2-10 inches in size was popular. Low-propeller types of pumps consisting of a turbine or a propeller pump driven by a long shaft connected to an engine were also used for lifting water at low heads. Other pumps popularly used were deep well pumps piston propeller or centrifugal multi-stage driven by a vertical shaft - and multi-stage centrifugal submergible pumps.

59. The various types of farm equipment employed in the twelve developing ECAFE countries visited, their level of use and the improvement areas that were necessary, were given in the attached list.

D. PRODUCTION AND SUPPLY OF AND DEMAND FOR AGRICULTURAL MACHINERY

Four-wheel riding tractors

60. The total number of tractors estimated in 1968 in the twelve ECAFE countries visited was 177,000. The demand for 1970 was expected to be 60,000 and for 1975 around 177,000. The number of tractors manufactured in 1968 was around 21,900 of which 12,000 were manufactured by plants using a high content of locally-produced parts, about 6,700 were assembled utilizing imported parts in the form of knocked-down components and 3,200 were assembled from components imported as sub-integral parts. The combined annual manufacturing and assembling capacity for 1968 was estimated to be 26,900 of which 12,300 represented the aggregate capacity of manufacturing plants operating with substantively increasing contents of locally-produced parts, about 11,650 represented the assembling capacity based on parts imported completely knocked down, and the balance of 3,000 represented the assembly from imported semi-integral parts. The tables in the annex show the manufacturing schedule as proposed for 1970 and 1975.

61. It was estimated that the percentages of demand and production of tractors by horsepower size for 1970 and 1975 would be as follows:

	<u>Tractor Demand (Percentage)</u>			
	<u>20-35 HP</u>	<u>35-50 Hp</u>	<u>50-65 HP</u>	<u>Above 65 HP</u>
1970	19.5	51	25	105
1975	20	40	29	11
	<u>Tractor Production</u>			
1970	9.0	60.0	29.0	2.0

The demand for 50-65 hp tractors and the ones above 65 hp would increase significantly while the demand for 20-35 hp tractors would remain constant. However, it was expected that there would be a significant drop in the demand for 35-50 hp tractors and that the over-all tractor demand in 1970 would be met except perhaps with the supply of tractors of 20-25 hp.

/Power tillers

Power tillers

62. The number of power tillers in 1968 in the twelve ECAFE countries visited was around 70,000 and the total sales for the same year was about 21,000. The estimated demand for 1970 would be around 38,000 and in 1975 around 100,000. In 1968 around 34,400 power tillers were produced from plants that had a combined annual manufacturing capacity of about 21,000. The number and capacity of plants were increasing and it was estimated that the aggregate manufacturing capacity for 1970 would be about 34,000 and for 1975 about 71,000.

Small engines

63. The total number estimated for 1968 of all small engines used for agricultural purposes in the twelve ECAFE countries visited was about 1.3 million. The total number of engines sold in 1968 was around 300,000. The annual demand estimated for 1970 was around 600,000 and for 1975 around one million. In 1968, about 280,000 engines were produced from plants having a total rated capacity of 400,000 annually. The aggregate annual production capacity estimated for 1970 was around 400,000 and for 1975 around 450,000.

(a) 1-2 hp gasoline-fed engines In 1968, the estimated number of such engines was around 80,000. The demand estimated for 1970 was around 90,000 and for 1975 around 185,000. In 1968, about 18,000 engines were produced from plants having a total annual rated capacity of 36,000.

(b) 3-5 hp gasoline-fed engines The total number of 3-5 hp gasoline engines estimated for 1968 was around one million. The total demand estimated for 1970 was around 80,000 and for 1975 around 160,000. The production in 1968 was around 25,000 for an installed capacity of 35,000. The existing plans indicated that the capacity might reach 42,000 units by 1975.

(c) 3-15 hp diesel engines The total number of this category of engine estimated for 1968 was around 750,000. The demand estimated for 1970 was around 325,000 and for 1975 around 465,000. The production in 1968 was around 140,000 for an

/installed

installed capacity of 170,000. The existing plans indicated that the production capacity might reach around 180,000 by 1975.

- (d) 12-30 hp diesel engines The total number of this category of engine estimated for 1968 was around 210,000. The number sold in 1968 was around 80,000. The demand estimated for 1970 was around 30,000. The production estimated for 1968 was around 77,000 from plants having a total installed capacity of around 104,000. The annual manufacturing capacity estimated for 1975 was around 112,000. It might be expected that a percentage of this excess capacity in certain countries might be converted into diesel engines of lower horse power.
- (e) 25-75 hp diesel engines The aggregate demand for 1970 of these engines intended for tractors was estimated to be around 57,000 and for 1975 about 120,000. The production estimated for 1968 was around 18,500 from plants having a total annual rated capacity of 33,000. The existing plans indicated that the aggregate annual manufacturing capacity might reach around 50,000 by 1975.

Pumps for irrigation

64. (a) Hand-operated pumps The number estimated for 1968 was around 300,000. The demand estimated for 1970 was around 165,000 and for 1975 around 420,000. The production in 1968 was estimated to be between 8,000 and 10,000. Data regarding future plans were not available.
- (b) 3-15 hp power-operated pumps The number estimated for 1968 was around 1.75 million. The demand estimated for 1970 was around 385,000 and for 1975 around 800,000. The production estimated for 1968 was around 340,000 from plants having a total annual installed capacity of 350,000. The capacity for 1970 was estimated to be 360,000 and for 1975 around 400,000.

/(c) Deep

- (c) Deep well power-operated pumps The total number estimated for 1968 was around 75,000. The demand estimated for 1970 was about 57,000 and for 1975 about 135,000. The production estimated for 1968 was about 33,000 from plants having a total annual installed capacity of 33,000. The future manufacturing plans were not known.

Plant protection equipment

65. (a) Hand-operated sprayers and dusters The estimated total number in 1968 was around 900,000. The demand estimated for 1970 was around 330,000 and for 1975 around 650,000. The production estimated for 1968 was about 240,000 from plants having a total annual installed capacity of about 250,000. Data regarding the future manufacturing plans were not known.
- (b) Power-operated knapsack sprayers and dusters The total number estimated for 1968 was around 225,000. The total number sold in 1968 was around 25,000 units. The demand estimated for 1970 was around 80,000 and for 1975 around 200,000. The production estimated for 1968 was around 24,000 from plants having a total capacity of 57,000. The total manufacturing capacity estimated for 1970 was around 66,000. The future plans for 1975 were not known.

Threshers

66. (a) Pedal-operated paddy threshers The number estimated for 1968 was around 1.5 million. The demand estimated for 1970 was around 65,000 and for 1975 around 200,000. The production estimated for 1968 was around 30,000 from plants having a total installed capacity of 36,000. The total manufacturing capacity was estimated to increase to around 46,000 by 1970.
- (b) Power-operated paddy threshers The number estimated for 1968 was around 160,000. The demand estimated for 1970 was around 50,000 and for 1975 around 150,000. The production estimated for 1968

/was

was around 18,000 from plants having a total installed capacity of about 20,000.

- (c) Power-operated wheat threshers The total population estimated for 1968 was around 30,000. The demand estimated for 1970 was around 26,000 and for 1975 around 65,000. Production estimated for 1968 was about 11,000 from plants having a total installed capacity of around 14,000.

Marketing of farm equipment

67. Agricultural equipment Marketing organizations had been created in an organized way in most of the countries, although there was scope for improvement. The marketing of farm machinery was done through private distributors and in some cases through state trading agencies. General organizations incorporating all aspects of marketing such as detailed market analysis, machinery usage, product analysis, sales forecasting, sales, communication, extension etc. did not really exist. As activities were centered merely on sales, it would be necessary to reinforce the marketing organizations in all the countries visited. Personnel needed to be trained and important positions within the marketing organization needed to be established. The management should be oriented into long term goals. As service facilities were lacking, there was a need to reinforce the extent and quality of facilities that were available including the improvement of technical skills of the service personnel. The government and industry should find ways of making available the stock of crucial spare parts which should be priced reasonably in order that consumers might be able to purchase them conveniently. The retail selling prices of farm machines varied from country to country. It had not been possible to investigate the detailed cost structure breakdown.

/E. EXISTING











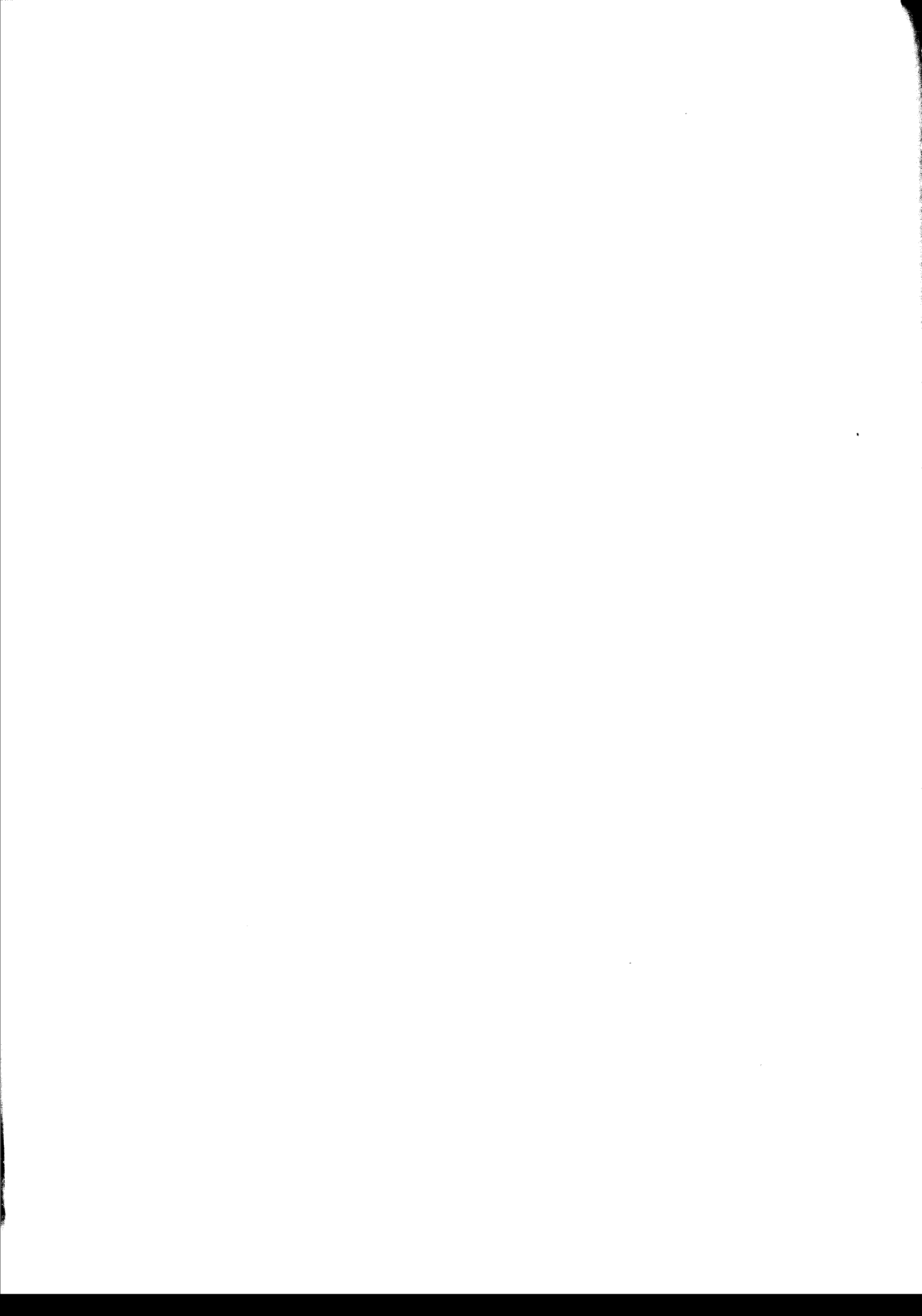
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E. EXISTING FACILITIES FOR MANUFACTURING SELECTED TYPES OF AGRICULTURAL MACHINERY AND THE ANCILLARIES IN THE INDIVIDUAL ECAFE COUNTRIES

Tractors

68. There were five tractor manufacturing plants all located in India. All the plants were producing tractors built with a high percentage of local content. There were twelve companies engaged in assembling tractors. The details of their operations were as given below:

<u>Country</u>	<u>Name of the Company</u>	<u>Tractor Models</u>	<u>1968 Production (in units)</u>
Ceylon	Brown and Co.	Massey Ferguson	700
"	Sathiyawadi Stores	Ford	450
"	Ceylon Service	IH	220
"	Rowsland	David Brown	NK
Iran	-	BM/Volvo	400
Pakistan	Rana Tractors	Massey Ferguson	1,300
"		Deutz	400
Thailand	L.T. Leonowens Co.	Massey Ferguson	900
"	Thai Motor Industries	Ford	100
"	Thai Machinery Co.	Steyr	200
Philippines	GAMI	Ford	700
"	International Harvester	IH	300

Power tillers

69. In Ceylon, China (Taiwan), Korea, India, Iran and Malaysia, power tillers were being produced. The local contents varied from 30-40 per cent and might reach 70 per cent in the near future. In Ceylon and Pakistan (East), licences for establishing power tiller factories had already been issued. Indonesia and Malaysia had plans to start power tiller factories.

Small engines

70. Low-speed diesel engines were manufactured mostly in India and in Pakistan. High-speed diesel engines were manufactured in China (Taiwan), India,

/Pakistan

Pakistan and South Korea. Small gasoline engines were manufactured in China (Taiwan), India, Indonesia and Korea. 1000 cc gasoline engines were manufactured only in India. Iran, Thailand, Pakistan and the Philippines had plans to manufacture diesel engines. In Thailand there were plans to manufacture gasoline engines. The engines produced were predominantly of the low-speed type of diesel engines. Very few countries had manufacturing programs for high-speed compact diesel engines of 12-15 hp suitable for automotive purpose and other applications in agriculture. Particulars about engine manufacture in the twelve countries visited were given below:

Ceylon

None

China (Taiwan)

Diesel engines: Total manufacturers - 15

Gasoline engines: Total manufacturers - 20

Major manufacturers:

- a) China Agric. Machinery Co. - Taipei (1968 production 3,500 diesel engines)
- b) Ping Hing Machinery Works - Tschung 7 (1968 production 2,400 diesel engines)
- c) Shin Taiwan Agriculture Machinery Co. - Kaohsiung (1968 production 1,800 diesel engines)

India

Diesel engines for industrial, agricultural and transport and gasoline engines for transport and agriculture purposes were manufactured.

- (a) Diesel engines. There were more than a hundred companies of which the following seven were major manufacturers. The total production in the large scale sector was about 150,000 in 1968 and in the small scale sector about 110,000.

Kirloskar Oil Engines Ltd. Total production in 1968 - 85,000, of which 65,000 were for agricultural purposes.

- Cooper Engineering Co.** - 1968 production 24,000 of which 22,000 were for agricultural purposes.
- Simpson & Company** - 1968 production 12,000, of which about 400 were for agricultural purposes.
- Ruston Hornsby Company** - 1968 production 7,000, of which 3,000 were for agricultural purposes.
- Indian Equipment Company** - 1968 production 2,000, mostly for agricultural purposes.
- Indian National Diesel** - 1968 production 2,000, mostly for agricultural purposes.
- Laxmi Ratan Co.** - 1968 production 3,000, of which 2,000 were for agricultural purposes.

(b) Gasoline engines There were about 10-15 manufacturing firms of which the following produced yearly about 20,000 engines of 2-5 hp and about 18,000 engines of 1.2 hp.

- a) **Enfield India Ltd., Madras** - 2-5 hp gasoline engines, 11,000 units produced yearly.
1.2 hp knapsack engines, 18,000 yearly.
- b) **Krishi Engines, Hyderabad** - 3.5-5 hp engines, about 1,000 produced yearly.
- c) **Veegal Engines and Engineering Ltd., Calcutta** - 2-6 hp engines, about 5,000 produced yearly.

Indonesia

- a) **P.N. Broom** - 3 hp gasoline engines, annual capacity 2,000 units, production in 1968 was less than 100 units.

Iran

- a) **English Electric Co.** - 24-230 hp engines, annual capacity 4,000 units.
- b) **Metallurgical & Engineering Plant No. 1 (not yet in production)** - 2-27 hp diesel engines, annual capacity 4,200.

/Korea, Republic of

Korea, Republic of

There were four diesel engine manufacturers, two manufacturing engines for power tillers. Total 1968 production: 500 units. The manufacturers of engines for power tillers were:

Daedong Industrial Co., Ltd. - Chizu
Dongyang Machinery Works - Seoul

Malaysia

None

Nepal

None

Pakistan

There were thirty manufacturers of diesel engines of which there were three major ones in West Pakistan and one in East Pakistan. The major manufacturers were as follows:

Mohammad Hussain and Sons, Lahore	- 10-100 hp low-speed engines, 1968 production - 2,000 units.
Ittefaq Foundries and Workshop, Lahore	- 15-20 hp low-speed and 15-30 hp high-speed engines, 1968 production 6,000.
Batala Engineering Co., Lahore	- High & low speed 10-100 hp engines, 1968 production 6,000.
Deutz Pakistan Co., Dacca	- Licensed to manufacture 3,000 units of 1 & 2 cylinder diesel engines. Present assembly capacity about 500/ye
Ruston Engine Plant	- Under consideration.

Philippines

None

Singapore

None

Thailand

None at present. However, the Thai Machinery Industries Co. had plans to manufacture $3\frac{1}{2}$ -6 hp Wisconsin gasoline engines at a total annual /capacity

capacity of 500 units by 1973 and Southern Cross (Austria) diesel engine of $3\frac{1}{2}$, 12 and 26 hp rating, at a total annual capacity of 1,000 units.

Pumps

11. Ceylon, China(Taiwan), India, Indonesia, Pakistan, the Philippines, South Korea and Thailand were manufacturing centrifugal pumps. The Philippines and Thailand were also manufacturing power paddy propeller pumps. China, India, Republic of Korea and Pakistan were manufacturing deep well pumps. Iran, Malaysia and Thailand had no significant production of power pumps for irrigation, but however, had plans to manufacture. Iran had already laid down the programme to manufacture 10,000 pumps by 1973. In Thailand two firms had plans to manufacture pumps. Nepal and Singapore had no manufacturing programmes. Hand pumps were manufactured in most of the countries. It appeared that in most of the countries, foundry techniques and quality control needed to be improved. Particulars about pump manufacturing operations in the countries visited were as follows:

Ceylon

Jinasena & Co., manufacturer of centrifugal pumps, 1968 production - 207.
Walker Industries, manufacturer of centrifugal pumps, 1968 production-252.
(Both establishments imported the engines)

China (Taiwan)

Total manufacturers of power-operated pumps: 15
Centrifugal and deepwell pumps: 10 small-scale manufacturers
Hand-operated: 20 small-scale manufacturers.

India

There were about 80-100 manufacturers of which 40 were operating on a small scale, 45 medium scale and 15 were large scale manufacturers. Total annual production about 300,000 of which 80 per cent were below 5 hp.

/Indonesia

Indonesia

P.N. Indra - Power centrifugal & screw type: annual capacity 300.
Production in 1968 - 120 units.
P.N.Barata - Production in 1968 - 150 centrifugal pumps.

Iran

Metaalurgical & Engineering Plant No. I, Tabriz - 2"-10" Centrifugal and turbine pumps. Capacity 10,000/yr. The plant was under construction.

Korea, Republic of

Power pumps: No. of manufacturers, 10; total production 1968: 5,000 units.

Malaysia

30 manufacturers manufacturing pumps used only for mining purposes.

Nepal

None.

Pakistan

There were 20-30 manufacturers. The major manufacturers were as follows:

Batala Engineering Co., Lahore	- Centrifugal and turbine production in 1968: 2,400.
KSE Pump Co., Lahore	- Production in 1968: 1,000 centrifugal and turbine pumps.
Ittefaq Foundries and Workshops, Lahore	- Production in 1968: 6,000 centrifugal pumps.
Mohammad Hussain & Sons, Lahore	- Production in 1968: 1,000 centrifugal pumps.
K.S.B. Pump & Co., Dacca	- Production in 1968: 4,000 centrifugal & deep well pumps.

/Philippines

Philippines

- Feati Industries - 2-12" centrifugal pumps, 17 sizes, annual capacity 2,400/yr.
- Marsteel Corporation - 2-12" centrifugal pumps, 1967 production - 800 units.
- Mechanical Center - Volute centrifugal pumps and self-priming turbine pumps, production in 1968: 2,150 units.
- Philippines United Foundry - Annual rated capacity: 600 centrifugal pumps.
- U.S. Engineering Co. - Deepwell turbine and low-land paddy pumps, production in 1968: 400.
- Oriental Machinery - 1 $\frac{1}{2}$ -4" centrifugal pumps.

Singapore

None

Thailand

There were about 30 small-scale manufacturers and 1-2 medium-scale manufacturers.

Mechanized Equipment Co. had plans for propeller pumps (3,000/yr), small turbine pumps (500 units/yr) and heavy centrifugal pumps (80 units/yr).

Thai Machinery Industries Ltd. had plans to manufacture Southern Cross pumps.

Knapsack Sprayers and Dusters

72. There were plants in China (Taiwan), Republic of Korea and Pakistan producing power sprayers. In Ceylon, Pakistan and Thailand there were plans to manufacture power sprayers. In Ceylon, China (Taiwan), India, Indonesia, Republic of Korea and Pakistan, there were plants manufacturing hand sprayers. In Ceylon, Pakistan and Thailand there were plans to expand the production capacity for sprayers. In Iran, Malaysia, Nepal, the Philippines, Thailand and Singapore, there were no substantial facilities for manufacturing sprayers

/and

and dusters. There was need for each country to manufacture hand and power sprayers starting with imported engines in the case of the production of the latter. Particulars about the manufacturing operations of the producers of plant protection equipment were listed below:

Ceylon

- AIC Industries & Co. Ltd., annual capacity 900 sprayers, 100 mist blowers and 30 weed slashers.
- Jinesera Industries, 1,000-1,200 sets.
- Diesel & Motor Engine Co. Ltd., 100 sprayers.
- Mini-Power Ltd., 800 sprayers.
- Hayles Ltd., 1968 production 2,200 sprayers.
- M.P.I. de Silva, 1968 production 400 sprayers.
- Colombo Commercial Co., not yet in production.

China (Taiwan)

There were many small manufacturers and one medium scale manufacturer. China Agriculture Machinery Co. Ltd. produced both hand and power sprayers.

India

There were about 35-40 small-scale and 6-8 medium scale and 2-3 large scale manufacturers.

- American Springs & Pressing Works, Bombay-67 - annual capacity:
hand-operated 1,200,000/yr/shift and power-operated sprayers,
40,000/yr/shift.
- Shaw Wallace, Calcutta (Hand sprayers produced by Dass & Co.)
- S.M. Agrico - manufacturers of hand sprayers
- Solo India Ltd.

Indonesia

P.N. Roma - Hand sprayers production in 1968: 5,000 units.

Iran

None

/Korea, Republic of

Korea, Republic of

Hand sprayers: 4 manufacturers, total production in 1968, 50,000 units.
Power sprayers: 2 manufacturers, total production in 1968: 2,000 units.

Malaysia

None

Nepal

None

Pakistan

Jaffar I Bharian & Co.,
Karachi

- Hudson-type hand sprayers

Drums Metal Works

- Harimatsu-type

Sidhriyang, Dacca

- Hand sprayer

Philippines

None

Singapore

None

Thailand

Mechanised Equipment Co. Ltd. had plans to make 800 sprayers/year.
There were 5-6 small scale manufacturers of hand sprayers at a total annual rated capacity of about 1,000.

Threshers

73. In China (Taiwan), India, the Philippines and South Korea, there were plants manufacturing pedal-operated paddy threshers. In Ceylon, China (Taiwan), India, Iran and South Korea, there were plants manufacturing power paddy threshers. The Philippines and Indonesia had plans to manufacture power paddy threshers. Power wheat threshers were manufactured in India and Pakistan. There was a great need for all countries to manufacture power threshers. Particulars about the manufacture of threshers were listed below:

Ceylon

Ceylon

Brown & Co., produced paddy threshers as attachments for power tillers.

China (Taiwan)

There were about 35 manufacturers of which the major ones were as follows:

Ta-Yu Farow Machinery Co., Taiwan.

China Agriculture Machinery Co., Ltd., Taipei.

India

There were about 60-100 very small scale manufacturers of which 10-15 might be small scale. The major manufacturers were as follows:

American Springs & Pressing Works, 15 units/day capacity.

Fulia Sheet Metal & Hardware Industry, Calcutta.

Jaycee & Co., Calcutta.

Lynx Machinery Ltd., Calcutta.

New Maharashtra Engineering Co., Poona.

Qualitex Machinery Ltd., Foidabad.

Indonesia

None

Iran

Ashtad - Iran Co., Teheran - Paddy power thresher production in 1968: 1,200 units.

Korea, Republic of

There were about 10 producers of hand-operated paddy threshers. The production in 1968 was around 5,000. There were two manufacturers of automatic threshers. The production in 1968 was around 200. There were also three manufacturers of semi-automatic threshers. The production in 1968 was around 500.

Malaysia

None

Pakistan

Pakistan

The following were the producers of power-operated threshers.

	<u>Capacity/year</u>
Mohd. Husain & Sons, Lahore	500
Ittefaq Foundries & Workshop, Lahore	500
Anwar & Co., Lyallpur	200
Danishmand & Co., Lyallpur	35
Caravan Eng. Works, Okara	300
Ghazi & Co., Multow District	360
Co-op Karkhana, Bahawal Pur	300
Ali Industries, Hyderabad	258
GTMC Ltd., Isakhed	300
Northern Industries, Rawalpindi	1,250

Philippines

About three manufacturers had just started producing power paddy threshers.

Singapore

None

Thailand

None

Rice processing machinery

74. With the exception of Japan, there was no other country in Asia manufacturing a full range of rice processing machinery on a significant scale. Rice hullers were manufactured in Ceylon, China (Taiwan), India, Republic of Korea, the Philippines and Thailand. In Ceylon and Indonesia there were plans to manufacture rice hullers. Indonesia, Iran, Malaysia, Nepal, Pakistan and Singapore had no programmes at the moment. Particulars about the manufacture of rice hullers were given below:

/Ceylon

Ceylon

There were five plants licensed but only three were in production.

	<u>Annual capacity</u>
J.A. Kamalaratne*	2,000 hullers
Tissa Industries*	1,200 "
Dheerasekera Motors, production 1968:	125 "
Somasiri Hullers	250 "
Walker Industries Ltd.	56 "

* not yet in production

China (Taiwan)

There were three manufacturing companies; the China Agricultural Machinery Co. was operating on a medium scale.

India

There were about 20-30 very small manufacturers and about 8-10 small-scale manufacturers.

Qualitex Machinery Ltd., Feridafad
New Maharashtra Engineering Co., Poona
Lynx Machinery Ltd., Calcutta
Jaycee & Co., Calcutta-1

Indonesia

There were plans to manufacture rice hullers.

Iran

None

Korea, Republic of

There were four manufacturers which produced in 1968 about 500 units.

Malaysia

None

Nepal

None

/Pakistan

F. SUPPORTING AND ANCILLARY INDUSTRIES

75. Tabulated below was a description in brief about the availability of castings, forgings and other ancillaries necessary to support industries for the manufacture of agricultural machinery.

<u>Country</u>	<u>Castings</u>	<u>Forging</u>	<u>Other items</u>
Ceylon	Limited facilities	Plans existed	Plans existed to make other tractor parts
China (Taiwan)	Fairly good facilities	Limited facilities	-
India	Good facilities available including malleable castings	Good facilities available	Machining, fabrication, tooling and other facilities available
Indonesia	Public sector projects	For defence	-
Iran	Public sector projects on cast iron castings. No facility for malleable castings	Public sector projects	-
Korea, Republic of	Limited facility for castings including malleable	Limited facility	-
Malaysia	Small foundries	Very limited facility	-
Nepal	Limited facility	Govt. implement factory	-
Pakistan	Public sector projects steel castings	Public sector project under plan	-
Philippines	Limited facilities	Limited facilities	-
Singapore	Grey cast iron and steel castings, production on small scale	Small prototype facility	-
Thailand	Limited facilities	Limited facilities	-

Implements

76. Hand tools were manufactured in most of the countries. Bullock-drawn tillage implements were also manufactured by the small-scale sector in most of the countries visited. Regarding tractor-drawn implements, only primary /tillage

tillage implements were made in India, Pakistan and Thailand. Iran and Thailand had plans to manufacture more tillage implements. Power tiller accessory equipment such as cage wheels were manufactured in Ceylon, China (Taiwan), India, Malaysia, Pakistan and South Korea. Thus only primary tillage tractor drawn equipment was at present manufactured. It was necessary to manufacture also other farm implements and equipment, especially sowing, fertilizer application and harvesting equipment. Particulars of manufacturing implements were given below:

Ceylon Hand tools manufactured.

China (Taiwan) Hand tools, power tiller implements were locally made.

India Hand tools, bullock drawn implements and tractor drawn primary tillage and sowing equipment manufactured.

Indonesia Hand tools and small implements were made at the village level. No effective production on significant scale.

Iran Primary tillage and seeding machinery would be manufactured at the state-owned factory (Arak) which was now under construction. Power tiller implements were also produced.

Korea, Republic of Hand tools, bullock-drawn implements and a few power tiller tillage implements were locally made.

Malaysia Power tiller implements were to be made in factories producing power tillers.

Nepal Only hand tools and bullock drawn implements were manufactured at Birganj.

Pakistan One registered firm was manufacturing tractor drawn equipment. Others had been recently licensed. There were a few small scale manufacturers of bullock drawn implements.

Philippines A few hand tools and other implements were manufactured locally.

Singapore No implements were manufactured.

/Thailand

Thailand Implements were made by small scale manufacturers. Traitor drawn disc harrows and disc plows were commonly manufactured with imported discs and taper roller bearings.

77. Tabulated below was a description in brief of the availability of steel products and machine tools necessary to support industries in the manufacture of agricultural machinery.

<u>Country</u>	<u>Steel Products</u>	<u>Machine Tools</u>
Ceylon	All steel to be imported; new integral steel plant under construction	No local manufacture
China (Taiwan)	Imported	Radial drills, lathes, shapers, grinders available from local sources
India	Except for some kinds of carbon steel other kinds available	Most of the machine tools were now available
Indonesia	Limited steel-making facilities	No local manufacture
Iran	All steel imported; re-rolling facility max 60,000 t/yr. New steel plant to produce 1-2 million tons/yr	To be produced in state-owned machine building factory now under construction
Korea, Republic of	All steel to be imported, limited rerolling facility	Simple lathes, milling machines, shapers, grinders etc. locally manufactured. Other machines to be imported.
Malaysia	All steel to be imported M.S. steel section from integral steel plant and one re-rolling mill	No local manufacture
Nepal	All steel to be imported. One small re-rolling mill	No local manufacture
Pakistan	All steel to be imported. Pakistan Steel Mills planning to set up a steel mill.	A few machines locally made. The public sector machine tool factory at Karachi to provide three types of machine tools. One factory in East Pakistan also planned.

/Philippines

Philippines	Crude steel would be available as soon as the country's first integrated iron and steel mill starts production by the end of 1969	Limited local availability
Singapore	There was a plant manufacturing mild steel billets and bars. All steel was imported	A few small machines produced
Thailand	All steel to be imported. Recently C.S. Steel Mills started. Siam Iron & Steel Co. would expand and plans were under way for Thai-Japanese steel plants and also construction of second plant	No local manufacture

Ancillary industry

78. Ancillary industries in most of the countries visited were engaged in manufacturing automotive tyres and tubes and batteries. In a few countries, items such as gaskets, brake and clutch linings, piston rings, pistons etc. were available, on a limited scale. In India most of the required items for automotive industry were manufactured. Details of ancillary industries existing in the different countries were given below:

Country	Tyres & Tubes	Battery	Radiator	Other items
Ceylon	for automobiles	automotive	manufactured	
China (Taiwan)	for power tillers	automotive	--	gaskets, brake lining, clutch
India	for tractors and automobiles	available from local sources	available from local sources	all items for tractors and machinery parts; manufacture available except a few items
Indonesia	for automobiles	automotive	nil	
Iran	for automobiles	automotive	information not available	nozzle, fitter, leaf spring, silencer, etc. Limited facility for hydraulic components

/Korea, Republic of

Korea, Republic of	for automobiles	automotive	limited	limited electrical and rubber components. Limited facility for pistons, piston-rings, nozzle, etc.
Malaysia	for automobiles	automotive	information not available	M.S. hardware, fay electrical components
Nepal	nil	nil	nil	-
Pakistan	for automobiles	automotive	limited facility	piston rings, piston liners etc. on small scale, other ancillary items licensed in for pistons
Philippines	for automobiles	automotive	information not available	information not available
Singapore	nil	nil	"	"
Thailand	for automobiles	automotive	"	"

/G. MEASURES

**G. MEASURES FOR ACCELERATING THE DEVELOPMENT OF INDUSTRIES
MANUFACTURING AGRICULTURAL MACHINERY**

79. In most of the countries, the manufacturing of farm machinery had been given priority and certain incentives provided. However, the incentives for investment in the manufacture of agricultural machinery were not special since they were similar to those offered for investment in other industries that the governments were promoting. In a few countries, to popularize farm machinery manufacture, protection was extended to local industries. Subsidies were provided for the purchase of farm equipment on a limited scale. Such subsidy programmes, however, were intended primarily to support the overall agricultural development programmes without necessarily emphasizing the role of the local farm machinery industry and the particular development of such an industry. A few countries had floor support prices for crops thus providing adequate incentives to farmers to purchase some types of farm machinery. A few countries had official agencies for the development of farm mechanization. During the past few years, the rural credit system had been reinforced to provide more credit towards the purchase of farm machinery. Although much was left to be desired, most of the governments had started recognizing the necessity of manufacturing farm machinery and providing the necessary incentives for its manufacture and sale.

80. Most of the countries visited had agricultural colleges offering agricultural engineering as part of the curriculum. Only a few countries, however, had degree specialization in agricultural engineering. Even in such institutions, there was the necessity to reinforce practical training facilities. It was also necessary for all the countries where agricultural engineering was not given as a full time course to start agricultural engineering degree courses. Although farm machinery research was conducted by various agencies in most of the countries, there appeared to be a lack of trained personnel and also laboratory and testing facilities. Despite limited resources, however, substantive work had been accomplished.

/H. QUANTITY,

**H. QUANTITY, SALES, DEMAND, PRODUCTION AND
MANUFACTURING CAPACITY OF SELECTED TYPES OR
AGRICULTURAL MACHINERY IN THE ECAFE COUNTRIES**

81. Particulars of quantity, sales, present and future demands, present production and the existing and planned future manufacturing capacity for selected types of agricultural machinery were shown in the following tables for the twelve countries in the ECAFE region. The types of machinery selected included the following:-

Four-wheel riding tractors

Power tillers

Small engines (all types)

Rups (power and hand-operated)

Sprayers and dusters

Paddy threshers (power and hand-operated)

/Table 3:

Table 3: Summary of Selected Types of Pumps, Motors, Sprayers, Tractors, Demand and Manufacturing Schedules in the Twelve Countries Visited

(Number of units)

Item	Quantity		Annual Sales 1968		Projected annual demand		Manufacturing capacity	
	1968	Total	Imported	1971	1975	1971	1975	1975
Tractors	176,300	334,300	11,700	113,100	11,700	26,400	11,700	26,400
Power tillers	69,525	21,450	5,750	14,700	14,700	14,700	14,700	14,700
Small engines, all types	1,398,900	225,025	5,100	1,393,800	1,393,800	27,700	1,393,800	1,393,800
gasoline, 1-2 hp	77,250	20,000	(...)	105,250	105,250	17,000	105,250	105,250
gasoline, 3-5 hp	93,050	20,000	(...)	166,300	166,300	24,100	166,300	166,300
diesel, 3-15 hp	728,150	150,000	(...)	674,150	674,150	135,500	674,150	674,150
diesel, 12-30 hp	201,050	75,000	400	62,750	62,750	77,200	100,050	100,050
diesel, 25-75 hp	75,000	15,000	(...)	117,125	117,125	15,500	117,125	117,125
Pumps, all types								
hand pumps	290,500	5,000	5,500	162,500	162,500	16,200	(...)	(...)
power pumps, 3-15 hp	1,685,600	13,500	15,100	684,700	684,700	44,700	361,000	361,000
deep-well pumps	75,000	(...)	(...)	135,100	135,100	33,950	33,200	33,200
Sprayers &usters, all types								
hand sprayers	781,500	176,300	26,100	644,500	644,500	261,500	253,000	(...)
knapsack	209,600	17,000	9,000	80,150	80,150	23,500	56,500	56,500
Tractors, all types								
paddy thresher, hand-operated	1,357,000	8,000	(...)	203,000	203,000	8,500	46,000	46,000
paddy thresher, power-operated	155,670	3,200	600	146,500	146,500	17,800	(...)	(...)
hand-operated power	27,000	(...)	(...)	65,200	65,200	11,000	13,700	13,700

a) Excluding estimates from certain countries. Please refer to the subsequent tables for the composition of country by country estimates.

b) representing the annual sales of agricultural machinery imported in the form of fully-built units.

Table 5: Four-wheel Riding Tractors, Sales and Production for 1970, by State of Origin

Source: UNCTAD

Country	Annual demand				Annual production 1/			
	Total	20-25 HP	26-30 HP	31-40 HP	Total	20-25 HP	26-30 HP	31-40 HP
Ceylon	1,500	-	1,200	300	1,500	-	1,200	300
Per cent			(80)	(20)			(80)	(20)
China	100	-	50	50	411	-	-	-
Per cent			(50)	(50)				
India	40,000	10,000	24,000	6,000	30,000	3,600	21,000	5,400
Per cent		(25)	(60)	(15)		(12)	(70)	(18)
Indonesia	200	-	15	50	Nil	-	-	-
Per cent			(60)	(30)				
Iran	5,000	500	800	1,500	4,000	-	500	3,500
Per cent		(10)	(16)	(37)			(12)	(78)
Korea, Republic of	200	50	150	-	200	50	150	-
Per cent		(25)	(75)			(25)	(75)	
Malaysia	800	-	450	350	411	-	-	-
Per cent			(56)	(44)				
Nepal	100	-	100	-	Nil	-	-	-
Per cent			(100)					
Pakistan	5,000	500	4,000	500	3,500	-	3,500	-
Per cent		(10)	(80)	(10)			(100)	
Philippines	1,800	-	600	1,200	1,500	-	400	1,000
Per cent			(33)	(67)			(27)	(63)
Singapore	25	-	25	-	Nil	-	-	-
Per cent			(100)					
Thailand	4,500	500	3,000	1,000	4,500	500	500	3,500
Per cent		(11)	(67)	(12)		(11)	(11)	(67)
Total	53,225	11,550	37,275	4,400	45,200	7,250	33,300	5,650
		(21.5)	(70)	(8.3)		(16)	(62)	(12.2)

1/ Including tractor assembly

Table 6: Four-wheel Riding Tractors: Estimated Demand and Production for 1975
(Number of units)

Country	Estimated Demand					Estimated production
	Total	20-35 hp	35-50 hp	50-65 hp	Above 65 hp	
Ceylon	3,000	500 (16)	2,000 (68)	500 (16)	-	1,500
China	300	100 (33)	150 (50)	50 (17)	-	-
India	80,000	20,000 (25)	32,000 (40)	20,000 (25)	8,000 (10)	50,000
Indonesia	500	100 (20)	200 (40)	100 (20)	100 (20)	-
Iran	10,000	1,000 (10)	7,000 (70)	6,000 (60)	1,000 (10)	10,000
Korea, Republic of	500	150 (30)	250 (50)	100 (20)	-	450
Malaysia	1,500	200 (13)	600 (40)	500 (34)	200 (13)	-
Nepal	300	100 (33)	150 (50)	50 (17)	-	-
Pakistan	10,000	1,000 (10)	6,000 (60)	2,500 (25)	500 (5)	5,000
Philippines	4,000	500 (13)	1,000 (25)	1,500 (37)	1,000 (25)	1,500
Singapore	25	-	25 (100)	-	-	-
Thailand	8,000	1,000 (13)	5,000 (62)	3,000 (37)	2,000 (25)	6,000
Total	118,125	24,650 (20)	96,125 (81)	44,300 (37)	12,800 (11)	74,450

Note: Figures in brackets represent percentage of total.

Table 7: Power Plants: Quantity, Sales, Demand and Manufacturing Schedules

(Number of units)

Country	Quantity (MW)	Annual sales 1970		Annual projected demand	Manufacturing capacity		
		Total	Imported		1977	1979	1975 (known plans)
Beylon	1,200	1,600	1,100	1,500	1,400	1,700	1,000/3
China (Taiwan)	2,400	3,000	-	2,000	2,500/500/2	3,000	6,000/3
India	4,000	800	300	5,000	3,000	3,000	26,000/3
Indonesia	3,000	-	-	1,500	5,000	300/2	1,000/3
Iran	15,000	4,000	500	5,000	3,500/3	6,000	6,000/3
Korea, Republic of	9,300	7,100	-	1,000	7,100/3	10,000	10,000/3
Malaysia	1,800	1,000	1,000	1,500	-	600/3	3,000/3
Nepal	35	-	-	50	-	-	-
Pakistan	2,500	300	300	1,000	-	3,000/3	8,000/3
Philippines	7,500	2,800	2,800	1,500	-	1,500/3	5,000/3
Singapore	10	-	-	-	-	-	-
Thailand	2,800	850	850	1,500	-	500/2	5,000/3
Total	69,525	21,450	6,750	11,800	14,400	33,900	71,000

Note: 3 Assembly for imported fully knitted-wr components.

4 Progress to indigenous production.

Table 8: Small Engines (all types): Quantity, Sales, Demand and Manufacturing Scheduled

Number of units

Country	1975		1976		1977		Manufacturing Capacity	
	Quantity	Actual sales	Quantity	Demand	Quantity	Demand	Quantity	Capacity
Ceylon	(...)	(...)	110	260	-	-	-	-
China (Taiwan)	45,000	5,000	2,000	45,000	1,500	15,000	15,000	20,000
India	1,150,000	20,000	805,000	61,000	200,000	900,000	300,000	270,000
Indonesia	(...)	(...)	13,200	27,000	500	5,000	1,000	(...)
Iran	25,000	(...)	37,500	57,500	-	-	4,500	6,000
Korea, Republic of	25,000	(...)	20,700	42,500	7,800	17,500	15,000	15,000
Malaysia	30,000	(...)	6,500	15,000	-	-	-	-
Nepal	500	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Pakistan	(...)	(...)	49,000	171,000	11,500	17,000	25,000	20,000
Philippines	22,500	(...)	25,000	47,500	-	-	-	-
Singapore	300	25	50	(...)	(...)	(...)	(...)	(...)
Thailand	(...)	(...)	17,000	31,500	-	-	-	6,000
Total	1,298,300	268,025	590,550	1,002,500	277,800	307,500	404,400	441,050

1/ Including engines for tractors

Table 2: 1-2 Hp Gasoline-Fed Engines^{1/}: Quantity, Sales, Demand and Manufacturing Schedules
(Number of units)

Country	1968 Quantity	1968 Annual sales		Projected annual demand		1968 Production		Manufacturing capacity	
		Total	Imported	1974	1975	1974	1975	1974	1975
Ceylon	(...)	(...)	(...)	5,500	15,000	-	-	-	-
China (Taiwan)	(...)	(...)	(...)	5,000	10,000	-	-	-	-
India	75,000	20,000	-	30,000	75,000	10,000	36,000	36,000	40,000
Indonesia	(...)	(...)	(...)	5,500	10,000	-	-	-	-
Iran	(...)	(...)	(...)	15,000	22,500	-	-	-	-
Korea, Republic of	(...)	(...)	(...)	7,500	15,000	-	-	-	-
Malaysia	(...)	(...)	(...)	500	3,000	-	-	-	-
Nepal	(...)	(...)	(...)	150	300	-	-	-	-
Pakistan	500	(...)	(...)	11,000	20,000	-	-	-	-
Philippines	2,000	(...)	(...)	5,000	10,000	-	-	-	-
Singapore	50	-	(...)	(...)	(...)	-	-	-	(...)
Thailand	(...)	(...)	(...)	5,000	8,000	-	-	-	(...)
Total	77,250	20,000	-	90,150	155,800	10,000	36,000	36,000	40,000

^{1/} Driving engine for knapsack-type of sprayers.

Table 10: 2-5 Hp, Gasoline-Fed Engines^{1/} Quantity, Sales, Demand and Manufacturing Schedules
(Number of units)

Country	1968		Projected annual demand		Manufacturing capacity	
	Quantity		demand		1970	
	Total	Imported	1975	1975	Production	Installed capacity
Ceylon	(...)	(...)	4,000	5,000	-	-
China (Taiwan)	(...)	(...)	5,000	8,000	3,000	(...)
India	75,000	25,000	5,000	10,000	25,000	3,000
Indonesia	(...)	(...)	5,000	10,000	500	2,000
Iran	(...)	(...)	4,500	6,000	(...)	(...)
Korea, Republic of	(...)	(...)	2,500	5,000	600	3,000
Malaysia	(...)	(...)	1,000	2,500	-	-
Nepal	(...)	(...)	100	400	-	-
Pakistan	(...)	(...)	4,000	10,000	-	-
Philippines	18,000	(...)	4,000	8,000	-	-
Singapore	50	(...)	(...)	(...)	-	(...)
Thailand	(...)	(...)	3,000	6,000	-	100
Total	93,050	25,000	81,100	160,900	24,100	35,000
						35,100
						42,000

^{1/} Engines for driving power threshers, hullers, small milling equipment and small pumps.

Table 11: 2-15 Hp Diesel-Fed Engines: ^{1/} Quantity, Sales, Demand and Manufacturing Schedules

(Number of units)

Country	1966		Projected annual demand		1968		1970		1975		1975	
	Quantity	annual sales	1970	1975	Production	Installed capacity	1970	1975	Production	Installed capacity	1970	1975
Ceylon	(...)	(...)	4,000	8,000	-	(...)	(...)	(...)	(...)	(...)	(...)	(...)
China (Taiwan)	(...)	(...)	1,000	18,000	4,000	(...)	(...)	(...)	(...)	(...)	(...)	(...)
India	725,000	15,000	250,000	325,000	120,000 ^{2/}	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Indonesia	(...)	(...)	2,500	5,000	-	-	-	-	-	-	-	-
Iran	(...)	(...)	10,000	15,000	-	-	-	-	-	-	2,250	2,250
Korea, Republic of ^{3/}	(...)	(...)	1,000	20,000	5,000	7,000	10,000	10,000	10,000	10,000	10,000	10,000
Malaysia	(...)	(...)	4,000	7,500	-	-	-	-	-	-	-	(...)
Nepal	(...)	(...)	250	1,000	-	-	-	-	-	-	-	-
Pakistan	(...)	(...)	24,000	50,000	9,500	13,000	16,000	16,000	16,000	16,000	16,000	16,000
Philippines	3,000	(...)	5,000	15,000	-	-	-	-	-	-	-	-
Singapore	15,000	(...)	(...)	(...)	-	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Thailand	(...)	(...)	1,000	5,000	-	-	-	-	-	-	-	1,000
Total	726,15	25,000	327,750	413,500	136,500	170,000	187,000	187,000	187,000	187,000	187,000	187,000

^{1/} Including engines for power tillers, pumps and threashers.
^{2/} Kerosine engines.
^{3/} About 60% manufactured by the small-scale sector

Table 12: 12-30 Hp Diesel Engines ^{1/} Quantity, Demand, Sales and Manufacturing Schedules

(Number of units)

Country	1968		1969		1970		1971		1972		1973		1974		1975	
	Quantity		Annual sales		Estimated annual demand		Manufacturing capacity		Manufacturing capacity		Manufacturing capacity		Manufacturing capacity		Manufacturing capacity	
	Total	Imported	Total	Imported	Total	Imported	Total	Imported	Total	Imported	Total	Imported	Total	Imported	Total	Imported
Ceylon	(...)	(...)	(...)	(...)	2	1,000	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)
China (Taiwan)	(...)	(...)	(...)	(...)	20	5,000	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)
India	2,000	75,000	75,000	15,000	3,000	75,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Indonesia	(...)	(...)	(...)	(...)	1,000	2,000	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Iraq	(...)	(...)	(...)	4,000	4,000	6,000	(...)	(...)	(...)	(...)	(...)	(...)	(...)	2,500	6,000	(...)
Korea, Republic of	(...)	(...)	(...)	(...)	5	2,000	20	500	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Malaysia	(...)	(...)	(...)	(...)	1	500	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Nepal	(...)	(...)	(...)	(...)	5	25	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Pakistan	(...)	(...)	(...)	(...)	5	11,000	2,000	4,000	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Philippines	1,000	(...)	(...)	(...)	25	500	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Singapore	50	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Thailand	(...)	(...)	(...)	(...)	5	1,500	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Total	201,050	75,000	75,000	4,000	31,600	62,750	77,200	10,450	16,000	16,000	16,000	16,000	16,000	16,000	16,000	112,500

1/ For stationary use. The estimates do not include engines for tractors.

2/ Assumed to be imported for deepwell pumps.

3/ 20 hp and above diesel-fed engines used for deepwell pumps.

4/ About 25,000 production from large scale sector.

Table 13: 25-75 Hp Diesel Engines:^{1/} Quantity, Sales, Demand and Manufacturing Schedules
(Number of units)

Country	1968 Quantity	1968 annual sales		Projected annual demand		Manufacturing capacity			
		Total	Imported	197	1975	Production	Installed Capacity	197	1975
Ceylon	(...)	(...)	(...)	1,500	3,000	-	-	-	-
China (Taiwan)	(...)	(...)	(...)	1,000	300	-	-	-	-
India ^{2/}	75,000	15,000	(...)	40,000	8,000	15,000	3,000	30,000	50,000
Indonesia	(...)	(...)	(...)	200	500	-	-	-	-
Iran	(...)	(...)	-	4,000	1,000	-	-	-	(...)
Korea, Republic of	(...)	(...)	(...)	200	500	3,500 ^{2/}	3,500 ^{2/}	3,500	-
Malaysia	(...)	(...)	(...)	800	1,500	-	-	-	(...)
Nepal	(...)	(...)	(...)	1,000	300	-	-	-	-
Pakistan	(...)	(...)	(...)	5,000	10,000	-	-	-	-
Philippines	(...)	(...)	(...)	1,800	4,000	-	-	-	-
Singapore	-	-	-	25	25	-	-	-	(...)
Thailand	(...)	(...)	(...)	3,500	8,000	-	-	-	-
Total	75,000	15,000	-	57,225	117,125	18,500	33,500	33,500	5,000

1/ For tractor use only.

2/ For trucks and automobiles.

3/ Engines of 25-75 hp were manufactured for tractors and for other motive purposes. These estimates were only for tractor requirements.

Table 14: Hand-Operated Pumps: Quantity, Sales, Demand and Manufacturing Schedules

(Number of units)

Country	1968		1968		Projected annual demand		Manufacturing capacity	
	Quantity	Total annual sales	Imported	1974	1975	1969	1969	Installed capacity
Ceylon	3,000	(...)	(...)	1,000	5,000	-	-	-
China (Taiwan)	46,000	8,000	(...)	5,000	10,000	(...)	(...)	(...)
India	(...)	(...)	(...)	10,000	30,000	(...)	(...)	(...)
Indonesia	34,000	(...)	(...)	5,000	15,000	-	-	-
Iran	74,000	(...)	8,500	25,000	35,000	(...)	(...)	(...)
Korea, Republic of	46,500	(...)	(...)	10,000	20,000	6,200	8,000	-
Malaysia	(...)	(...)	(...)	5,000	10,000	-	-	-
Nepal	50,000	(...)	(...)	500	2,000	-	-	-
Pakistan	(...)	(...)	(...)	1,000	5,000	-	-	-
Philippines	50,000 ^{1/}	(...)	(...)	5,000	15,000	(...)	(...)	(...)
Singapore	(...)	(...)	(...)	(...)	(...)	-	-	-
Thailand	(...)	(...)	(...)	5,000	1,000	(...)	(...)	(...)
Total	290,500	8,000	8,500	162,500	418,000	6,200	8,000	-

^{1/} Out of 90,000 water pumps, it was assumed that 50,000 were hand-operated and 40,000 were power-operated

Table 15: 2-15 Hp Power-Operated Pumps: Quantity, Sales, Demand and Manufacturing Schedules
(Number of units)

Country	1968		1975		1968		1975	
	Quantity		Projected annual demand		Production	Installed capacity	Manufacturing capacity	
	Total	Imported	1970	1975	1968	1975	1970	1975
Ceylon	5,000	1,200	4,000	12,000	300	(...)	(...)	(...)
China (Taiwan)	20,000 ^{6/}	(...)	10,000	15,000	7,000	10,000	12,000	15,000
India	1,500,000	5,000	3,000	60,000	30,000 ^{1/}	30,000	30,000	350,000
Indonesia	30,600 ^{2/}	(...)	3,500	7,000	500	1,500	(...)	(...)
Iran	(...)	(...)	1,000	20,000	4,200	(...)	13,200	27,300
Korea, Republic of	32,000	(...)	1,000	49,000	5,000	20,000	3,000	(...)
Malaysia	55,000 ^{3/}	(...)	2,000	6,000	2,000	5,000	(...)	-
Nepal	(...)	(...)	200	1,000	(...)	(...)	(...)	(...)
Pakistan	(...)	(...)	2,000	60,000	12,500	19,000	(...)	(...)
Philippines	4,000	6,000	1,000	20,000	6,000	(...)	(...)	(...)
Singapore	(...)	(...)	-	(...)	-	-	-	(...)
Thailand	(...)	(...)	15,000	3,000	5,000	(...)	3,600 ^{2/}	(...)
Total	1,682,600	313,500	384,700	82,000	34,700	351,000	350,000	392,300

1/ Including about 75,000 units from the small seal-sector.
 about 50% of the total production was used in irrigation.
 2/ Assumed to be lower-operated.
 3/ Pumps for all purposes including mostly industrial types.
 4/ 147.
 5/ Plans for 3, low high pumps.
 6/ Out of about 6,000 pumps of all types, 2,000 units were assumed to be power-operated.

Table 16: Deepwell Pumps: Quantity, Sales, Demand and Manufacturing Schedules

(Number of units)

Country	1968		Projected annual demand		Manufacturing capacity		
	quantity	annual sales	1974	1975	1968		1975
					Production	Installed capacity	
Ceylon	(...)	(...)	(...)	(...)	-	(...)	(...)
China (Taiwan)	500	(...)	(...)	(...)	100	(...)	(...)
India	(...)	(...)	40,000	1,000,000	30,000	3,000	(...)
Indonesia	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Iran	12,500	(...)	3,000	5,000	600	(...)	2,300
Korea, Republic of	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Malaysia	-	-	-	-	-	-	-
Nepal	(...)	(...)	50	100	-	-	-
Pakistan	60,000	(...)	14,000	30,000	3,000	3,200	(...)
Philippines	1,000	-	(...)	(...)	250	(...)	(...)
Singapore	-	-	-	-	-	-	(...)
Thailand	(...)	(...)	(...)	(...)	-	-	(...)
Total	74,000	-	57,050	1,95,100	39,950	33,200	35,500
							4,000

Source: ...

Table 17: Hand-Operated Sprayers and Dusters: Quantity, Sales, Demand and Manufacturing Schedules

(Number of units)

Country	1968 Quantity ^{a/}	1968 Annual Sales		Projected annual demand		Manufacturing capacity		
		Total	Imported	1970	1975	1968		1970
						Production	Installed capacity	
Ceylon	43,300	(...)	(...)	10,000	20,000	3,000	5,000	(...)
China (Taiwan)	225,000	28,000	(...)	30,000	50,000	25,000	(...)	(...)
India	200,000 ^{e/}	150,000	(...)	130,000	225,000	150,000	150,000	(...)
Indonesia	700	(...)	(...)	25,000	75,000	5,000	8,000	8,000
Iran	100,000	(...)	23,600	25,000	35,000	-	-	-
Korea, Republic of	187,000	(...)	4,500 ^{b/}	60,000	125,000	50,000	75,000	100,000
Malaysia	-	-	-	10,000	20,000	-	-	-
Nepal	500	-	-	200	500	-	-	-
Pakistan	25,000	-	-	18,000	50,000	6,500	15,000	15,000
Philippines	(...)	-	-	10,000	20,000	-	-	-
Singapore	-	-	-	-	-	-	-	-
Thailand	-	-	-	10,000	20,000	1,000	-	-
Total	781,500	178,000	28,100	328,200	640,500	241,500	253,000	273,000

a/ Including mist blowers, dusters, etc. of all types.

b/ 1967

c/ Out of about 30,000 sprayers and dusters, 75,000 were assumed to be power-operated.

Table 18: Power-Operated Knapsack Sprayers and Dusters: Quantity, Sales, Demand and Manufacturing Schedules
(Number of units)

Country	1968		1968 annual sales		Projected annual demand		Manufacturing capacity		
	Quantity ^{a/}	1968	1968		1975		1968		
			Total	Imported	1970	1975	Production	Installed capacity	
Ceylon	1,600	-	-	-	4,000	6,000	500	1,500	5,000
Chin. (Taiwan)	12,000	4,000	-	-	4,500	10,000	3,500	-	-
India	100,000	15,000	-	-	25,000	100,000	15,000	50,000	50,000
Indonesia	-	-	-	-	5,000	10,000	-	-	-
Iran	18,000	-	9,000	-	12,000	20,000	-	-	-
Korea, republic of	56,000	-	-	-	7,000	15,000	2,000	5,000	10,000
Malaysia	-	-	-	-	2,500	5,000	-	-	-
Nepal	-	-	-	-	150	500	-	-	-
Pakistan	2,000	-	-	-	10,000	20,000	2,500	-	-
Philippines	20,000	-	-	-	5,000	10,000	-	-	-
Singapore	-	-	-	-	-	-	-	-	-
Thailand	-	-	-	-	5,000	8,000	-	-	800
Total	209,600	19,000	9,000	-	80,150	204,500	23,500	56,500	65,800

a/ Including mist blowers, dusters, etc. of all types.

Table 12: Pedal-Operated Paddy Threshers: Quantity, Demand and Manufacturing Schedules
(Number of units)

Country	1968 Quantity	Projected annual demand		Manufacturing capacity		
		1970	1975	1968		1970
				Production	Installed capacity	
Ceylon	200	5,000	8,000	-	-	-
China (Taiwan)	150,000	10,000	15,000	10,000	15,000	15,000
India	300,000	25,000	125,000	15,000	20,000	30,000
Indonesia	-	10,000	15,000	-	-	-
Iran	-	-	-	-	-	-
Korea, Republic of	900,000	7,500	20,000	5,000	10,000	20,000
Malaysia	-	1,000	2,500	-	-	-
Nepal	200	500	1,500	-	-	1,000
Pakistan	300	1,000	5,000	500	1,000	-
Philippines	6,000	2,000	5,000	500	1,000	-
Singapore	-	-	-	-	-	-
Thailand	300	3,000	6,000	-	-	-
Total	1,357,000	65,000	203,000	30,500	46,000	66,000

Table 20: Power-Operated Paddy Threshers: Quantity, Demand, and Manufacturing Schedules
(Number of units)

Country	1968 Quantity	Projected annual demand		Manufacturing capacity	
		1970	1975	1968 Production	Installed capacity
Ceylon	60	2,500	8,000	250	500
China	75,000	12,000	20,000	10,000	10,000
India	50,000	10,000	50,000	5,000	5,000
Indonesia	(...)	5,000	10,000	-	-
Iran	1,000	1,200	3,000	1,200	2,000
Korea, Republic of	25,500 ^b	10,000	20,000	700	2,000
Malaysia	1,800 ^a	750	5,000	-	-
Nepal	10	100	500	-	-
Pakistan	50	3,000	15,000	-	-
Philippines	2,000	3,000	10,000	250	500
Singapore	(...)	-	-	-	-
Thailand	250	3,000	6,000	-	-
Total	155,670	50,550	147,500	17,400	20,000

a/ Including pedal-operated threshers

b/ 1967

Table 21: Particulars about the Manufacturing Operations of Tractor Plants in India

Name of the company	Eicher Tractors India Ltd.	Escorts Ltd.	Hindustan Tractor Ltd.	Tractors & Farms Equipment Ltd. (TAFE)	International Tractor Co. of India
Collaboration	Cicher	Ursus	Zetor	Massey Ferguson	International Harvester
Date of establishment	1959	1966	1966	1966	1961
Capital	7.5 million rupees authorized	45.0 million rupees authorized	10.0 million rupees authorized and paid	20.0 million rupees (paid)	40.0 million rupees
Investment	3.0 million rupees	10 million rupees	20.3 million rupees	24.8 million rupees	25.0 million rupees
Foreign participation, per cent	30	-	17	49	17
Area in sq. miles: Total	-	40,000	-	65,000	155,000
Covered	6,000	20,000	-	13,500	15,500
1968 production	3700	4270	2200	4000	3500
annual rate capacity	1000 (2000) ^{a/}	3000 (7000) ^{a/}	3000 (7000) ^{a/}	4800 (7000) ^{a/}	3500 (7000) ^{a/}
Tractor horsepower	26.5 hp	28/37/42	35/50	35	35
Percentage of local production	64 ^{b/}	73 ^{b/}	57/85 ^{b/}	80.3 ^{b/}	76.5 ^{b/}

^{a/} First figure is the installed capacity. The figure in parenthesis is the sanctioned capacity.

^{b/} obtained from the Fourth (5 year) Plan, Annex 1 B.

Table 22: Particulars about the Manufacturing Assembly Operations of Power Tiller Plants

Name of the country	China	China	Iran	Korea	Korea	Ceylon	Malaysia	India
Name of the company	Shin Taiwan Agri. Machinery	China Agri. Machinery	Ashtad-Iran Manufacturing Co.	Daedong Industrial	Dongyang Machinery Works	Brown & Co.	United Manufacturers	Krishni Engineer Private Limited
Locality	Kaohsiung	Taipei	-	Chinsu	Seoul	Colembo	Kuala Lumpur	Hydrabad
Collaboration	Kubota	Iseki-Yanmar	Mitsubishi	Mitsubishi	Iseki	Land Master	Iseki	(Japanese)
Date of establishment	1961	1961	1962 (started manufacturing in 1967)	1967	1967	1959		1963
Capital	NT\$27 million	NT\$60 million	102 million Rials	300 million wons	none		M\$2 million	
Foreign participation	58% (Japan)	30% (Japan)	none	none	none			
Investment	-	NT\$25 million	111 million Rials					
Area (sq mi)								
Total	5,400	-	75,000	115,000			2.4 hectares	
Covered	1,350	-	31,500	17,000			33,500 sq ft	
Personnel (number)	326	400	283	975	650		2,000	
1968 production	1,800	2,400	3,500	6,000	1,100	500	(1969) 1,800	500
Annual rated capacity	2,000	2,400	6,000	6,500	3,500	500	(1970) 2,400	(licensed 3,000)
Products	4 Iseki models	Yanmar (5 models)	3 models (diesel & gasoline)				(1972) 3,600	5-7
Percentage of local content	70	-	60	70	60	-	(1969) 15%	70% (estd)
							(1972) 35%	

Note: 1. In India, three other companies having Japanese collaboration were granted licenses.

2. In Pakistan, two companies - Iseki & Yanmar - have been granted manufacturing licenses.

3. Assembly plants using CKD components are found in Ceylon, Indonesia, Iran, Malaysia, and the Philippines.

ANNEX

**Statistics on farm machinery - quantity, imports, demand and
manufacture - in selected countries of the region.**

- A. Ceylon
- B. China (Taiwan)
- C. India
- D. Indonesia
- E. Iran
- F. Korea (Republic of)
- G. Malaysia
- H. Nepal
- I. Pakistan
- J. Philippines
- K. Thailand

A. CEYLON

1. Farm Machinery Estimate

No systematic survey of farm machinery had been done. The table below gave the estimated number of agricultural machines in 1968.

Estimated Quantity of Agricultural Machinery in 1968

<u>Category</u>	<u>Item</u>	<u>Nos.</u>
1) Hand operated machines	a) Duster	14,000
	b) Sprayers	29,300
2) Animal drawn implements	a) Cultivators	8,314
	b) Improved seed drill	15
3) Riding tractors	a) 12-18 hp	2
	b) Improved seed drill	1,135
	c) Above 35 hp	10,581
4) Power tillers	a) Less than 5 hp	15
	b) 5-10 hp	3,153
	c) Above 10 hp	1
5) Combine harvester	a) Less than 1 meter cut	2
	b) 1-2 meters	nil
	c) Above 3 meters	4
6) Irrigation equipment	a) Centrifugal pump	2,309
	b) Sprinkler units	20
7) Tractor drawn implements	a) Primary tillage implements	11,270
	b) Seed drill cum fertilizer drills	15
	c) Planters cum fertilizer distributor	8
8) Plant protection equipment (power)	a) Duster	150
	b) Sprayer	1,200
	c) Tractor mounted sprayer	8
9) Harvesting equipment (power)	a) Mower	120
	b) Reaper	21

(10)

10) Threshers	a) All types	264
11) Seed processing	a) Cleaner	100
	b) Treater	10
	c) Rice huller	1,046
12) Transport	a) Trailer	4,314
	b) Transport boxes	191

2. Imports

- (a) Riding tractors (from 1950) - 11,718 (estimated)
- (b) Walking tractors (power tillers) imported (from 1950) - 3,169
- (c) Implements and attachments imported

(i) Attachments for 4-wheel tractors imported from 1950^x

Disc ploughs	-	1,310
M.B. ploughs	-	497
Disc harrows	-	937
Tine trillers	-	8,314
Trailers	-	4,314
Rotavators	-	212
Transport boxes	-	191
Seed drills	-	15
Combine harvesters	-	4
Water pumps	-	7

(ii) Attachments for 2-wheel tractors imported from 1950^x

Reversible ploughs	-	1,250
Water pumps	-	575
Threshers	-	270
Combine harvesters	-	2
Reapers	-	21
Rotavators	-	400
Rotary cultivator sets	-	850

- (d) Pumps imported and manufactured locally from 1962 - 21,037 units

It is estimated that about 25-30% of the above were pumps for agricultural purposes. Others were for industrial and household purposes.

3. Estimated Demand for Farm Machinery

Based on the views gathered during the preliminary investigation, the national demands for selected types of farm machinery were estimated as follows:

<u>Items</u>	<u>Specification</u>	<u>1968</u>	<u>1970</u>	<u>1975</u>
Riding tractor	40-50 hp (farming) (estate)	1,400 50	600- 800 200	1,000- 1,500 200- 400
Power tiller	5-8 hp	1,000	2,000- 4,000	5,000-10,000
Pumps agricul- tures	2"-4"	1,000-1,500	3,000- 5,000	10,000-15,000
Engines	a) 1-2 hp (sprayers & pumps)	1,700-2,250	4,000- 7,500	10,000-15,000
	b) 3-5 hp (pumps, threshers)	500- 750	2,750- 5,000	7,500- 2,000
	c) 5-8 hp (tillers & threshers)	1,800-2,000	2,500- 5,000	6,750-12,500
Sprayers	a) Hand	5,000-7,500	10,000-12,000	15,000-20,000
	b) Power	1,200-1,500	2,500- 5,000	5,000- 7,500
Threshers (power)	3-5 hp	250	2,000- 3,000	7,000-10,000

4. Farm Machinery Manufactures

(a) Tractors

No tractors were manufactured but most of them were assembled from CKD components.

(b) Agricultural Trailers - 3 to 5 tons range were being manufactured by five firms. All these firms imported the wheel axles, hubs, rims and the hydraulic lift components.

/(c)

(c) Agricultural Implements and Attachments

All implements for riding tractors were imported. However, for power tillers, attachments such as puddling wheels, rotary tiller components, trailers were being locally fabricated.

(d) Cage Wheels

Almost all tractor companies manufactured their own with imported raw materials accounting for 80 per cent of the total cost of the cage wheels.

(e) Water Pumps

Two companies manufactured pumps (capacity 1/2" to 6") but with imported engines and electric motors.

(i) Out-put of water pumps

	1962	-	90
	1963	-	174
	1964	-	194
	1965	-	216
	1966	-	656
	1967	-	867
	1968	-	559

(f) Engines

No small engines were manufactured in Ceylon.

(g) Threshers

One company manufactured threshers for 5 hp tractors. About 250 had been manufactured with imported raw materials.

/(h)

(h) Sprayers

There were several approved manufacturers in knapsack hand sprayers and power sprayers. Total local production was about 25,000.

(i) Implements were manufactured. Total manufactured - 141,971.

(j) Local Seeders and Sowers

Production during the last ten years had been

Hand weathers	24,954
Hand seeders	14,423
Bullock drawn ploughs	244
Winnowers	78
Hand tools (mammoty, etc)	1,637

(k) Other Production Facilities

A few firms located in Colombo had facilities for castings, machining etc. There were also three government institutions that had such facilities, namely:-

- (i) Government Factory of the Public Works Department.
- (ii) State Hardware Corporation.
- (iii) Implements Factory of the Department of Agriculture.

5. Ancillary Industries

- (a) Castings: Only grey cast iron was available.
- (b) Forgings: The State Hardware Corporation had forging facilities.
- (c) Sheet Metal: No facilities were available.
- (d) Heat Treatment: Facilities were available at the State Hardware Corporation.

/(e)

(e) Rubber parts and gaskets: One company manufactured a limited range of rubber parts and gaskets from imported raw materials.

(f) Electrical parts: One firm manufactured certain electrical components on a limited scale.

(g) Availability of machine tools: No machine tools were manufactured in Ceylon. All machine tools were imported.

(h) Availability of iron and steel: All the iron and steel was imported.

(i) Availability of locally-made components: The following were available:

- (1) Tyres and tubes (not tractor tyres at present)
- (2) Engine filter elements
- (3) Batteries
- (4) Silencers (exhaust)

/B.

B. CHINA (TAIWAN)

1. Farm Machinery Estimate (1966-67)

<u>Category</u>	<u>Item</u>	<u>Model</u>	<u>Numbers</u>	
Animal-drawn	Ploughs	Total	- 613,509	
		(Improved)	414,826	
		(Conventional)	137,684	
		(Kia Kong (weeder))	40,428	
	Harrows	(Lister)	20,571	
		Total	- 652,710	
		(Knife tooth)	325,541	
	Puddlers	(Comb type)	327,169	
		Total	- 137,647	
	Hand Operated	Wheel markers (spacing gauge)	(Puddling rotors)	100,797
			(Cultivator type)	36,850
		Bullock carts	- 127,410	
		Bicycle trailer	- 102,654	
Weeder		- 27,684		
Duster		- 34,920		
Mist blower		- 21,886		
a) Sprayers (including portable sprayer)	- 6,123			
b) Power sprayer and duster	- 180,780			
Threshers (including power thresher)	- 9,734			
		- 204,337		
		/Hand		

<u>Category</u>	<u>Item</u>	<u>Model</u>	<u>Numbers</u>
Hand Operated (continued)	Winnowers (including power winnow)	-	158,176
	Potato slicers (including power operated)	-	67,970
	Pumps (including power operated)	-	42,330
	Hydraulic ram	-	100
Crawler Tractors	Total	-	467
	Less than 40 Hp	-	379
	More than 40 Hp	-	88
Wheel Tractors	Above 25 Hp	-	87
Power Tillers	Total	-	14,272
	Less than 5 Hp	-	2,039
	5-8 Hp	-	7,045
	Above 8 Hp	-	5,188
Others	Trailers	-	3,000
Engines	All Hp up 15	-	40,380
	Diesel	-	19,206
	Kerosine	-	3,334
	Gasoline	-	17,840

2. Five High Power Machinery Produced during the period 1962-67

<u>Item</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>
Power tiller	1,326	1,205	1,231	1,893	2,424	3,611
Diesel engines ^{x/}	1,500	1,800	2,000	2,500	3,200	6,000
Sprayer and duster	185	224	1,921	1,540	2,734	3,611
Pumps	1,564	8,050	8,926	3,453	3,194	7,029
Threshers	-	11,528	9,557	2,465	11,537	10,100

x/ Estimated

3. Local Production and Import of Power Tillers

Year	Power Tillers		Total
	Imported	Locally Made	
1963	370	1,205	1,575
1964	15	1,231	1,246
1965	119	1,893	2,012
1966	-	2,424	2,424
1967	-	3,611	3,611

4. Capacity and Production of Farm Machinery

Item	Power Tillers	Diesel Engines	Pumps
Existing annual capacity	4,800	12,000	8,000-10,000
Established	4,400	10,000	4,000
Small scale	400	2,000	2,000
Production in 1968-69	4,600	11,000	7,000- 8,000
Established	4,200	9,000	-
Small scale	400	2,000	-
Local content 1968	About 70%	About 85%	About 95%
Probable expansion programme up to 1975 by established industries	8,500	16,000 18,000	about 12,000-15,000

/5.

Year	Power Tillers	Diesel Engines	Pumps
1963	370	1,205	1,575
1964	15	1,231	1,246
1965	119	1,893	2,012
1966	-	2,424	2,424
1967	-	3,611	3,611

5. Future Trend in Demand and Use of Farm Machinery (1970-1980)

Item Present 1967-68

Crawler Tractors Used for land development and sugarcane fields and mills only. Quantity about 500

Riding Wheel Tractor Only a limited number was in use. Many models, makes and horsepower. Quantity about 90.

Power Tiller 60% of sales was in the 15 Hp range. Demand for higher Hp was increasing. Total demand about 5,000 units a year. Total power tiller population was about 17,000. Total manufactured in 1967 was about 3,600 units.

Engine-Gas 1-3 Hp lightweight. No effective manufacturing programme. Total number of gas engines about 3,500. Total manufacture in 1967 not known

Immediate 1968-1970

As the demand was limited, the feasibility of replacing them with higher Hp wheel type tractors might be examined.

Manufacturers were interested in introducing 20-30 Hp tractors on a limited experimental basis.

80% of the demand to be for 15 Hp tillers, and 20% for 8-10 Hp. Total demand of power tiller in 1970 would be about 7,000.

Requirement for 1970 about 5,000/yr.

Next Five Years 1970-75

As the demand was limited, any requirement could be met by importing. The feasibility of replacing them with higher Hp wheel type tractors might be examined.

1970-75 would be the transitional stage. Interest by farmers in 20-30 Hp should be created. Expected requirement in 1975 about 300 tractors

The demand for 8-10 Hp power tiller would increase to 50% and demand for 15 Hp power would be 50%. Total demand for power tiller in 1975 would be about 20,000 per year.

Demand was expected to increase from 8,000 to 10,000/yr in 1975.

1975-80

There would be greater interest and preference shown by a class of farmers, for 20-30 Hp tractor. Expected requirement in 1980 would be about 500.

Static or declining demand for 50% of the 8-10 Hp and 50% of the 13-15 Hp power tiller. Total demand for power tillers in 1968 would remain about 40,000 and 20-30 Hp riding tractor would be introduced.

Demand was expected to increase 10,000-15,000 per year in 1980.

/Diesel Engine

Item	Present 1967-1968	Immediate 1968-1970	Next Five Years 1970-75	1975-80
Diesel Engine	3-5 Hp 6-8 Hp 10-12 Hp 15 Hp Total number of engines about 20,000. Total manufacture in 1967 about 6,000.	5,000/yr in 1970 5,000 sets 4,000 sets 7,000 sets	7,000-8,000/yr in 1975 12,000 sets 15,000 sets 10,000 sets	15,000-20,000/yr in 1980 15,000-20,000 sets 15,000-20,000 sets 10,000-12,000 sets
Plant Protection Equipment	Knapsack type duster, sprayer, etc. Just introduced. Total quantity, including hand sprayers, 10,000. Total manufactured in 1967 about 3,500.	4,500 sets of knapsack type under 1-3 Hp lightweight gas engines in 1970.	Introduction and usage of high speed duster and sprayers. About 8,000 sets per year in 1975.	Introduction of tractor mounted sprayer and usage of highspeed duster etc. 10,000-15,000 sets/yr in 1980. Introduction of tractor mounted sprayer.
Power Threshers	2-3 Hp threshers not very efficient. Present quantity about 75,000 units. Total manufactured in 1967 about 10,000.	Necessity for high efficiency threshers. Demand about 12,000/yr with about 3-6 Hp engine.	Demand about 12-15 thousand in 1975.	Demand about 15-25 thousand by 1980.
Power Pumps	3-4" more popular 5-6" Total existing quantity about 35,000. Total manufactured in 1967 about 7,000 units	Pumps with 6-8 and 10-12 Hp diesel engine. Estimated demand about 10,000/yr.	Estimated demand about 15,000/- by 1975.	Estimated demand about 15,000-20,000 by 1980.
Other Hand Operated Machines	Farms in the range of 0-1 ha, in size and especially those in the range of 0-0.5 ha would be requiring hand operated sprayers, dusters, foot operated threshers, etc. in large numbers.			

6. Farm Machinery Manufacturers

It was estimated that there were about 150 manufacturers of agricultural equipment in China (Taiwan) of which about 15 had operations on a large scale levels.

Estimated Number of Manufacturers Producturise^{x/}

	<u>Medium Scale</u>	<u>Small Scale</u>
Power tillers	2	3
Diesel engines	5 (including 2 of power tillers)	10
Gas engines	3	22
Pumps (power)	4	12
Pumps (hand)	-	17
Deep well pumps	2	-
Threshers (power and hand)	2	25
Other hand and animal-drawn equipment	-	25
Estimated total	17	110

^{x/} Most of the "factories" categorised as operating on a small scale were merely small fabrication shops.

7. Ancillary Industries

a) Castings: There were about 118 foundries with an average monthly output of 3,090 tons of castings, 8 electric arc furnaces for large castings, blast cupola for machinery castings, moulding machines and sand treating equipment.

b) Forgings: According to a report, two 2-ton steam and pneumatic hammers were available. Simple forgings were normally done at ancillary industries.

/c)

- c) Sheet Metal Press Work: Most of the existing manufacturers obtained sheet metal material from outside ancillary industries which use either mild steel or deep drawing steel.
- d) Machine Shop: Most of the components of power tillers, engines, pumps etc. were fabricated at the plant. Only a small number of the established manufacturers had adequate engineering know-how with respect to designing of jigs and fixture and precision manufacturing techniques.
- e) Tools and Dies: Copying lathes, shapers, die sinking machines, jig borers, grinders, electro-discharge machines and optical comparators were available from certain established industries and government workshops.

/C. INDIA

C. INDIA

1. Farm machinery estimate

Items	(Number of Units)		
	1961	1966 ^{a/}	1968 ^{b/}
Tractors (four-wheel)	30,931	55,222	75,000
Power tillers	n.c.	4,705	5,000
Floughs - wooden	38,371,787	39,923,291	45,000,000
- iron	2,298,215	3,171,191	5,000,000
Oil engines with irrigation pumps	229,972	448,754	700,000
Electric pumps for irrigation	160,168	390,505	800,000
Improved harrows and cultivators	n.c.	2,691,267	Not known
Improved seed drills	n.c.	1,121,762	"-
Improved threshers	n.c.	344,292	"-
Rotary chaff cutters	n.c.	3,667,357	"-
Sprayers and dusters	n.c.	201,720	"-
Carts	12,072,390	12,614,664	"-
Sugarcane crushers (by bullocks)	590,210	637,671	"-
(by power)	33,300	42,957	"-

Note: n.c. = not collected.

a/ Data for 1966 were provisional and subject to revision.

b/ Estimates

2. Import and production of farm machinery

The import of farm equipment in general was prohibited in India. Only a few units were imported for test purposes. The import of tractors and power tillers only in a limited number was allowed and upon special licence by the Government, usually in the horse power range that was not under the manufacturing programme of the country.

/(a)

(a) Import and production of tractors

Year	Import	Units Production	Total
1956	4,468		4,468
1957	4,772		4,772
1958	3,733		3,733
1959	2,652		2,652
1960	3,843		3,843
1961	3,248	612	3,860
1962	3,033	1,470	4,503
1963	1,523	1,610	3,133
1964	2,999	3,172	6,171
1965	2,064	6,318	8,382
1966	2,884	7,616	10,500
1967	3,705	10,526	14,231
1968 (estimated)	5,000	14,000	19,000

(b) Production of power tillers in India

1965-66	308 Nos.
1966-67	556
1967-68	479
1968-69 (up to Aug. 68)	95

(c) Production of diesel engines in the organized sector

1961	44,482 units
1962	42,835
1963	55,540
1964	69,172

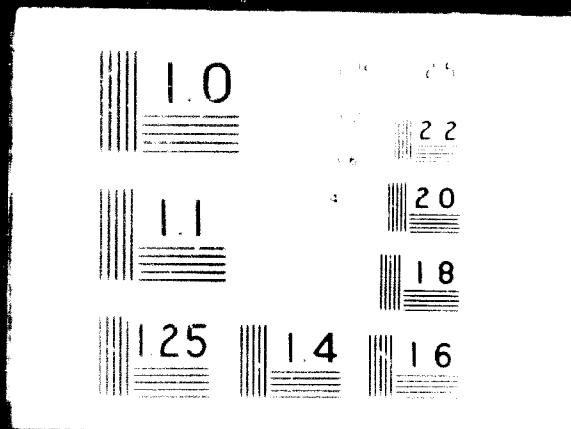


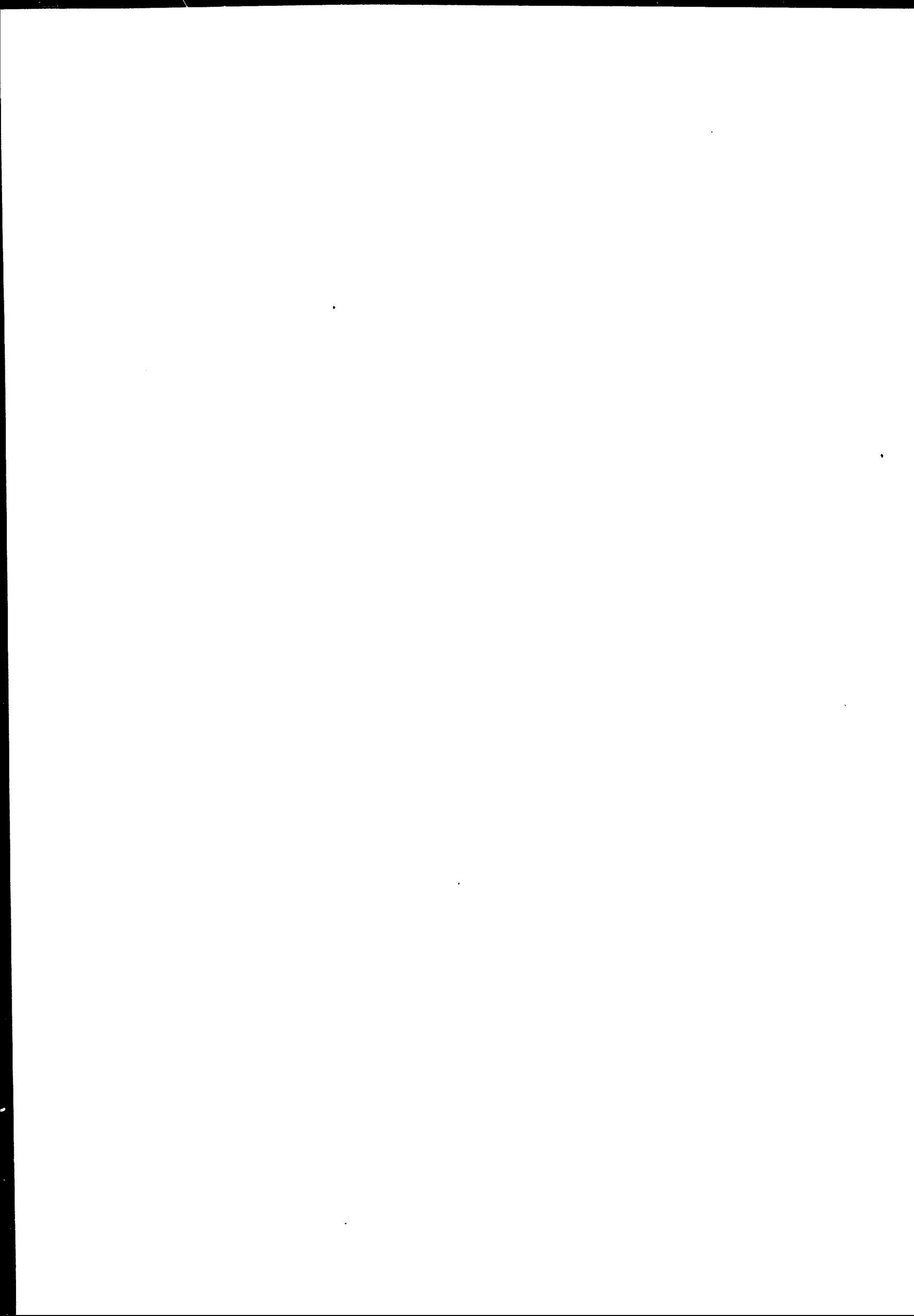
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1965	55,217
1966	107,153
1967	116,651
1968	140,000

- Note:** (a) The above figures were applicable to the large-scale sectors only. In the year 1967, the small-scale sector produced approximately 100,000 diesel engines of 5-10 hp.
- (b) About 80% of the above production figures was for the agricultural sector.

The following was the estimated total production of diesel engines in 1968 for agricultural use.

Total		210,000
Diesel 3-15 hp	120,000	
12-30 hp	75,000	
30-75 hp (for tractors)	15,000	
Gasoline engines		38,000
Micro: 1-2 hp	18,000	
3-5 hp	20,000	

(d) Production of pumps (in thousand)

1964	173.4
1965	218.5
1966	293.3
1967	342.1
1968	360.0

- Note:** These estimates excluded the production of the small-scale sector estimated to be 80,000 for 1968. About 95% of the production was made up of machines for irrigation purposes.

/(e)

(e) Importations of pumps

	<u>Quantity (Unit)</u>	<u>Value (Million Rs)</u>
1964-65	5,187	19.76
1965-66	6,313	26.71
1966-67	4,453	23.59

(f) Crop protection equipment: The estimated production of crop protection equipment for 1968 was as follows:

Hand sprayers and dusters	150,000 units
Power knapsack sprayers and dusters	15,000 "
Other types of power sprayers	3,000 "
Tractor mounted sprayers, less than	50 "

Imports were negligible

(g) Threshers: The estimated production for 1968 of threshers was as follows.

Pedal paddy thresher	15,000
Power paddy thresher	5,000
Power wheat thresher	10,000

Imports were almost nil.

(h) Production of agricultural implements

<u>Year</u>	<u>Agricultural implements^{a/}</u>	<u>Agricultural machinery^{b/}</u>
1963	17,328	Not available
1964	19,790	"
1965	22,750	"
1966	22,310	1,200
1967	22,000	1,200

^{a/} Bullock drawn implements.

^{b/} Mostly tractor drawn primary tillage implements

Note: The estimates excluded the production from the unregistered small-scale sector.

3. Estimated Projected Demand for Selected Items of Farm Machinery

Item	Type	Estimated Demand	
		1973-74	Total Fourth Plan
Mould Board Plough (30-35)*	Conventional, reversible sub-soil, chisel	25,000	90,000
Disc Ploughs (15-20)	Conventional, reversible rotators	12,000	45,000
Cultivators (60-75)	Tillers, spring loaded, inter-cultivators, spike tooth	55,000	200,000
Disc harrow (60-75)	Offset, tandem, paddy	55,000	170,000
Sowing Equipment (50-60)	Planter/fertilizers distributors, seed/fertilizers drill, gas/liquid fertilizers appliances, fertilizers broadcasting, drills or cultivators, potato, ground-nut planter	42,500	170,000
Levelling Eqpt. (40-45)	Blade leveller, line planers, scrapers, dozer blades, clod crushers, packers	27,000	80,000
Plant Protection Equipment (10-15)	Sprayer, duster	6,000	16,000
Harvesting Eqpt. (25-30)	Mowers, wind rower, reaper, binder combiner, forage harvesters	17,000	50,000
Harvesting eqpt. Special Crops (10)	Potato, maize, ground-nut	7,500	20,000
Grinding Eqpt. (5)	Rotary choppers, feed mills, feed grinders	3,500	10,000
Threshers (30-35)	Wheat, sorghum, paddy	25,000	70,000

/Processing Eqpt.

<u>Item</u>	<u>Type</u>	<u>Estimated Demand</u>	
		<u>1973-74</u>	<u>Total Fourth Plan</u>
Processing Eqpt. (25-30)	Seed cleaners, grinders, driers	18,000	43,000
Transport Eqpt. (50-55)	Trailers	37,000	138,000
Loaders		400	1,350
Pumping Sets (15-20)	P.T.O. operated	1,200	38,000

* Figures enclosed in parenthesis represented the assumed demand of a given item for every 100 tractors required according to the Fourth Plan

/4.

4. Summary of Quantity, Sales, Demand and Manufacturing in Schedule of Farm Machinery in India

Item	Quantity 1968		1968 Annual Sales		Projected Annual Demand		Manufacturing Capacity	
	Total	Imported	1970	1975	1970	1975	1970	1975
Tractors	75,000	4,500	40,000	80,000	12,000 ^{a/} 3,000 ^{b/}	30,000	30,000	50,000
Power tillers	4,000	100	5,000	25,000	300 ^{c/}	5,000	5,000	25,000
Total Engines (agr. use)	1,150,000	-	85,000	610,000	248,000	346,000	346,000	370,000
Gasoline 1-2 Hp	75,000	-	30,000	75,000	18,000	36,000	36,000	40,000
Gasoline 3-5 Hp	75,000	-	50,000	100,000	20,000	30,000	30,000	30,000
Diesel 3-15 Hp	725,000	-	250,000	325,000	120,000 ^{a/}	150,000	150,000	150,000
Diesel 12-30 Hp	200,000	-	15,000	30,000	75,000 ^{d/}	100,000	100,000	100,000
Diesel ^{e/} 25-75 Hp	75,000	-	40,000	80,000	15,000	30,000	30,000	40,000
Pumps all types	-	-	-	-	-	-	-	-
Hand pumps	-	-	100,000	300,000	-	-	-	-
Power pumps	1,500,000	5,000	300,000	600,000	700,000 ^{a/}	300,000	300,000	350,000
Deep well pumps	-	-	40,000	100,000	30,000	30,000	30,000	-

/Sprayer &

a/ Out of about 300,000 sprayers and dusters (both power and hand-operated)
b/ Assembly from imported fully knocked-down components
c/ Manufacture at substantially increasing local content
d/ About 35,000 production from large scale sector
e/ Manufactured for tractors.

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Item	Quantity 1968	1968 Annual Sales		Projected Annual Demand		Manufacturing Capacity	
		Total	Imported	1970	1975	1968 Production	1970 Installed Capacity
Sprayer & Duster all types							
Hand sprayers	200,000 ^{a/}	150,000	-	130,000	225,000	150,000	150,000
Knapsack sprayer	100,000	15,000	-	25,000	100,000	15,000	50,000
Threshers all types							
Paddy thresher (pedal)	300,000	-	-	25,000	125,000	15,000	20,000
Paddy thresher (power)	50,000	-	-	10,000	50,000	5,000	5,000
Wheat thresher (power)	25,000	-	-	20,000	50,000	10,000	10,000

a/ Out of about 300,000 sprayers and dusters (both power and hand-operated)

b/ Assembly from imported fully knocked-down components.

c/ Manufacture at substantially increasing local content

d/ About 35,000 production from large scale sector

e/ Manufactured for tractors.

5. Statement showing the production of agricultural tractors from 1961-62 to 1967-68 and the level of indigenous content reached.

	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	Total	Indigenous content - reached.
1. M/s. Tractors & Farm Equipment Ltd; Madras - 35 hp	681	1100	1450	1970	3066	3397	4087	15751	80.3%
2. M/s. Hindustan Tractors Ltd, Baroda (20 hp) (50 hp)	-	100	482	589	397	1093	1303	3964	85.0%
3. M/s. International Tractor Co. of India Ltd, Bombay - 35 hp	-	-	-	812	870	800	343	2825	57.0%
4. M/s. Escorts Ltd. E-37(34.5hp) Faridabad-Haryana E-27w(28 hp) E-47 w	-	-	-	225	-	1301	2901	4427	76.5%
5. M/s. Eicher Tractors India Ltd. Faridabad Haryana. 26.5 hp 12/18	116	132	5	144	64	92	204	757	64%
Total	897	1414	1993	4323	5714	8816	11394	34524	

6. Estimated number of diesel engines manufactured in India in 1968

Sr No.	Name of Company	Total Production	Export	Industrial Usage	Transport Usage	(Number of Units)		
						Total	5-15 Hp	15-25 Hp
1	Krausskopf Oil Engines	85,000	13,000	8,000	-	65,000	45,000	20,000
2	Cooper Engineering Co.	24,000	-	2,000	-	22,000	12,000	10,000
3.	Simpson and Co.	12,000	1,000	2,000	6,000	3,000	-	3,000
4.	Kustor Hornsby Co.	7,000	-	1,000	3,000	3,000	1,000	2,000
5.	Laxmi Nathar Engineering	5,000	-	1,000	-	4,000	4,000	-
6.	Indian Equipment Co.	2,000	-	-	-	2,000	2,000	-
7.	Indian National Diesel Eng. Co.	2,000	-	-	-	2,000	2,000	-
	Total	146,000	15,000	18,000	9,000	101,000	66,000	35,000

17.

7. Manufacturers of Agricultural Machinery

(a) Small engines

(i) Diesel engines: There were more than 100 manufacturers of diesel engines of which about 8-10 were large scale manufacturers. The total production of diesel engines was about 250,000 per year out of which 200,000 were for agricultural use. About half were produced by the large scale manufacturers and the balance by small manufacturers.

(ii) Gasoline engines: There were about 10-15 manufacturers. The three largest manufacturers produced yearly about 20,000 engines of 2-5 hp and about 18,000 engines of 1.2 hp.

(b) Power-driven pumps

There were a total of about 80-100 manufacturers. Forty were engaged in small scale operations, 45 in medium scale and about 15 in large scale. The total annual production was about 300,000. 80% of the pumps was below 5 hp and was used for agriculture.

(c) Plant protection equipment

There were about 35-40 small scale manufacturers, 6-8 medium scale and 2-3 large scale manufacturers.

(d) Threshers

There were about 60-100 small scale manufacturers.

(e) Rice hullers

There were about 20-30 small manufacturers and about 8-10 small scale producers.

/(f)

(f) Farm implements - tractor drawn

There were many small scale manufacturers, primarily manufacturing disc harrows and cultivators. Apart from implements manufacturers; tractor manufacturers, there were about 6-10 other manufacturers who had a total turnover of Rs. 2-5 million per year.

(g) Other bullock drawn implements and hand tools

There were many small scale manufacturers.

8. Ancillary Industries and Raw Material

(a) Ancillary Industries

Factories had been established for the manufacture of a wide range of ancillary items which were required particularly in the automotive industries. They included among the major items, batteries, tyres and tubes, brake linings, clutch assemblies and parts thereof, dynamos, starter motors, fuel injection equipment, valves, gaskets, pistons and rings, filters, thin-walled bearings, wheels etc.

(b) Supporting Industries

(i) Ferrous casting: Factories for the manufacture of castings such as malleable, spheroidal - graphite, cast iron and other ferrous alloy castings had already been established in the country, both in the organized and in the small scale sectors. Almost every type of ferrous casting could be made within the country except a few special types which were required for transmission housings etc. of automobiles. Even those were in the process of development.

/(ii)

- (ii) Non-ferrous castings: Factories for non-ferrous casting had also been established and could produce enough to meet the requirements of the countries outside India.
- (iii) Forging: There existed considerable facilities for producing both open and closed die forgings. Quite a number of units manufacturing automobiles, railway wagons etc. had forging capacity for meeting their own requirements. In addition, there were a large number of forging plants all over the country to cater to the needs of engineering and other industries. Much of the forging quality steel required in those industries was already being produced in India, but certain special grades of forging quality steels had to be imported.

/D. INDONESIA

D. INDONESIA

1. Agricultural Machinery Quantity^{a/}

	<u>Number of Farms using Farm Equipment and Implements</u>	<u>Number of Implements and Farm Equipment</u>
Ploughs	3,402,419	4,002,000
Special ploughs	1,100,152	1,549,910
Hand dusters	11,857	13,676
Combined duster sprayer	6,595	626
Wind mill - pump	200	200
Hand operated pump	19,360	30,609
Other types of pump	10,504	30,624
Rice huller	26,398	36,941
Cane crushers	26,182	28,506
Rubber rollers	26,629	43,176
Tractors	1,610	4,118
Carts	74,000	85,151

^{a/} Based on the 1963 Agricultural Machinery Census

2. Import and Production of Farm

(a) Imports: No reliable data were available.

(b) Production: There was one state enterprise manufacturing pumps, petrol engines and hand operated sprayers. About five private manufacturers produced pumps and hand operated sprayers.

/Estimated

Estimated Production of Farm Machinery

<u>Item</u>	<u>Specification</u>	<u>Annual Production 1967-68</u>		
		<u>State Enter- prise</u>	<u>Private</u>	<u>Total</u>
Petrol engine	3-4 Hp	less than 1,000	Nil	less than 1,000
Pumps	3-5 Hp	500	500	1,000
Sprayers	Hand operated	5,000	1,000	5,000

There were no factories manufacturing bullock-drawn implements and hand-tools on a significant scale.

3. Estimated Demand and Total Production of Farm Machinery

<u>Item</u>	<u>Specification</u>	<u>Estimated Annual Demand (up to 1970)</u>	<u>Annual Production (1967-68)</u>
Petrol engine	3-4 Hp	3,000-5,000	less than 1,000
Diesel engine	8-10 Hp	2,000-2,500	Nil
Pumps	3-5 Hp	3,000-3,500	1,200
Sprayers	Hand operated	25,000-30,000	5,000
Sprayers	Power sprayers	3,000-5,000	Nil
Power threshers	3-5 Hp	5,000-10,000	Nil
Power tiller	6-8 Hp	1,000-1,500	Nil
Tractors	35-40 Hp	150-200	Nil

E. IRAN

E. IRAN

1. Estimated Farm Machinery (1968)

<u>Item</u>	<u>Number</u>
Tractors	20,000 - 25,000
Power tillers	10,000 - 15,000
Diesel engine stationary type (agricultural usage)	20,000 - 30,000
Deep-well pumps	10,000 - 15,000
Hand pumps	60,000 - 80,000
Hand sprayers	100,000 - 125,000
Sprayers (power operated)	18,000 - 20,000
Fertilizer spreaders	400 - 600
Seed drills	1,500 - 2,000
Cultivators	10,000 - 15,000
Crushers	800 - 1,000
Mowers	800 - 1,200
Combine harvesters	1,000 - 2,000
Paddy threshers (power)	1,000 - 1,200
Rice hullers (small)	2,500 - 3,000

2. Production of Farm Machinery

	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>
Tractors (30-40 hp)	Estimated about 400 - 500/year			
Power tillers	800	1,200	1,500	3,500
Semi-mechanized paddy threshers	-	570	760	1,200
Small trailers (for power tillers)	-	140	200	500
Small ploughs, cage wheels, etc.	-	-	-	-
Pumps (including hand pumps)	2,575 ^{a/}	3,000	3,500	-
Deep-well pumps	187 ^{b/}	260	610	-

Note: a/ 1950

b/ 1964

3. Import of Farm Machinery (1965-68)

	<u>1965-66</u>	<u>1966-67</u>	<u>1967-68</u>
Tractors ^{a/}	3,879	3,093	3,247
Power tillers	-	-	2,570
Tractor engines	50	5	13
Diesel engines stationary, agricultural usage	210	227	371
Deep-well pumps	1,673	2,671	2,731
Hand pumps	3,924	11,218	8,420
Hand sprayers	16,968	26,519	23,599
Sprayers - machine	1,334	1,630	8,973
Fertilizer spreaders	56	94	134
Seed drills	301	108	638
Clod crushers	225	183	50
Cultivators	-	2,004	4,238 ^{b/}
Mowers	160	227	69
Combine harvesters	54	62	369
Threshers	303	149	812

Note: a/ Including all type 2 tractors - imports 1961 (2,500 units), 1962 (1,800 units), 1963 (1,566 units), 1964 (2,728 units).

b/ Including 1870 rotary tillers from Japan.

4. Demand for Major Forms of Farm Machinery

Tractors: Roughly, the total tractor demand by 1970 might be 4,500 units, and 7,000-10,000 units by 1975. The trend appeared to be in the range of 60-70 Hp tractor usage. They were mainly used for dry land cultivation.

Power Tillers: The market trend was towards 4½ Hp (50 per cent) and 7 Hp (35 per cent). However, with a larger area and an intensity of paddy cultivation in the Caspian area and also in other plain areas with irrigational facilities, the demand for power tiller was expected to increase. It was also felt that in future 8-12 Hp power tillers would become popular.

Engines: There would be a demand for 1-2 Hp micro engines, 3-5 Hp gasoline engines, 5-15 Hp diesel, and 12-30 hp stationary diesel engines. About 30,000 engines of all types per year were expected to be in demand by 1970.

Pumps: There was no substitute demand for hand pumps. 2"-8" centrifugal pumps would be largely used by farmers. There was a limited demand for deep-well pumps (about 3,000 by 1970).

Sprayers and Musters: The demand for hand sprayers in 1970 would be about 25,000. However, demand would increase for knapsack sprayers and trolley mounted sprayers. There would be a good market for tractor mounted sprayers also.

Threshers: Paddy: The demand in future for pedal threshers would be nil. The demand for power threshers was expected to be 1,200-1,500 by 1970.

Wheat: No wheat threshers were in use. Combines were popular, but the number was not very high. To meet the requirement of a "class" of farmers and taking into account the usage pattern in West Pakistan and India, there appeared to be a necessity to introduce power wheat threshers. Demand was expected to be about 500 by 1970.

Rice hullers:

Rice hullers: The demand for 1 ton/hour rice hullers was expected to be about 600-700 units by 1970. However, the actual number required and the demand needed further detailed investigation.

Seed cleaners: No manufacturing programme existed. There would be a demand and good scope for manufacture.

Combine harvesters: Rice: No Combine harvester was in usage. There was a necessity to introduce the same on an experimental basis.

Wheat: There was good scope for combine harvesters. There could be a place for local manufacture of self-propelled combines.

Mechanization of sugar beet: A light 30-45 Hp row-crop tractor was required in that field. About 60,000 ha of sugar beet was under package plan of integrated input and credit supply. Beet lifters were imported from Israel, Germany and U.S.A. There would be scope for a sugar beet harvesting machine.

Cotton Pickers: The Fourth Plan had no programme in that field. It was felt that it was "too early" to introduce the same on a mass scale. Although there was a need for cotton pickers, it was necessary to introduce the same on an experimental scale.

Other Equipment: Sprinkler Irrigation System: The Ministry of Water and Power had given special priority to the sprinkler irrigation system. There were irrigation loans for deep-well pumps, pumps and the sprinkler irrigation system. There was good scope for local manufacture.

Other implements: There was good scope for manufacture of disc ploughs, mould board ploughs, cultivators, harrows and seed/fertilizer drills. The government had plans to manufacture a few items in the state factory.

5. Summary of the Future Demand and Trend in Design of Farm Equipment in Iran

<u>Item</u>	<u>Specification</u>	
Crawler Tractors	60-150 Hp	About 50/year was the present demand. It might go up to about 200/year by 1975
Agricultural Tractor	20 Hp small (weight 1,000-1,200 kg)	For orchards, gardens. About 300/year by 1970. Demand may go up if suitable for paddy cultivation.
	35-40 Hp Row Crop	For sugar beet. About 500 per year by 1970. Demand for standard types might go up if used on paddy fields and for dry land crops.
	50-90 Hp	60-70 Hp appeared to be most popular. About 3,500 units per year by 1970, 6,000-7,000 by 1975 and about 10,000 per year by 1978-79.
	50-120 Hp	About 50 units by 1970 per year and about 200 units by 1975.
	Total tractors	About 4,000-5,000 by 1970 and 8,000-10,000 by 1975.
Power Tillers	6-8, 8-12	The present demand was about 4,000 units/year. The demand by 1970 was expected to be about 5,000 units and might reach 10,000 by 1975.
Engines	1-2 Hp gasoline	Demand for micro engines for plant protection was expected to be 15,000 by 1970.
	3-5 Hp gasoline	For pumps and light application, demand was expected to be 4,500 by 1970.
	3-15 Hp diesel	For power tillers, pumps etc., demand was expected to be 10,000-12,000 by 1970.
	12-30 Hp diesel	For deep-well pumps, demand was expected to be 4,000 by 1970.
Pumps	Centrifugal 2"-8"	Demand was expected to be about 10,000 by 1970.
	Deep-well	Demand for deep-well pumps was expected to be about 3,000/year by 1970.

<u>Item</u>	<u>Specification</u>	
Sprayers & Dusters	Hand operated	Demand was for about 25,000 by 1970. Trend was towards knapsack sprayers.
	Power sprayers	Knapsack and trolley mounted engine-driven sprayers would be popular. Total demand about 12,000-15,000/vr. by 1970. Demand for tractor-mounted sprayers also.
Threshers	Paddy (power)	Demand 1,200-1,500 by 1970.
	Wheat (power)	Demand 500 by 1970.
Rice Hullers	1 ton/hour	Demand by 1970 about 600-700 units.
	3-5 ton/hour	Required further investigation.
Seed Cleaners	Rice and wheat	Good scope for manufacture.
Combine Harvester	Rice	Introduction on experimental scale necessary.
	Wheat	The present import of about 300/year was expected to go up. There was scope for local manufacture of self-propelled combine harvesters.
Sugar Beet Harvesters	Root lifters	Good scope for local manufacture.
	Automatic harvesters	Necessity to introduce on a significant scale. Scope for manufacture existed.
Cotton Pickers	-	Necessary to introduce on experimental scale.
Other Equipment	Sprinkler Irrigation	Good scope for local manufacture.
	Tractor drawn implements	Good scope for local manufacture especially seed drills/fertilizers distributors, mould board ploughs, cultivators, etc.

6. Proposed Manufacturing Programme of Machinery in Teheran

Name of Industry	Estimated capacity in operation in 1967	Additional capacity commissioned	Total capacity for operation	Additional capacity under construction
Diesel engines ^{1/}	-	-	-	7,450
Centrifugal pumps	3,500	700	4,200	10,000
Deep well pumps	610	472	1,082	650
Tractors	500	-	500	5,000

	1967			1970	
	Additional capacity commissioned	Total capacity in operation		Additional capacity commissioned	Total capacity in operation
2,235	2,235	5,425	118	2,353	5,097
3,504	7,704	7,000	5,414	13,118	5,500
646	7,728	500	557	2,285	250
5,000	5,500	-	-	5,500	-

	1971			1972	
	Additional capacity commissioned	Total capacity in operation		Additional capacity commissioned	Total capacity in operation
491	5,588	1,862	1,862	7,450	-
9,073	22,191	2,500	5,161	27,352	-
1,293	3,578	-	154	4,009	-
-	5,500	-	-	5,500	-

^{1/} Including for industries and other usage.

7. Summary of Details of Manufacturing Programme of Farm Machinery in Iran

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Item	Manufactured by or to be manufactured by	Collaboration with	Model	Specification	Estimated production units per year	
					1968	1971
1. Agricultural tractors	B.M. Volvo Teheran	B.M. Volvo Goeteborg, Sweden	35 Hp		250	250
	Metallurgical Engineering Plant, Tabriz (Tractor plant)	UZINA Tractoral Brasov, Rumania	U-650 U-651		-	4,000 1,000
2. Power tillers	Ashtad-Iran Co., Teheran	Mitsubishi Heavy Industries Ltd., Tokyo, Japan	CT-331H3C CT-531K5A CT-531SD5 CT-835D6	5 Hp-Petrol 7 Hp 7 Hp-diesel 8 Hp-diesel	3,500	5,000
3. Stationary diesel engine (including)	Metallurgical & Engineering Plant-I	Slavia Napajedla Czechoslovakia	1-S-100K 2-S-100K 3-S-100K	9 Hp 18 Hp 27 Hp		2,250 1,750 300
4. Pumps	- " -	- " -	15 models	2"-10"		10,000
5. Diesel engine	Private company	English Electric Co., Ltd. Stafford G.B. (Dorman)	2 L-B 2 I-B 5 L-B 6 L-B	24 Hp 64 Hp 91 Hp 230 Hp (4 stroke water cooled)		4,000
6. Tractor mounted on drawn agricultural implements	Machine Building Plant, Tabriz	Not yet decided (probably USSR)	11 implements	-	-	8,000 t/yr
7. Power tiller implements	Ashtad-Iran Col, Teheran	Mitsubishi Heavy Industries Ltd.	Flows, cage wheels etc.	-	-	-
8. Paddy threshers	"	-	-	2 types	1,200	-
9. Small trailers	"	-	3/4 ton	-	500	-

/F.

F. REPUBLIC OF SOUTH KOREA

1. Farm Machinery Estimate

	<u>Units</u>
1. <u>Ploughing machines</u>	
Ploughs	970,510
Power tiller	3,819
Tractors	34
2. <u>Anti-Insect Equipment</u>	
Hand power sprayer	43,148
Hand sprayer	183,373
Power equipment	12,768
3. <u>Threshing machines</u>	
Rake thresher	528,799
Hand thresher	373,692
Power-driven	25,474
4. <u>Winding Machines</u>	
Hand	219,334
Power-driven	7,304
5. <u>Straw Rope Machines</u>	
Pedal driven	67,698
Power driven	340
6. <u>Straw Bag Machines</u>	
Hand operated	413,173
Pedal driven	44,754
Power-driven	63
7. <u>Pump</u>	
Hand operated	46,463
Power-driven	31,613

/8. Other

	<u>Units</u>
8. <u>Other Agricultural Implements</u>	
Sewing machines	1,255
Weeders	450,078
Hullers	25,708
Rice polishing machines	43,058

Source: Farm Machinery Census (1967)

2. Production and Trade of Farm Machinery

(a) Import of five major power machinery produced during the past five years

Year	Automatic cultivators		Tractors		Hand-operated sprayers		Power sprayers (n.e.s.)	
	US\$1,000	Units	US\$1,000	Units	US\$1,000	Units	US\$1,000	Units
1963	141	-	76	-	-	-	316	-
1964	108	-	72	-	-	-	318	-
1965	42	23,542 ^{a/}	22	2	2	216	41	2,474
1966	38	5,577 ^{a/}	915	28	2	129	109	1,648
1967	257	709 ^{a/}	8	3	3	115	321	4,131

Source: Commerce and Industry Statistics Yearbook, 1968

^{a/} These estimates seemed to refer to parts or components of power tillers.

(b) Five major power machinery produced during the past five years

Year	Sprayers ^{a/}	Threshers	Power tillers	Engines	Rice millers	Water pumps
1963	77,334	3,155	-	7,266	6,600	20,993
1964	66,652	3,897	263	8,186	8,102	14,301
1965	41,444	3,243	708	15,119	5,210	9,486
1966	50,845	2,966	748	9,434	4,065	3,566
1967	63,094	3,127	6,762	13,033	2,442	6,288

Source: Commerce and Industry Statistics Yearbook, 1968.

^{a/} Including man-power

/(c)

(c) Exports

Exports were reported for 1967 for 61 engines, 200 power tillers and 43,216 hand shovels.

3. Demand and Sale of Farm Machinery

Four-wheel tractors

Demand was very limited because of the small size of the holdings and lack of finance by the farmers. 58 tractors were reported to be in use in 1968 in the range of 35 Hp to 47 Hp (Ford and Bolinders; 40 others were being imported from Japan).

Crawler tractors and threshers

A few of them (16) had been imported for land development and land reform.

Power tillers

Introduction of power tillers from Japan started in 1957. In 1961, 30 units and in 1962 90 units had been used. In 1967, two companies were licensed to assemble power tillers. In 1968, 5350 power tillers were reported to be sold with the following distribution:

6 HP	8 HP	9 HP	10 HP
400	2380	920	1650

and the total number sold by the National Association of Farmers Co-operatives (NACF) was 9,265 at the end of 1968. 80% of the power tillers were sold to individual farmers and many of them were rented or leased to other farmers part-time. The other 20% were bought by contractors. They were mostly used for tillage with rotary tillers (twice for each crop) and also for transport and for operating paddy threshers and rice hullers (200 days a year). Sales were almost entirely made by NACF with a subsidy of 30% and 30% loan at 9% interest rate for 5 years.

/Engines

Engines

Data were not available for sales in agriculture. Input statistics mention 5,850 units gasoline engines and 577 diesel engines imported in 1967 and production figures for the same year were 13,033. In 1967, 4059 engines had been delivered for irrigation pumps (50% diesel - 50% gasoline).

Pumps

Irrigation pumps were provided free by the government to village self-governing bodies which lend them to the farmers on a rental basis. 4059 units (pumps and engines) had been supplied in that way in 1967.

Sprayers and dusters

Hand sprayers were very popular in Korea. About 40,000 were sold in 1968 but there was a tendency towards the use of power knapsack sprayers: 2,000 in 1968 partly manufactured in Korea. (Total government supply was 2,200).

Harvesting machines

Harvesting of paddy and other cereals was entirely done by hand.

Threshing machines

Simple pedal-operated paddy threshers were widely used. Production in 1968 was around 5,000 for a production capacity of 20,000, showing that the market was almost flooded. Demand was towards power threshers automatic or semi-automatic (as concerning the feeding) about 3,000 a year.

4. Manufacture of Farm Machinery

Item	No. of mfgs	Claimed Production	1968 Production	Import %
Power tillers	2	10,000	5,000	30
Power sprayers	2	10,000	2,000	50
Hand sprayers	4	100,000	50,000	nil
Power pumps	10	30,000	5,000	nil
Manual threshers	10	20,000	5,000	nil
Automatic threshers	2	1,000	200	nil
Semi-automatic threshers	3	2,000	500	nil
Diesel engine (including 2 power tillers)	4	20,000	5,000	Raw material
Grain polishing, husk- ing, milling, etc.	4	10,000	500	nil
Hand tools	37	-	-	-

/G.

G. MALASIA

1. Farm Machinery Estimate

West Malaysia^{a/}

(as at the end of March 1968)

Description	4-wheeled tractors	2-wheeled tractors	Power threshers	Water pumps	Power sprayers	Total
Departmental machinery	170	66	87	111	153	587
Machinery owned by farmers	310	817	14	243	103	1,487
Machinery owned by contractors	590	58	1	67	18	734
Machinery owned by Farmers Association and Co-operative Societies	24	66	1	2	1	94
Total	<u>1,094</u> =====	<u>1,007</u> =====	<u>103</u> =====	<u>423</u> =====	<u>275</u> =====	<u>2,902</u> =====

a/ Data for Sabah and Sarawak were not readily available. The above figures do not include machinery used on estates.

/2.

2. Imports of Farm Machinery for the whole of Malaysia
(1958-67)

Item	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Tractors 4-wheel or track 40 hp and above	197	392	523	646	374	445	64	51	114	31
Crawler tractors - 95 hp and above	92	137	447	365	400	211	277	295	378	137
Tractors and power tillers up to 40 hp	170	140	105	310	722	843	490	490	472	590
Diesel engines - stationary 50 hp and above	866	1218	1354	2944	2669	3316	3261	3642	3362	2666
Centrifugal and rotary pumps	1870	2492	2840	3156	4134	5594	7076	8350	8172	8863
Machinery for soil preparation	143	518	714	782	29	42	-	-	-	-
Harvesting threshing machinery	2	18	80	1025	268	536	-	-	-	-

3. Demand and sales of farm machinery

No reliable data were available regarding actual sale figures of farm implements. The demand trend patterns were however, expected to run as follows:

(a) Crawler tractors:

About 75% of imported crawler tractors were used for industrial and construction purposes. About 25% were used for land clearing and limited agricultural usage.

(b) 4-Wheel riding tractor:

Usage: In paddy fields, around 60 hp tractors were widely used. They were normally owned by the contractor for custom work for agriculture. 35-45 hp tractors were used on estates for transport purposes.

Sales: It was estimated that the total sale in 1968 was about 600 tractors.

Ford	30%
Massey Ferguson	40%
International Harvester	20%
Nuffield and others	10%

(c) Power tillers:

Usage: In West Malaysia during the past couple of years, an increased number of power tillers had been imported. Normally they were farmer-owned.

Market share: The estimated demand was about 800 units and would go up to 1,000 a year in 1969. The most popular HP range was 8-10 hp.

/(d)

(d) Engines:

Diesel engines: No diesel engines were being manufactured. Since diesel fuel was inexpensive (about M\$0.78 per gallon), diesel engines were popular. No tax relief for usage of diesel oil for agriculture was offered. The engines were imported. The estimated demand for engines was about 3,000 per year, excluding engines for power tillers. The horsepower ranged from 4 to 14 hp.

Gasoline engines: There was also a necessity for 1-2 hp gasoline engines for power sprayers.

(e) Pumps:

Centrifugal water pumps for dry land cultivation were becoming popular. Only pumps used in the mining industry were being manufactured. The total demand for pumps was about 1,500 per year.

(f) Sprayers:

The usage of hand-operated sprayers had just been started. There were not very many power sprayers. However, with emphasis on paddy and other dryland crops, their usage was expected to increase.

(g) Dryers:

More than 15 types of dryers were being imported and tests were being carried out. It was expected that dryers would become popular and would be bought by millers, contractors and farmer associations.

Big dryers with 3-4 tons/hour up to 10 ton/hour costing about M\$ 30,000 were suitable for big licensed rice mills.

(h) Threshers:

The pedal-type of threshers introduced were not popular because of low capacity. There was a great necessity for power driven high capacity threshers.

(i) Harvesting and threshing:

A few self-propelled and pedestrian combine harvesters had been imported. As combine harvesting was a new concept, it was expected that it would take some time to educate the farmers in its usage. The self-propelled combines were being tested in the paddy fields. A 7-foot combine imported - it was reported - had taken $2\frac{1}{2}$ hours per acre whereas a 13-foot combine had taken $\frac{1}{2}$ hour per acre. However, the results were not conclusive. The small roads and small fields offered limited market for big self-propelled combine.

The small riding combine harvester, had a maximum capacity of 2 acres per day. Although it was slow compared to the big combine, it might offer an intermediate solution, for harvesting problems. In that connection, it was to be pointed out that the labour input for harvesting paddy was 21 man days/acre costing M\$63/acre out of which about M\$36-39 were given to hired labour. The time interval factor for harvesting in double crop areas would become very critical.

During the next 4 or 5 years, it might be advisable to introduce different makes of combine harvesters and popularize them.

(j) Tractor drawn implements:

For estates and dry land cultivation, the following were popular:

- Disc ploughs
- Disc harrows
- 3 ton trailers

For paddy, cagewheels and rotary tillers were popular. As government was encouraging crops such as maize, tapioca and sorghum, seed drillers, fertilizer distributors, and harvesting equipment would be

/necessary.

necessary. The target was 50,000 ha of maize and sorghum. The quantity offered limited scope for local manufacture. Again, although about 48,000 ha of sugar cane was expected to be planted in the near future, the scope for local manufacture of specialized machinery for sugar cane was limited.

(k) Trailers:

There were a few firms making trailers locally with about 20-30% local content. Tyres, tubes and bodies were locally made while axles, chasses and brakes were imported. There was a need for varied types of trailers - having 2, 4, and 6 wheels.

Trailers were used for farming and non-farming operations extensively.

5. Estimated Demand and Future Trend for Major
Agricultural Machinery

Item	Specification	Estimated demand in 1969	Future trend 1972-73
4 wheel riding tractor	35-45 hp	200-300 (Estate)	Total demand by 1972-73 is about 1200-1500. It is expected that percentage share of 35-45 hp tractors will go up as it may be used by farmer owners for paddy and upland.
Power tiller	8-10 hp	1000-1500	Demand by 1972-73 will go up by 2000-25000
Pumps	2"-6"	1000-2000	As dry land cropping is being encouraged, demand will go up to 4000-6000 by 1972-73.
Engines	4-10 hp (diesel)	3000-5000	Estimated demand 5000-7500
	1-2 hp (petrol)	500	Estimated demand 2000-3000
Sprayers	Hand operated power	10,000	20,000
			3,000
Dryers	$\frac{1}{2}$ ton per hr 4-10 tons/hr	-	Need introduction and extension for the present.
Threshers	Power operated	500	Need introduction and extension for the present.
Combine harvester	2 row	75-100	Need introduction and extension for the present.

/H. NEPAL

H. NEPAL

1. Farm Machinery Estimate

No survey on farm machinery had so far been made. Surveys on farm machinery were due to be undertaken by census department on the agricultural census programme.

However, in 1960, it was estimated that the number of agricultural tractors was 210 and the number of garden type tractors 11. The number in 1968 was estimated as follows:

Tractors (Agricultural)	700
Power tillers ^{x/}	15

^{x/} The power tillers in use were mostly for demonstration purposes.

2. Import of Tractors and Farm machinery

As from 1967, the following types of implements were imported:

Item	Specification	Approx. units
Tractors	25-35 Hp	600
Irrigation pumps	8-10 Hp with engine centrifugal	150
Power tillers	-	15
Hand pumps	For water supply	50,000
Mouldboard ploughs	Bullock drawn	15,000
Plant protection equipment		500
Rice huller with engine or motor		1,000
Pedal threshers		200
Power threshers		10
Hand implements		100,000

3. Estimated Demand of Farm Equipment in Nepal (1969-1974)

Item	Specification	Estimated demand	
		1969-70	1973-74
Riding tractors	30-45 Hp	100	300
Power tillers	8-10 Hp	50	500
Power threshers	18" size drum for rice & wheat	100	500
Knapsack sprayers	35 cc. 6-8 kg (engine operated)	150	500
Irrigation pumps	5-10 BHp TDH -30-40 ft	200	1,000
Deep-well pumps	TDH 100-200 ft., 20-40 BHp, engine or motor	50	100
Rice hullers	20 BHp engine or motor	50	200
Oil crushers			
Flour mills			
Dryers	Mobile type	10	100
Mould board ploughs	Animal drawn 6"	10,000	50,000
Cultivators	Animal drawn - 3 tine	1,000	10,000
Harrow	Animal drawn - peg tooth type	1,000	10,000
Ditchers	Animal drawn	250	Needs extension work
Hand sprayers & dusters	Knapsack type	100	1,000
Pedal threshers	-	500	1,500
Harvesting equipment	Animal drawn	25	150

/I. PAKISTAN

I. PAKISTAN

1. Estimated Farm Machinery Population

	<u>East Pakistan</u>	<u>West Pakistan</u>
Tractors (Track & non agricultural)	75 - 100	1,000 - 2,000
Tractors (Agricultural)	1,200 - 1,300 ^x	20,000 - 22,000
Power tillers	2,000 - 2,500	less than 50
Tube-well pumps	not known	50,000 - 60,000
Centrifugal pumps	11,041	not known
Diesel engines	not known	not known
Wheat threshers	20 - 50	1,500 - 2,500
Combine harvesters	3	20 - 30
Hand Sprayers & Dusters } Power Sprayers & Dusters }	20,000 - 25,000	5,000

x As estimated by private tractor dealers; official estimates: around 500-600.

2. Import of Tractors to Pakistan

(Value in Rupees)

<u>Year</u>	<u>Private (Rs.)</u>	<u>Public (Rs.)</u>	<u>Total (Rs.)</u>
Jan.-Dec. 1955	5,710,966	-	5,710,966
1956	4,529,117	-	4,529,117
1957	5,255,555	2,269,562	27,951,217
1958	6,540,062	10,334,116	16,880,178
1959	4,617,946	6,421,990	11,039,936
1960	16,282,322	8,650,784	24,933,106
1961	12,866,913	4,355,705	1,722,618
1962	17,631,458	1,809,299	19,440,757
1963	1,621,103	1,284,139	17,705,242
1964	22,060,431	5,317,305	27,377,730
1965	28,518,670	53,655,907	34,154,577
1966	-	-	57,367,776

/Complete data

Complete data about the actual number of tractors imported in the country were not available.

3. Estimated Existing Major Manufacturing Facilities for Farm Equipment in Pakistan (in unit)

Item	Total		West Pakistan			East Pakistan		
	No. of Plants	Production Capacity 1968	No. of Plants	Prod. 1968	Capacity	No. of Plants	Prod. 1968	Capacity
Tractors 30-45 Hp	2	1,700	3,500	1	1,700	3,500	-	-
Diesel Engines 10-30 Hp	4	11,500	17,000	3	9,000	14,000	1	2,500 3,000
Centrifugal Pumps	3	12,500	19,000	2	9,000	15,000	1	3,500 4,000
Deep well Pumps	3	3,000	3,200	2	800	2,000	1	1,000 1,200
Threshers Wheat Power Driven	2	950	2,000	2	950	2,000	-	-
Sprayers (hand operated)	3	8,500	15,000	2	7,500	10,000	1	less than 5,000 1,000

4. Future demand for major forms of farm machinery

(1) Tractors: In West Pakistan, the demand of 3,000-4,000 tractors of 45-55 Hp and 1,000-1,500 tractors of 55-65 Hp by 1969-70 was expected to increase to 6,000-7,000 and 3,000-4,000 tractors respectively by 1974-75. The demand for tractors in the higher horsepower range was anticipated to be of higher percentage in 1975 than the demand in 1968. In East Pakistan, the maximum demand would be in the range of 30-45 Hp tractors. The demand

/by 1969-70

by 1969-70 was estimated to be about 500 and was expected to increase to about 1,000-1,250 in 1974-75.

- (ii) Power tillers: In West Pakistan, power tillers had not yet been marketed although it was expected that their demand could be substantial if higher gains were obtained in the larger-sized paddy fields with the use of irrigation. There appeared to be a good market for power tillers in East Pakistan farm. Almost all the agricultural lands were planted with paddy. The demand for power tillers was around 1,000 units a year. That might increase to 1,500 by 1969-70 and to about 4,000 by 1974-75.
- (iii) Engines: The demand for 1-2 Hp gasoline micro engines was expected to increase from about 10,000 in 1969-70 to about 18,000 in 1975. For 3-5 Hp kerosine/gasoline engines it was expected to increase from 4,000 in 1970 to 10,000 in 1975. For 3-15 Hp Diesel engines it was expected to increase from around 25,000 in 1970 to 60,000 in 1975.
- (iv) Pumps: The demand for hand pumps was expected to be limited. The demand for 2-4" centrifugal pumps was expected to increase from 20,000 in 1970 to around 50,000 in 1975. There was a necessity to introduce low lift paddy propelled pumps in East Pakistan.
- (v) Plant Protection Equipment: In West Pakistan, the annual demand for hand sprayers in 1975 was expected to be around 50,000 units. The demand for 1-2 Hp knapsack sprayer was expected to go up from around 10,000 in 1970 to around 20,000 in 1975. In West Pakistan the demand trend would be towards tractor-mounted sprayers and in East Pakistan towards boom and power tiller-mounted sprayers.

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- (vi) Threshers - Paddy: The existing wheat threshers were suited for 'Indica' type paddy. However, it might not be efficient with the 'Japonica' variety of paddy. The demand for pedal-operated threshers was expected to be limited while the demand for power operated threshers might be around 5,000 by 1975 if a suitable thresher could be introduced. In East Pakistan, the demand for pedal-operated threshers might be around 5,000 by 1975 while the demand for power paddy threshers might increase from 3,000 by 1970 to 10,000 by 1975 if a suitable design were introduced.
- (vii) Threshers - Wheat & Paddy: The present wheat threshers manufactured in West Pakistan had capacities in the range of 300-500 kg/hr. The demand for power wheat threshers was likely to increase from 5,000 units by 1969-70 to around 20,000 by 1975 and more if a suitable paddy cum wheat thresher were introduced.

5. Summary of the Estimated Demand and Trend in Design for Farm Equipment in Pakistan

	Specification	Demand in 1969-70	Demand in 1974-75	Remarks
Agricultural Tractors	West Pakistan (WP)	3000-4000 1000-1500	6000-7000 3000-4000	Demand during 1974-75 would greatly increase and higher horsepower range might be required in a higher percentage than that at present.
	East Pakistan (EP)	500	1000-1250	Usage on wet land and winter crops with irrigation facilities was expected to increase.
Power Tillers	WP	100	not known	There was a market for farm equipment to service the needs of about 520,000 rice farms. Necessary to import power tillers to conduct demonstration and extension.
	EP	1500	4000	There was a good potential for power tillers. Power tillers had gained acceptance.
Engines	WP	5502	Total around 15,000-20,000	Demand would increase, primarily for the usage of plant protection.
	EP	5500		
	WP	1000	Total around 8,000-10,000	Primarily for light work. Demand would not significantly increase.
	EP	3000		
	WP	15000	40-50,000	Primarily used for pumps, power tillers and other light work.
	EP	9000	15,100	
	WP	4000	Total around 15,000-18,000	Used for pumps and other stationary work. Demand in West Pakistan would grow at a slower rate because of extension of rural electrification.
	EP	limited		

		Specification	Demand in 1969-70	Demand in 1974-75	Remarks
Engines (continued)	WP	Diesel (for tractor)	5,000	10,000	Demand estimates were primarily for tractors.
	EP	30-75 Hp			
	EP	30-45 Hp	500	1,200	
	WP	Hand pumps	1,000	5,000	Limited demand.
	EP	"-			
	WP	Centrifugal 3-15 Hp	15,000	40,000-50,000	In East Pakistan, there was a necessity for paddy propeller pumps and low lift pumps. For 2"-6" centrifugal pumps demand in West and East Pakistan increase.
	EP	"-	5,000	10,000-15,000	
	WP	Deep well 20 Hp & above	12,000	25,000-35,000	With increased land reclamation projects, demand was expected to go up.
Sprayers & Dusters	WP	Hand sprayers	7,500	Total around 50,000	Demand would tend to increase.
	EP	"-	10,000		
	WP	Knapsack	5,000	Total around 15,000-20,000	Demand in West Pakistan would tend towards tractor-mounted sprayers.
	EP	"-	5,000		Demand in East Pakistan would tend towards boom-sprayers and power tiller-mounted sprayers.
Threshers	WP	Pedal operated	limited	limited	Although demand might increase, trend would be towards power operated threshers.
	EP	"-	1,000	around 5,000	
	WP	Power-Paddy	limited	around 5,000	Demand for a larger capacity thresher would increase. In West Pakistan a combination of wheat and paddy threshers was necessary.
	EP	"-	3,000	10,000	
	WP	Power-Wheat	5,000	15-20,000	Although demand would increase in West Pakistan, trend would be towards combine harvesters.
	EP	"-	limited	around 1,000	

/s/owers,

Specification	Demand in 1969-70	Demand in 1974-75	Remarks
Mowers, Reapers and Binders	-	-	There was a need to introduce the same.
Combine Harvesters	-	-	Combine harvesters had just been introduced. The future demand might be towards self-propelled combines.
	-	-	For West Pakistan, a combine harvester for both wheat and rice was necessary. In East Pakistan, testing and extension work on small rice combines might be desirable.
Paddy Transplanters	-	-	It was desirable to introduce on a modest scale for testing and demonstration purposes.
Rice Processing & Equipment	-	-	A detailed analysis of rice processing was necessary. Import testing should continue on a more intensive scale. It was necessary to establish the capacity, and processing techniques.
Other Implements (Tractor Drawn)	-	-	The demand was expected to go up. It was necessary to examine the production potential and draw up detailed manufacturing plans.
	-	-	Demand for all such implements would go up.

/J. PHILIPPINES

J. PHILIPPINES

1. Estimates of Farm Machinery

<u>Items</u>	<u>Estimated Number in 1968</u>
Four-wheel tractors	12,000
Power tillers	7,500
Engines	(.....)
Water pumps	90,000
Threshers	8,000
Sprayers	60,000
Sugarcane crushers	2,300 ^{1/2}
Abaca stripping machines	5,700 ^{1/2}
Rice and corn mills	3,500
Rice hullers/cleaners including cone-type mills	4,000
Power cultivators	(.....)
Animal ploughs	1,951,000 ^{1/2}
Harrows	1,315,300 ^{1/2}

Farm machinery estimate was to be understood as the summation of the total sales and imports, disregarding obsolete machines and those in disuse.

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2. Import of Farm Machinery

I t e m s	1963		1964		1965		1966		1967	
	Qty. (pcs)	x Cost (CIF)	Qty. (pcs)	x Cost (CIF)	Qty. (pcs)	x Cost (CIF)	Qty. (pcs)	x Cost (CIF)	Qty. (pcs)	x Cost (CIF)
1. Ploughs animal drawn	6,107	330,354	7,511	365,217	1,223	47,539	2,553	26,194	971	435,231
2. Cultivators animal drawn	233	81,763	111	33,471	815	193,976	627	99,711	253	107,133
3. Harrows animal drawn	618	241,698	3,223	258,046	272	77,722	32	38,082	940	219,751
4. Other Agri. Machinery for the Preparation of soil	1,071	179,993	3,391	699,230	10,355	388,423	3,744	933,812	9,709	2,823,135
5. Reapers	-	-	112	3,724	102	5,201	6,080	12,809	12,129	46,763
6. Rice threshers	50	3,128	70	2,602	73	18,193	133	36,034	278	124,108
7. Mowers	1,217	17,965	859	15,565	273	22,252	238	24,086	299	5,438
8. Rice Hullers Cleaners Incl. cone type mills	2	700	10	2,124	10	3,965	964	18,166	31	12,514
9. Other machinery, harvest threshers	25	48,659	299	86,284	1,535	80,477	266	171,016	321	129,925
10. Tractors, including power tillers	1,006	4,362,739	3,252	3,790,248	618	2,215,607	634	2,414,241	1,938	6,915,135
11. Crawlers	1,686	3,106,441	386	4,069,902	239	2,428,492	331	4,083,877	2,429	11,026,790
12. Engines, stationary gasoline and kerosene	-	-	-	-	18,739	1,159,688(FOB)	-	-	-	-
13. Diesel and semi-diesel engines, marine, stationary and locomotive	-	-	-	-	4,971	4,608,091(FOB)	-	-	-	-

x Cost in US dollars equivalent.

3. Production of Farm Machinery

Riding tractors: In 1967, 1200 tractors representing 80% of the total domestic sales were assembled by two firms.

Power tillers: Nearly all the power tillers marketed in 1967, estimated at 2,800 units, were assembled at no substantive local content by assemblers of 15 various brands.

Engines: There was no significant production of engines for agricultural purposes.

Pumps: In 1967, the demand for pumps for agricultural use was about 6,000 units which was met almost entirely by local production.

4. Future demand for Agricultural Machinery

The following was a breakdown of the estimated sales and projected demand of selected farm machinery.

	<u>1968 Annual Sales</u>	<u>Projected 1970</u>	<u>Demand 1975</u>
Four-wheel tractors	1,500	1,800	4,000
Power tillers	2,800	3,500	7,000
Engines	n.a.		
Micro-gasoline	(...)	6,000	-
Small gasoline	(...)	5,000	-
Small diesel	(...)	8,000	-
Medium-sized diesel	(...)	200	-
For tractor	(...)	1,800	-
Water pumps	6,000	10,000	20,000
Power sprayers and dusters	(...)	5,000	-
Hand-operated sprayers & dusters	(...)	10,000	-
Power operated paddy threshers	(...)	3,000	-
Foot-operated paddy threshers	(...)	2,000	-

✓. THAILAND

K. THAILAND

1. Estimate of Farm Machinery in Thailand (1968) (number of units)

Riding tractors	28,000
Crawler tractors	4,250
Power tillers	2,800
Ploughs general	100,000
Harrows	50,000
Cultivators	500
Seed distributors	250
Fertilizer distributors	150
Harvesting machines	90
Threshing machines	250
Hullers & shellers	100
Winnowing machines	300

2. Import of Farm Machinery (number of units)

	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>
Tractors (including power tillers)	1,922	3,446	3,047	3,862	4,036
Tractors (crawler type)	1	418	473	677	1,348
Ploughs	12,158	5,966	15,176	26,378	
Harrows	236	5,600	733	15,869	
Cultivators	107	22	18	21	
Seed distributors	3	6	64	31	
Fertilizer distributors	6	8	1	29	
Harvesting machinery	1	3	21	12	
Threshing machinery	12	53	24	41	
Hullers & shellers	31	3	19	3	
Straw & fodder presses	2	4	21	4	
Hay & grass mowers	2,060	3,189	3,113	4,287	
Winnowing and similar machines	3	1	5	121	

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3. Demand and Sales of Farm Machinery

- (a) Tractors: It was estimated that the present annual demand for farm tractors ranged from 3,200 to 3,600.
- (b) Power tillers: The demand for power tillers was expected to be around 1,000 units per year.
- (c) Other farm machinery:
 - (i) Included were implements for tractors. The most popular implements were mounted disc ploughs, cage wheel and disc harrows. A few of them were imported but most of them were made locally by small manufacturers at low cost.
 - (ii) There was a great demand for pumps-centrifugal and lift propeller types - used for irrigation and engines-gasoline or diesel.
 - (iii) Regarding all other operations such as harvesting and threshing of paddy, no other operations such as harvesting and threshing of paddy, no other forms of machinery were used to any great extent.

4. Farm Machinery Manufacturers

- (a) Farm tractors: Two firms now assembled farm tractors at a combined output of 3,000 units a year. Before the end of 1969, two more firms, would start assembling tractors from imported components.
- (b) Power tillers: A few numbers were made locally by small manufacturers with imported engines.
- (c) Diesel engines: No diesel engines were presently manufactured.

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- (d) Pumps: Small centrifugal pumps were locally manufactured and sold widely in the local market. The sturp-tail pumps which had been developed by the Engineering Division of the Rice Department were still produced in limited quantities. Pumps of bigger capacities were imported. Pump makers imported the engines since none were yet locally available. It was estimated that there were about 30 one-room workshops manufacturing propeller pumps, of which a few were of medium sizes and manufactured about 40-50 pumps a day for three months of a year.
- (e) Farm implements: Four firms were known to manufacture iron ploughs and disc harrows. They were small enterprises located up-country. The one in Chonburi was perhaps the biggest among them. As late as 1967, the firm manufactured about 3,000 iron ploughs per year, but now the firm produced only disc harrows.
- (f) Sprayers and dusters: No power operated knapsack sprayers were manufactured. However, about 5-6 small firms were manufacturing hand sprayers at a total capacity of about 1,000/year.
- (g) Rice milling machines:
- (i) The Engineering Division of the Rice Department had introduced a centrifugal rice huller and polisher with a maximum output capacity of 400 kg of white rice per day.
 - (ii) The Rice Milling Industry Co., Ltd. manufactured 'Pinco' rice mills with a capacity of 24-30 tons per 24 hours of high-grade rice.
- (h) Grain dryers: No manufacture had yet been undertaken although research in this field was being done by the Engineering Division.

5. Research and Testing

The research and development work of the Engineering Division of the Rice Department of the Ministry of Agriculture had developed many agricultural implements suitable for local conditions. It was reported that the Division had been allocated only a small sum for this research work each year (about US\$100,000 in 1967-68). 60% was for wages and salaries. Hence it was difficult to demonstrate the effectiveness and capability of the developed machines on a nation-wide basis in order that they might be accepted and become popular among the farmers. At present there was no manufacturing firm which mass-produced such equipment. The Government had however supported the establishment of the Mechanized Equipment Co., Ltd. and the Thai Machinery Co., Ltd. with the hope that those firms would eventually manufacture the machinery developed by the Engineering Division.





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