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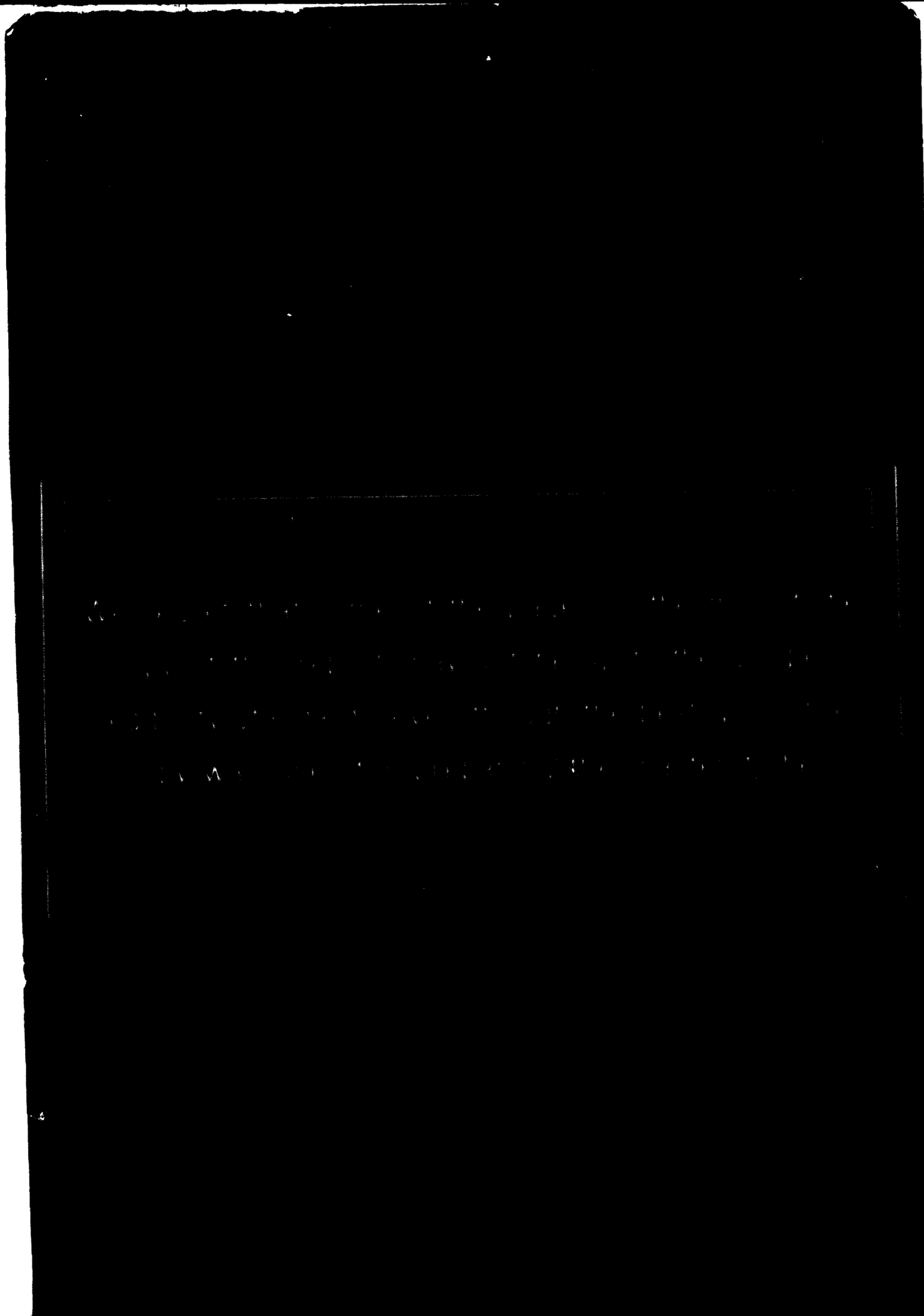
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org



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Expert Group Meeting on the Design and Manufacture of Wet-land (Rice) Mechanization, Harvesting and Threshing Machinery in Developing Countries of Asia and the Far East Region

Los Baños, Laguna, The Philippines
12 - 17 March 1973

COUNTRY STUDY REPORTS ON THE RICE MECHANIZATION MACHINERY AND IMPLEMENTS MANUFACTURE IN THE SELECTED NINE COUNTRIES* OF ASIA AND THE FAR EAST REGION[1/]

(* Burma, India, Indonesia, Iran, Korea, Nepal, Pakistan, Philippines and Thailand)

by

Mr. G. Pellissi: UNIDO Consultant (Team leader)

Mr. M. Turrini: Consultant on manufacture of agricultural machinery in Italy

(9 July - 27 September 1972)

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1 - INTRODUCTION

1.1 - The team of experts was entrusted with carrying out a preliminary mission in nine countries of ECAFE for the purpose of studying problems of the design and construction of Wet-land mechanization machinery in those countries. In particular, it was charged with and made responsible for the following tasks :

- to prepare a study on the status of agricultural machinery and implement manufacture and their allied facilities and services, such as design, adaptation, testing, repair and maintenance, with specific reference to rice mechanization, the nature of specific problems of their development and use and development of storage and transport equipment for use in agriculture;
- to identify local manufacturers who may be interested in product diversification and expansion of their manufacturing facilities;
- to brief the participants chosen to attend the Expert Group Meeting on the subject to be discussed, and assist them in preparation of the reports which each country is expected to submit prior to the meeting.

This because, following up the mission, an Expert Group Meeting, organized by UNIDO and the International Rice Research Institute, will be held at Los Banos, the Philippines, during the second week in March, 1973. The purpose of this meeting is to discuss the main objectives of the mission.

1.2 - The mission visited the following countries : India (July 14, 1972 - July 21, 1972); Nepal (July 21, 1972 - July 27, 1972); Burma (July 29, 1972 - August 3, 1972); Thailand (August 3, 1972 - August 12, 1972); Korea (August 12, 1972 - August 19, 1972); the Philippines (August 19, 1972 - September 3, 1972); Indonesia (September 3, 1972 - September 9, 1972); West Pakistan (September 10, 1972 - September 17, 1972); Iran (September 18, 1972 - September 23, 1972). In

addition, it spent four days briefing (July 10-14, 1972) and three days debriefin g (September 25-27, 1972) at UNIDO Headquarters in Vienna.

The Mission was made responsible for preparing the country reports by October 31, 1972 and a regional report by November 30, 1972. Both are to be presented at the Expert Group Meeting in 1973.

1.3 - In order to obtain comparable information for each of the countries, two questionnaires were made available to each of the participating groups. The first is more general, and deals with the state of agriculture in the country, its socio-economic development, infra-structure, mechanization, and incentives provided by eah Government both for the development of agricultural mechanization, and for new industrial investments in the sector of construction of agricultural machines and tractors. The second questionnaire is more specific. It serves to sound out the current situation and future prospectives in the manufacturing sector both as regards tractors and other agricultural machines of specific interest to mechanization of Wet-lands, and as regards the local situation (current and future) of ancillary industries and raw materials. The schemes of the prepared questionnaire follow :

1.4 - <u>Questionnaire A</u>

1 - Total country area (Hectares)
2 - Total arable area (hectares)
3 - Total cultivated area : - today (hectares)
- estimated in 1980 (hectares)
4 - Total irrigated area : - today (hectares)
- estimated in 1980 (hectares)
5 - Total area under two crops per year (hectares) and kind of crops, today and in the future
6 - Total paddy area (hectares)
7 - Average paddy yield production (ton/hectare) today and estimated in 1980
8 - Average use of fertilizer per hectare (kg/hectare)

9 - Total population (no.) and year growth
10 - Total active population (no.)
11 - Total active population in agriculture : - today (no.)
- estimated in 1980 (no.)
12 - Number of farms (no.)
13 - Average size of farms (hectares)
14 - Average size of paddy farms (hectares)
15 - Percentage of farms with size more than 4 hectares (%)
16 - Percentage of cultivated area covered by farms of more than 4 hectares (%)
17 - Population of tractors (no.); size of tractors (HP)
18 - Present annual demand of tractors (no.) and size (HP)
19 - Future estimated annual demand of tractors in 1975 and in 1980 (size and no.)
20 - Population of power-tillers (no.)
21 - Present annual demand of power-tillers (no.)
22 - Future estimated annual demand of power-tillers in 1975 and in 1980 (no.)
23 - Population of farm machinery and implements (engines, plows, harrows, pumps, rotary tillers, cultivators, seeders, transplanters, fertilizer distributors, sprayers, harvesters, threshers, combine-harvesters, dryers, cleaners, hullers, storage equipment, etc.) by commodity group and size (no.)
24 - Present annual demand of farm machinery and implements by commodity group (no.)
25 - Future estimated annual demand of farm machinery and implements in 1975 and in 1980, by commodity group (no.)
26 - Manufacturers of tractors (no., yearly capacity, today's production, size and type of tractors)
27 - Manufacturers of power-tillers (no. yearly capacity, today's production, size and type of power-tillers)
28 - Manufacturers of farm machinery and implements (no., yearly capacity, models and today's production)
29 - Manufacturers of spare parts and special parts (i.e. fuel injection pumps, batetteries, typres, gears, etc.) : no., yearly capacity, today's production
30 - Research, testing, design, adaptation and standardization facilities on farm machinery and tractors : no. of units, principle field of research, prfnciple equipment
31 - Repair and maintenance organization and facilities
32 - Extension service for agricultural mechanization and technical training-facilities for farmers
33 - Organization of sales of agricultural machinery and tractors
34 - Credit facilities for purchase of agricultural machinery and tractors (loans, no. of years, interest rate, etc.)
35 - Farmers' cooperatives; agricultural machinery and tractor service

centers, etc.

36 - Incentives for local and foreign investments, priorities and conditions

37 - G.D.P. per capita

38 - Yearly growth of G.D.P. in the past years and estimated in the future

39 - Percentage of G.D.P. represented by agriculture, by mechanical and metallurgical industry and by mining

40 - Yearly growth of agriculture and industry in the past year and estimated in the future.

1.5 - Questionnaire B

1 - 4-wheel tractors

- Agricultural population in 1971 — less than 20 HP no. .....
  20 to 35 HP no. .....
  more than 35 HP no. .....
- Agricultural sales in 1971 — less than 20 HP no. .....
  20 to 35 HP no. .....
  more than 35 HP no. .....
- Manufacturers no. .....
- Annual manufacturing production in 1971 no. .....
- Manufacturing capacity in 1971 no. .....
- Estimated manufacturing production in 1975 no. .....
- Estimated manufacturing production in 1980 no. .....

2 - Power-tillers

- Agricultural population in 1971 no. .....
- Agricultural sales in 1971 no. .....
- Manufacturers no. .....
- Annual manufacturing production in 1971 no. .....
- Manufacturing capacity in 1971 no. .....
- Estimated manufacturing production in 1975 no. .....
- Estimated manufacturing production in 1980 no. .....

3 - Diesel and gasoline engines more than 5 HP

- Agricultural population in 1971 no. .....
- Agricultural sales in 1971 no. .....
- Manufacturers no. .....
- Annual manufacturing production in 1971 no. .....
- Manufacturing capacity in 1971 no. .....
- Estimated manufacturing production in 1975 no. .....
- Estimated manufacturing production in 1980 no. .....

4 - Diesel and gasoline engines less than 5 HP

- Agricultural population in 1971 no. .....
- Agricultural sales in 1971 no. .....
- Manufacturers no. .....

- Annual manufacturing production in 1971 no. .....
- Manufacturing capacity in 1971 no. .....
- Estimated manufacturing production in 1975 no. .....
- Estimated manufacturing production in 1980 no. .....

5 - **Pumps**

		Hand operated	Power operated	
			Centrifugals	Deep-wells
- Agricultural population in 1971	no.			
- Agricultural sales in 1971	no.			
- Manufacturers	no.			
- Annual manufacturing production in 1971	no.			
- Manufacturing capacity in 1971	no.			
- Estimated manufacturing production in 1975	no.			
- Estimated manufacturing production in 1980	no.			

6 - **Plows**

		Animal drawns	Tractor or power-tiller drawns	
			Disc	Mould-board
- Agricultural population in 1971	no.			
- Agricultural sales in 1971	no.			
- Manufacturers	no.			
- Annual manufacturing production in 1971	no.			
- Manufacturing capacity in 1971	no.			
- Estimated manufacturing production in 1975	no.			
- Estimated manufacturing production in 1980	no.			

7 - Sprayers and dusters

		Hand operated	Knapsack power operated	Tractor or power-tiller p.t.o. driven
- Agricultural population in 1971	no.			
- Agricultural sales in 1971	no.			
- Manufacturers	no.			
- Annual manufacturing production in 1971	no.			
- Manufacturing capacity in 1971	no.			
- Estimated manufacturing production in 1975	no.			
- Estimated manufacturing production in 1980	no.			

8 - Transplanters

		Hand operated	Power operated
- Agricultural population in 1971	no.		
- Agricultural sales in 1971	no.		
- Manufacturers	no.		
- Annual manufacturing production in 1971	no.		
- Manufacturing capacity in 1971	no.		
- Estimated manufacturing production in 1975	no.		
- Estimated manufacturing production in 1980	no.		

9 - Threshers

		Hand operated	Power operated
- Agricultural population in 1971	no.		
- Agricultural sales in 1971	no.		
- Manufacturers	no.		
- Annual manufacturing production in 1971	no.		
- Manufacturing capacity in 1971	no.		
- Estimated manufacturing production in 1975	no.		
- Estimated manufacturing production in 1980	no.		

10 - Dryers

- Agricultural population in 1971 and average size — no. .....
- Agricultural sales in 1971 — no. .....
- Manufacturers — no. .....
- Annual manufacturing production in 1971 — no. .....
- Manufacturing capacity in 1971 — no. .....
- Estimated manufacturing production in 1975 — no. .....
- Estimated manufacturing production in 1980 — no. .....

11 - Hullers

- Agricultural population in 1971 and average size — no. .....
- Agricultural sales in 1971 — no. .....
- Manufacturers — no. .....
- Annual manufacturing production in 1971 — no. .....
- Manufacturing capacity in 1971 — no. .....
- Estimated manufacturing production in 1975 — no. .....
- Estimated manufacturing production in 1980 — no. .....

12 - Ancillary facilities production

		YES		NO
		adequate (to local agric. machinery and tractors production)	inadequate	
Tyres	1971			
	1980			
Pistons	1971			
	1980			
Gears	1971			
	1980			
Bearings	1971			
	1980			
Chains	1971			
	1980			
Batteries	1971			
	1980			
Fuel injection pumps	1971			
	1980			

		YES		NO
		adequate (to local agric. machinery and tractors production	inadequate	
Carburettors	1971 1980			
Tool Machines	1971 1980			
Hot-rolled carbon steel	1971 1980			
Hot-rolled alloy steel	1971 1980			
Cold drawn carbon steel	1971 1980			
Hot-rolled plates, sheets and strips	1971 1980			
Gray iron malleable	1971 1980			
Rubber parts and gaskets	1971 1980			
Hydraulic parts	1971 1980			
Foundry	1971 1980			
Steel casting	1971 1980			
Non-ferrous casting	1971 1980			
Steel forging	1971 1980			
Heat treatments	1971 1980			

BURMA

SUMMARY

1 - The rice-growing development is mainly based on production improvements (better seeds, fertilizers and agronomical practices) and on losses reduction in processing.

2 - The agricultural machines actual population is a very modest one with a density of 0.46 tractors per 1000 ha. and 0.8 power-tillers per 1000 ha.. Almost all works are - especially in paddy lands - hand or with animals help made.

The mechanization development is going to be very slow, and the priority will be given to machines for industrial crops.

In the paddy growing sector, mechanization of primary and secondary tillage, of anti-parasites distribution and threshing will be shortly realized, while the use of modern hullers is gradually spreading in order to reduce product losses. A complete mechanization will not certainly be realized before 30 years from now. The problem of rational mechanization has not been faced yet and it depends on the cooperatives development.

In such case, it can be foreseen the use of : 14-16 HP power-tillers (to be transformed in 4-wheel drives tractors), which can be utilized on 10-15 ha.; 25-35 HP tractors, simple, low cost, easy to maintain, both 2 and 4-wheel drives, articulated, equipped with mounted implements like plows, harrows, puddlers, rotary tillers and spading machines, the last two p.t.o. driven.

It should also be considered the problem concerning power operated pumps and self-propelled reaper binders to improve harvesting in time, and the one concerning repair, maintenance and extension services development.

3 - Agricultural machinery local manufacturing concerns : tractor over 50 HP; 7 HP power-tillers; power threshers; pumps; primary and secondary tillage machines; hullers and trailers. This sector is now developing following the Government's policy. Existing factories cover

a large range of agricultural machinery production but realize small series not standardizazed in the common parts, with production costs higher that it would be possible to obtain. It is foreseen manufacturing of self-propelled reaper binders and transplanters. Later within this decade the problem of combine harvesters manufacturing will have be faced. There is a considerable gap between small power-tillers and big tractors production and it would be useful to consider the opportunity to cover this gap producing medium size tractors which will be optimal for the mechanization levels that will be startely reached in the country. The main problem is the standardization and the defining of economies of scale in manufacturing sector.

4 - Ancillary industries and raw materials are considerably developing and in a few year will reach level able to greatly reduces imports of machines and materials.

5 - The Government's policy aim to realize a farm ceiling policy creating 4-12.5 ha. farms and constituting cooperatives for using machines, processing and outputs commercializing. For this aim the Government will allow interesting facilities also for the agricultural structures and the rural road system adequacy.

6 - Research sector on agricultural mechanization is scarcely developed and every now and than is done by the Institute of Technology and the Agricultural Mechanization Dept.. There is testing unit and no researches are developed to define optimum agricultural mechanization.

7 - The Government's policy is in favour of big development in the secondary sector to be realized also through joint-ventures.

Research sector in the agricultural machinery manufacturing is underdeveloped and it is suggestable to constitute a design, prototypes,

construction, adaptation, standardization and testing unit to help local manufacturers. Finally it is essential to develop an efficient repair and maintenance organization, together with spare parts production, extension service and technical training for farmers to teach them a rational use of agricultural machines and tractors.

1 - General pattern of agriculture

1.1 - The total arable area is evaluated around 17.500.000 ha.; the cultivated area is 7.500.000 ha. and represents about 12% of the whole country area. Compared to 1961, the cultivated area has a 20% increase, and it is possible to add new areas because of future needs, in connection with the social and economical development.

Cereals are grown on 75% of the cultivated land and paddy by itself represents 66%; in 1962 it represented about 62%. The paddy production has increased from 6.700.000 tons in 1961 to 8.030.000 tons in 1971. The average yeld production is about 1.6 tons per ha..

The irrigated area is 10.6 % of the cultivated one and had an increase, in the last ten years, of 300.000 ha.. The irrigated area with 2 crops per year - only one of them is paddy - covers some 750.000 ha. and represents 10% of the total one.

The paddy yield production development is looked after by Government Authorities and Research Institutes; the used varieties - according to experiments - do not react too well to fertilizers, whose average use, even if doubled in the last 10 years, is about 5 kg per ha.. Average increase of production will reach 150% in the next 10 years. Right now about 15% of rice is exported.

The agricultural land is divided into 4.330.000 farms, 86% has - size of less than 4 ha. and represents 57% of the cultivated area. The average size is 1.7 ha.. Paddy farms are the smallest and the most fragmented ones, with plots scattered aroud and with an average size of 800-1200 m^2 each.

1.2 - The total population in Burma is 28.200.000 inhabitants; a little more than 39% constitutes active population.

The agricultural workers represent 70% of active population;this means there is almost 1 worker per each cultivated hectare.

In the last 10 years the population increase has been 2.1% per year

and no kind of family planning is provided, even if in the last 3 years increases are bigger, amounting to 2.4%.

This happens because lands to be recuperated for agricultural purposes are big. There are no informations on the evolution of active population in agriculture; anyway it is not supposed to diminish in the next 10-15 years.

1.3 - The G.D.P. per capita is evaluated around 85 dollars per year; the per capita gross income is about 75 dollars per year, with minimum values in the northern parts of the country. The agricultural production constitutes 50% of G.D.P. it has increased - at constant money value - 1.4 times compared to 1961, with a 3% rise per year. This is due both to production increase and new lands acquired to agriculture.

The actual 4-years plan (Oct. 1971 - Sept. 1975) supposes a total G.D.P. increase as big as 19% (little less than 5% per year). The total agricultural production should rise of 16%.

Among the investments programmed by the plan, 8% will benefit agriculture, mainly irrigation and production of high valued crops such as jute, tobacco, maize, cotton, whose development will have a priority.

Rice farms will be strictly bound to an subsistance economy and their evolution, together with their mechanization, is going to be a very slow one.

1.4 - All the agricultural works are, practically, made by hand or with the bullocks or buffalos help. In some case, use of tractors for primary and secondary tillage is starting; transplanting, as well as harvesting are hand-made; threshing is mostly hand-made with flails or animals. Threshers also hand or pedal operated models, are not popular. There are no drying systems - nor they seem to be needed - and storage equipments because farmers immediately carry the pro-

ducts to the storing centers, keeping only what is needed for their family . In the Government's store-houses storage and processing losses are small and evaluated around 4-6%. On the contrary, generally speaking, processing losses are considerable, because hullers are small and at least 30 years old. Such losses are evaluated around 25%. These losses - at least for broken seeds - do not seem to represent a problem, because they are used within the farms.

The spreading of selected seeds had, in the last 10 years, an 800% increase; it is still very scarce compared to the country's needs and should be implemented.

2 - Pattern of farm mechanization

2.1 - Paddy mechanization is still at a primitive stage, even if the Government is trying to develop the industrial sector. Anyway, the economic plan does not foresee any incentive for the development of mechanization.

In general terms, the actual population of tractors - 50 HP average power - has been evaluated (1971) in 3390 units; it had a 300% increase in the last 8 years. Every tractor - generally not belonging to the single farmer - works 325 hours per year, ploowing an area of about 80 ha.. Such tractors whose average density corresponds to 0.46 units per 1000 ha. are working on lands for industrial crops; rarely for paddy. They are 2 wheel drives models, heavy, essentially designed for good drawbar pull, and mainly imported.

A certain amount of them is out of service waiting for repairs and spare parts, which are not easily available.

The power-tillers population is about 500 units, while it is not possible to acquire informations about the actual population of engines pumps and threshers. There also are : 1.800.000 plows, 2.000.000 harrows, 82.000 cultivators all animal drawn, and 27.500

knap-sack sprayers, mostly hand operated.

Their population has increased 3 times in the last 10 years. There are also a population of 2.000 hullers with 0.9 tons per hour average capacity and some big and modern mill plants installed nearly the capital.

There are no data about annual demand for machines and tractors.

2.2 - It is difficult to have idea of the development of mechanization and of the future demand for tractors and agricultural machines, also because no priority is given to mechanization itself in the economical plan.

Because import are almost closed down, future demand can be identified with the previsions - which will take about in the next chapter - on the development of the annual local production especially as far as power-tillers, pumps, equipments for primary and secondary tillage, reaper binders and threshers are concerned.

In 1975, there will be an annual demand for 2.000 tractors and in 1980, for 4.000 units. In any case, the Agricultural and Industry Ministries should define the country needs for machines, following the economical development policy.

It is common opinion that mechanization development should be realized - as it is already happening - through cooperatives and service centers, whose best dimension has not been decided yet.

Paddy growing seems to be considered in the present social-economical situation, the last one to be mechanized, even if all the advantages of mechanization - among which time saving, better processing, less losses wireness reduction - are recognized.

Taking as a basis what it is said above, it is possible to foresee a 5-6000 tractors in 1975 and 18-20.000 units in 1980. In the same way the population of agricultural machines and implements will increase. Anyway tractor sizes (more than 50 HP) which are at present ma-

nufactured are not the best ones for a rational mechanization of paddy.

Such development - even if very slow - should be obtained together with an efficient repair, maintenance and extension services and technical training for farmers. As far as repair and maintenance is concerned, the actual service is organized by the Government through 90 workshops, which provide, in peripherical areas, to ordinary maintenance and through 2 workshops for extraordinary repairs.

Such system is not too well organized because the spare parts provisions is lacking or very slow.

2. 3 - Mechanization in the paddy areas is supposed to be realized in a very long time; it is advisable to start researches in order to define the best mechanization levels for further times, according to the real possibilities of development of cooperatives.

For this purpose the different use of tractor and power-tillers should be defined. Between them there are many power-range which can be useful for a rational development of mechanization itself also depending from the Government choises from a structural point of view. It seems useful and economic the utilization of 14-16 HP power-tillers which can be transformed into 4-wheel drives tractor in a further time, to be used by small farm groups (10-15 ha.), leaving primary tillage to more powerfull tractors, covering larger areas in reference to timelyness for such work and to the possibilities for seed scattered along the year of better rice varieties.

Another solution to be studied consists in the generalized spreading of 25-35 HP tractors, both 2 and 4-wheel drives, able to operate on 25-30 ha. areas, totally using their work-capacities.

Together with the suggestable development of one or both the above mentioned machines, there should be a more and more generalized spreading of equipments and implements, according to the follo-

wing priorities:mould board and disc plows, spading machines, harrows, puddlers, pumps,sprayers and trailers (both bearing-axle and p. t. o. driven).

In any case, it is suggested the use of self-propelled reaper binders, strong, simple and low cost with 1. 50 m cut width,operated by a 8-12 HP engine. If the use of 25-35 HP tractors will increase, it will be convenient the use of reaper binders. tractors drawn and p. t. o. driven.

Only when agricultural labour will diminish to 0.4 workers per ha., it will be possible to use combine harvester. It is also suggested, in order to improve after sale service, the use of mobile workshops.

3 - Manufacturing industries and ancillary facilities

3. 1 - The industrial sector contributes as much as 15% to G. D. P. and it is developing. The actual 4-year plan - which is a part of a 20 - year plan - supposes, at a constant money value, a production increase of : 16% for manufacturing industrues, 36% for heavy industry and 20% for mine one.

3. 2 - Agricultural machines and tractors industries - even if there are only 5 of them - are increasing both in the amount and in the production capacity. There is already a riding 50 HP tractors factory (at the beginning only asembling, but right now manufacturing with a 70% of local content), working on east-Europe license.

This industry has a 2000 tractors per year production capacity, but it is actually manufacturing a little more than 1000 units. It is now expanding and at the actual development plan end it will be able to produce 4200 units per year, in the two 50 HP and 85 HP sizes.

In cooperation with Japan, a 7 HP power-tillers factory has been planned with an annual production capacity of 1200 units. Up to now about 700 units have been manufactured and next year probably a little less than 1000 units will be constructed. This factory also pro-

duce more diesel engines than power-tillers, to be used together with irrigation pumps, locally realized with a 8000 units per year production capacity. Anyway the 1971-1972 production has been limited to 3300 4"-6" ϕ units, with different heads.

A fourth factory has been realized to produce power-thresher with a production capacity of 2000 units per year, even if 1000 units have been producted so far. In the end, there is an agricultural trailers factory up to6. 5 tons, especially used for industrial crops, and some smaller factories for hand operated sprayers and dusters. It should be remembered a rice hullers factory which produce about 50 plants per year, small and medium size, useful to renew the already existing ones.

This is the present situation but it is necessary to keep in mind that in 1973 a local production of disc plows and harrows (about 2000 units per year) will be started, together with rototillers production in cooperation with Japan. The Government is considering also a coo-production of transplanters (both hand operated and self-propelled models) and - in a further time - of self-propelled reaper binders. There an no exact plans for combine harvesters production, even if the problem should be faced within the present decade.

As it can be seen, besides the few hundred units of power-tillers, pumps, threshers and hullers there has not been so far a realization of machines leading to a rational paddy mechanization.

Considering the existing connection between paddy growing and planned production capacity it will not be possible talk about complete paddy mechanization before 20-30 years. This depends on the decision to mechanize first high value crops, which can be exported, and to aim to a processing development.

The decision about the yearly production to be realized is taken by the Government and the machines are sold : for industrial crops, directly to farmers, and for rice and pulses ones, to farmer's cooperatives. Each factory owns a private experimental farm, which all

the realized prototypes are tested in.

According to the Heavy Industry Corporation's data from next year, it will be started the production of all the agricultural machines and tractors parts, besides full injection pumps.

3.3 - Ancillary industries and raw materials are developing. Concerning the former ones, there are 35 metal products industries at present compared to 8 of them in 1968. There are also two foundries; some forging shops producing 4800 finish casting tons per year and 6 metal ores industries. Their production and the expansion plan can satisfy all the needs of transforming industries, according to the plan's programs.

All factories are run by the Government. From 1974-1975 it will be started the production of now imported tool machines.

Mine research and raw materials production (among with iron, zinc, tungsten, tin, coal and oil) are increasing.

Three factories are already under production : two for fertilizers and one for insecticides and pesticides. It seems that their production capacity meet the internal demand, which looks quite modest so far.

3.4 - As it has been said in the above chapter, also industrial sector does not consider local production of Wet-lands machines. Therefore it seems important point out the complete lack of tractors in the range between 7 HP power-tillers and 50-85 HP tractors. Such lack can not be justified from a rational mechanization point of view and it is to recomand the Government gives this problem the right consideration.

This especially concerns the suggested production of medium size (25-35 HP) tractor, with consistent equipment among which spading machines seem particularly useful.

Similar consideration should be given to a production of reaper-binders to be choosed following a broad research and testing of what the international market offers. This is needed with the goal to choo-

se the models more adaptable to local conditions, both from agricultural and manufacturing (workshops equipment, skilled workers, raw materials, ancillary facilities, etc.) point of view.

Far all these factories there is the need to conduct deep studies on economical productions (capacity and investment levels able to reduce production costs to a minimum) and on maximum standardization of common parts.

Finally it seems useful to suggest the opportunity to realize bigger capacity mill-plants, in the view of their cooperative use, with connected dryers and storage equipments to reduce product losses.

4 - Policy toward farm mechanization

4.1 - Farms will keep belonging to the workers, but a land ceiling programme - which foresees a farm size between 4 and 12,5 ha. . in accordance to the family composition and to the outputs value - is going on. The 1st fours-year development plan forsees to gain 400.000 new hectares to the agriculture, partly from vergin and partly from fallow lands, and to extend irrigation on new 80.000 hectares.

Priority is given to agricultural production increasing for export and paddy seems will reach 110% of the present production.

The greatest support will be given by the Government in order to create farmers cooperatives (already existing in 12.560 units with 4.600.000 members) with the following purposes : products commercialization, modern agronomical practices application, and structures (plots, roads, etc.) adequacy to mechanization needs. These cooperatives will be charged with the purchase of agricultural machines and with their renting to single members. The Government forecast loans facilities for the above mentioned purchases.

4.2 - Research in the agricultural machines sector is rather limited even if there is an agricultural machines design, repair and mainte-

nance unit to obtain an Agricultural Engineering degree in the frame of the Institute of Technology. This Institute is composed by 9 departments two of them concern Mechanical and Metallurgical Engineering. 3500 students attend such Institute which is well organized; the teaching standards is high and the didactic and laboratory equipments meet actual needs and they are constantly compleeting and improoving.

Some researches in the agricultural mechanization sector are developed toghether with the Agricultural Mechanization Dept. and the Applied Research Institute. Testing, design and prototypes construction units in the agricultural machinery sector does not exist. The Mechanical Engineering Dept., opportunily enlarged, could take up this activity and it already constitutes a good basis for the development of the above mentioned unit.

Education is expanding and there are technical schools and training courses for skilled workers, well equipped and organized. Students number is constantly increasing.

4.3 - Repair, maintenance and extension services are still lacking, mainly because of a slow supplying of spare parts. However, this sector is under expansion and there are actually 92 tractor stations compared the two existing in 1968. Technical training for farmers is developing even if it mainly concerns the agronomical sector rather than a rational choise and use of machines.

4.4 - Following the above mentioned opinions, it looks ncessary to improve actual institution in order to study the optimum mechanization levels in the different socio-economic development stages, to choose tractors and their equipments models and sizes from the international market to locally produce them in the frame of a very deep standardization.

Consequently it will be necessary to organize a more and more

efficient and spread technical farmers training, extension, repair and maintenance services, following the mechanization development.

5 - Policy toward industrialization

5.1 - Besides the future development in the tractors and agricultural machinery manufacturing sector, the Government is planning an increasing programme according to the following priorities : heavy industries and raw materials; textile industries and agricultural products processing. This, mainly, is connected with the high value industrial crops development.

It is also considered rather important to renew and improve rice processing plants in the goal to increase exports and to reduce losses.

5.2 - The Government is interested in cooproduction with foreign well established manufacturers but therms and conditions for such joint-ventures are not known.

5.3 - Research in the mechanical and industrial sector is completely in care of Government's Agencies and Institutions like the above mentioned Institute of Technology whose development level is satisfactory. The scientific level is quite good and scientists often spend long research periods abroad.

6 - Conclusions

The Burma Government has not asked for any kind of help from UNIDO in the agricultural machinery sector. However, in order to lead to on agricultural mechanization and manufacturing industry rational development it is suggested to consider the following UNIDO assistence :

1 - to assist the Government in defining the levels of mechanization

better fitting the socio-economical development stages, in choising models and sizes of consistent machines and tractors, and in creating a testing, design, standardization unit for tractors and agricultural machinery. An UNIDO Expert : agricultural machinery engineer; duration, 4 months; course of the mission 1974;

2 - to help the Government in standardization and unification of agricultural machinery and tractors production also according to the optimum sizes and to the investment level in order to obtain the most economical production. Team of 2 UNIDO Experts : an agricultural machinery engineer and an industrial economist; duration, 4 months each; course of the mission 1976.

Before sending the above mentioned experts off it is suggested to assign two fellowships, for the duration of 6 months each, to send one agricultural machinery engineer and one mechanical engineer abroad, to be used later as counterparts for the proposed esperts.

PERSONS MET

1 - Mr. A. K. SURANI - UNDP Officer in Charge, Rangoon

2 - Mr. TUN WIN - UNDP Liaison Officer, Rangoon

3 - Mr. U. CHEIN HAI - Dir. for Foreign Economical Relation Dept. - Ministry of Planning and Finance, Rangoon

4 - Mr. TUN KHIN - Manager Trade Corporation n° 1, Rangoon (counterpart)

5 - Mr. MAUNG MAUNG - Mech. Eng. at Trade Corporation n° 1, Rangoon

6 - Mr. M. TIN U - Manager n° 1 Base Workshop - Agricultural Mechanization Dept., Rangoon

7 - Mr. AUNG KHIN - Head of Dept. of Mechanical Engineering - Institute of Technology, Rangoon

8 - Mr. TAN THEIN - Farm Manager, Office of Deputy General Manager Research, Rangoon

9 - Mr. KHIM MAUNG CHIT - Farm Manager, Hmawbi Research Farm Paddy, Hmawbi

10 - Mr. THET TIN - Farm Manager, Hmawbi Central Research Farm Paddy, Hmawbi

11 - Mr. Lt. Colonel MAUNG CHO - Gen. Manager, Heavy Industries Corporation, Rangoon

12 - Mr. Cap. SOE AUNG - Heavy Industries Corporation, Rangoon

J.N.P.I.A

SUMMARY

1 - The development of rice-growing proceeds very slowly. This is due to the small size of agricultural holdings, the fact that useful knowledge of agriculture is not sufficiently developed and generalized, and the fact that the labor force will remain constant for the next 20 years. Nevertheless, the current fourth five-years development plan forsees an increment of 30% in the yield production of paddy by 1974. In addition a land rearrangement (which requires a re-examination of general mechanization policy) is in the process of realization.

2 - The current population of tractors and agricultural machines is quite limited. Models of implements operated by hand or animal traction are excluded in the following count. At present there are : 1. 13 tractors/1000 ha; 0. 1 power-tillers/1000 ha; 12 power operated pumps/1000 ha and 3. 8 threshers/1000 ha. Mechanization has, however, made considerable progress in the last decade.

Future progress is seen in long-range terms as passing through the stage of employement of animal drawn machines. However many experts are of the opinion that this stage must be omitted, both to give a greater impulse to production development (seasonability timing of activities, smaller losses, etc.), and for socio-economic motives. A close study of cooperative organization systems and of service centers for cooperative use of agricultural machines and tractors in paddy areas are needed toghether with definition of optimal machine population, and of economic advantages which could be derived.

There is a complete lack of the following machines, the use of which, both in technical terms and from the economic point of view, seems advisable in the Wet-lands : power-tillers of 14-16 HP convertible in the future into small tractors by the addition of a back

end; four-wheel drive tractors of 18-22 HP, articulated, simple, durable and low-cost; equipment for primary and secondary tillage,irrigation and drainage, plant protection, and transport, of dimensions proper for the into above-mentioned tractors. It is also to be recommended small self-propelled reaper-binders (1.50 m work width), dryers and mobile workshops for repair and maintenance to be made available. All these machines are convenient on surfaces from 8 to 15 ha when they are employed optimally from the technical and economic points of view. The dryers and mobile workshops would, on the other hand, be used for larger surfaces, respectively of 50 and 300 ha. It would be further desirable to employ small and medium power-operated threshers and, on a cooperative scale, large mill centers, suitable to reduce the now great losses in production.

3 - The industries of the sector are in a period of uncertainty, and their production holds mostly at a lower level than their production capacity. The quality of the products is adequate, but it is necessary that the production be controlled and standardized, especially in the field of small-scale industries. A greater forward impulse could be felt with the creation of more favorable incentives on the government side.

4 - In general terms, there is much possibility for expansion in the industrial sector of the field of machines for paddy cultivation and especially for the production of : spading machines, pumps, seeders, broadcasters, sprayers and trailers, for the above-mentioned power-tillers and small tractors of power between 12 and 22 HP. The initial annual production of the two types of tractor and connected equipment could be valued on the order of 10.000 pieces per model and that figure could be doubled within ten years time. Some forecast is reasonable for self-propelled reaper-binders.

5 - Ancillary industries and raw materials are in an advanced state of development, and still not completely sufficient to cover the country's needs. There is a lack of some types of alloy and special steels. Some operations cannot yet be performed and improvement is required in the fields of heat treatments, casting and forging.

6 - There are good bases and facilities for research in the sector, bases which merit a closer coordination and development through the creation of one or two centers, with modern equipment for design, adaptation, prototype construction and standardization.

7 - Also to be developed is an organization of services for repair and maintenance, and technical training for farmers.

1 - General patterns of agriculture

1.1 - The total arable area is about 177.000.000 ha; 75% of which is made up of coltivated land. A progressive increase in the amount of cultivated land is predicted, as well as an increase in the amount suitable for producing two crops a year.

The paddy area now covers about 37.000.000 ha (22% of the total); the paddy therefore represents the most extended crop, with a total production of about 64 millions tons, corresponding to an average production of 1.6 tons/ha.

An increase up to 85.000.000 tons (+30%) is forseen for the end of the current fourth five-year economic development plan (1969-1974).

Irrigated land is steadily increasing. It came up to a level of 35 million ha in 1971. The forecast is to increase irrigated land to a level of 58 million ha (+70%) by 1981 by a series of projects, some already being executed, the most important of which consists in joining five main rivers which flow in a latitudinal direction, with north-south canalizations, suitable for adducing waters toward the southern part of the country. Nevertheless in some states, like Punjab, Haryana and Tamil-Nadu, during the last 20 years the water available for irrigation and from wells and reservoirs, has been increased by 500%. In irrigated areas, the production of paddy reaches a level of 1.8-2.5 tons/ha for each of the two harvests which are performed each year.

The agricultural land is divided into 50.000.000 farms, having an average size of 2.6 ha.. Farms of less than 4 ha represent 80% of the whole number, though they only cover an area equal to 50%. In the Wet-land, however, the average farm size seems lower (2.3 ha), and farms of more than 4 ha. represent about a 15% numerically, covering, however, almost 40% of the surface devoted to rice production. In addition a very fragmentary character of land holding is usual in the paddy areas, with very small plots scattered often at quite a di-

stance one from another.

1.2 - Total population of India is 560.000.000 inhabitants, 45% of which represents the active population.

Farm labor figures up to 167.000.000 people equal to about 70% of the total active population. This means 1.2 worker for every hectare of cultivated land. Even though there is an intense rural family planning hold by 5.000 centers and 30.000 subcenters (which has reduced the birth rate increase by about 7.000.000 in the last five years) it is nevertheless predicted that in the next 20-30 years the active population in agriculture will not decrease, in percentage terms, except in small amounts, therefore increasing in overall value.

Mechanization, and auxiliariy activities (i.e. repairs, maintenance, and extensione service) development, fertilizers and antiparasites using, and irrigable land area increasing, all together should increase production per hectare. This would absorb a large part of the predicted rising in absolute rural population. Furthermore, mechanization can play an important role in soil preparation improvement, timing for seasonability of activities, reduction of production losses and reduction of human wearness.

1.3 - Though it was not possible to have exact G.D.P. figures (it is said to be little more than $ 100 per capita per annum), Indian agriculture furnishes more than 50% of the G.D.P. and contributes to a 60% of the country export.

The average increase of agricultural production has been, in the last 10 years, about 2% per annum, while the planned estimates would require, for the next ten years, an average increment of 5% annually, which is dumed by experts unlikely to be achieved. Great progress has been obtained in the production of wheat in the last 5

years; for the paddy, however, we can't speak about a "green revolution". Evolution in genetic terms still moves quite slowly, use of fertilizers is scanty (an average of 10 kg/ha), and it is uncertain as yet which more productive varieties to adopt. Newertheless it is believed, on the basis of projects and researches now in progress, that in the next 3-5 years it will be possible to increase considerably paddy production, fixed the fact that there is no perspective for increasing the cultivated area of rice.

In order to face the country's future needs for food and at least hold the present nutrition standard (which means a minimum annual production increasing of 3%), a notable but still not large increasing (5 times in the next decade) in the use of fertilizers is planned.

1.4 - The paddy represents one of the lowest income crops. This is due to the small size of the farms, the backward state of a large part of the rural population and the agricultural conditions, but also to the lack of demonstration and of spreading of information, and to the lack of an efficient network of roads to make possible the use of modern cultivation techniques. The large part of the work on the paddy is performed manually or with the use of single animal drawn machines, especially the primary tillage, the leveling and the puddling. The transplantation is still performed entirely by hand. The first transplanters imported from Japan have furnished increases in the productivity of labour of about ten times, but they have not shown high efficiency in every case. It is necessary the ground to be perfectly on level, a condition difficult to obtain by means of animals. The harvest and thrashing are also carried out entirely by hand. The first processing is done with small, old hullers, which cause losses of about 20-25%. The transplanting and harvesting, however require (especially in the irrigated areas which produce two crops per year), accurate timing, and in some states (Punjab, Mysore, Tamil Nadu,

Haryana) it is difficult to find the necessary labour, even at salaries 3-3,5 times (9-10 Rs/day) the normal.

Further, the transport problem, up to now neglected or carried out by hand and with antiquated vehicles, has to be solved.

It seams also that there is a certain tendency on the part of the very small land holders to rent their lands to be worked by others. This is not a legal practice. It means, however, that the land holding result as larger, and therefore more easy to mechanize. The phenomenon of renting involve more than 40% of small rice farms in some areas.

Finally it is interesting to note the great steps already taken in the development of rural electrification, development provided for in the current 5-year plan and in the next one now under elaboration. In some states electrification (both for lighting and power) has reached all villages.

2 - Pattern of farm mechanization

2,1 - Agricultural mechanization is poorly developed, on the whole, and it is difficult to have exact figures as to the numbers of agricultural machines and implements in use.

It seems, however, that the population of tractors normally powered between 25 and 50 HP, was 150.000 units in 1971, corresponding to 1,13 tractors/1000 ha. Their average use is of about 600 h/year. Development in the past few years has been notable, growing from 8.500 tractors in 1951 to 30.930 in 1961 to the present number. Therefore the increase has been of five times in the last ten years. The present market is very calm, however, the demand being for about 30.000 units, 40% of which imported.

Crawler tractors(2.000 units) are used for the land reclamation. Otherwise their use in paddy areas is not frequent. The present annual demand for these tractors is less than 500 units.

Power-tillers (mostly equipped with special cage wheels) have a degree of usefulness. The population covers around 15.000 units and the current annual demand is valued at about 4-5000 units.

There is a rather high number of diesel and gasoline engines of various sizes, used for agricultural machines in fixed position and for pumps. They have doubled in number in ten years, up to about 1.000.000 in 1971, 65-70% of that number are engines of less than 5 HP. For these engines there is a demand for agricultural purposes of about 70-80.000 units per year.

There are about 700.000 engines used in coordination with pumps, and about 500.000 electric powered pumps. This corresponds to 12 power-operated pumps per 1000 ha. The current annual demand for pumps is not exactly known. However it seems, that is corresponds more or less to the amount of local production, as importation in this area is practically non-existent.

For operating machines and implements, the use of plows (about 50.000.000 units of which only 10% on steel) is general, together with puddlers and manual or animal drawn harrows, produced locally in small villages work-shops. Transplanters are practically non-existent. The demand of fertilizer distributors of different size is around 4.000 units per year. The use of sprayers and dusters for pesticides and herbicides distribution is limited to the knapsack models. There are about 300.000 units with a demand of about 20.000 units per year.

Finally, the population of threshers is estimated at 500.000 units. Most of them are hand or pedal operated, but frequently also by 3-5 HP engines (sometimes electric motors). It was not specified how many of these machines are used exclusively for paddy. The annual demand seems to be on the order of 20.000 units.

A few initial attempts are being made for the employment of combine harvesters (self-propelled or mounted on tractors), in Wet-lands. They have been recently tested by the Tractor Testing and Training

Station in Budni, and are already in use in 500 units for other products. Reaper-binders (self-propelled or tractor driven) are also being tried out. These tests have given positive results. The future use of such machines, however, requires reorganization of the plots of land on larger and more regular lines than those currently existing.

The use of trailers is limited because of the road system inefficiency and the annual demand is around 25,000 units, tractors and power-tillers drawn. There is also a big amount of the old animal-drawn carts.

The drying and storing operations on the paddy are still on a primordial level; only in some areas low temperature static dryers are used, usually collectively on a village level. Their number is valued at a few tens. Finally, there are about 50,000 hullers, and a few tens of modern rice-mill plants. The annual demand for hullers and rice-mills is not known.

2.2 - Opinions on the future development of mechanization are various. A few of the unknown variable are the farms sizes, the agricultural population increase during the next 20 years, the necessity of contemporaneous development of more modern and rational practices of agronomy, and scarcity of technical information for the small scale farmers, such as those on the paddy lands. Reference farm size, the proposed land ceiling act defined limits of 10-18 acres, corresponding to 4-7.5 ha.

One opinion runs on necessity of going on very slowly in mechanization development by means of :

- an increase in the quantity and more diffuse use of manual machines, which merely alleviate the workers wearness and improve the work quality without substantially increasing the productivity of the work itself;

- betterment and a more widespread use of animal-drawn machines, which can push up to a two or three times increasing of work productivity. These would be simple in terms of manufacture, maintenance and utilization.

It is mostly in this direction that the main research centers of the country are working.

In other experts opinion, however, mechanization must follow a more modern trend and one more consistent with the necessities of social evolution. This would involve the use of small and medium-sized tractors. The most recent Congress of the Indian Association of Agricultural Engineers, February, 1971, expressed a preference for the diffusion of tractors of 15-25 HP, both two-wheel and four-wheel drive. Along with those tractors would go the needed agricultural machines and implements, to be used also for transport, not only of paddy but also of wheat and other cereals. This in order to : better face peak periods (transplanting and harvesting); allow better timing for the seasonability of activities, especially in irrigated areas with two or more harvests per year (obtaining larger production and smaller losses); liberate the children (that is allowing them to attend school) and the women from work in the fields. This mechanization could come about on the level of the single farm (as long as it is of sufficient size) though the cooperatives use of machines chosen on the basis of the production's cost minimization, or by the diffusion of service centers. In these centers, processing equipment must be included, especially dryers, hullers, cleaners and storage equipment. This problem of optimum choice and organization of mechanization level for paddy areas does not seem to have been properly considered yet. As a result, it is difficult to predict the numbers, models and sizes of machines best suited to the future development of the mechanization of Wet-lands.

In nay case, the official estimates are for an annual demand of : 90.000 riding tractors in 1974 and 130.000 units in 1980. From 10

to 12% of them must serve for the replacement market. Other estimates predict a demand of about 250.000 units in 1990. These figures, though it is impossible to check them, seem reasonable, provided that not only tractorization is considered, but that at the same time suitable implements are provided, technical assistance is organized, an efficient policy for the cooperative use of machinery is laid out, and appropriate size for the tractors is chosen, in the light of the proposed land ceilings. With these forecasts, it is possible to think of a tractor population on the order of 650.000 in use by 1980. These figures correspond to 7 tractors per 1000 cultivated hectares.

With this goes the forecast for the development of the use of power-tillers, even though they are very difficult to use and suitable for mechanizing only a part of the work in the fields. Official estimates speak of a demand between 30 and 40.000 units in 1974 and 60.000 in 1980.

Other estimates for 1974 call for : 80.000 engines; 250.000 electric pump sets; 30.000 power operated sprayers and dusters; 50.000 power threshers; 300.000 improved bullock-drawn implements and 250.000 bullock-carts, pneumatic tyred.

Concerning the development of the demand for hullers, it seems that the tendency is toward a gradual realization of large complexes for processing (dryers, hullers, etc.), each intended to serve a few hundred hectares and reduce production losses to not more than 10%.

The lack in the services of repair and maintenance of machines is still to be corrected. This service is now entrusted to the manufacturers and retailers, but it is not sufficiently developed and coordinated. On the other hand, an extension service for farmers, carried on by government supported organizations, has begun and showed positive results.

2.3 - A rational development of mechanization cannot, however, be

based only on the above listed estimates. There is a complete lack of simple, durable, low-cost machines, suitable to the present rearrangement of the farm. Such machines must constitute the core for future development, as they would improve the quality of work, reduce human weariness and increase flexibility in timing for seasonability, even without markedly growing the productivity of labor.

This lack manifests itself particularly :

- in the tractors sector, in which is advisable the use of : a power tiller of 14-16 HP with classical transmission, convertible in the future by the farmer into a four-wheels tractor by addition of an adapted rear-end; of a four-wheel drive tractor possibly articulated, simple and durable, of 18-22 HP with a big clearance, the possibility of being fitted with tyres at very low pressure (0.3-0.4 kg/cm^2) and metal wheels for paddy areas, or normal tyres for other types of crops;
- in the sector of agricultural machines and implements, in which is advisable the diffusion of : mould-board plows, spading machines, harrows, seeders, broadcasters, sprayers and trailers (with bearing axle or p.t.o. driven) of dimensions suitable for being used with the above mentioned two types of tractors; and reaper binders. The latter, can be drawn, carried on tractors or self-propelled, with a width of 1.50 m and engine of 8-12 HP. These machines (usefull also for the harvest of wheat, barley and other cereals)seem particularly interesting, as long as their cost is low, in facing the peak periods of work, during the harvest, and in reducing losses;
- in the sector of processing where are advisable mobile small and medium-size dryers operable by the same above mentioned tractors, to be used progressively more widely;
- finally, in order to aid the organization and efficiency of the service of repair and maintenance, the use of small but well-equipped mobile work-shops is to be recommended for ordinary operations.

Concerning the development of the demand of such machines, we

can foresee a complete mechanization within the next thirty years, and a distribution of the machines in order to optimize their employment, reducing, in consequence, the cost of their operation to a minimum. This can come about on a basis of models of 12-15 ha. for the 18-22 HP tractors, of 6-8 ha. for the power-tillers convertible in tractors, and of 50-300 ha. for dryers and mobile workshops. It is even possible to formulate precise hypotheses for development, and therefore for annual demand. The demand could call on a minimum of about 8-10.000 units per year per machine beginning 1975, and double that amount by 1985. It is obvious that such a prospective must be verified by more detailed study, to be carried on with the assistence of international experts.

Similar forcast must be made for the development of irrigation, and therefore for the distributions of pumps. There is a total lack of machines for drainage, with particular reference to the realization and maintenance of trenches and canals. The development of such mechanization must move according with the realization of the projects of irrigation themselves.

It is more difficult to hypothesize, in the present state and for the areas cultivated in paddy, an increase of combine harvesters population. These latter machines must be employed on cooperative systems, or by means of the creation of convenient service centers. Just as perplexing are the estimates for distribution of transplanters, the latest models of which require more research to improve and to adapt them to the needs of the farmers.

Finally, one sector of fundamental importance which it is not advisable to neglect, is that of organization, on rational basis, of an efficient repair and maintenance service of the agricultural machines.

3 - Manufacturing industries and ancillary facilities

3.1 - The industrial sector contributes about 19% to the G.D.P.. In

general, mechanical and metallurgical industries have made notable progress in recent years, developing in all sectors. The growth of the mining sector has been slower. Forecasts for the development of the mechanical sector are of an average increase of 5% annually, which will cause the industry to account for an average of 22% of the G.D.P., at constant money value, at the end of the current fourth economic development plan.

The sector of tractors and agricultural machines construction is developed, yet in a phase of slow growth. Difficult is to know the exact figures of yearly production by commodity group.

3.2 - There are at present 5 local factories for tractors, some of them have joint-ventures with foreign companies. They produce about 17.000 units per year. This is despite the fact that the sanctioned production capacity is about double. This lower production rate seems due : to the high purchase price of the tractors (twice, on an average, the European price), which limits the market; to the hours lost in strikes which take place in the course of the year, and to insufficience or slow supply of locally produced steel. The four most important and best organized companies have a production capacity of 7000 tractors a year each in the size between 30 and 45 HP. One of these companies is presently expanding. A fifth local factory has a production capacity of 2000 units per year, with an annual production, in 1971, of 1200 tractors of 26.5 HP, very simple and durable, with a single cylinder diesel engine.

At present, license concessions of another fifteen plants for construction of medium and high size tractors are pending at the Ministry of Development. These plants would be realised in coproduction with manufacturing firms of various countries, mostly eastern European. These concessions, however, have not entered the phase of realization. It seems that delay is due to the uncertainty of the market. The total production capacity of all factories, on-

ce all in function, should be about of 125.000 tractors per year. This production rate would come be up to the market of 1980, even with the complete lack of the production of 12-22 HP tractors. These sizes of tractors seem the optimum with reference to the land ceiling act realization.

Production level of the above mentioned industries appears, on the whole, satisfactory and in some cases with a high standard. Some of them also produce agricultural equipment adapted to their own tractors, and often they avail themselves to the local production of engines.

As regards power-tillers, of the seven plants which have been granted licences for construction (in cooperation with japanese firms) for a production capacity of 50.000 units/year, only two are currently producing. One began its activity in 1963 and produces about 500 units per year; a second has recently finished a modern and viable plant with a sanctioned production capacity of 5.000 units a year. Now it produces only about 700 units.

It seems that the other plants have not yet entered into a productive phase, because of the uncertainty of market both in financial terms, and from the point of view of the validity of a real utilization of machines such as power-tillers. In fact, the possibility to use models of less than 10 HP seems limited, both because of the tenacity of soil and because these machines are not adapted to mechanize all agricultural operations.

Local content comprises between 50 and 70% of the total tractors and power-tillers production. The remaining 30-50% are imported from the foreign home branches of companies with which accords for cooproduction exist. The above mentioned percentage will be reduced gradually in time, according to legislation in force, to zero within 5-7 years from the beginning of the cooproduction, unless it is possible to demonstrate that certain parts cannot be made in the country. This occurs either for pieces requiring special alloyed-

steel, for parts requiring particular heat treatments, or for sophisticated processes not executable in India. Gears and bearings are typical examples.

As far as engines, there are about 100 manufacturers for diesel models and 15 or so construction plants for gasoline engines.

Diesel engines (5-80 HP) are produced at a level of about 300.000 units per year, about 70% of which are for agricultural use. About 50% of these are manufactured by 7 companies. Of these : one has an annual production of around 80.000 units; two have an annual production of between 12.000 and 24.000 units, and the other four have a production of between 2000 and 8000 units each. There are no information of expansion of their production (even though there are many requests for licences of cooproduction pending with the offices which have the authority to grant them) in the last four years. The present level of production seems sufficient to cover the internal demand of current and for the near future agricultural needs. The present production is, moreover, practically equal to the sanctioned capacity.

That is not true for small (1.2-5 HP) gasoline engines, produced at a rate of about 80.000 units per year. The demand for these engines is increasing, it seems in connection with the progressively spreading use of knap-sack sprayers and dusters.

Many of the engines are employed together with a pump, the use of which is becoming steadily more popular. These pumps can be of centrifugal, deepwell or submersible deepwell type.

Quality of the production is satisfactory, in general, especially on the part of the bigger manufacturers. Yet it seems advisable to introduce a push toward standardization of models and spare parts, in the goal of reducing the production costs and facilitating the repair and maintenance services.

There are an estimated 100 local pump manufacturers, only 15 or so of medium or large scale (5-25.000 units/year). The whole

production is about 300.000 units annually, corresponding to the installed capacity. About 80% of these (powered less than 5 HP) are for agriculture purposes.

The number of workshops for the construction of agricultural machines and implements is vast and it is difficult to obtain information on. There are several thausand manufacturers of implements. The great majority (more than 95%) have small workshops with less than 10-15 workers and produce just a few units a year, providing the local needs at a village level. This is true especially for the construction of plows, tillers, puddlers, hand-operated sprayers, small sowing-machines, etc.. In practice, in each village there is one or more one-room workshops capable of satisfying local demand of simple machines (hand or animal operated), often made partly of wood. There are very few proper industries manufacturing more sophisticated machines either of local design or under foreign licence with the necessary and small adaptations. The conditions for coo-production of these machines are the same as for the tractors.

In particular, there are about thirty small-scale manufacturers of plant protection equipment, 8 medium-scale and 3 large-scale. About 30-40.000 knap-sack sprayers, of good quality, are produced per year. Threshers are produced by a hundred small-scale industries.

There are four industries for the combine harvesters (self-propelled or tractor mounted) production. Most of them are still in the stage of realisation. Only one seems to have begun production. It has a capacity for 700 units per year, and to now has manufactured 400 units of the tractor mounted model.. It is now about to start with the production of three models of self-propelled combine harvesters for paddy and wheat, in cooperation with a European firm. The same industry (well-organized and having a technical department which has taken care of the necessary adaptations of the original designs to the

agricultural conditions and, especially, to local raw materials), produces also a few hundred disc-plows and around hundred fertilizer distributors per year.

In the specific sector of paddy mechanization, very few machines are being produced, except for those used for primary and secondary tillage by animal drawn (plowing, leveling, puddling), for plant protection (knapsack hand or power operated), and, in smaller amounts, for thrashing, (both hand or pedal operated or power operated with small engines less than 5-7 HP).

Reaper-binders for paddy are not being produced at all. The dryers production is very modest, as is that of cleaners and hullers. The latter are produced in small series by about 40 small manufacturers working without chechs on their production. Drying of the paddy still comes about by natural means, though cleaning is aided by small machines, in general hand operated. The production capacity of such machines is not known.

The existing industries are not always interested in expansion and diversification of their production. This fact is due to the present market conditions and the forecast for a low development (as opposed to theoretical demand). Only a few, and not necessary the most important, seem disposed to try new forms of cooproduction for simple machines, able to increase very little the productivity of labor and not always requiring adaptations.

3.3 - The level of ancillary industries and raw materials is developed, though they do not cover all needs of the country. The great majority of ancillary items which are required particularly in automotive industry (batteries, tyres and tubes, broke linings, clutch assemblies, dynamos, starter motors, fuel injection equipment, valves, gaskets, filters, etc.) is locally produced, except for gears (a mass production of which is expected within a few years) and other components requiring the use of valuable materials, such as some special

steels, commonly used in the agricultural machines and tractors production. Also noted was a want of heat treatments, foundry and casting, even though there are certain capacities for casting such as malleable, sphreroidal-graphite, cast iron, etc. both in the organized and in the small-scale sector. There is also some production in the sector of non-ferrous casting, and the capacity for both open and closed die forgings is considerable. It even seems that for some products, production capacity is bigger than the present internal demand.

The level of machine tools production is fully satisfactory. Except in particular cases, they can cover the whole internal demand for the agricultural machines and tractors construction. They are suitable, both in terms of production capacity and of models, to sizes and needs of the existing, manufacturing industries : from lathes of various types to milling, from grinding machines to gear-cutting machines.

Six large steel plants have already been established in the country. These plants manufacture all the primary iron and steel products including pig iron, ingot steel, etc.. There is also a large number of re-rolling mills whose production covers quite completely the needs of the industries.

The raw materials for the steel plants are abundantly available and only certain alloying elements need to be imported.

Finally the technical education of personnel needs to be improved, both for skilled workers and for specialized technicians. In the meantime, there seems to be a surplus of agricultural engineers, and mechanical engineers, whose instruction appears more theoretical than practical. They would need specialization courses abroad. Technical education is often carried out directly inside the existing industries.

The development of the industrial system is followed in close particular and promoted by economic development plans. This is necessary if, as it seems, within a short time import of finished

agricultural machines will be shutted down for the local market, and it will not be possible to proceed except through forms of co-production.

3.4 - On the whole, the analysis of the existing situation in the country is satisfying. There are, practically, all the structures necessary for a rapid industrial take-off in the sector of agricultural machines manufacture.

Obviously even in the rapid analysis carried out, certain lack aspects were noted. It seems usefull to recommend :

- the development of industrial units for the manufacture of 14-16 HP power-tillers convertible in time into tractors, and of 18-22 HP four-wheel drive articulated tractors, simple, low cost and durable. These latter should be produced with the equipment and fittings necessary to primary and secondary tillage, plant protection and transport. The suggested industries must be ready for an initial annual production capacity not less than 8-10.000 units for each of the mentioned machines, developing gradually in time to be able to turn out double that number ten years from the starting of production;
- the development of industrial units for the manufacture of self-propelled reaper-binders, threshers, dryers and mobile workshops. These units should have an annual production of about 4-5000 units of each item;
- the development of industrial units for the manufacture of equipment for irrigation, in particular of pumps and machines for the digging and up-keeping of canals and trenches. These units should have a production capacity coherent with the development of irrigation (still to be defined);
- a study to enable a deep standardization of different machines, and particularly of engines, in reference to the small scale industries

production, with the goal of simplifying spare parts and reducing costs;

- a study to define the optimum size of production and the level of investment necessary in the small-scale industries sector, in order to obtain the necessary economies of scale in production;
- a study to fix more suitable incentives to the farmers for the purchase of machines. The models of the machines to purchase with special loans must be defined on the basis of criteria of optimum mechanization with reference to cost of labor;
- the development of facilities in the heat treatments and products quality control sectors.

4 - Policy towards farm mechanization

4.1 - The agricultural reform is in effect, and in the opinion of the Ministry experts, should settle the problems of rearrangement and distribution of the land within the next five to eight years. There is still much to be done in the following sectors : agronomical development in rice-growing, irrigation, rivers protection, rural buindings and roads, cooperatives and organization of machine service centers.

The development of mechanization is closely bound with that of the above sectors. In the opinion of government officers, the growth of mechanization must proceed very slowly for the social reasons mentioned earlier in this report. However this opinion is not shared by many expert who deem necessary a more incisive policy in favour of service centers and cooperatives achievement.

Government, however, through its agencies and agro-industrial corporations, helps farmers purchase machines, assisting with the payment, for 5-7 years, of 4% of the interest on bank loans asked by farmers (total interest rate = 9%). This aid is extended on 75% of the cost of the machine.

There are, in addition, noteworthy and interesting plans for international aid, like that established by the International Coordinated

Project on the Mechanization of Paddy, financed and coordinated by a European country. This project has the goal of collecting data on the present stage of paddy mechanization, and of collaborating with local technicians for its rational development. Further, experts from FAO, and the Ford and Rockefeller Foundations are working on the problem of paddy development and mechanization. However, most of these researches have been undertaken only a short time ago, and it is too early to draw conclusions as to there possible results.

4.2 - Research is carried out in the Department of Agricultural Engineering of the Faculties of Agriculture located in all the Indian States. The scientific personnel is prepared but with rather inadequate scientific equipment at its disposal. The scientiest are generally involved with the studing of prototypes of small machines suitable for facilitating hand or animal labour. These projects can be either original or adaptations of machines imported from abroad. In some Department there is a shortage of scientiest; in some cases there is also a lack of instruction.

Despite the fact that a government level Indian Council of Agricultural Research - connecting 17 research centers - is operating, it seems that there is little exchange among the various Department and Centers themselves as well as between research and industry. Many institutes, in fact, are contemporaneously working on similar machine models.

In addition, an Institute for Agricultural Research is operating in New Delhi. Included is a rather well enough equipped Department of Agricultural Engineering. Its main job, in the sector of agricultural machines, is to design and manufacture simple, easily manufactured and easy to use prototypes of machines.

On this subject it is to be recommended that the type of research being done be directed toward other goals, to avoid repeating the results already achieved in other countries. Some research should be dedicated to the optimum choice of machines (to be produced locally) sui-

ted to the local structural and agronomic conditions, to their adaptation, and to the organization of mechanization.

The Tractor Testing and Training Station at Budni is well equipped and its staff at a good level. Its job it to test all imported machines before the granting of concessions of permission for local manufacture in cooproduction. This center follows the OECD testing methods, adding extensive and prolonged field tests to the laboratory ones. Even this, however, needs strengthening and the aid of international experts for a more organic and integral organization and development.

In short, external aid is needed for the research coordination, development and modernization.

Lastly, there exists an Indian Standardization Institute which till now has taken care of standardization of various parts of simple machines, especially in the primary tillage sector. The work this Institute is called upon to perform in the near future is of utmost importance in the field of agricultural machines and tractors production. Its activity must be able to be carried out in close connection with the world of research, also in the general mechanical sector (Central Mechanical Engineering Research Institute, National Research Development Corporation, National Council of Applied Economic Research, etc.).

The organization of technical education seems to be good on the whole. The same applied to university education, divided up among several high-level universities. These universities should have more contact with the practical side, and therefore with the productive sector both in the country and abroad.

4. 3 - The training and extension services in the field of mechanization represent a sector still in evolution. The Central Government is operating in this field through the State Governments, the agro-industries corporations and the main manufacturers. Courses las-

ting 1 to 3 months for drivers and repairmen, with demonstrations in the field, are being organized. 2500 Agro Service Centers are collaborating in this effort.

However it is the opinion of international and local experts that that activity is not sufficiently developed, and that to it has not been given the necessary very primary importance.

4.4 - The following recommendations result from the above examination :

- a greater strengthening of the centers of research and testing and coordination among them : the creation of one or two centers for adaptation, design and prototypes construction of machines suitable to the conditions of the country. To be avoided is to study machines and tractors "ex novo", as example similar to these have existed for years on foreign markets. To be recommended on the other hand is to limit activity to the study of necessary adaptations and simplifications;
- a strengthening of the organization of technical training in the farm mechanic area for farmers, by the initial creation of 2 or 3 centers to prepare drivers and skilled repair and maintenance workers;
- strengthening of the extension service.

5 - Policy towards industrialization

5.1 - The Government is interested in developing the policy of progressive industrialization of the country which, however, is proceeding more slowly than was projected.

5.2 - The Government encourages cooproduction with foreign companies according to the needs of the market forcast in the economic development plans. In particular, it furnishes financial assistence, with low interest loans, tax and customs exemption and technical assis-

tence in the planning, and choice of material. This is for the installation of industries which require a capital investment of less than 700.000 Rs (about $ 100.000). The government also helps in the organization and sale of outputs.

In this frame international cooperation both bi or multilateral is very well looked upon.

The long-term objective is to develop agricultural machine industry to be able to serve also foreign markets. However, in the short run, that development appears intentionally slowed down to contain the increase in mechanization within limits consistent with social needs. Some Experts feel, nevertheless, that the policy in the agricultural mechanization sector (and therefore of the manufacturing industries development) is not wiwed in its true capacity of mowing the whole country economy forward and of absorpting of labor.

5.3 - Research in the mechanical and industrial sector in general is entrusted to the state organizations and universities, whose level of development (through satisfactory) would profit from being strengthened, within a short period of time, in order to furnish the right mowing force to the growth of the country.

Also in this area international cooperation is looked on favorably, as long as it is aimed at precise objectives.

6 - Conclusions

Toward aiding the rational development of paddy mechanization and the local manufacture of machines suitable to the present and future needs of the country, in particular, of the paddy areas according to the delineation in the forward paragraphs, the following UNIDO assistance is recomended :

1 - To assist the Government and the existing manufacturers in the standardization and unification of production of tractors and agricultural machines (with particular reference to the sector of

small-scale industries), in the formulation of feasibility studies and definition of the economies of scale of the same industries. A team of 2 UNIDO Experts : an agricultural machinery engineer and a small scale industry expert; duration height months each; course of the mission 1973.

2 - To assist the Government in the preliminary study and in the creation of a pilot center for technical training, repair and maintenance, and organization of a tractor and machinery hiring service : 1 UNIDO Expert; duration four months; course of the mission, the second semester of 1973.

3 - To assist the Government in the coordination and strengthening of the existing centers of research and testing and in the fixing of one or two centers for design, adaptation, prototypes construction, standardization and testing of tractor and agricultural machinery. A UNIDO Expert; duration,4 months; course of the mission, the second semester of 1974.

4 - To assist the Government in the study and creation of an industry (on the basis of an examination of the possibilities of local manufacturers) for the manufacture on economic scale of a 18-22 HP tractor and of a 14-16 HP power-tiller (both simple and low cost). A team of two UNIDO Experts : an agricultural machinery engineer and an industrial economist; duration, 8 months each; course of the mission,1975.

5 - To assist the Government in improving heat treatments, casting and forging in favor of the local mechanical industries, and to study the possible organization of a governmental center for assistence in the area. A UNIDO Expert; duration, 6 months; course of the mission, 1976

Before sending the above mentioned experts off it would be advisable to assign 5 fellowships, for the duration of six months each, to send 3 agricultural machinery engineers and 2 mechanical engineers abroad, to be used later as counterparts for the proposed experts.

PERSONS MET

1 - Mr. G. GRISOGONO - UNDP Res. Rep. i. a. - New Delhi

2 - Mr. J. LASCELLES - UNIDO Senior Ind. Dev. Field Adviser - New Delhi

3 - Mr. G. HUTTON - FAO Senior Agr. Adviser and FAO Country Rep. - New Delhi

4 - Mr. B. RADOVIC - UNDP Res. Rep. Assistant - New Delhi

5 - M. M. R. MALHOTRA - UNDP Programme Officer - New Delhi

6 - Mr. D. B. KHERDEKAR - Joint Commissioner for Agricultural Machinery - Ministry of Agriculture - New Delhi - (Counterpart)

7 - Mr. SHRI J. S. BALI - Secr. of Indian Society of Agricultural Engineers - New Delhi

8 - Mr. H. S. CHADA - Director Escort Ltd. - Faridabad

9 - Mr. W. LAL - Technical Dir. Eicher Tract. India Ltd. - New Faridabad

10 - Mr. H. BASHARE - Qualitex Priv. Ltd. - New Delhi

11 - Mr. B. BHASKARE - Comm. Dir. Greaves Cotton & Co. Ltd. ,Cons. Eng. - Bombay

12 - Mr. S. E. ROY - Head of the Division of Agric. Engineering - I. A. R. I. - New Delhi

13 - Mr. M. RAMAC HANDRAN - Dir. Vicon Ltd. - Bangalore

14 - Mr. C. VEDANTHAN - Gen. Manager Vicon Ltd. - Bangalore

15 - Mr. K. YAMAMOTO - Tech. Dir. V. S. T. Tillers Tractors Ltd. - Bangalore

16 - Mr. B. P. BALAKRISHNA - Dir. Mysore State Agro. Ind. Corp. Ltd. - Bangalore

17 - M. A. B. DATAR - Secretary of Agriculture - Government of Mysore - Bangalore

18 - Mr. G. RANGASWAMI - Vice-Chancellor, Tamil Nadu Agric. University - Coimbatore

19 - Mr. R. K. SIVANAPPAN - Head Dept. Agric. Eng. , Tamil Nadu Agric.

University - Coimbatore

20 - Mr. A. SUBRAMANIAM - Head Dept. Botany, Tamil Nadu Agric. University - Coimbatore

21 - Mr. S. K. MISRA - Senior Test Engineer - Tractor Testing and Training Station - Budni

22 - Mr. B. JACOBI - Ass. Expert FAO in the International coordinate project on the mechanization of rice production -CRRI - Cuttack

INDONESIA

SUMMARY

1 - The paddy growing has considerably developed in the last few years, so to reach a production sufficient to local needs. With the foreseen development in the use of fertilizers and in the extension of irrigation, paddy will gradually abandon dry areas, rising yield production and spreading areas with two crops per year. The active population in agriculture is still numerous and because of the high growth, a considerable reduction of it is not foreseen in the near future.

2 - The mechanization development has been a very low one; its density concerns 0,25 tractors, 0.06 power-tillers, 1 pump (power or hand operated) and 0.25 threshers per 1000 ha..

The machines actual demand is quite modest and it is referred to few thousand units of pumps, knap-sack sprayers, threshers and hullers per year. Concerning future development the following priorities have been stated : pumps, plant protection equipments, dryers and hullers, power-tillers with primary and secondary tillage equipments and trailers.

Because such development should be realized through machinery use cooperatives, it is suggested,in the frame of the above mentioned priorities, to use 14-16 HP power-tillers which can be transformed in 4-wheel drive tractors, with plows, sprayers and driving-axle trailers. Concerning dryers it is suggested to use continous belt models, both mobile and stationary, the latters coordinated with new hullers with capacity no less than 0,7-1 tons/h of polished rice.

It is also suggested to study the convenience of small power operated pumps and self-propelled reaper binders to be used by single farmers.

3 - The production sector is not too well developed even if there is a

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great interest in diversifying and developing production, especially through joint ventures. Some hundreds tractors are assembled every year and some hundreds of threshers, hullers, cleaners and 2000 2"-8" ∅ centrifugal pumps are manufactured.

The assemblying of diesel engines (with gradual increase of local content) is in an organizing phase, in order to produce 10.000 units per year in different sizes.

Industries present low labour productivity and need to be developed and ammodernized especially as far as technical assistance, quality control, standardization, definition of economical production series are concerned. To obtain this goal the recently started M. I. C. D. is seriously working.

It is suggested to study the possibility to economically produce the machines needed for agriculture and especially a 14-16 HP power-tiller equipped with trailer p. t. o. driven, small pumps and reaper binders.

4 - Ancillary industries and raw materials are practicaly at primitive stage and large increasing previsions are foreseen, referring to the manufacturing ot steel, ferrous and no-ferrous casting, forging and heat treatments. This is also true in the spare parts and components construction sector.

5 - The Government policy aims to realize cooperatives for the use of machines which can be purchased through not so interesting facilities. Researc h is developed by the Agricultural Engineering Division of the Directorate of Agricultural Techniques. This organization should be improved in the frame of the foreseen general development.

Training and extension service should also be improved while the repair and maintenance services should be completely riorganized.

6 - The industrial development in the private sector, is regulated by

two laws concerning incentives offered to local and foreign investments. These incentives will be able to develop internal and foreign investments in such a way that in 1980 ancillary industries and raw materials will meet 80% of local demand.

1 - General pattern of agriculture

1.1 - The total cultivated area is evaluated around 17.000.000 ha. and represents about 18% of the whole country area. Only on 20-25% of it there are two or more crops per year, generally in connection with paddy. Such area is going to diminish in the future because of a progressive abandoning of dry areas even if there is actually a lack of production compared to local needs. Present imports interest about 400.000 tons of rice per year.

Paddy covers some 8.000.000 ha. corresponding to about 50% of the cultivated area; 85% of paddy growing is concentrated in the Giava island.

In 1970 the total paddy production reached 24.000.000 tons, corresponding to an average yield production of 2.7 tons per ha. and it is going to reach a 40% rising in 1974.

Such production increase is mainly due to a spreading use of fertilizers (100 kg urea and 50 kg of super phosphate per hectare for rice production), to selected seeds and to irrigation. The irrigated area covers 5 millions hectare (4.400.000 in 1965) and it can doubled, according to official evaluations on hydraulic resources. Anyway this is going to take a lot of time, not less than 15-20 years, even if it has been planned a big water regimen system in the Giava island (1.000.000 ha.) with the technical and financial assistance of other countries. The first 300.000 ha. will start functioning in 1973.

It is foreseen a progressive rising in the use of fertilizers to reach 100 kg of urea and 75 kg of super phosphate per every paddy growing ha..

The agricultural area is distributed into 12.360.000 farms with an average extension of 1.1 ha.. Such farms are often fragmented in small plots some hundred meters apart from each other. Only 3.7% of the farm population has a size larger than 4 ha. and covers an area on 29% of the total cultivated one. The paddy growing farms average extension is,however, inferior and valuated around 0.5-0.6 hec-

tares.

1.2 - The total population of Indonesia is 124.000.000 inhabitants, whose 40% constitute active population. Over 70% of the total population is concentrated in the Giava island, which represents less than 10% of the country total area.

Agricultural workers represent 65% of active population, which means a 1.9 workers density per each cultivated hectare. A large number of this population works only part-time in agriculture and gets only some of their income out of agriculture. This usually happens in the areas about 30-40 km out of the biggest towns and around the main roads.

The population increase, in these last few years, has been between 2.6 and 2.8% per year and it has recently rised compared to preceding data. Anyway this is going to diminish in a near future thanks to a family planning program started in the frame of the actual 5-year development plan (1969/70-1973/74). However, the agricultural active population will remain - at least on absolute terms - more or less constant still for a long time. A density riduction per ha. infact will happen only when large areas in the main Indonesia island are recuperated to agriculture.

1.3 - The G.D.P. value per capita is about 90 dollars per year and it is suppoeed to have as 6-7% average increase per year in the frame of the actual 5-year development plan.

Up to 1970 agricultural products represented 48.7% of G.D.P. and this value had a 2.7% per year increaeement in the last few years, at a constant money value. According to the plan, there should be a 9.6% average increase per year, at a constant money value, representing - at the end of the 5-year development plan - about 40% of G.D.P..

1.4 - Practically all the works concerning rice-growing, which is mainly conducted on fertile lands offering high production improvement, are hand realised or with the animal help. There do not seem to be peak periods along the year, because of the very good climate. Drying is usually made through natural systems, while processing is mainly conducted through old and small plants which are more and more developing into cooperatives. The actual situation leads to considerable losses concerning some 26% of the total production. About one third of these losses seems to depend on harvesting, threshing and transporting. The transports problem should be faced and solved in the most rational way.

2 - Pattern of farm mechanization

2.1 - The agricultural mechanization level is a very low one and it does not seem possible - even if it is difficult to know the exact agricultural machinery and implements population - to obtain a rational development of mechanization itself in a short time, because of the farms small sizes, the large amount of labour in the primary sector and the low farm income. Therefore, this will be realised only through the constitution of cooperatives to use machines.

The actual tractor population is evaluated around 4.000 units (may be a little more), mostly between 30 and 50 HP. This corresponds to 0.25 tractors per 1000 cultivated hectares.

The tractor population increase has been quite modest in the last few years, with an annual demand of less than 400 units, whose 10-12% is utilized for the replacement market. Their annual average utilization is about 500-600 hours.

The power-tillers population is evaluated around 1000 units, less than 10 HP powered, belts and chains transmission model. Total annual demand for this kind of machines is around 400-500 units which means that power-tiller use has been started only few years ago.

While it is not possible to acquire data about agricultural engines population (in 1970 the total demand was about 6000-7000 units both diesel and gasoline), there seems to be a population of : little more than 1000 power operated, 200 wind-operated and 20.000 hand operated pumps; 18.000 powered knap-sack sprayers and dusters with engine of less than 4 HP and 60.000 knap-sack hand operated sprayers. There are also more than 4.000.000 plows, 3.000.000 animal drawn harrows, 1.500.000 hand operated cultivators, 1.000 small size rototillers normally applied to power-tillers and a small amount (unknown number) of seeds and fertilizers distributors.

The agricultural machinery actual demand is valued in the following way : 3.000 power operated centrifugal pumps per year; 2000 power knap-sack sprayers per year; 54.000 hand sprayers per year; 500 power operated threshers per year. The trailers population (which correspond, at the most, to the total number of existing tractors) is unknown, while there are about 100.000 animal drawn carts.

Some testing is conducted by the Agricultural Engineering Division of the Directorate of Agricultural Techniques around the use of small self-propelled reaper binders and combine harvesters, whose utilization, anyway, is not known by farmers yet.

In the processing sector, dryers population is valued around 600 units, whose 80% has a bigger capacity than 5 tons per day; there are about 16.000 hullers, usually old and with a work capacity between 300 and 500 kg/h of paddy. This data seems to contradict the 1963 census results which were presenting a hullers population of about 28.000 units (such population would be better responding to the country's needs). The hullers actual demand is valued around 800-1000 units per year.

The 1969-1973 plan foresaw, on the contrary, a total demand of : 200-230.000 power-tillers; 600-650.000 power operated knap-sack sprayers; 300-350.000 hand operated dusters; 20-25.000 power pumps; 100-120.000 power and pedal operated threshers; 50-60.000

hullers.

2. 2 - According to information furnished by the Directorate of Agricultural Techniques, the future agricultural mechanization development should be led according to the following priorities which will also be pointed out in the next 5-year plan :

- 8" ∅ irrigation pumps with around 50 l/s flow and 15 HP power, in order to reach an average density of 40-50 irrigated hectare per unit;
- plant protection equipments;
- dryers and hullers;
- power-tillers furnished with equipments for primary and secondary tillage and for transport.

The mechanization development is quite a modest one compared to the plan especially concerning power-tillers, threshers, dryers and hullers. This is probably due to the fact that all machines, excluding pumps and sprayers, are imported.

Therefore, it is difficult to foresee a future development and the annual machinery demand, without having conducted a serious and broad analysis on the rational mechanization models which can be used in the frame of production and structure development.

Cooperatives are spontaneously rising among rice-farmers around the big paddy storage and processing centers so that definition of these mechanization models should be carefully studied in connection to the cooperatives sizes. The Directorate of Agricultural Techniques is thinking of a future agricultural organization based on centers for machines and irrigation common use; each one of them should serve areas between 600 and 1000 hectares large. Such areas are considered production economical units in the frame of machines best utilization.

Because of the low mechanization level it can not be considered - at the present stage - the realization of a repair and maintenance ser-

vice, which is actually conducted, not always in an efficient way, by the different trade companies. A reason of the agricultural machines and tractors small market is the complete lack of spare parts, which caused in 1967 that only 50% of total tractors population were working. The dimonstrative atctivities conducted by the Agricultural Extension Service as well as training, are consistent with the mechanization development actual degree.

2.3 - Despite that the Government's agencies aim to organize paddy-growing on the basis of the above mentioned centers for a common use of agricultural machines and irrigation plants, mechanization should be organized with simple and strong machines, easy to use and to maintain, able to improve soil preparation, to obtain greater timeliness especially on lands under 2 crops per year and to reduce labour's weariness and product losses, without considerably increasing of labour productivity.

A coherent choise of machines has to be done in the frame of the above mentioned priorities. There are precise indications on pumps choises, and it has to be valuated the opportunity to spread other models (i.e. 2-4" ∅ small gasoline engine operated models) and the amount of annual requests. According to official informations, the future total population will amount to 100-120.000 units, both for 8" ∅ and 2-4" ∅ sizes. This means an annual average demand about 12-15,000 units (7-8% for replacement market) for each one of the suggested models.

For all the other machines, considering operatives needs and the necessity to develop their cooperative use, it is suggested to use :

- in the tractor sector, 14-16 HP power-tillers p.t.o. equipped, convertible in the future in a 4-wheel tractor, adding an adapted rear-end, to be used for primary and secondary tillage, transport and plant protection equipment. This kind of machine - in the model equipped with driving-axle trailer - can cover 15-18 ha areas and be therefo-

re, broadly utilized, with a 4-6.000 units annual demand which will doubled within a decade. It should be carefully considered the spreading of 25-35 HP tractors, articulated, two and four-wheel drive, useful for primary tillage especially in hard soils and for 2 crops per year areas;

- in the agricultural machines and implements sector, mould-board plows, harrows, puddlers, levelers, sprayers and trailers adequate to power-tillers. Sprayers and trailers should be p.t.o. driven. Their annual demand will be as large as the one for power-tillers. It is suggested to test spading machines, whose use could present satisfactory results considering the low power request and the fact that is does not ask any draw-bar pull. It is also suggested the spreading of power operated threshers - rotating on horizontal axle model, designed by IRRI - while two different models of dryers can be useful : a 4-6 paddy tons per day mobile model, and a 10-12 tons per day fixed one. Concerning processing it is important to consider the spreading of mill plants for 0.7-1 tons/ha. of polished rice as it has already been done in some centers.

It should be kept in mind the necessity to organize harvesting mechanization through self-propelled reaper binders (1.50 m width cut) simple, strong, easy to use and to mantain.

Together with the mechanization development, repair and maintenance service should be increased and organised on the basis of mobile work-shops.

3 - Manufacturing industries and ancillary facilities

3.1 - The industrial sector gives a 9.1% contribution to G.D.P. and its development rate has been 5.7% per year in the last few years at a constant money value. By the end ot the actual and of the next 5-year plan, it is foreseen a 8.1% annual increase. This means that the industrial field will cover almost 20% of G.D.P. in 1976. Anyway there are some doubts on the connection between real development and previsions,

especially in the mechanical sector where a 92% development is foreseen.

The mechanical and metallurgical sectors have been improving quite well, even if they are still at the first development stages and are facing only now the problems concerning mechanical industries reorganization, with the technical help of a recently constituted Metal Industry Development Center (M. I. D. C.). In any case, production is inferior to demands.

In the mine sector development has been quite a modest one and especially the mineral oil and coal sectors are improving now, while the electrical field is increasing (8. 2% per year) in the frame of the above mentioned water regimen.

Finally, fertilizers production - which meet 15-20% of requirements up to now - should have a 300% increase by 1974.

Such developments seem possible to realize considering that, in the plan, the first two years should be spent in the rehabilitation stage, after which expansion, beginning from 1971, has been started.

3. 2 - The agricultural machines local development is very low and limited to : 3 small tractors engines assembly companies with an annual production of 50-100 units each; a small assembly company in cooproduction with Japan, for gasoline engine power-tillers.

It is also under construction a factory for 4,000 diesel engines per year (3-15 HP)production which will start in 1973 as a simple assembly unit, gradually increasing in the time local content. Such modern quite lively factory, is gradually renewing all its equipments to produce new machines and implements : 700 hullers per year with a 300-400 kg/h production capacity; 4"-8" ∅ pumps, with imported 15-18 HP enginees; small 3-5 HP diesel operated pumps; 300-400 threshers, Japanese model. This factory plans to manufacture - or, at least, to assembly - 8-10 HP Japanese power-tillers. These machi-

nes are, at present, too expensive (about 1200 dollars) compared to farmers possibilities, but a great amount of them could be sold if it will be possible to reduce costs to no more than 850 dollars. The same factory has a small foundry and a big production of screws and bolts.

Another industrial unit, owned by the Government and constituted by 3 industries, it has been in a reorganization phase from August 30, 1971, in order to produce threshers, paddy cleaners, centrifugal and screw 2-4-6" ∅ pumps and to assembly, on european licence, rice milling machinery. This production - which is not standardized and limited to 100-150 units per year for each kind of machines - besides pumps manufactured in 2000 units per year - has to be added to the actual one of metallic carpenter and spare parts for sugar-cane mills. The factories present good facilities for a future development thanks to large workshops and sheds, but need to completely renew practically all the existing equipments, which are about 40 years old. Its actual total production amounts to 5.000 tons of metallic products, whose 60% is constituted by components for civil engineering.

The actual labour productivity of this unit is about 1.200 dollars per worker. The factory has at the beginning a joint venture with an european company for the production of 2.500 diesel engines (10-140 HP);2000 of them will be in the 10-20 HP range. Such joint venture supposes a 4-5 years assembly stage, a second stage of manufacturing with 40% local content and a third one with 90% local content. It is to suggest - for this factory which is interested in production diversification - a productions concentration and specialization taking in account the economy of scale problems and the highest standardization of components, with the goal to reduce production cost and semplify spare parts service.

There are also some small factories to produce hand operated sprayers covering about 20% of actual demand, in addition to plows

and other animal drawn implements for soil tillage.

3.3 - As far as ancillary industries and raw materials are concorned, the actual situation is not completely known and by the end of 1972 a broad research on local industries actual production should be finished by the Directorate of Industry.

Anyway there is, even if inadequated, a production of tyres, tubes, gears, batteries and ferrous and non-ferrous materials foundry components. They are produced by small-workshops, no mechanized and without any quality control.

There are some facilities for forging and heat treatments. In every industry sheet metal rollers for heavy fabricated equipments are broadly used, but it seems there are no facilities for complicated press parts.

Machines tools are actually imported, together with raw materials.

In the mine sector as well as is the raw materials and ancillary facilities sector there is supposed to be a considerable increase; by 1980 local production should meet about 80% of internal requests, especially concerning : cold drawn carbon steel, cold drawn alloy steel, hot rolled plates, sheets and strips and gray iron malleable. Casting, forging and heat treatments will be developed according to needs.

The mechanical and metallurgical development is slowed down by the lack of technicians and skilled workers; this lack can be solved only improving secondary education.

3.4 - The actual situation is going through a development phase and it is useful to suggest the production (with gradually growing local content) of all the above mentioned machines (tractors and implements) encouraging and specializing the already existing factories, with incentives to expand and diversify their production.

The suggested construction of 14-16 HP power-tiller with driving-axle trailers, self-propelled reaper binders, 25-35 HP tractors can be realized both by private and state owned industries, in connection with the existent joint ventures for a diesel engines production. The manufacturing of power operated threshers, dryers (800-1000 units per year) and modern rice millers should be increased.

All this has to be done, considering standardization and analysis of the economy of scale, according to the expenses than can really be paid by single farmers and cooperatives, to purchase machines and equipments.

M. I. D. C. is supposed to have, in this sector, an important role for technical assistance, research, materials and production control, while the Laboratory and Engineering Division of the Directorate of Agricultural Techniques will have to lead research on the basis of the best machines models choise and of their testing. This can be done in a much better way with assistance of international experts.

4 - Policy toward farm mechanization

4. 1 - The paddy mechanization development is going to be as low one, depending on labour reduction and on the general development of the country. The main efforts are made in the irrigation and processing fields, as well as to spread the use fo fertilizers and pesticides.

Credit facilities to farmers to purchase agricultural machines are quite limited and practically consist in 3 years loans, at 12% of interest. Such interest - considering the stability of currency - seems too high and the duration too short and it is suggested that the Government takes into consideration the opportunity of more interesting credit facilities, especially to favour cooperatives.

4.2 - Research and testing on agricultural machines are conducted by the Engineering Division of the Directorate of Agricultural Techniques, with equipments which need to be implemented in order to improve a rational mechanization development, as far as machines choises, testing, adaptation and standardization are concerned.

Such development is necessary especially considering the increase of cooperatives to use agricultural machines on 600-1000 ha. lands, as mentioned above. Techno-economical studies on the optimal mechanization level according to socio-economical conditions - and consistent needs have to be broadly conducted.

The University courses both in the agricultural and mechanical sectors, furnish good preparation and develop a satisfactory research level.

The organization of vocational training both for technicians and skilled workers seems not sufficiently developed and particular efforts should be made in connection with practical instruction, in order to improve mechanization.

Training and extension services level are quite low especially concerning mechanization. Such activities are conducted by the Directorate of Agricultural Extensione Service and by the Agricultural Engineering Division.

Finally, the repair and maintenance service is run by private industries and it is not satisfactory because of lack of spare parts.

4.3 - Taking as a basis what it is said above, it is useful to suggest :

- to develop the actual Agricultural Engineering Division, especially concerning machines choises, their testing and adaptations. It will have to operate - in cooperation with M. I. D. C.- in researches about construction standardization of tractors,engines, machines and their implements;
- to develop the technico-mechanical training service for farmers and the after-sale service;

- to improve vocational schools for technicians and skilled workers.

5- Policy toward industrialization

5. 1 - The development in the industrial sector is supposed to be continuous and coordinate, because, at the present point, 70% of manufacturing industries is controlled by State's enterprises. To obtain this development, incentives concerning tax exemption, custom and technical facilities are offered, according to a law stated in 1967, for foreign investment, and to another one in 1968 for local invesments.

These laws do not foresee particular facilities to develop the agricultural machines industrial sector. Such development will be helped and leaded by the above mentioned M. I. C. D., which is in realizing phase right now with european experts assistance. Its job will concern technical assistance for rational design and prototypes construction in favour of local industry, technical traning at different levels and applied researches and quality control.

This center should start to full activity by 1973 and it is suggested to develop standardization of materials and agricultural machines in order to reduce costs of production, together with defining the best economical dimension of factories and capacity production of different kind of above mentioned machines.

5. 2 - Research in the mechanical sector has to be mainly conducted by M. I. D. C. together with the Engineering University whose level should be developed taking more care of practical education.

6 - Conclusions

In order to help a rational development of mechanization and of the local construction of agricultural machines and tractors adequated to actual and future needs, particularly referring to paddy areas, it

is useful to suggest the following UNIDO assiatnce :

1 - to assist the Government - in connection with the Directorate of Agricultural Techniques and M. I. D. C. - in cohordinating and teveloping research and testing centers especially concerning design, adaptation, prototypes construction, standardization and testing of tractor and agricultural machinery. An UNIDO Expert : duration, 4 months; course of the mission : second semester 1973;

2 - to assist the Government - in connection with M. I. D. C. - to define production on the basis of the local manufacturers possibilities on the economical scales and in the frame of the best standardization for 25-35 HP tractors, 14-16 HP power-tillers, and reaper binders, simple and low cost. Team of 2 UNIDO Experts : an agricultural machinery engineer and an industrial economist; duration, 6 months each; course of the mission : second semester 1974;

3 - to assist the Government in preliminary study and in the creation of a Center for Technical training, repair and maintenance and in the organization of tractor and machinery hiring service. An UNIDO Expert; duration, 4 months; course of the mission : first semester 1975.

Before sending the above mentioned experts off it is suggested to promote 3 fellowships, lasting 6 months each in order to send 2 agricultural machinery engineers and 1 mechanical engineer abroad to be used later as counterpart for the proposed experts.

PERSONS MET

1 - Mr. A. Y. MORVAN - UNDP Ass. Resident Rep., Djakarta

2 - Mr. EMAN JOGASZARA - Director of Planning, Directorate General of Basic Industry, Bandung

3 - Mr. AZ - Director of M. I. D. C., Bandung

4 - Mr. SUGIHARTO B. E. - Directorate Gen. of Basic Industry, Djakarta (counterpart)

5 - Mr. SOCDHARSO RAWIDJIO - Director of the Agricultural Techniques - Dir. Gen. of Agriculture, Djakarta

6 - Mr. SUDIYANTO - Directorate Gen. of Agriculture - Chief Engineering Service Dept., Djakarta

7 - Mr. R. DADANG TARMANA - Directorate Gen. of Agriculture - Head Laboratory and Engineering Division, Djakarta (counterpart)

8 - Mr. O. P. SITUNORANG - Directorate Gen. of Basic Industry, Djakarta

9 - Mr. M. CHAFIED - Directorate Gen. of Basic Industry, Djakarta

10 - Mr. KOMARNA MIHARDJA - M. I. D. C., Bandung

11 - Mr. M. N. MUSLIMIN - Head of National Logistic Agency, Djakarta

12 - Mr. SUEKIMAN - B. B. I., Manufacturer, Surabaja

13 - Mr. SUROYO Eng. - B. B. I. Manufacturer, Surabaja

14 - Mr. SAMBODO WIDSJOKONGKO - Directorate of Cooperatives, Jojakarta

15 - Mr. KIRDJOHADISCESENO - President Karya Hidup Sentosa, Manufacturer, Jojakarta

IRAN

SUMMARY

1 - Rice-growing covers about 5% of the whole cultivated area with an average paddy production of 3.8 tons per hectare.

Paddy area is going to double by 1980 (700.000 ha.) while yield production increases are going to be less consistant. The irrigated area covers more than 40% of the total cultivated one.

While a land reform is going on, cooperative organization of farmers is developing, in order to a common use of machines and irrigation and to develop processing and product commercialization.

2 - Considering the rice-growing small area, it is not possible to have specific data on actual mechanization and its development relating to the area itself. In general terms, actual density of main agricultural machines is : tractors with average size in the range of 55-65 HP: 3.5 units/1000 ha.; power-tillers and power operated pumps : 2.2 units/1000 ha. each; sprayers : 35 units/1000 ha.; power operated threshers : 0.2 units/1000 ha.; hullers - referred only to the paddy area - 11 units/1000 ha..

The present demand is quite small and its development is difficult to value. By 1975 there is supposed to be an annual demand of : 7.000 tractors (60-70 HP); 1.000 power-tillers; 90.000 diesel and gasoline engines (1-30 HP); 15.000 centrifugal pumps and 15-12.000 power operated threshers for paddy.

Examining actual situation, it seems important to suggest the spreading, especially for rice-growing areas, of a small-medium mechanization consisting in : 20-35 HP tractors, simple, low cost, 4-wheel drive, to be used for primary and secondary tillage and for transport; self-propelled multipurposes reaper binders; continous belt dryers, both mobile and stationary models; mobile workshops to develop an efficient repair and maintenance service. For each one of this machines it is theoretically possible to foresee an

annual demand starting with 3000-4000 units in 1975 and rising up to 6-7000 units per year in 1980. Use of power-tillers in paddy areas is going to be quite modest also in the future. All this, of course, has to be verified on the basis of broad studies to define the best mechanization levels.

3 - While the industrial sector results quite a developed one, agricultural machines and tractors are locally manufactured in a very limited quantity.

There are : a factory (45% local content) with a sactioned production capacity of 5.000 wheel tractors per year (production in 1971, 3.000 units); 2 assemblying units for 2.000 tractors per year; a power-tiller factory with a 6.000 units/year capacity (60% of local content) and a production of 3.000 units in 1971; some factories to produce 3.000 engines (7-30 HP) and 10.000 centrifugal pumps. There are, also, 30 smaller factories to manufacture animal drawn implements, and hand tools.

In a short time a few factories should start functioning while it is noticed the lack of skilled workers and ancillary facilities. In the development policy frame, it should be remembered the project of a regional cooperation among Iran, Pakistan and Turkey to produce tractors and machines on economical series. At the same time it seems useful to suggest that it should be taken into consideration the possibility to manufacture : 4-wheel tractors in the range between 20 and 35 HP equipped with implements and trailers; self-propelled multipurposes reaper binders; micro gasoline engines between 1 and 5 HP; dryers and mobile workshops.

4 - Ancillary industries and raw materials are at a primitive stage but with a very promissing development possibilities. Local production in the metallurgical and mechanical sectors is foreseen to cover, by 1980, 80% of internal demand, following an established develop-

ment plan which has given good results realising some important factories.

5 - To help agricultural mechanization development, the Government gives loans to farmers for a 6 years period at low interest rate. Research is conducted by the Agricultural Engineering Research Center equipped with modern instruments with a scientific and technical staff at a quite high level. This Center deserves to be improved in the testing, adaptation, and standardization. Training also for post graduates, technicians and skilled workers in the repair and maintenance sector, should be developed.

6 - The actual development plan gives considerable importance to the rising of mechanical industry. The Government gives facilities for new investments, both local and foreign, with low interest loans, tax exemption, duty free, etc.. This aims to install new factories not closed to Teheran than 120 km.. The development of small industries is considerably helped with UNIDO assistance.

7 - It seems necessary to develop technical and vocational training in the mechanical and metallurgical sectors at every level (from skilled workers to university graduates) as well as the assistance to factories in the metallurgical, quality control and standardization sectors. For this purpose UNIDO has been requested to assist the Government in realising a Center of Metallurgical Technology.

1 - General pattern of agriculture

1.1 - The total cultivated area is estimated around 6.850.000 ha. and represents 4.2% of the whole country. 15.000.000 ha. more could be brougth under plow without much cost.

The irrigation area covers 2.910.000 ha. and is continously expanding. Infact, in the last 5 years the irrigated land increased 450.000 ha..

Cereals cover 28% of the cultivated area, but paddy is grown only on 360.000 ha. completely irrigated, with an average yield production of 3,8 tons/ha.. This is due to the use of selected seeds and fertilizers actually distributed in 250 kg/ha.. The use of the latters has greatly improved, triplicating itself in the last 5 years. Most of fertilizers is imported, even if local production is increasing. The total paddy production is about 1.400.000 tons and it has a 3-4% increase per year, after a 50% rising in 5 years due to the use of varieties particularly adapted to soil's and climate's conditions. According to the official plan, paddy area should be doubled by 1980 to reach 700.000 ha., with a total production of 2.800.000 tons per year, sufficient to country's needs.

The agricultural land is divided into 2.200.000 farms with an average size of 3.07 ha.. It is estimated that 50% of land owned is by holding of less than 3 ha, 32% by holding of 3-10 ha. and 18% by holding of above 10 ha.. Average size of paddy farm is about 3 ha., but in most cases paddy does not consistute the only crop.

It is going on a land reform with farm size rearrangement, shifting of the land to workers and cooperatives promotion, each on some thousand hectares. These cooperatives are on experimental stage, rigth now.

1.2 - The Iran total population is about 26.000.000 inhabitants; 31.7% constitute active population. Agricultural workers are about 5.070.000 units which is 64% of the total active population. Their density corres-

ponds to 0.74 workers per cultivated hectare. The population growth is considerable and reaches 3% per year. A very active family planning campaign is going on with the goal to reduce annual population increase to 1%. Because it will be very difficult to obtain this, Authorities forecast an increase of cultivated areas.

A future reduction of the agricultural workers will be due to the under crops areas development and to the shifting of labour to industry.

1.3 - G.D.P. per capita is valued around 310 dollars per year and it had a 8-12% yearly increase, in the last 10 years. At a constant money value, it is foreseen a 530 dollars G.D.P. per capita by 1976, and a 1.200 dollars one per year by 1980. Agriculture furnishes products amounting to 15.5% of G.D.P., compared to 28% in 1968 and it has increased of 3.5-4% per year in the last 10 years, at a constant money value.

The fourth 5-years development plan is finishing and the fifth plan (March 1973-1978) is in preparing phase; there are no exact informations about its purposes. The investments planned for agriculture will be 4 times bigger to the one of the last plan and it is foreseen to considerably develop agro-industry cooperatives to transform agricultural products, to use machines is common, and to develop irrigation in the frame of great rearrangement plans which suppose costs of about 1300 dollars per hectare. All this will concerns paddy areas in a very limited way. The fifth development plan foresees a 5.5% average increase per year in the agricultural sector, in which paddy development will be quite important.

1.4 - Almost all work concerning rice-growing are hand made or with the help of animal drawn machines. In some cases primary tillage is mechanized using rented tractors with mould-board and disc plows. Every other work is practically hand or animals made, including

threshing. Drying is done through natural methods, while processing is generally done with small hullers, generally old and causing considerable product losses.

The above mentioned agricultural cooperation plan is going on, at an experimental level, to utilize machines and irrigation in common, to develop productions and agro-industries. The 30 existing cooperatives have areas no less than 1000 ha. each.

2 - Pattern of farm mechanization

2.1 - Paddy - whose area represents about 5% of the total cultivated one - is mechanized at a very primitive level.

Therefore, considering the great economical development of the last few years, the planned doubling of rice growing and the Government's big effort for agricultural improvement in the frame of the above mentioned cooperatives development, paddy will be progressively mechanized, also if slower than industrial crops.

The data about tractor and agricultural machines actual population are referred to the whole agricultural area and there are no informations concerning paddy areas. Therefore, only the general development level of agricultural mechanization can be shown.

The riding tractor actual population is valued around 24.000 units with a 6.500 units increase compared to 1968, corresponding to an annual average rising of 1.700 units. The average size of this tractor population is in the range of 55-65 HP. The annual demand is not completely known but it seems to be increasing. It has been valued around 3.300 units in 1970, while for the present year it is about 4.000 units with 10-12% replacement market. Most of tractors sold are around 60-70 HP; nevertheless, local experts consider that 35-40 HP tractors for light soil and paddy areas and raw crop cultivations should be useful. The actual demand for such medium size tractors covers no more than 15-18% of the total amount.

To this population it should be added some hundred crawler tractors whose present demand is about 50 units per year.

Power-tillers actual population is valued around 14.000-15.000 units, sized in the ranges between 6-8 and 10-12 HP. Their actual demand is some 4.000-5.000 units.

Concerning population and annual demand for engines, pumps and other agricultural machines and implements, the situation looks as follows :

- engines, both stationary and high speed more than 5 HP : population of 28.000-30.000 units; annual demand : 2.000-2.500 units;
- engines, diesel and gasoline types, less than 5 HP; unknown population; annual demand : 6-8.000 units;
- deep well and centrifugal pumps; population : 14-16.000 units; annual demand : 1.500-2.000 units;
- hand pumps :population of 80-90.000 units; unknown but diminishing demand;
- hand operated sprayers and dusters : population 130-150.000 units; annual demand : 15-20.000 units; power operated sprayers and dusters : population 22-24.000 units; unknown annual demand;
- paddy power operated threshers : population 1.300-1.500 units; annual demand 500-800 units; no demand for pedal operated threshers;
- hullers : population 3.000-3.500 units; annual demand, for the model for 0.5-1 tons/h of polished rice, 300-400 units.

There are, also, 3.000 combine harvesters, which are almost completely used for wheat, with an annual demand of 300 units, besides 20.000 tractor mounted or drawn implements for primary and secondary tillage, seeding, fertilizer distribution, levelling, etc.. No information about trailers population. In Iran, too, agricultural transport - even if more advanced than in other countries - seems generally lacking as well as good rural road system.

2.2 - The future mechanization development looks uncertain, because

broad studies have not been conducted yet in order to determine optimum mechanization levels and tractors and equipments populations in different years, following the foreseen development and annual demand.

In order to study agricultural mechanization in the country, a FAO expert has been sent over for a 6 weeks period.

In any case, development foreseen for 1975 (if different informations are not given) seems results as follow :

- crawler tractor : annual demand, in 1980, 300-350 units (80-150 HP, size); wheel tractor : annual demand, in 1975, 6.000-7.000 units (60-70 HP) per year reaching 10.000 units in 1980; 400-500 units (20 HP) per year and 800-1200 units (35-40 HP rawcrop) per year; 200 units(more than 90 HP) per year in 1975 and 500 units per year in 1980;
- power-tillers : estimated demand of 10.000 units per year;
- engines : micro and gasoline models (1-3 HP) for plant protection : estimated demand of 18.000-20.000 units per year; 3-5 HP gasoline models for pumps and light applications : estimated demand of 50.000 units per year; 3-5 HP diesel model for power-tiller, pumps, etc. : estimated demand of 15.000-20.000 units per year; 12-30 HP diesel model : estimated demand of 5.000 units per year;
- pumps : centrifugal type 2"-8" ∅ : estimated demand of 15.000 units/year; deep-well type : 4.000 units/year;
- sprayers and dusters : knapsack hand operated models : estimated demand of 30.000 units/year; knapsack power operated : 15.000-18.000 units per year;
- power operated threshers for paddy : estimated demand of 15.000-18.000 units/year, plus 1.000 units/year for wheat;
- hullers : 1 ton/h size : estimated demand of 800-1.000 units per year; 3-5 tons/h size are considered interesting but their future demand is unknown.

Local experts think it is necessary to introduce, at least on expe-

rimental level, some combine harvesters for paddy (destroying and later reconstructing the existing bunds in the different plots), while there are no informations about actual and future reaper binders and dryers utilization.

The above mentioned previsions can not be discussed referring to paddy, but they seem coherent with the actual situation of mechanization. It is unknown if they take into consideration the development of cooperatives which are already functioning at an experimental level and the first results furnished by them.

For all these machines repair and maintenance service is organized by the Government for cooperatives, and by private dealers; there are no informations on the way this service works.

2.3 - The analysis of the actual and future mechanization does not give too many informations on the peculiar possibilities for paddy areas, for which it is suggest to take into consideration the possibility to use :

- 20-22 and 30-35 HP tractors, simple, low cost, possibly articulated, 4-wheel drives, to be used for primary and secondary tillage with mould board plows, harrows, puddlers, levellers, etc. and for transport, examining also possible applications with adequated spading machines;
- self-propelled reaper binders multi purposes, simple and equipped with cages wheel whose use seems interesting both in actual conditions and in the paddy future development plans;
- mobile and stationary dryers, continous belt model, with working capacity to be defined depending on the sizes of hullers which will be installed;
- mobile workshops for the ordinary maintenance and repair service.

While for each one of these machines future demand will be about 3000-4000 units per year by 1975 and 6-7000 units per year by 1980, it is necessary also to introduce machines for construction and maintenance of canals and trenches for irrigation and dreinage.

On the contrary, as far as power-tillers are concerned, it does not seem that, in the country's actual and future conditions, this machine will be largely used, because of a relatively small agricultural labour and the farecast to create, during the next 5-years development plan, 1.500.000 new jobs which will cause - together with the rising of cultivated area - an interesting density riduction in the agricultural active population and the consistent need of a labour's productivity increase. Power-tillers seem, therefore, to find a good utilization in connection with vegetable growing, which needs ligth soil, frequent and not very deep tillages, etc.. For this aim it is suggested to spread models of no more than 6-8 HP sizes. Finally, it should be underlined that the above mentioned sizes and models of tractors can be used also on other crops than paddy and for peculiar works, together with 60 HP models whose optimal utilization is quite a different one.

Together with the gradual development of this kind of mechanization, it has to be improved an efficient repair and maintenance service and technical training for farmers and mechanics, strengthening the already existing organization.

3 - Manufacturing industries and ancillary facilities

3.1 - The industrial sector contributes to G.D.P. for 22.8% and its annual average rising - at a constant money value - was 12.2% in the last 5 years. It seems that the future 5-years development plan foresees 15.2% yearly increase in the manufacturing industry and mining. In the manufacturing development sector, the mechanical and metallurgical industry will have an important role, forecasting to completely substitute, in the next 10 years, imports with local products.

Mine sector is developing rigth now (about 10% per year) especially concerning oil resorts; their production value had a 16.3% increase per year, at a constant money value. However, only a small part of the existing mine resources is known; there are, anyway, great

possibilities to develop production of iron, copper, lead zinc, chromite, coal, phosphate, etc.. Particular emphasis will be put on the developing of this sector in next 5 years.

3. 2 - The tractor and agricultural machines manufacturing sector is still a very limited one. There is only one wheel tractor factory, in cooperation with an east-european country, with a sanctioned production capacity of 5000 units/year but which has been manufacturing up to now, 3000 units/year (65 HP sizes) both 2 and 4-wheel drive, and 45 HP, 2-wheel drive. This factory - at the beginning an assembly unit - has gradually increased the local concent which now seems to represent 45% of the tractor value. There are, also, 2 assembly units for 50-70 HP wheel tractors with a whole sanctioned capacity production of 2600 units/year. The real total production of the 3 factories together was about 5000 units last year.

As far as engines are concerned, there are 3 factories which are only manufacturing stationary and trucks engines, with a total capacity of about 20.000 units per year. There is also a diesel engines factory (7-30 HP) with a sanctioned manufacturing capacity of 30.000 units/year able to reach 50.000 units per year, but with a real production in 1971 reduced to 50%. Such factory, at the beginning for assembly, has been gradually increasing local content and, in few years,it will be able to produce with only 25% of imported materials. For power-tillers too, there is only one factory in cooproduction with a Japanese firm, with a production capacity of 6.000 units/year and with an annual production of 3000 units. The realized power-tillers (with a supposed local content of 60%, but there are some doubts about this datum) cover range between 4 and 12 HP in 4 models, with both gasoline and diesel engines. This factory - which started 10 years ago only assembling - is interested to expand and diversify its production and already now is assembling some hundred threshers, mould-board plows, rotary tillers and trailers for the manufactured power-tillers

per year.

Also single and 3 phases electric motors (5.000 units/year) and 10.000 centrifugal pumps (2"-10" ∅) are manufactured. Finally, an assembly plant for 2.500 threshers is functioning and it is foreseen to manufacture dryers, in 1.500 units/year too.

There are also 10 factories for agricultural implements (specially for primary and secondary tillage) and 20 other very small workshops for local implements, hand tools and repair and maintenance services.

There are no precise development plans for this industry and local construction of small engines, mould board plows, cultivators, seed and fertilizer distributors, irrigation and sprinkler equipments, self-propelled reaper binders and combine harvesters for all cereals, including paddy, in only hoped. Anyway, it is foreseen to produce : centrifugal pumps for 10.000 units/year and earth moving machines for 5.200 tons/year in 1973. Agricultural implements production will increase from the actual 2.000 tons per year to 6000 tons per year in 1975. By the end of 1972, it should be started also a conveyors production.

Factories, usually, lack skilled workers and ancillary facilities. Considering labour average wages, they have a productivity of about 1200 dollars per year and per worker; this productivity should have a 9% increase per year, with progressive investments.

Finally, it should be remembered a regional cooperation project among Iran, Pakistan and Turkey to commonly produce cheaper tractors and agricultural machines on a large scale through a manufacturing specialization in the 3 countries.

3.3 - Ancillary industries and raw materials are at a primitive stage but with a very promising development possibilities.

The production of special parts is, so far, limited only to tyres and tubes, batteries, filters, leaf-spring and other minor items. So-

me of these productions are increasing, through joint ventures, and they will be able to meet, in next few years, the total internal demand.

By 1980, it is foreseen that local production will meet 80% of the internal demand, concerning bearings (4 millions of pieces per year), springs (already locally producted for 50% of needs), machines tools (whose production will start in 1973 with 2. 200 units per year of different models, rising to reach 30. 000 units/year), chaines, gears, full injection pumps, etc..

Concerning metallurgical production, big steel mill plants are already working and their production is constantly increasing. The actual pig-iron production amounts to 600. 000 tons per year and the cast rolling one is about 1. 200. 000 tons per year. These productions will rise,by the next ten years, 4. 500. 000 tons/year.

A new steel rolling factory will start to produce in 1973 with a 500. 000 tons per year capacity production.

To summarize the situation concerning basic steel, the actual production, which started in 1971, is supposed to increase 3 times; in 1971 pig-iron imports were 1. 600. 000 tons.

There is, actually, non production of billets so that about 200. 000 tons per year are imported, but the planned capacity is about 470. 000 tons/year; the situation looks the same for section and structural shapes imported for 370. 000 tons in 1971; their production is suppose to rise up to 650. 000 tons by 1980.

Iron and other metallical products looks as said above, while local development for steel forging and no-ferrous casting facilities - actually non existing - is planned for 1980, as weel as an improvement of steel casting and heat treatments facilities.

3. 4 - Compared to the actual production situation, it seems - in the frame of local tractors and agricultural machines production able to be used for a rational development of mechanization - that some sec-

tors should be taken into consideration in a near future, through joint ventures with reputed and well-established foreign manufacturers.

It is useful to suggest the production - initially with assembly and in the next 8-10 years with no less than 80% of local content - of :

- 20-22 HP and 30-35 HP tractors, simple, low cost, to be used both for paddy areas and other crops, equipped with mould board plows, harrows, sprayers and trailers, both bearing axle and p.t.o. driven (besides some other implements which can not be used for paddy but for forage crops). . If spading machines actually sold on foreign markets would give favourable test results, it can be taken into consideration their construction , whose use presents many positive aspects;
- self-propelled multi-purpose reaper binders (which can be transformed into mower) 1.50 m cut width, with 8-12 HP engines, starting with 3.000 units per year;
- micro gasoline and diesel engines (1-5 HP), deeply standardized to be used with knapsack sprayers, pumps and other light applications, starting with a production not less than 30.000 units per year with a foreseen expansion up to 50.000 units.

These are, of course, only suggestions which are considered useful to recommend; they all need feasibility studies referring to local market, choice (among the different models offered by the international market) of the most interesting and useful models according to their strength and semplicity, to the market itself and to the most economical annual production. In order to help a rational choice and to obtain the necessary technical assistance, it is recommended to develop the already existing organizations (i.e. the Agricultural Machinery and Soil conservation training Center in Karaj), and to start the planned Center of Metallurgical Technology. For both these

initiatives, and UNIDO assistance with international experts is already foreseen, in cooperation with the Industrial Development and Reconstruction Organization.

4 - Policy toward farm mechanization

4.1 - As said above, the fifth 5-years development plan foresees investments in agriculture 4 times superior to the ones in the last plan, to consistently increase agro-industry cooperatives for agricultural product processing, to create new cooperatives for agricultural machines and irrigation, to expand irrigation itself and recuperate new areas to crops.

In such a program, it is considered particularly important to develop mechanization, as well as technical training for farmers, extension service, etc..

The Agricultural Bank gives loans to farmers even for 15 years at a low interest (7.15%); concerning machines, loans are given for no more than 6 years. Private dealers, on the contrary, want to be paid 1/3 in cash and 2/3 in 2 years with a 13% interest rate.

4.2 - Research in the agricultural mechanical sector is conducted by the Agricultural Engineering Research Center, depending from the Dept. of Agriculture, which has a division of farm machinery equipped with laboratory for tractors, implements, combine harvesters and pump testing performances. This laboratory is now developing and it will be equipped with dynamometers and after instruments for testing materials. It is a quite completely established Center with a high level scientific staff; in the frame of a rational mechanization development, it could bring useful technical assistance. It could be suggestable to develop this center, especially concerning the improvement of studies and researches for the standardization and adaptation of machines in the technical and economical sectors, in order to define op-

timum mechanization levels for different crops and in the different stages of economical and social development. The center is equipped with a section for machines and tractor drivers training courses for a 10 months duration with 30 students per year.

A 12 months training is also provided to high school graduates in extension work that covers farm machinery operation and maintenance. There is also a unit for specialization of 20 post-graduate students every year in the Agricultural Engineering Sector.

The scholarization is rapidly improving and generalizing, with gradual elimination of illiterates. Secondary school sector, to prepare skilled workers and technicians does not seem sufficiently developed and needs to be improved.

Finally, university education is in an improving stage and graduates have rather good background.

4.3 - Extension, repair and maintenance services, as said above, are related with the still low development of mechanization and need to be considerably improved in a near future, spreading all the new technical and mechanical informations to farmers and developing repair and maintenance centers equipped with mobile workshops.

4.4 - Taking as a basis what it is said above, it seems useful to suggest :

- to conduct broad researches , in order to define the best mechanization level and the consistent machines models and sizes;
- to develop the already existing research centers - like the Karaj one - both in the testing sector as well as for standarization of machines and optimum choices of models;
- to develop technical training for farmers and workers to drive and repair machines;
- to develop extension service as well as repair and maintenance with well equipped peripherical organizations.

5 - Policy toward industrialization

5.1 - The actual economical development plan gives considerable importance to mechanical industries, among which factories for agricultural machines production. This happens also through the Industrial Development and Reconstruction Organization which gives incentives for new investment consistent with public sector and Government policy.

5.2 - Foreign countries' investments are regulated by a law published in November, 1965. This law, whenever investments are done through an special organization depending from the Ministry of Economy, foresees : possibility to transfer profits abroad, under budget presentation;low interest credits(9% per year);tax exemption for a 5 year period and custom exemption to import machines for new industrial plants. With Authorities' autorization, same custom exemption for machines and plants imported in further times to replace the obsolete ones, is also given.

All this concerns only investments related to plants built at least 120 km from Teheran.

There is also the Organization for small scale industries and industrial estates of Iran, established on July, 1968 and depending from the Ministry of Economy. Its main job is to assist in the promotion and development of modern small scale industries (investment in machine and equipment of less than 100.000 dollars). On this case, too, there are loans at a low interest (6%), and tax and custom exemptions. Such organization is technically assisted by UNIDO and has now finished the construction of the Industrial Estate at Ahwaz. These priorities have been now fixed : promotion of new modern small industries; industrial extension service, credit assistance to small industries.

5.3 - Finally, concerning education, research and testing development

in the industrial sector, there is a complete lack of skilled workers and technicians;in order to improve schools, considerable efforts have to be done. The university education level seems to be high, even if there is a tendency to obtain university degrees in the technical field,abroad.

It should be soon realised a Center of Metallurgical Technology, very useful in the frame of material quality control and standardization studies. This center will benefit by UNIDO assistance.

Researches about economical productions problems are not obtaining the rigth consideration.

6 - Conclusions

The UNIDO and FAO assistance in the metallurgical, mechanical and agricultural mechanization sectors, is consistant and the Government has not asked for anymore help in the agricultural machinery sector. Anyway, industry and research implementation for a rational and economical mechanization development, should be leaded with deeper researches and with increasing of actual organization. Therefore, it is to be confirmed the usefulness to realise as soon as possible the UNIDO project actually in pipe line, to assist the Government in developing the existing Agricultural Engineering Research Center of Karaj, giving a priority to testing, design, adaptation, standardization and control of material for agricultural machines and tractors to be locally manufactured. An UNIDO Expert, agricultural machinery engineer; duration, 4 months; courses of the mission : 1973-74.

The following UNIDO assistance is also recommended :

- to assist the Government in the rational development, on the basis of the economies of scale and of the greatest standardization, of new industries - in cooperation with well established foreign companies - for tractors, micro gasoline engines, self-propelled multipurposes reaper binders, dryers and mobile workshops production.

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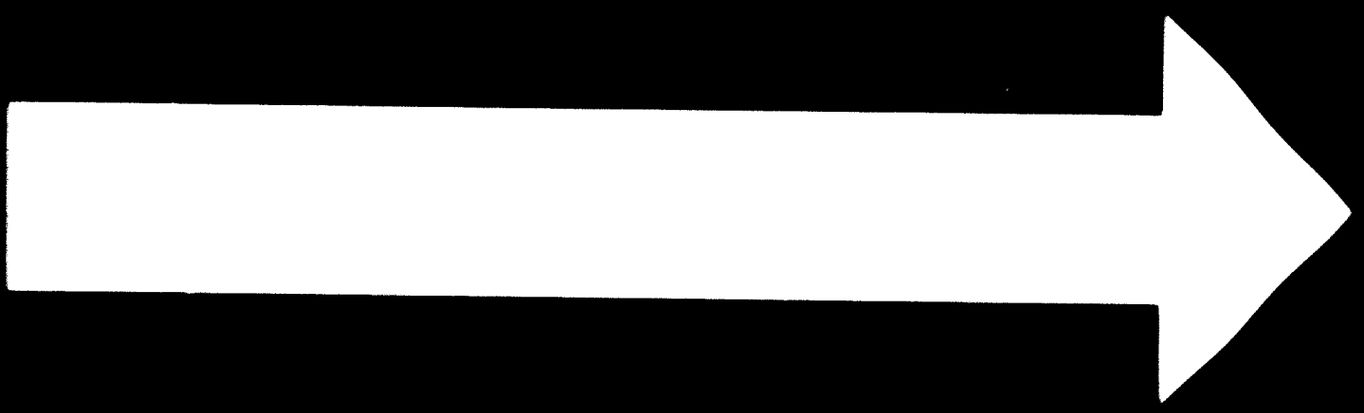

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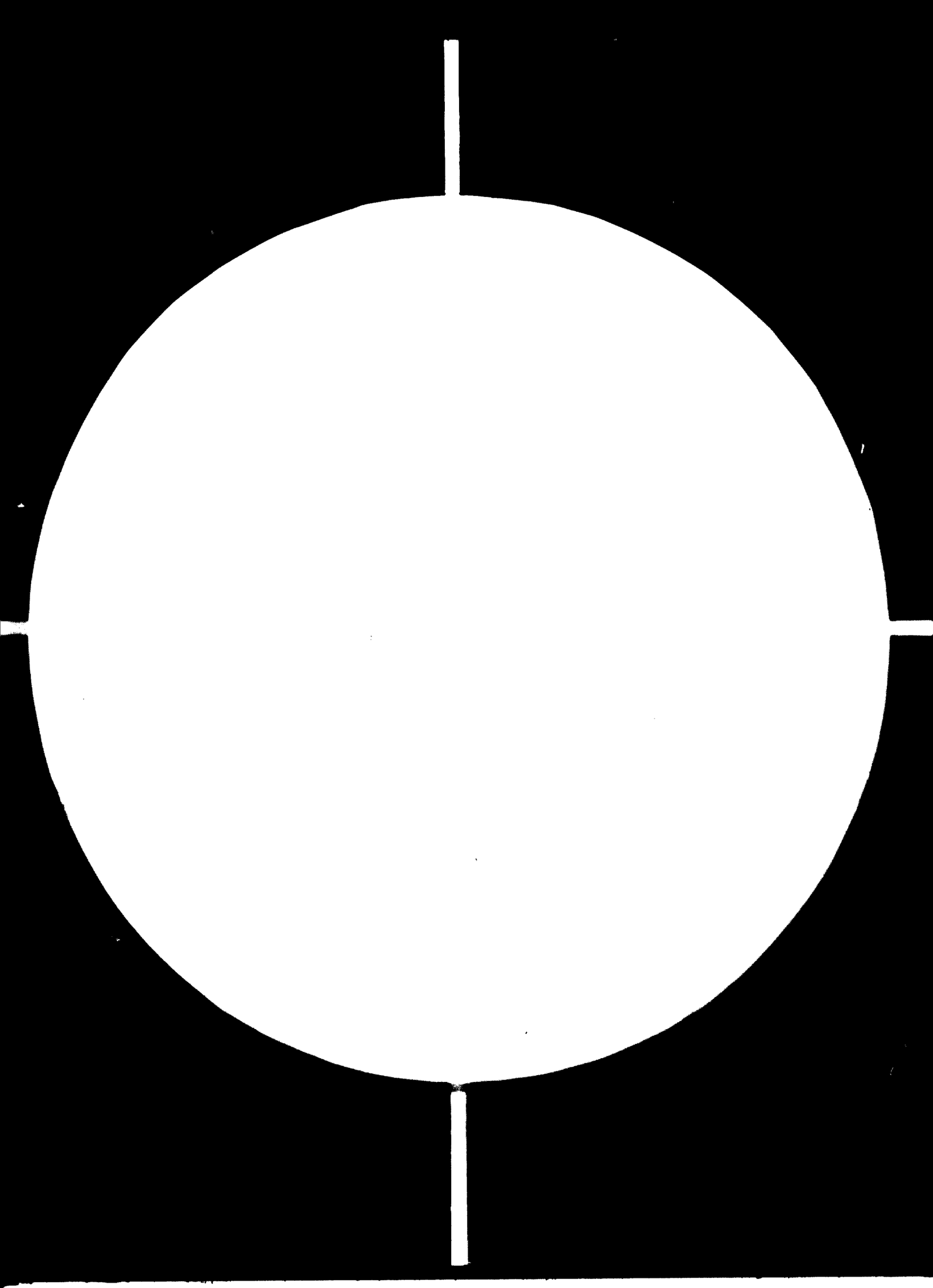

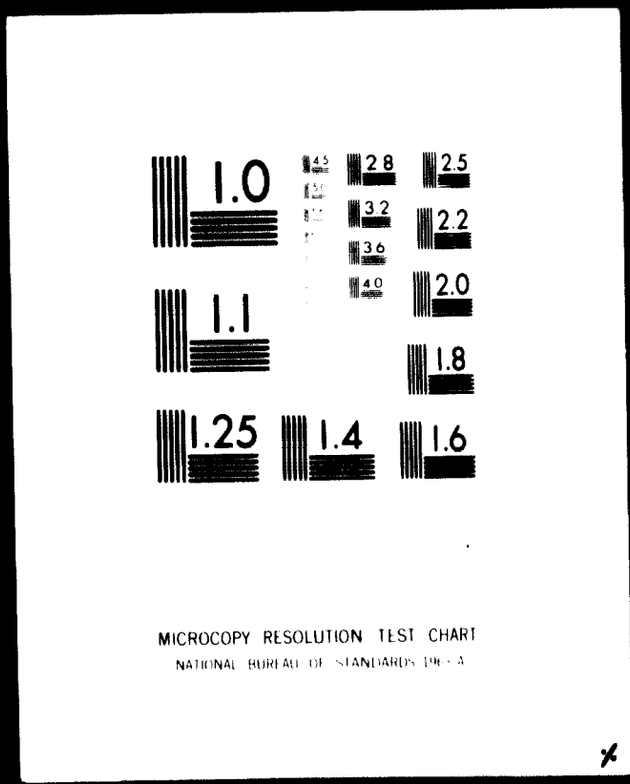
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Two UNIDO Experts : an agricultural machinery engineer and an industrial economist; duration, 6 months each; course of the mission : 1975.

Before sending the above mentioned experts off it is suggested to promote 2 fellowships, lasting 6 months each, in order to send 1 agricultural machinery engineer and 1 mechanical engineer abroad, to be used later as counterparts for the proposed experts.

PERSONS MET

1 - Mr. E. CACOURI - UNDP Dep. Res. Rep., Teheran

2 - Mr. R. WHITEMAN - UNDP Programme Officer, Teheran

3 - Mr. H. BOORHAN - Director, Agricultural Engineering Dept. - Ministry of Agriculture, Teheran

4 - Mr. M. KIANZAD - Chief Agric. Machinery Testing Center - Agric. Eng. Dept., Karaj (counterpart)

5 - Mr. MARDUKHI - Plan Organization, Division of Industry and Mine, Teheran

6 - Mr. H. DAVARI - Ministry of Economy, Development and Industry, Teheran

7 - Mr. SANANDAJI - Ministry of Economy - Automotive Industry, Research Center, Teheran

8 - Mr. A. VACCARI - FAO, Irrigation practices, Teheran

9 - Mr. P. C. ALEXANDER - UNIDO, Small Scale Industries, Teheran

10 - Mr. R. KARIMIZADEH - Head of Agric. Machinery and Soil Conservation Dept, Karaj

11 - Mr. T. OKUI - Ashtad Iran Mfg. Ind. Co. Ltd. - Manufacturer, Teheran

12 - Mr. G. W. GILES - FAO Expert - Agricultural Mechanization, Teheran

KOREA

SUMMARY

1 - Korean paddy is already in an advanced stage of development, both in qualitative and quantitative terms. Future increase will come especially from the choice of more apt varieties of rice, better anti-parasite distributions as well as the increase of irrigation and drainage plans. Mechanization is becoming more and more necessary especially in terms of farm operation timelyness, given the development of two crops per year. The predicted improvement in processing should allow great reductions in the now occurring losses. In the current decade it is hoped that paddy production will arrive to cover country needs.

2 - Present mechanization involves mostly use of hand-operated or animal drawn machines. Power-tillers are coming into use, but their present population is limited to 17.000 units. The future development is seen through ever more wide-spread use of : power-tillers with equipment for primary and secondary tillage; sprayers; power operated threshers and dryers. Transplant will remain at the stage of manual or semimanual mechanization for the present decade.

The progressive reduction of the labour force in agriculture obliges to consider the advantage - in the very near future - of more complete and sophisticated power-operated machines, such as four-wheel drive 18-22 HP tractors or 14-16 HP power-tillers convertible in time in 4-wheel tractors. The spreading of the use of simple, low cost, self-propelled reaper binders is also advisable, are they are suitable for reducing labour peak periods during harvesting and soil preparation for the two crops which are normally cultivated in the same year. It is also recommended machines to be used for escavating and maintaining canals and trenches for irrigation and drainage.

The drying sector is on a study stage. For this sector expe-riments on machines already existing in more advanced countries is recommended. They would be adapted to local conditions, especially

in terms of size. As for hullers the government plans substitution of the existing plants and therefore reduction of production losses.

3 - The present production of farm machines and power-tillers is very low; the one of tractors almost non-existent. Still, the industries involved are strong enough to stand an ample fulfillment of the country's present and future needs, as soon as a general plan for the development of production and the specialization for manufacturing sectors has been defined. One of the main problems is that of finding the production scale and the industrialization level such as to reduce to a minimum costs. Another problem is that of studying the deepest standardization of the single parts in order to reduce costs and simplify repair and maintenance. Facilities granted for installation of new industrial sites are ample.

4 - Ancillary industries and raw materials are at a reasonably advanced development stage.. In some sectors they cover 70% of the total needs of the country. The predictions for increase are such as to allow us to predict that in 1976 they will cover 90% of the country's needs. In that year, the demand should run three times over the present one . In act is a vast program for strengthening all the sectors of mechanics and metallurgy, as well as mining..

5 - Research is developed and is encouraged by the Government with basic aid for the development of study of mechanization and industrialization.

An effort is needed in the sectors of standardization, testing of machines and prototypes, and of a wider organization of technical training and after-sales service.

1 - General pattern of agriculture

1.1 - The total arable and cultivated land is estimated at 2.330.000 ha. which represents 24% of the whole surface of the country. Annual utilization of the cultivated land is about 1.7 times; that is, on 70% there are performed two crops per year.

Paddy covers about 1.230.000 ha., corresponding to 55% of the total cultivated surface; over a million hectares of rice-growing land is cultivated also in the same year on barley as second crop.

In 1971 paddy produced a total of 3.939.000 tons corresponding to an average yield production of 3.3 tons/hectares. Production has notably increased in the past five-years thanks to gradual (though still marginal) spreading of mechanization and by mean of using fertilizers, which are now being distributed at a rate of 160 kg/ha..

However development in productivity in rice-growing areas is destined to continue. The present economic development program plans an increase in productivity (referring to constant money value) of about 3.1% per year, finally reaching a total production of about 4.800.000 tons in 1976 (the end of the third five-year plan). By that time, fertilizers will be employed at an average ratio of 230 kg/ha., therefore with an increase of about 40%.

An analogous increase is predicted for the development of irrigated areas, which in 1976 will reach a level of almost 1.200.000 ha.. At the same time an act for rearrangement of paddy areas has to be carried out, for a total of 450.000 ha..

And later on it should be covering up to 600.000 ha.. A development of networks of gates and drainage corresponds to the development of irrigation.

Agricultural land is divided up among 2.488.000 farms, with an average size of less than 0.9 ha.. The farms are, in general, fragmented in numerous small lots, often at a distance of several hundred meter from one another. Only 0.5% of the farms have a surface

of more than 4 ha., covering an area of 3% of the total cultivated land.

There has been, in the last few years, a slight tendency toward an increase in size of farms, with a diminution of the quantity of farms smaller than 0.5 ha. and an increase (10.000 in 5-years) of those with a surface of more than 3 ha..

1.2 - The total population of Korea is just a little more than 31.000.000 persons, 33% of whom constitutes the active population.

The workers in agriculture represents 47% of the total active population, which corresponds to 2.2 people per cultivated ha..

The population increase, thanks to well-organized family planning, is now around 1.8% per year and is supposed to fall to 1.5% per year by 1976. In addition due to general development of the country, by the same date the active population in agriculture should fall to 37.7%, diminishing also in absolute value by about 300.000 units. This would bring the density to 2 imployees per cultivated hectare.

In the next five-years, that number is supposed to be reduced to 50% of the above figure.

1.3 - The per capita G.D.P. is about $ 230 per year, and is intended to rise to $ 390/year (referring to constant money value) at the end of the present third development plan.

Agriculture represents 28.4% of the G.D.P.. This incidence should be reduced to 22.4%, by 1976, although an increase in production of 33.9% is planned within the five-years. The increase in rice-growing production is estimated at 23%, aiming to an amount sufficient for the needs of the internal market. For other products greater increase are planned. The production of barley is supposed to increase by about 25%. An increase of 140% is also planned for milk cattle population.

The plan draws clearly the development of farm mechanization. Especially concerning paddy gradual development is planned, because

of the high workers density per ha., even though there are often two crops per year. However it is interesting to note that in 1980, at standing currency, the average Korean gross income per rice-growing farmer will be 3 to 4 times more than that of the other southern East Asia countries (India, Burma, Thailand, the Philippines).

1.4 - Almost all the farm work connected with rice-growing is today performed by hand and with the aid of animal power. In fact, the population of farm machines is still quite low. The existing one is especially used for primary tillage and transport. The transplant area covers more than 97% of the whole paddy area. The operation of transplanting as those of harvesting and threshing is carried out manually.

Because of the double harvest (barley and rice) there are two peak periods a year of labour. They have a duration of 10-15 days each, in the months of June (harvest of the barley, and soil preparation and transplanting of paddy) and October (harvest of paddy, soil preparation and seeding of barley). In these periods there generally occurs a shortage of labour on hand to perform the work with the necessary timeliness flexibility. Therefore there would be a high priority for mechanization of the pertinent work, by means proper to the existing infrascructure.

Storing and drying of paddy are up to date carried on by natural methods, generally in the farms themselves, with consequent losses estimated at about 12-17%. There are losses in processing, due to size and age of the existing mill-plants, of about 20-22% of the product.

2 - Pattern of farm mechanization

2.1 - Level of farm mechanization is still very low. Already mentioned are the goals of the economic plan. Otherwise, there are in early stages of execution, some serious programs of research to point out

the real technical and economical advantages of various possible levels of adoptable mechanization, by machines and tractors management cooperatives.

The present population of tractors is estimated around 150 units which develop an average power of about 50 HP each. This corresponds to 0.07 tractors per 1000 ha.. In the last 5 years there has been a 5 times increase. However, authorities plan to pass at first through a stage of using of power-tillers. At present there are about 17.000 power-tillers. Their population has been increasing at an average rate of 3-4.000 units per year, in the last five years. The average utilization varies (depending on crops and soils) from 600 to 900 hours per year, 80% of which are dedicated to transport.

Official figures provide the following data for other machines :

- 98.000 diesel and gasoline engines of more than 5 HP; 58.000 gasoline engines of less than 5 HP; 5500 electric motors;
- 62.000 hand operated pumps; 65.500 centrifugal power operated pumps and 100 deep well pumps;
- 1.022.000 animal drawn plows; 25.300 mould-board and 100 disc plows, drawing by tractors and power-tillers;
- 365.300 hand operated sprayers and dusters; 94.000 power operated knapsack sprayers and 3.300 p.t.o. driven sprayers;
- 8.500 power operated winding machines;
- 10 hand operated transplanters;
- 402.000 hand operated threshers and 41.000 power operated threshers;
- 350 dryers and 117.800 small and medium size hullers.

The replacement market is estimated at around 8-9% per year. This means that 11-12 years is considered the average lifetime of machines.

The demand for tractors and farm machines in 1971 was as follows;

- 20 tractors and 4.000 power-tillers;

- 9000 diesel and gasoline engines of more than 5 HP;
- 6000 gasoline engines of less than 5 HP;
- 4600 hand operated pumps; 4500 power operated pumps (15 deep well);
- 80.000 animal drawn plows; 5.000 mould board and 30 disc tractor and power-tillers drawn plows;
- 95.000 hand operated, 20.000 knapsack power operated and 1500 p.t.o. driven sprayers and dusters;
- 10 hand operated transplanters;
- 10.000 hand operated and 7160 power operated threshers;
- 300 dryers and 2.000 hullers.

2.2 - Official estimates for the increase of annual demand are as follows :

- 1973 : 7.000 power-tillers; 7.000 power operated threshers; 2000 power operated sprayers (in part to be connected to power-tillers); 50 hand transplanters;
- 1975 : 10.000 power-tillers; 10.000 power operated threshers; 2800 power operated sprayers; 200 hand transplanters;
- 1980 : 28.000 power-tillers; 28.000 power operated threshers; 9000 power operated sprayers; 550 hand transplanters.

Is also predicted a year demand for about 400 tractors and 5000 power operated pumps in 1980. These predictions refer to the rice-growing area only. Other data have been formulated for orchard areas and for animal farms necessities.

Estimated for 1980, is a total population of machines on the following order : 110-120.000 power-tillers, 500 tractors (average power of 35 HP); 110-120.000 power operated threshers; 40.000 power operated sprayers, part of them to be mounted on power-tillers. These figures refer to rice-growing only. Implements population (especially plows, harrows, puddlers, rotary tillers and trailers) should increase, side by side with the development of the population of power-

tillers and tractors.

On the other hand, it was not possible to ascertain the exact future demand for engines. It is estimated roughly at 18-20.000 units (both diesel and gasoline) in 1975 and at about 30-40.000 units in 1980. Along with this should go an increasing demand for power operated and other types of pumps, consistent with the development of irrigation and drainage projects. Though estimates are only rough, they are of about 250.000 pumps in 1980 with an annual demand of between 15.000 and 20.000 units..

There is a shortage of modern machines for the excavation and upkeep of trenches and canals for irrigation and drainage. This sector has not yet been properly considered, and should prove interesting ared useful to be developed.

On the other hand, researches and studies are being carried out in the fields of drying, storing and processing. The demand for equipment in those fields is at present very low. But local authoritires intend to develop the sector rapidly, by use of simple, and low cost machines and installations, with the goal of lowing a large part of the production losses which now occur. At the same time they expect to renew the hullers and storage equipment. Research is being carried out in order to do so.

After-sales service is at present at a low level of development. This is due also to the modest mechanization degree. In the same manner organization of an efficient extension service and training courses for farmers for properly using machines are on a first step.

It is interesting to note the various research project being carried out on agricultural machines and mechanization, in order to choose machines best suited to present and future needs of the country. They include power-tillers, tractors, transplanters, harvesters,dryers and trailers. This research is concentrating on the wet-lands for which there is a wide plan for future spreading of mechanization. Some of the projects are being carried out in cooperation with various

nations. A plan of development of the rural road networks is also underway.

2.3 - The above listed official development estimates seem correct and consistent with the demands of socio-economic development in the country. They are based on a serious and detailed series of technical and economic studies and researches.

It seems necessary to mention that the possibility of using small to medium size, 18-22 HP tractors 4-wheel drive, if possible articulated, simple and low cost, has not sufficiently been taken into consideration. They would be equipped with the implements necessary to primary and secondary tillage (including spading machines), to the distribution of pesticides and herbicides, and to transport. These tractors must be forseen relating to present and future labour load and average wages.

Other interesting possibilities are offered by 14-16 HP power-tillers convertible in time into four-wheel drive tractors by the addition of a back frame.

Implements for primary and secondary tillage, trailers with driving axle or equipment for the distribution of antiparasites are to be drawn consistently to the above mentioned power-tillers.

These two power machines could be profitably used in the framework of the predicted development of cooperative use of machines on areas of between 10 and 20 ha. (as judged reasonable by experts of the Agricultural Development Corporation).

The development of double harvest and the necessity of timelyness in the execution of jobs during the mentioned periods of heavy work, shows useful to increase the use of 8-12 HP self-propelled reaper binders adapted to the harvest of paddy and barley. These machines could be conceived as multipurposes. Therefore, with a basic structure (motor, chassis, transmission, etc.), they could be used with transplanters (as soon as these have been rendered more

functional), sprayers, etc..

Finally, within the framework of cooperatives development, it seems pertinent to suggest the spreading of mobile dryers with a capacity of 6-8 tons per day and of mobile workshops for the repair and maintenance of these machines.

For all the above mentioned machines, it is recommended to test models already existing on the world market, choosing the most trusty, simple, and low cost kinds. It is also necessary to provide the on-line adaptations and to introduce them into local agriculture gradually. This should be done on the basis of application of criteria of technical and economic optimalization in use of machines and labour which have already been adopted in most of technologically advanced countries.

To such a goal the annual demand estimates of the official authorities can be taken as true, but for those regarding estimates on the real possibility of introducing the mentioned 18-22 HP tractors. A gradual introduction of self-propelled reaper binders, starting with 1500-2000 units per year by 1975, to 5000 units per year in 1980, seems reasonable.

3 - Manufacturing industries and ancillary facilities

3.1 - The industrial sector contributes 29.7% to the G.D.P.. An increase to 37.9% is predicted for the end of 1976, within the framework of the current third five-year plan. This means, in practice, that in the 5 years the mechanical industry will increase its present production by more than 130%, and the mine industry will develop, increasing by 54% (referring to constant money value).

3.2 - The industry of agricultural machine manufacture is rather developed, keeping in mind the present stage of mechanization. Still, many of the existing plants have a production capacity much higher than the present one. It is calculated, in fact, that only about

30% of that capacity is utilized. Productivity of labour is very low. Value of production in fact, is not above an average of $ 2000 per year per worker. For that reason, local construction of tractors and agricultural machines can be carried on only at costs higher than those of import from Japan. This fact was revealed in a study made by foreign experts.

The majority of manufacturers have joint-ventures with foreign firms. There is only one factory for the assembly of 27-45 HP tractors, with 20% of local content. It has a capacity about 3000 units per year, but actually produces only 300 units per year (1971).

There are three factories of power-tillers with a capacity of about 28-30.000 units per year, and with a present production of 5500 units, which are manufactured with a local content of about 65% in value.

There is a year production of 22.000 diesel and gasoline engines, thought the plants have a capacity of about eight times that amount. As re- [illegible] pumps, production in 1971 was of [illegible] units, against a sanctioned capacity of almost [illegible] mes that number. In addition, there is an annual production of 85.000 plows (90% of which are animal-drawn), about 24.000 knapsack power operated sprayers and 107.000 hand-operated sprayers. Also in these cases, about 30% of the parts are directly imported from abroad. The same is true for power operated threshers of which 8600 were manufactured in 1971, against a production capacity 3-4 times higher. In the same year 14.000 hand operated threshers were produced. There is in addition a factory for hand operated transplanters, which produced 100 machines in 1971, though its production capacity is quite higher. The production of hullers (in 12 factories, of which 3 are important) is of about 3000 units per year and that of dryers (by two manufacturers) is 300 units. To this production must be added that of the artisans and villages of simple animal drawn machines for primary and secondary

tillage. They are all declining, or in the most favorable view, in a static phase. There are also many firms which do not produce the above-listed machines, for a lack of demand.

There is also a necessity to improve the planning of the machines, in order to reduce the problems of repair and maintenance, and so to standardize spare parts. Also, the plants themselves (often old and inadequate) should be rennovated in order to increase productivity of labour and reduce costs of production. It all seems possible, also with the necessary standardization of single parts.

In any case, it seems that a development in the manufacture of agricultural machines is to be hypothesized only when there is a tight standing market. This will come about, on one hand when active population in agriculture is reduced and, on the other hand, when the yield production reaches values which require the use of machines to carry out jobs with regard to their timeliness. Development will depend, besides, as a priority, on the progress made in the constitution of cooperatives for commune use of machines.

Predictions for development in the sector seem consistent with those formulated by the official authorities for development of mechanization. They forcast the possibility of covering the internal needs of the country by 1980, at the same time reducing the percentage value of imported parts.

Only for pumps and engines, probably, local production will not be able to develop so as to face the predicted increases in demand. Another problem to be considered is the one of diversification of products for the manufacture of new types of machines.

3.3 - For ancillary facilities and raw materials, the situation seems encouraging at a stage of full development. At the same time, measures for the technical improvement of personnel, better planning, modernization and strengthening of foundry operations, forging, casting and heat treatments all seem of urgent necessity. The basic industries of the sector should develop in a short amount of ti-

me. Development is predicted in the local car industry as well, which is now passing from the stage of assembly to that of manufacturing. This fact will doubtlessly facilitate the possibility of an increase in the production of farm machines and its quality improvement.

Production of the metallurgy industry has increased, in the past 7 years, by more than four times for iron, 2.6 times for steel and 2.2 times in the rolling plants.

Future plans are for a further very notable development of the same production, expected, in 1976 to fulfill 90% of the annual internal demand which will reach 4.000.000 tons of metal products. Therefore this means an increase of 3 times the present demand (which is now met only 70% locally).

A new plant is planned for the manufacturing of machine tools, at 8600 units of various types and models in 1976, covering about 60% of the demand in that year.

Furthermore, there exists a tyre factory which is to be expanded to fulfill the local demand completely. Especially local construction of gears, bearings, chains, hot rolled carbon steel, hot rolled alloy steel, cold drawn carbon steel, hot rolled plates, sheets, and strip is planned by 1980 on adequate standard to market needs and to the local population of tractors and farm machines. However, for other products not being produced yet, the 1980 production will not be such as to cover the total needs in that year.

Complete development is predicted for forging, casting and heat treatments.

Today there are eight plants for production of fertilizers. Their expansion is planned in order to meet increasing demands in this area.

Finally, there is a remarcable push toward the development of rural electrification; in 1971 it involved 27% of rural lands. By the end of 1976 it should cover 70%.

3.4 - The analysis of the existing situation is satisfying on the whole. That is especially refering to the government intentions to specialize the existing industries sectorially, explaiting production capacities in a framework of a most strict and improved scale of standardization in order to obtain an economy of scale, able to reduce production costs.

At this point it seems opportune to recommend local manufacturing of what follows in cooperation with well-established reputed foreign companies :

- 14-16 HP power-tillers convertible in time to four-wheel drive tractors, fitted out with proper equipment for primary and secondary tillage, crop protection and transport;
- 18-22 HP tractors, if possible articulated, four-wheel drive, simple, durable and low cost, also fitted out with all the necessary equipment;
- self-propelled reaper binders of 8-12 HP with 1.50 m cut width usable both for paddy and barley.

The annual production of such machines could be valued initially at 1500-2000 for each of the items considered, with progressive increase, also of local content. These figures serve only in absence of the necessary more detailed investigations.

In more general terms, there is yet a need for a detailed study of the choice of models and sizes of machines to be produced. Study needs to be done also in order to improve standardization. For this, experience already acquired in most of technologically advanced countries, which have already met and solved similar problems should be utilized as much as possible.

4 - Policy toward farm mechanization

4.1 - The present third five-year development plan makes explicit and clear mention of the necessity of mechanization development, with priority for paddy areas. Aims are : to cope with the in-

creasing shortage of labour during heavy work periods;to increase productivity and utilization of soil; to carry on farming operations with the necessary timing for seasonability. An example of measures toward last aim is the fact that the authorities intend to develop the sprayer machine population in such a way as to reduce the antiparasites spreading from the present 8 days time to a 5 days time in 1976.

Consistent with those predictions, the authorities intend to proceed :

- toward a complete rearrangement of land in order to adapt it to mechanization, with development of irrigation and drainage;
- toward construction of good rural road network;
- toward development of technical training for farmers;
- toward development of extension services in the agricultural machines sector;
- toward organization of efficient services of repair and maintenance;
- toward development of courses of specialization in agriculture machinery on university level;
- toward the development of tests for farm machines before their entry on the market, basic conditions for the granting of loans at eased rates toward their purchase by farmers;
- toward the development and generalization of cooperatives for commune use of machines;
- toward a system of prices and materials quality control;
- toward granting easy term loans for farmers.

Part of these points are already in a phase of realization, through appropriate agencies. The Agricultural Development Corporation, with two separate sections, is involved in the planning and experimental research on optimal mechanization of the future agricultural cooperatives, and in the preparation of technical training service for the farmers, etc..

The National Institute for Agricultural Material Inspection has a section which takes care of controlling material necessary to the construction of farm machines and of testing manufactured machines. The organization and scientific and experimental equipment of that Institute is adequate (as far as the mechanical part is concerned) in terms of control of materials. However it proves insufficient in its tests on the machines. Nevertheless, it can be a useful reference point for future development. The Farm Management Division is carrying out economic studies of noteworthy interest on farm mechanization.

Basic support, therefore, exists, as does the law for granting loans to farmers at rates eased to 9%, for the purchase of power-tillers, plows, diggers, trailers, power operated sprayers, to 70% their value at five years, and loans to 50% of their value at three years for the purchase of other machines. This system constitutes a clear choice priority in the development of mechanization.

4.2 - As for the higher level, that is, research and university instruction, there is an Institute of Agricultural Engineering of the National University, which has a Machinery Division. On the whole it is satisfactorily equipped and carries on good research and experimentation which would profit from being more widely developed.

The government aims to a greater develpment of the sector.

On a more general level, there is the Korean Institute of Science and Technology. It is very modern, well equipped and in a stage of full development. Right now it is suited to being a very important basic contribution to the development of the farm machinery sector, if it is decided to develop it toward the service of mechanical industry.

4.3 - The least developed field, at present, is that of after-sales service and technical training for farmers. Repair and maintenance

are entrusted to the commercial organizations, which do not always furnish the necessary service.

4.4 - The examination of the present situation gives satisfying results. It is to be recommended : a greater coordination among the different institutions which are involved in research and experimentation in the sector; a strengthening of the Machinery Division of the National University. To the latter should also be entrusted the job of the study of standardization and adaptation of the various models of machines to local conditions.

5 - Policy toward industrialization

5.1 - The current five-years economic development plan intends to give a strong push to industrialization of the country, according to the information reported above.

Consistent with that there is in act a plan of technical and financial assistance which has quite a wide aim. From the technical point of view, the assistance concerns the qualitative improvement of raw materials, of the production of ancillary industries, and of agricultural machines. . Moreover for the latter two, the intention is to arrive at a sectorial specialization of the production and a precise definition of models and standards. This would be done by a rigorous selection of the existing industries, supported by a wider development of the research organizations, a tight control and standardization of the production.

5.2 - From the financial point of view, loans will be granted for the expansion and diversification of the production (limited to the products designated by the government), of a duration of 7 years, at rates eased by 10%. The rates do not seem excessive if one considers that the average annual increase in the cost of living is estimated on the order of 13%.

Incentives are being granted also for the setting up of joint-ventures with more developed countries, for the construction of agricultural machines, tractors and implements which have recognized local importance and are in the order of established priorities.

5.1 - Mechanical and professional education in the metallurgical and mechanical sectors are on a good level and in an encouragiung phase of development.

6 - Conclusions

The stage of mechanization and manufacturing industry in the country seems satisfactory. There is an obvious necessity for sectorial specialization of the production on the part of the many existing factories and for a precise definition of models and standards.

While in the field of mechanization, and therefore of the choice of types of machines, organizations of research and experimentation are ready to give precise conclusions within a short period of time, it seems necessary to recommend UNIDO assistance as follows :

1 - To assist the Government in strengthening and coordinating existing centers of research, experiments on farm machines and training, on the basis of choices made of models of machines most useful for agricultural purposes. A UNIDO Expert; duration, 4 months; course of the mission : the first 6 months of 1974.

2 - To assist the Government and manufacturers in the definition of production specialization, in standardization and in studies of economy of scale, in order to reach a complete conceptual organization of the sector as soon as possible. A team of two UNIDO Experts : an agricultural machinery engineer and an industrial economist; duration, 6 months each; course of the mission : the first 6 months of 1975.

Before sending on the above suggested experts, it would be advisable to grant two scholarships (of a time duty of 6 months each), to

send one agricultural machinery engineer and one mechanical engineer abroad, to be used later as counterparts of the proposed experts.

PERSONS MET

1 - Miss NINA NASH - UNDP Res. Rep. a.i., Seoul

2 - Mr. CHUL CHOO LEE - Prof. Agric. Machinery - Seoul Nat. University, Suwon (counterpart)

3 - Mr. S. K. HAN - Director, Institute of Agric. Eng. and Utilization - Ministry of Agriculture, Suwon

4 - Mr. S. R. KIM - Chief, Agric. Machinery Division - Ministry of Agriculture, Suwon

5 - Mr. J. C. SUK - V. President, Agricultural Dev. Corporation, Seoul

6 - Mr. A. M. SOON - Chief Office of Planning - Agric. Dev. Corporation, Seoul

7 - Mr. M. Y. JU - Chief Farm Machinery Section - Agricultural Dev. Corporation, Seoul

8 - Mr. L. K. MO - Agricultural Dev. Corporation, Seoul

9 - Mr. S. T. CHUNG - Chief of Planning and Material Section - Ministry of Agriculture, Seoul

10 - Mr. K. S. AHN - Planning and material Section - Ministry of Agriculture, Seoul

11 - Mr. L. EHRMAN - Executive V. President Exotech Systems, Seoul

12 - Mr. T. A. KWON - Head of Food Resources Laboratory - K. I. S. T., Seoul

13 - Mr. R. S. LEE - Ministry of Industry, Seoul

14 - Mr. K. J. BAE - Chief, Farm Management Division - Agric. Economic Research Institute, Seoul

15 - Mr. J. Y. LEE - Director, National Institute for Agricultural Materials Inspection - Ministry of Agriculture, Seoul

16 - Mr. D. OH - Chairman, Daedong Industrial Co. Ltd., Seoul

17 - Mr. K. I. BOK - Manager, Korea Farm Machinery and Tool Industry Corporation, Seoul

18 - Mr. C. T. HOON - Managing Director, Korea Farm Machinery and Tool Industry Corporation, Seoul

N E P A L

SUMMARY

1 - The development of paddy seems to be quite a good one and its production will probably increase twice in the next 10-12 years. In order to reach this goal, it becomes necessary to organize farmers in cooperative, to buy selected seeds and fertilizers, to organize storage and selling of products and, in further times, to use agricultural machines and tractors in the most rational way.

2 - The development of mechanization is going to be very slow and it does not stand in any priority in the actual 5-year plan, which mainly aims to improve the processing, the irrigation and the transportation systems. However, a progressive demand of machines is sure. As far as all agricultural machine have to be imported, there is a very important problem concerning a rational choice of standardized models, a rational supply of spare-parts, and the organization of an efficient repair and maintenance service. Anyway it is usefull - especially in paddy areas - to use a 10-12 HP power-tiller, which can be transformed in a 4-wheel drive tractors in a further time, furnished with spading machines, plows, harrows and p.t.o. driven trailers. It also should be taken into consideration simple self-propelled reaper binders, to be used in areas where 2 crops per year can be made.

3 - The only important factory which manufactures agricultural machines is now going through an organizing period and it is equipped to produce equipment for tillage and hand tools. It could be expanded and organized in order to manufacture threshers and dryers, too. In the next 5-year plan it should be taken into consideration the setting of an assembly factory (15-20% local content) of the above mentioned kind of power-tillers. Its production capacity should go from 300-400 units per year, at the beginning, to 1800-2000 units in 10 years time.

4 - There are no ancillary industries and raw materials. The production of the latter is slowly increasing, while there are no plans to realize and develop the formers.

5 - Research in the agricultural-mechanical field is fragmentary and it does not exist a center for the design, adaptation, prototypes construction and testing of agricultural machines. In any call, it is essential to realize an efficient repair and maintenance service, to unify and standardize models imported and to supply spare parts; also an extension service is to be recommended.

1 - General pattern of agriculture

1.1 - The total cultivated and plowing area is about 2.185.000 ha, which represent the 13% of the whole country. This conclusion is in a deep contradiction with general opinions, that furnish values twice as big.

The 70% of the cultivated area is near the Indo-gangetic plain, in Terai, which presents flat soil as well as mild sloping terraces. The remain 30% is in the central hilled area called Pahar, which is rich of water and usually fertile, especially in the lower part.

Cereals are grown on about 90% of the whole cultivated land; paddy is the main product (about 50,5%) together with maize (20%). In 1970 the paddy production amounted to about 2.2 million tons and in 1971 to 2.4 million tons. This means that the average yeld production is 1.5-1.8 tons/ha. which can rise up to 3 tons/ha in the most fertile irrigated and fertilized areas.

Only between 3 and 4% of the paddy area is able to produce two crops per year : usually both of them are of paddy but frequently also paddy may be the first crop and maize the second one or wheat the first one and paddy the second.

The irrigated area covered in 1970 128.400 ha (which is about the 6% of the whole cultivated surface) but the last 4th five-year plan for the economical development (15/7/70 - 15/7/75) foresees an increasing of the irrigated area up to 184.000 ha. This means that in the future the irrigated area will cover 15% of the total cultivated land. The most important problem about irrigation is of course the rational regulation of waters.

In the feeling of the FAO experts who have been conducting in the last 4 years a broad research on the response of different crops to the use of fertilizers, it is possible with a rational use of fertilizers and of new rice varieties,to improve production of paddy of 1.5-2 times in the next 10-12 years, and to reach an average yeld production of about 3 tons/ha. The surplus of the rice production (200.000 tons per

year) in Terai - which, representing the 70% of the whole cultivated area, has a population covering 30% of the whole country one - is exported to India rather than be transferred to the northern part of the country. This happens - even if inside the country there is a considerable shortage of food supply - because a good communication systems is missing. Recently, a 25-year plan has been studied; it should be realized with the financial support of the World Bank. Such plan provides the realization of a modern roads system, in order to connect the northern valleys with the Terai plain and to build a broad East-West road in the Terai itself.

The agricultural area is divided into 1.700.000 farms, with an average size of 1.23 ha., which rises to about 3 ha. in Terai and gets down to about 0.7 in the inside valleys. Paddy farms are usually the smallest, the most fragmented and the most scattered ones. The farms with a size of more than 4 ha. represent only the 5% of the total number though they cover an area which amounts to the 37% of the whole cultivated area. It has been recently started a land reform program which plans to realize farms with maximum extension of 16 ha..

1.2 - The total population of Nepal is about 11.300.000 inhabitants, 42% of which constitutes the active population.

According to the U.N. experts, 85% of the active population is employed in agriculture. This means that there is 1.7 wokers per hectare of cultivated land.

A very active family planning compain is going on, but population keeps increasing and if the increasement is only 1.9% per year, this is due to high child mortality. Medical assistance is more and more taking place and the population increasement is supposed to reach the 2.3-2.5% in quite a short time.

Such fact will bring along many economical and social problems, and in the first place the problem of how not to reduce the actual nu-

trition standard.

1.3 - The G.D.P. per capita is about 70 dollars per year; the gross income goes from a minimum of 30 dollars per year in the mountains to a medium of about 50 dollars per year in Terai, to a maximum of 180 dollars per year in the Katmandu valley.

The agricultural production represents some 66% of the G.D.P.. In the last 5-6 years the average increasing of agricultural production has been 2% per year.

According to the new national economical plan, such increase should reach 4% per year in a very short time. This is mainly because of the increasing productivity of soil, which is due to the spreading out of irrigation, of selected seeds of different varieties and of fertilizers. The 60% of the used fertilizers are distributed only on the 2% of the cultivated area; there average use is about 2.5 kg/ha. per year.

1.4 - All the work-at least as far as paddy is concerned - is hand-made and only in some areas the hardest jobs are done with the help of animals.

The primary tillage is hand-made, especially in the small terraces on the hills, as well as sowing and transplanting. Drying is realized by natural methods and as far as processing is concerned, old and very small hullers are used with losses reaching 40%. A loss of product which goes from 15 to 30% is due to a complete lack of the right drying and storing equipment.

The main problem to be urgently solved seems to be the one concerning construction of a complete road system in the country.

2 - Pattern of farm mechanization

2.1 - Mechanization of agriculture is at its first stage and the actual economic plan of the Government does not give any attention to this

problem, leaving the priority to the development of plants for processing of agricultural products - this is also concerning paddy -and to the development of heavy industry.

Today there are only 900 tractors in the whole country (210 in 1960; 600 in 1968), a third of them has been bought by the farmers through private dealers. Such population corresponds to 0.4 tractors per 1.000 ha. and has been rising 3 times at the average rytm of 200 tractors per year in the last 5 years.

Less than one hundred power-tillers can be counted, while the population of pumps, which were 1400 in 1971, has been going up together with the one of engines.

The tilling of soil is made with animal-drawn plows, puddlers and harrows, but it is often made by hands with a particular kind of short-handle hoes. Everything else is hand-made.

Of course there is an unknown amount of knap-sack sprayers, sowing machines and fertilizer distributors (amounting to a few tens). The introduction of reaper binders and combine self-propelled harvesters has only an experimental purpose.

Weights are carried, usually, on peoples' backs even on long distances; animal drawn carts are not often used because of a complete lack of a rural road system.

There are no dryers at all and only some 1800 hullers, usually old and with a low capacity.

2.2 - It was not possible to find out the future demand for tractors and agricultural machines, also because of the fact that no priority is given to mechanization in the economic plan. Import of agricultural machines and, mainly, of tractors, is made through tenders called by the Government 2-3 times per year for 50-100 machines of each model. All this brings along the problem of a lack of spare parts, ot the standardization of models, and of the organization of repair and maintenance centers.

According to evaluations of the Agricultural Development Bank, the

demand for tractors, in the next 5-10 years, will concern some 400-500 units per year to be used especially for primary and secondary tillage and transportation and not on the paddy lands.

Local technicians believe that the developing of mechanization should be realized through cooperative centers, whose features have not yet been stated. This is already done on a small scale. Researches conducted by the Ministry of Agriculture and by specific Corporations, show that - at this stage - the cost of mechanization and especially of tractorization results superior to the one of manual work or animal use, at the same production parameters.

They recognize, anyway, the technical importance (better tillage; timelyness in the agricultural practices, smaller amount of losses) and the social value of mechanization. In order to develop it in an organic way, it is necessary to wait for the shifting of man-power from the agricultural field to the industrial one, so to create raw materials for installation of new factories (cookies, oil, margarine, etc.).

In any case, the land has already been divided in 3 categories: intensive, preliminary, exploratory, according to the priority of development and of the introduction of mechanization.

As far as the drying and storing of paddy is concerned, we still are - as said above - at the primitive stage. The problem of a better and more controlled storage will be faced together with the processing giving it a certain priority on mechanization. We can conclude therefore that there will be a demand for about 300-400 mobile drying machines and for the same amount of hullers per year in a near future (1980).

Basing on some informations, we came to think that the population of tractors will be 3.000-3.500 units in 1980; such tractors should be purchased from the same factory, be easy to use and at a low price. In 1980 the annual demand for power-tillers (10-12 HP) will amount to 700-800 units; they should be used with plows, spading machines, harrows, sprayers and trailers p.t.o. driven.

These power-tillers should be planned considering their further uti-

lization as 4-wheel drive tractors.

Talking about transportation, its cost is so high - for example as far as fertilizers are concerned - to make its use improductive and the rising of paddy production per ha not convenient.

The requests for the above mentioned machines will rise up to 200-300 units of each model in 1980. The situation for animal drawn machines looks different : in 1980 some 60.000-80.000 mould-board plows, cultivators and harrows, some 1.500-2.000 hand sprayers and pedal threshers will be needed.

Only at the beginning of the 80s a more rational mechanization of rice-growing can be planned, and this will bring along the need of organizing an efficient repair and maintenance service together with spare parts market, of providing farmers with technical and mechanical training courses and extension services, according to what the plan states.

The service, today, is fragmentary and realized through service-centers and rural communities, besides some private plants which has to go through tenders called by the Government.

Sometimes demonstrations of new machines are organized too. In the end, transplanting is entirely hand-made and the further step - once the irrigation system has been developed on about 2/3 of the whole cultivated area - will be realized with the introduction of broad-casting.

Considering 1.200-1.500 work-hours per ha necessary for paddy cultivation every year, the distribution of work is organized as follows : 29% for primary and secondary tillage; 22% for transplanting; 1% for irrigation; 16% for plant protection; 17% for harvesting; 11% for trashing; 2% for drying and storing. Animals are used just for plowing and trashing.

2.3 - A rational development of mechanization will take a long period

of time starting from small machines able to improve the different practicies and their timelyness, and to reduce wireness.

It is important, therefore, to keep in mind that machines should be carefully selected according to their usefullness and to the more economical utilization in the local conditions, pushing standardization and unification as far as possible.

A particular kind of 10-12 HP power-tillers with gear box, furnished with mould-board plows, harrows, puddlers, levellers, spading machines, sprayers and small p. t. o. driven trailers is suggested as especially usefull and easy to use.

A machine of this kind - to be transformed in a 4-wheel drives tractor in further time-could have an annual demands going from 300-400 units up to 1. 800-2. 000 units per year.

About the 8-10% of this amount should be used for the replacement market. The final results will be 60-80 units per 1. 000 ha. and a total population of some 40. 000-50. 000 units.

Other machines, whose introduction is necessary, are : power operated knap-sack sprayers; self-propelled reaper binders (for the areas where two crops are possible); power operated threshers (i. e. drum model realized by International Rice Research Institute); hand and power operated pumps; small and medium capacity mobile dryers able to satisfy 50-80 ha. of paddy areas, and modern hullers. The last mentioned machines are considered very important to avoid heavy losses of products which to be now fall.

To obtain a rational use of them, technical training for farmers, extension service and repair and maintenance services should be developed.

3 - Manufacturing industries and ancillary facilities

3. 1 - The industrial sector gives a 7% contribution to G. D. P. and it is very slowly developing. At the same time researches are carried on

to discover the real possibilities of development as far as the mine situation is concerned.

The mechanical sector is stands with the least developed ones.

3. 2 - In Nepal there is only one manufacturer : the Agricultural Implements and Tolls Factory, in Birguny, which started by the Government in 1963 and replanned and completed in 1968 through foreign helps, with the purpose to build simple agricultural equipment and hand tools.

The factory is theoretically well organized and it has a foundry, a forge and all the tool machines needed to produce plows, cultivators and animal-drawn harrows.

It is planeed to produce 1.000 tons per year of finished metallic product (10.000 Nepali type plows, 1.000 cultivators, 20.000 hand hoes, etc.).

In the last four years its production has gone as low a 200-250 tons per year, because of lack of : production plans based on a market analysis; technical documentation and studies on the standardization of the products; plans for providing itself of raw materials; cost analysis and collaboration with the Agricultural Supply Corporation.

To study how to improve production of this factory there is an UNIDO expert in Nepal right now, with a 6 months mission; the first results of his researches are summarized above.

Besides this one, there are some few handy craft workshops which build plows, hand tools and little hand or pedal threshers following the requests of local markets in the different villages.

3. 3 - Ancillary industries and raw materials do not practically exist. The extractive industries is just starting but it is expanding.

3. 4 - It is not usefull to plan right now, an organic industrial development in the agricultural machines sector. The factory in Birguny - on-

ce its full production capacity will be realized - is able to diversify and enlarge its production in order to build 40-50 dryers and 150-200 power operated threshers, IRRI model. In a further future - when the annual request will not be less than 600-800 units - it could be suggested to build an assembling unit, with 15-20% of local content, for a 10-12 HP Power-tiller of the above mentioned model, and a trailer p.t.o. driven.

Considering the lack of spare parts it seems usefull to encourage the local construction of particular spare parts which can be utilized not only in the agricultural sector, in order to make their production as cheap as possible.

4 - Policy toward farm mechanization

4.1 - With the help of other countries, studies about resettlment are now being realized; the results of this researches which have been recently started, are not known yet.

The great assistance of UN coordinated by the local UNDP office will bring an important contribution to a rational development of agriculture. The Government, through the Agricultural Development Bank, gives loans to farmers on a low interest (9%) for 5-7 years to buy agricultural machines.

Before lending the money the Bank inquires on real needs and it is easier to obtain it if farmers join a cooperative.

The technical training of farmers about agronomic and mechanic practicies is still lacking but on stake.

One of the Government's purpose is, in fact, to start training programs for farmers and courses for mechanics of tractors (repair and maintenance).

4.2 - The research in this field is just starting and there are no centers specialized in design, adaptation, prototypes construction and

testing machines. There is a Department for Agricultural Training and a Research Center with sixty experts, but they are not working on it.

The National Economical Plan foresees to build 28 selected districts by 1975 for an intensive agricultural development to be realized by an extension service which will need the help of 833 technicians and 700 young assistants. Some of these districts are already on work. The educational field is rapidly developing. Students have been rising 50-60 times in 20 years; in primary schools the number has increasing from 8500 to 450.000 pupils. The University graduations are mainly taken abroad.

5 - Policy toward industrialization

Policy toward industrialization is developping through the increasing of basic industries and mainly of the processing. This one seems to be, in fact, the first aim of the Government, connected with the improvments in the irrigation and road system.

Particular effort is put on ammodernizing mill plants and realizing modern store-houses, so that the losses of products can be reduced. In order to encourage foreign investments for joint ventures in the manufacture of agricultural machines, the Government offers 10 years tax exemption and the possibility to use the 65% of the foreign exchange earned by export.

6 - Conclusions

The development of mechanization is certainly going to be very slow, but in order to help it to expand in the best way, it is raccomanded the assistance of UNIDO as follows :

1 - to assist the Government chosing the machines most suitable to the local conditions based on the need of standardization foreseing a local economical production. An UNIDO Expert; duration, 6

months; course of the mission 1973;

2 - to help the Government to define and realize a center for testing design and adaptation of agricultural machines and for repair and maintenance service organization. An UNIDO Expert; duration, 4 months; course of the mission 1974.

Before sending off the above mentioned experts, it is suggested to promote 2 fellowships, lasting 6 months each in order to send 2 agricultural machinery engineers abroad to be used later as counterpart for the proposed experts.

PERSONS MET

1 - Mr. Y. J. JOURY - UNDP Res. Rep. - Katmandu

2 - Mr. S. CHANDRA LAKHEY - Senior Administrative Assistant, UNDP - Katmandu

3 - Mr. G. ESPINOSA - Increased use of High-yelding, FAO Project - Katmandu

4 - Mr. M. J. SAKYAMA - Agricultural Economist, FAO - Katmandu

5 - Mr. N. MAYER - FAO Agric. Expert - Katmandu

6 - Mr. N. B. BASNYAT - Dir. Dept. of Agriculture, Education and Research - Katmandu

7 - Mr. T. BAHA DUR BASNYAT - Chief of Agric. Engineering Section - Dept. of Agriculture - Katmandu

8 - Mr. M. P. D. TEWARI - Gen. Manager of Agric. Marketing Corporation - Katmandu

9 - Mr. M. G. B. THAPA - Gen. Manager of Nepal Industrial Development Corp. - Katmandu

10 - Mr. M. B. P. DHITAL - Chief of Economic analysis and planning division, Ministry of Food and Agriculture - Katmandu

11 - Mr. D. R. KOIRALA - Gen. Manager of Agric. Development Bank - Katmandu

12 - Mr. M. JYOTI - Managing Director of Himal Iron Steel Ltd., Dealer - Katmandu

13 - Mr. S. S. RANA - Proprietor Scoothaway System, Dealer - Katmandu

14 - Mr. R. K. SHRESTHA - Agricultural Machinery Dealer - Katmandu

PAKISTAN

SUMMARY

1 - Rice-growing covers about 9% of the whole cultivated area with an average paddy production of 1.5 tons/hectare. Actual production is largely sufficient in comparison to the population's necessities and future policy will aim to improve quality rather than yield production. A land reform has been started in 1955 and an integrated rural development project with special assistance in the agronomy, irrigation, land reclamation, social development and education sectors is starting now.

2 - Agricultural, and particularly paddy, mechanization is at the first stage. Tractor (45-65 HP) density is 1.3 units per ha.; power operated pumps: 4 units per hectare; power operated knapsack sprayers : 0.6 units per ha.. Power-tillers are not commonly used, and their utilization is not considered economical, compared with animal and tractor ones. Threshers are used especially for wheat.

There are not exact data about actual yearly demand of tractors and machines, but it is foreseen about the following demand in 1975 : 10.000 tractors per year (45-65 HP), 20.000 centrifugal pumps; 3.500-4.000 delp well pumps; 30.000 knap sack sprayers; 4-5.000 p.t.o. driven sprayers; 4.500 hand operated threshers and 3.000 power operated threshers. Referring to the latters, especially hand operated models are foreseen to be used for paddy.

Transplanters and dryers are thought as machines to be utilized in a near future; infact, the following priorities for the mechanization of transplanting, harvesting, threshing, drying and processing are given by the Government. While it should be remembered the Government's purpose to razionalize agricultural machinery import through a careful choice of models and sizes, the exam of actual situation leads to notice the opportunity to favour the spreading, for paddy areas, of : power-tillers (14-16 HP) to be transformed in further time in 4-wheel drive tractors; 25-30 HP 4-wheel

tractors, if possible articulated, simple, strong and low cost; equipment for primary and secondary tillage, plant protection and transport (trailers, both bearing and driving axle), spading machines, consistent with the above mentioned tractor sizes; self-propelled reaper binders with 1.50 m cut width; mobile and stationary dryers for a 7-10 tons per day paddy production; hullers (0.7-1 tons per hour of polished rice); mobile workshops; machines for trenches and canals excavation and maintenance.

The initial annual demand for all the above mentioned machines can be evaluated aproximatly around 3-4.000 units per year for each model, except for dryers, hullers and mobile workshops whose demand can be valued around few hundred units per year.

This forecast, of course, has to be verified on the basis of broad studies to define the best mechanization levels.

3 - The agricultural machinery manufacture sector is rather limited up to to now. There are only two tractors assembly plants for production of a little more than 1000 units/year in the range 45-65HP, in comparison with a sanctioned capacity of 3500 units/year. There are besides : 36 sizeable factories and 144 small workshops to produce 10.000-11.000 engines (both diesel and gasoline) above 10 HP yearly with a sanctioned capacity of 25.000 units per year; about 20 factories to yearly produce 10.000 hand operated pumps, 17.000 power operated pumps and 1500 deep well pumps; 10 factories to produce stationary hand and power operated threshers (10.000 units per year). There are also some workshops to produce implements for primary and secondary tillage tractor drawn, and more than 200 workshops for animal drawn plows and similar implements production.

The annual value of these small factories production is evaluated around 3.000.000 dollars.

While Government has recently called an international tender

for the country's manufacture (45% local content) of 6.000 tractors per year in the range 35-45 HP, it is to be mentioned a future regional cooperation project among Pakistan, Iran and Turkey for tractors and agricultural machinery production on larger series, able to serve the 3 countries market and consequently with the goal to obtain a cheaper production.

It is considered valuable to suggest to take into consideration the possibility of local construction of : 14-16 HP power-tillers transformable in 4-wheel drive tractors; 25-30 HP 4-wheel drive tractors simple, strong and low cost; spading machines consistent to the above mentioned tractors and other implements for primary and secondary tillage; self-propelled reaper binders; dryers and mobile workshops.

4 - Ancillary industries and raw materials are at a very primitive but promising stage. Many parts and components, useful for tractors and agricultural machines construction, as well as many raw materials are locally produced. The Government aims to realise a local production able to meet atleast 80% of the demand, by 1980.

5 - The Government started an integrated rural development project on 5 experimental areas 300-500 square miles each, and gives technical assistance and credit facilities to farmers to purchase agricultural machines with loans 1-7 years, at 8% interest rate.

Research is developed by Agricultural Engineering Stations in Lyallpur and Tandojam which deserve to be developed in testing, standardization, adaptation and technical training for technicians and university graduates sectors.

It would also be useful to improve technical training for farmers, extension service, repair and maintenance organization to be conducted under the leadership of Agricultural Engineering Dept. of the Ministry of Agriculture.

6 - The Government's actual policy gives considerable importance to the increasing of mechanical industry and helps new investments through facilities consisting in loans at 9% interest for 12 years and some forms of tax exemption and duty free.

These incentives are different according to the factory's production, and to the more or less developed areas where new factories have to be installed.

7 - There is still a general lack of skilled workers especially concerning heat treatments and particularly sofisticated workings.

1 - General pattern of agriculture

1.1 - The total cultivated area (limited to west Pakistan) is evaluated around 19.230.000 hectares and represent about 24% of the total country area. The irrigated area covers 12.500.000 ha and it is continously increasing; infact, it enlarged 5 times between 1955 and 1970.

Cereals cover about 45% of the cultivated area and paddy by itself 1.500.000 hectares, representing 9% of the whole cultivated area, with an average yield production of 1.5 tons/ha.. In the last 10 years while paddy areas is increased 32.5%, its production has doubled and there is the possibility, through the use of better seeds, the growing but still very low (9 kg/ha) use of fertilizers and the irrigation development, to increase at least 1.5 times the actual paddy production. Anyway such production - which actually covers 2.300.000 tons - is superior than local needs and future policy will be oriented to improve quality rather than yield production.

Agricultural land is divided into 4.800.000 farms with a 4.1 ha. average area. Farms with a size of more than 4 ha. represent 31% of the total population and cover 75% of the whole cultivated area. It is underknown the size distribution of rice holdings even if, generally speaking, paddy farms are smaller compared to average size. According to 1960 census rice holdings population is about 92.000; only 10% of them is constituted by large farms.

An integrated rural development project is starting, based on coordinated helps concerning technical, social and educational sectors. A land reform was started in 1955, limiting property to no more than 200 hectares.

1.2 - The total population of Pakistan is about 61.300.000 inhabitants; 32-36% constitute active population. Agricultural workers represent 75% of active population with a density of 0.9 workers per hectare. By 1980 an average reduction of agricultural labour is foreseen down

to 60-65%; anyway it is difficult to think of a reduction in absolute terms. A part of active population works in agriculture only part time. The annual population growth has been recently evaluated around 2.7% and it is hoped, through a very active family planning campaign, to reduce it to about 2% within the present decade.

1.3 - The G.D.P. value per capita is not exactely known but it seems to be around 110 $ and it had a yearly 6% increase from 1965 to 1970. On the contrary in the last two years, the increase has been lower (about 1% per year). This asks for a deep revision of the actual fourth 5-year development plan (1970-1975) because this plan foresaw a 5.5% average increase per year at constant money value.

Agricultural production represents 41% of G.D.P. compared to 49% in 1961. It has been increasing is very irregular way in this last period, at the average rate of 2-3% per year. Considering the actual revision phase, it is not possible to know what the annual increase previsions will be in the near future.

Agricultural products represent about 63% of exports and 28% of imports.

1.4 - Almost all works concerning rice-growing are hand made or realised with animal drawn machines. Only in some cases primary tillage is mechanized with the use of tractors, equipped with mould board or disc plows, which are rented to farmers. Threshing is also hand or animal made. Drying is done with natural methods and processing is made with small hullers often old and causing considerable losses of products (25-30%). On 70% of paddy area rice is transplanted while in the remaining 30% broadcasting has been used. Rural electrification is in a developing stage.

2 - Pattern of farm mechanization

2.1 - Agricultural and paddy mechanization is still at a primitive

stage.

The actual tractors population is valued around 25.000 units ranging between 40 and 65 HP; according to some informations it had a 1200-1400 average increase per year, according to others it was about half. Density is about 1.3 units/hectare. The actual annual demand is valued bigger and around 5.000 units/year in the range between 40 and 65 HP. There are also about 2000 crawler tractors for non agricultural purposes, but used for land reclamation.

Power-tillers, which are imported in Pakistan not on commercial scale, do not practically exist. This happens because - according to the Government - the use of these machines would be more expensive than the bullocks or bigger tractors ones. Power-tillers demand is also non existing.

Concerning more than 5 HP diesel and gasoline engines, it seems that 1971 population was about 50.000 units; around a third of them, in the range between 10 and 30 HP, is used for non agricultural purposes. There are no data concerning annual demand as well as micro gasoline engines population and demand; it is proposed to plan, in the next 5 years, separate capacity based on cheap fuel for envisaged use on power operated sprayers. There are also about 38.000 electric motors in use.

Hand operated pumps population is about 500.000 units while power operated models are spread in 84.000 units, whose 10% is constituted by deep well models. The actual annual demand is not abailable.

There is also a population (1968 data) of : 50.000 hand operated and 10.000 knapsack power operated sprayers and dusters, together with 100 models p.t.o. driven; 800 stationary power operated threshers for wheat and some hundreds at all, of hand operated threshers, transplanters, dryers and mills. Present annual demand is not available.

Generally spread in all farms are animal drawn plows and har-

rows while the total number of various types of tractor powered drawn implements for primary and secondary tillage is estimated about 30-40.000 units. The present annual demand of implements for tractors is valued around 7500-9000 units corresponding to an average of 1.5 implements for tractor. There are also 100 combine harvesters while no informations are available on the population of trailers. However, it seems that transport sector is not well developed as well as the rural road system.

2.2 - Mechanization future development previsions are uncertain because no studies have been conducted to determinate the best mechanization level and the optimum population of each model and size of tractors and equipments in different years, according to the foreseen socio-economical development, and the annual demand.

Some technical and economical research on mechanization has been conducted by the Directorate of Agriculture in the state of Punjab and by its research departments. The future annual demand of tractors - between 1975 and 1980 - is estimated around 10.000 units per year, in the range between 45 and 65 HP, and it is expected an increase of 2-2.5 implements per tractor, that means a whole implements demand around 20-25.000 units/year. This is, of course, especially for primary and secondary tillage implements and it means that it will be a gradual substitution from the animal drawn plows to tractors mounted ones.

It is confirmed opinion that there is no future for power-tillers. Development previsions of annual demand for other machines can be, at least in part, indentify with the local production foreseen between 1975 and 1980. Therefore, the following development can be hypotizise :

- pumps : 25.000 hand operated, 19.500 centrifugal and 3500 deep well units in 1975; 30.000 hand operated, 22.000 centrifugal and 5.000 deep well units in 1980;

- sprayers and dusters : 29.000 knapsack power operated and 4.400 p.t.o. driven units in 1975; 30.000 knapsack power operated and 7.000 p.t.o. driven units in 1980;
- threshers : 4.500 hand operated and 6.000 power operated in 1975; 4.500 hand operated and 7.500 power operated units in 1980. Actual situation is unknown, but up 1968 no rice threshers were beeing used.

There will be an increasing demand (less than 400 units/year by 1980) of combine harvesters. For other machines, like transplanters, dryers and hullers, it seems there is a completely lack of interest by farmers. This interest will wake up in a near future according to the spreading of the integrated rural development projects. The improvement of processing is one of the priorities foreseen by the Government. Other priorities concern : transplanting, harvesting, threshing and drying. In the official feeling it will be not possible to reach a complete spreading of two crops per year and of a rational mechanization, before 1990.

For this purpose, technical training for farmers, extension service, repair and maintenance service and spare parts providing are to be implemented.

2.3 - In order to complete actual situation it should be considered the right intent of the Government to razionalize imports, limiting the quantity and number of agricultural machinery and tractors models. The exam of the actual situation and of the future development of mechanization points out the opportunity to consider, for a near future, the use of machines able to alleviate labour weariness and to do agricultural practices in time and with better results, with a very small growth of labour productivity. This concerns the use of:

- 14-16 HP power-tillers to be transformed in 4-wheel drive tractors is further times, adding an adapted rear-end, completed with p.t.o. and cages wheels to be equipped with mould board plows, har-

rows, trailers (both bearing and driving axle) and sprayers and stationary threshers and pumps; 25-30 HP tractors simple, low cost, if possible articulated, 4-wheel drive, to be used for primary and secondary tillage, transports and eventually with reaper binders p.t.o. driven. It will be useful to examine, also, possible applications of adequated spading machines;

- self-propelled reaper binders simple and equipped with special cages wheel, no less than 1,50 m cut width, whose use seems particularly important considering rice-growing local conditions (10-12 HP engines). The above mentioned power-tillers could be used as multi purpose and be completed with mounted reaper binders;
- mobile and stationary dryers, with a capacity of 7-10 tons per day of paddy, and bigger models consistent with new mill plants;
- mobile workshops for ordinary maintenance and repair service.

The above mentioned machines could be used in rice-growing starting from 3-4.000 units per year, concerning power-tillers, tractors (with 2-2.5 implements per unit) and self-propelled reaper binders; 4-500 units per year, concerning dryers, hullers and mobile workshops. Requests could doubled by 1980, considering a 8-9% average replacement market. Population of the above mentioned models should reach about 70-80.000 units, which, in present and near future socio-economical conditions, seem to be most useful and of economical utilization.

This population - as the actual annual demand foresees - is referred only to paddy areas which covers less than 10% of the total cultivated one, but the above mentioned machines can be usefully used for other crops, with consequent growth of demand.

Obviously it is important to choose machines which can better be adapted to local conditions on the basis of deep tests of the different sizes and models offered by the international market and to verify the validity of the given suggestions on the basis of broad studies on the best mechanization level, referring to social and economical

local conditions. For this aim it is useful the assistance of international experts.

3 - Manufacturing industries and ancillary facilities

3.1 - The industrial sector gives a 17% contribution to G.D.P. and its increase, in the last few years, has been a floading one, but about 7-8% at a constant money value. Only last year - for international reasons- there was a production decreasing, compared to the year before. Anyway,this unfavourable trend - which in 1971-1972 has brought to a 40% reduction of private investments compared to the year before - does not seem to be a durable one and it will improve in a very short time.

The actual fourth 5-year development plan is now under revision and it is foreseen a gradual and growing expansion in the metallurgical, mechanical and mine sectors.

3.2 - Tractor and agricultural machines manufacturing sector is at the first stage of development. There are no tractors factories but only 2 assemblying plants with a total production of little more than 1000 units per year compared with a sanctioned capacity of 3.500 units. These factories will transform simple assembly into cooproduction with an increasing local content in further time. There is another factory which is actually trying to realise cooperation with an european industry to produce 2.000 tractors per year (45 HP); there is also a regional cooproduction project among Pakistan, Iran and Turkey for a production able to meet 3 countries demand (and export later), in series so to reduce production costs and investments, according to the economies of scale principles.

Recently, the Government has called an international tender for the progressive manufacture of agricultural tractors in Pakistan in the range between 35 and 45 HP and with a sanctioned capacity of 6.000 units per year. The starting of assembly is foreseen by the

end of 1973 and the local production should be completed (45% of local content) by the end of 1975.

Concerning engines, there are actually 3(sizeable factories and 144 small-medium sized units manufacturing (with 40 to 70% local content) all types of engines both diesel and gasoline, from 10 HP up. Annual production (only 50% of it is for agricultural purposes) is about 10.000-11.000 units compared to a sanctioned capacity of about 25.000 units/year. The gap between production and capacity is mostly due to inadequate availability of raw materials and financial resources to import them. Year production growth is going to be very low, reaching 15-18.000 units by 1980. There are no micro-engines factories which are supposed to be installed in the next 5 years.

Pumps are manufactured in about 20 factories with an annual production of about : 10.000 units of hand operated models, 17.000 units of power operated and 1500 units of deep wells models. This is in comparison with a total sanctioned capacity of over 50.000 units/year 70% of which in centrifugal and deep wells models. For these equipments it is foreseen a slow production increase which should reach, in 1980, 135% of the actual production. The greatest increase is going to be in the hand operated models sector, but, this seems to contradict rational mechanization, because it looks more interesting future production of small (1-2" ∅) low flow power operated pumps.

Concerning transplanters, local production will be taken into consideration in 1975, while there are 8 factories producing sprayers and dusters (both hand and power operated) whose capacity meets local demand and it is foreseen to develop according to local needs. There are also 10 factories to produce stationary power operated threshers with sanctioned capacity of 10.000 units/year and an annual production of 6000 units, by 1975, and of 7500 units per year by 1980. It is also foreseen a future local produc-

tion, in cooperation with a foreign company,of 250-300 combine harvesters per year by 1975. Local content of this cooproduction is not known.

Concerning the production of tractor's implements for primary and secondary tillage, there are some factories with a whole year capacity of 4000-5000 cultivators, 1500-2000 disc plows, 1700-2000 mould board plows, 1200-1500 rototillers and some thousands of other implements. However, actual production is very low and does not reach 20% of the whole capacity. There are also 200 small workshops for the animal drawn plows and other tillage equipments and hand tools.

The total production of small and medium factories is valued around 24 millions rupies (about 3 millions dollars) and the planned capacity is expected to be sufficient to meet the demand up to 1975. Finally, production of dryers and hullers should be started in the next 2-3 years.

The few visited industries show good facilities and are interested in expanding and diversifying their production which, generally speaking, need an active technical assistance in standardization of products and in quality control.

3.3 - Ancillary industries and raw materials are at a quite advanced stage and they look very promising.

There is also a considerable capacity to produce spare parts, and especially :

- tyres, with an year production of about 150.000 units for trucks and cars. The already existing factories, which do not produce tractor tyres because of small series, have all the facilities to do this, in future, according to the demand;
- gears, with a capacity corresponding to all models needed;
- ball bearings, with an year production of 1.200.000 units in different sizes. Split and other bearing models are also now locally pro-

duce in adequate quantitties;

- chaines, with an year production of 315.000 units of different sizes and types;
- pistons, pistons pins and cylinders with a production of about 60-70.000 units/year, plus 400.000 pistons rings, sufficient to present needs;
- starting batteries, radiators, pulleys, wheel rims, valve guiders, clutch housing, etc., with a production meeting actual necessities.

There are, also, many foundries and machine shops, which are manufacturing casting, forging and other components on a limited scale. These factories are also producing machines tools of different types and sizes, adequate to local needs from a technical point of view but not in terms of year production.

Finally, concerning raw materials, there are rolling capacities over 800.000 tons per year for low and medium carbon steel. Rolled milled and low alloy steels can be indigenously produced; forged steel both in high carbon content and alloy is also available with a capacity of 546.000 tons/year, practically all in the private sector.

There is also melting capacity of 550.000 tons per year for all steel and a year production of about 10.000-15.000 tons of cold drawn carbon steel. These productions are not adequated to actual demand; this will be realized by 1980. Also hot rolled plates, sheets and strips and grey iron malleable are locally produced but in inadequate quantity to local needs. The foreseen development shows that these productions will meet local needs by 1975; this concerns also cold drawn alloy steel, which is not actually produced.

There are also good facilities for heat treatments but in an inadequate way, compared to local needs; demand will be met only by 1980.

Concerning mine industries, this is developing but still at a very primitive stage, because resources have not been scarched yet; there seem to be, anyway, considerable quantities of iron, coal and copper.

3.4 - The actual situation - besides the momentaneous recession -

looks incouraging even if production of agricultural machines and tractors has been developed not always on the basis of real needs defined by deep studies on the best mechanization level.

Therefore, it is useful to suggest to take into consideration the possibility to increase local production - with a progressive growth of local content, through joint ventures with reputed and well established foreign manufacturers - concerning the following machines :

- 14-16 HP power-tillers with cage wheel and low pressure tyres, to be transformed in 4-wheel drive tractors and 25-30 HP tractors, simple, low cost, if possible articulated, 4-wheel drive, to be used in connection with equipments for primary and secondary tillage and plant protection and with trailers (both bearing and driving axle); whenever spading machines sold on the international market give good field-tests results, it can be planned also their local construction;
- self-propelled reaper binders simple, equipped with cages wheel, with about 1.50 m cur width (10-12 HP engine);
- dryers, mobile and stationary models, and mobile workshops.

These machines can be produced so to meet annual demand foreseen as in the chapter before. Because they are considered adopted also to other agricultural lands, it can be useful to foresee, in order to obtain the most economical productions, a regional cooperation as the project already started.

An open field concerns micro gasoline and diesel engines (1-5 HP), standardized, to be used with sprayers and other light applications. The initial production of these engines can be valued on about 30-40.000 units per year.

These are, of course, only general suggestions which need deep studies concerning year production and the best suitable models, easy to manufacture and simple to use and maintain.

It should also be suggested a broad research on standadization of the already locally produced machines and of their components, in order to reduce production costs, to simplify providing of spare parts,

and to meet farmer's real economical possibilities. A large part of already existing industries offers interesting facilities to expand and diversify their production.

Therefore, it can be useful to enlarge researches and to improve, through modern equipments, the existent Agricultural Engineering Research Stations and the Pakistan Industrial Development Corporation facilities in such a way as to be able to give to manufacturers technical assistance, concerning design, improvement and standardization of productions, together with quality control. For this goal an international experts assistance can be desirable.

4 - Policy toward farm mechanization

4. 1 - In the course of the actual fourth 5-years development plan, an integrated rural development project started; it is based on the concept to realise a general and integrated development of rural areas, giving technical and agronomical helps (more modern agronomical practicies, selected seeds, etc.), and improving hydraulic arrangements, infrastructures (road system, electrification, etc.) and social and educational sectors This is conducted on 5 experimental areas, each one of them covers between 300 and 500 square miles, with technical and financial assistance furnished by the Government, at least in the first stage.

The project aims to realise short and long therm goals, in whose frame mechanization is not considered in its whole importance. This happens because of the lack of broad researches on what mechanization can bring along, on what optimal mechanization of agricultural areas means, according to soil conditions and crops. In other words, it is to define the mechanization levels (and therefore machines models and sizes) able to minimize production costs according to social and economical conditions.

To purchase machines, the Agricultural Development Bank gives loans to farmers for 1-8 years at 8% annual interest rate. The most popular kind of loans is for a 5 years duration. Currency underwent

a considerable devaluation some months ago.

4.2 - Research in the agricultural mechanical sector is developed by two Agricultural Engineering Stations in Lyallpur and in Tandojam which take care of adapting and improving the already existing machines (especially animal drawn models, trying to reduce production cost to a minimum) of designing new simple machines, of organizing demonstrations experiments, and of hiring tractors and machines for land reclamation, canals excavation, levelling, etc..

These units with rather well equipped workshops, have a big work in soil preparation (the Lyallpur station has about 500 bulldozers), while research is rather limited. They deserve to be developed and equipped with modern instruments for a complete tractors and machines testing, adaptation and deep standardization. Technical training should also be developed in these stations, for technicians and university graduates in the agricultural machines sector.

In the country there are also some paddy research Centers - like the Rice Research Station in Lahore and the one in Dokri - which work, especially in the genetic and agronomical sectors, connected with I.R R.I . An engineering division is starting rigth now; its specific job should concern machines and tractors testing for rice-growing

4.3 - Extension, repair and maintenance services are done by importers (but farmers complain for a too slow providing of spare parts) and by some Government workshops whose number is gradually increasing and which should be developed under the supervision of the Agricultural Engineering Dept. of the Ministry of Agriculture. Such service should provide to organize some centers for technical training for farmers and repair-men.

4.4 - Taking as a basis what it is sais above, it seems useful to suggest :

- to conduct broad researches in order to define the optimal mechanization levels and the consistent machines models and sizes;

- to develop the already existing research centers in Lyallpur and Tandojam both in the testing and design sector as well as for standardization of machines and optimum choices of models;
- to improve technical training for farmers and workers to choose, drive, use and repair machines;
- to develop extension service, as well as repair and maintenance facilities with well equipped mobile workshops organized by the Agricultural Engineering Dept. of the Ministry of Agriculture.

5 - Policy toward industrialization

5.1 - The actual economical development plan gives considerable importance to the development of mechanical industries among which the ones to manufacture agricultural machines. This is mainly done, through good incentives for new investments. With 12 years credit at 9% interest and some forms of tax exemption and duty free to import special parts and no locally producted machines. Anyway these incentives are different according to priorities stated by the Government and to the more or less developed areas, where factories are going to be installed.

5.2 - To realise the above mentioned purpose is working a Department of Investment Promotion which operates in connection with the Pakistan Industrial Development Corporation, which is encharged of the technical sector. The most important actual project concerns the Regional Cooperation for development which should take care of regional production (Pakistan, Iran, Turkey) of tractors and agricultural machines in economical series.

5.3 - Mechanical and metallurgical research and testing are not sufficiently developed according to local needs and there is the necessity to improve quality control, studies on standardization and unification of materials, machines and their components.

There are no informations on university level in the mechanical sector, while for technicians and skilled workers there are good schools which should help students to choose jobs following local needs. There are, infact, too numerous workers for tool machinery, while heat treatments experts are lacking.

6 - Conclusions

International assistance in the metallurgical, mechanical and agricultural mechanization sectors is rather developed and actually the Government - besides an already approved request for two UNIDO experts in the repair and maintenance of agricultural machinery and a planned request for an expert in design and development center - has not advanced any specific proposals.

Anyway, assuming that the above mentioned request - which is recommended to favour - can be solved in 1973, it is useful to suggest UNIDO assistance to :

- assiste the Government in the rational development, on the basis of the principles concerning economies of scale and the highest production standardization, of factories in cooperation with well-established foreign companies, for the manufacturing of tractors, micro-gasoline engines, self-propelled reaper binders, dryers and mobile workshops. Two UNIDO Experts : an agricultural machinery engineer and an industrial economist; duration, 6 months each; course of the mission : 1975.

Before sending the above mentioned experts off it is suggested to promote 1 fellowship, lasting 6 months, in order to send 1 mechanical engineer abroad to be used later as counterpart for the proposed experts.

PERSONS MET

1 - Mr. KURT JANSSON - UNDP Res. Rep., Islamabad

2 - Mr. M. ALI AGHASSI - Senior UNIDO Adviser, Islamabad

3 - Mr I. A. LARI - Chief of Agric. Eng. Dept. - Ministry of Agriculture, Islamabad (counterpart)

4 - Mr. KHUDA BAKSH - Agric. Adviser to the President, Lahore

5 - Mr. M. ANRAAR ALI - P. C. S. - Secretary of Agriculture, Lahore

6 - Mr. M. HASSAN KHAN - Joint Sec. of Agriculture, Lahore

7 - Mr. M. KHAN - Director of Agriculture of Punjab State, Lahore

8 - Mr. M. AFZAR - Director of Agric. Eng. Research Station, Lyallpur

9 - Mr. A AZIZ - Agricultural Engineering Research Station, Lyallpur

10 - Mr. M. ANSARI - Manager P. E. C. O., Manufacturer, Lahore

11 - Mr. A. MAJID - Director of Rice Research Station, Lahore

12 - Mr. A. KHAN - President of Danishand - Manufacturer, Lyallpur

13 - Mr. R. ALFRI - Manager of Rana Tractor - Manufacturer, Lahore

14 - Mr. M. G. AFZAL - Farmer, lahore

15 - Mr. M. A. SALTAR - Add. Dir. Gen. Dept. of Investment Promotion and Supplies, Karachi

16 - Mr. F. ASSAN - Joint Dir. Dep. of Investment Promotion and Supplies, Karachi

17 - Mr. A. FARUQI - Dir. Rice Research Station, Dokri

18 - Mr. F. KAMAL - Agricultural Engineer, Hyderabad

PHILIPPINES

SUMMARY

1 - The paddy has obtained, in the last 5 years, deep progresses duplicating yield production, mainly because of the increasing use of better varieties and more responding to fertilizers. It is still aminly based on small farms fragmented into small plots and it is realized with tradizional methods, based on the use of animal drawn equipments and high employment of labour. This is not going to ruduce in the next 15 years.

2 - The agricultural mechanization level is a very low one. Population of tractors (from 40 HP to 80 HP) corresponds to an average density of 1.77 units per 1.000 ha.; power-tillers are 0.9 units per 1.000 ha. while there are 15 pumps per 1.000 ha. and 0.9 power operated threshers per 1.000 ha.. Tractors are not practically used on paddy areas while the other machines are mainly utilized for this crops, so that their population, referring to its area, is about 2.5 times the above mentioned one.

The request for tractors and other machines vary from year to year and it is slowly but constantly increasing. It is difficult to evaluate future demands for tractors and machines. Anyway, it is foreseen that in 1980 there will be a population of 80.000 power-tillers (7-9 HP) and that the population of power operated pumps will doubled, while threshers will increase 3-4 times. There is a complete lack of dryers (if not connected with the few mill plants), while the most common hullers are small and obsolete.

In order to develop a rational mechanization it is suggested to use : 14-16 HP power-tillers to be transformed in small tractors in further time; 28-32 HP tractors - both 2 and 4-wheel drives - articulated, simple, strong and low cost; equipments for primary and secondary tillage and plant protection; trailers consistent to the above mentioned tractors; reaper binders, especially self-propelled models, simple and at low cost; mobile dryers. These machines can be

used especially in cooperatives or creating service centers which should be equipped with mobile workshops for an efficient repair and maintenance service.

3 - The industries manufacturing agricultural machines are still at a primitive stage and mostly of small-scale. Local production is limited to the assembly of some 1500-2000 tractors per year and to construction of : 4-5.000 power-tillers per year (60-80% local content, besides engines); 5.000 power operated pumps; 700-1000 power operated threshers (IRRI model); 4-5.000 knap-sack sprayers and 1.500 0.4-0.8 tons per h hullers. By 1975 engines for extra-agricultural uses should be realized. The Board of investments has recently proposed to finance the installement of new factories for the production of power operated threshers; dryers, plows and harrows.

4 - Generally speaking, there is scope for expansion, especially in the sectors of : 14-16 HP power-tillers; 28-32 HP riding tractors; self-propelled reaper binders; diesel engines; equipments for primary and secondary tillage, for plant protection; trailers and mobile workshops. The annual production of these machines should be decided on the basis of deep studies on the development of mechanization, on the Government's policy and on economies of scale. Technical assistance for pumps standardization heat treatment facilities, forging, casting and quality control is needed.

5 - Ancillary industries and raw materials are not very well developed but they are increasing very fast thanks to the technical assistance furnished by the recently started Metal Industries Development Center (M.I.D.C.).

6 - Local facilities for research and testing are limited - with the

exception of the contributions furnished by IRRI - and should be increased, together with the technical training, the extension and the repair and maintenance services.

1 - General pattern of agriculture

1.1 - The total arable area is valued around 10.400.000 ha., among which only 7.900.000 ha. are cultivated at present. Such extension represents around 26% of the whole country area. Paddy is actually grown in 3.200.000 ha., corrisponding to a little more than 40% of the cultivated land; its average production is around 2.5 tons per ha. with an increase, compared to 1967, of about 100% mainly due to the spreading use of selected seeds which have a good response to fertilizers, and to the expansion of irrigation.

The total production amounts to 8.000.000 tons of paddy and it is still insufficient for the country needs; we are not considering the particular sfavourable condition created by floods in July 1972, which destroyed crops on more than 170.000 ha.

The actual 5-years development plan (1972-1975) foresees an important increase (6% per year) which should result in total production of 10.000.000 tons corrisponding to average yield production of more than 3 tons per ha.. This also is due to the implementation of the irrigation system which, as time goes by, has been spread on more and more large areas going from 620.000 ha. in 1960. to 960 000 ha. in 1971. The irrigated land will reach about 1.300.000 ha. in 1975. The paddy area, which is at present under irrigation, covers about 950 000 ha. and the one under 2 crops per year (usually distributed along the year so to imply continous harvests for about 8-9 months) amounts to 10% of the total area.

The agricultural land is divided into some 2.166.000 farms with an average size of 3.6 ha.. Rice is grown in 48% of them and usually in the smallest ones. Farms covering an area of more than 4 ha. represent about 26% of the total number with an extension a large as 65% of the whole cultivated land.

Development plans forsee a new utilization of large cultivable areas to be realized in the next 10-15 years.

1.2 - The total country population amounts to 39.000.000 inhabitants, among whom about 39% constitute active population. Workers in the agricultural sector represent 57% of total active population, which means 0.77 workers per ha..

The population increase is more than 3.1% per year; it is starting right now a very active family planning campaign which should lead - according to the development plan - to an increase of 2.6% in 1975 and of 1.9% in 1980. Considering the foreseen economical development, it is not possible to think of a reduction of active agricultural population in absolute terms before 1985, especially because about 18% of labour is now unemployed or underemployed at any educational level.

1.3 - In 1971 G.D.P reached 33 billions of pesos (currency which had a considerable devaluation in the last 4-5 year) corrisponding to an official value of 219 dollars per capita. This value - referring to the official exchange rate - is at present quite inferior. The development plan - which will be modified because of big damages from floods - forecasts an average G.D.P. increase of 6.9% per year, at constante money value. The agricultural contribution to the G.D.P. is about 33%. The increase plans of the agricultural production value forecast 5.3% per year. This means that, at the end of 1975, agriculture will contribute to G.D.P. as much as 25%.

The development plan aims to obtain : an higher income per capita, a reduction of unemployment, a better distribution of profits and a regional industrialization. Among its priorities, there are : the rural reform, the educational system and irrigation development, the rural elettrification spreading and the food production rising. Concerning the last mentioned problem, the rice production increasing is particulary important. To realize this goal, a broader spreading of selected seeds, of fertilizers and of mechanization in order to obtain a better soil tillage and a more timely farm practices execution.

are requested. A development of irrigation and dreinage is planned too.

Particular enphasis is put on ammodernizing processing equipments, in order to reduce losses and to obtain better quality of products. For this purpose, it is foreseen an improvement in the agricultural technicians training to prepare farmers to a better and more productive agriculture, with the utilization of more and more advanced techniques and of more rational plans for drying, storing and processing of rice.

1.4 - Almost all the work concerning rice-production is actually hand-made with the help of hand or animal-drawn tools.

Primary tillage (less than 10 cm depth), harrowing and puddling are done through animal-drawn equipment, while transplanting, harvesting and threshing are usually completly hand-made. Broadcasting does not practically exists while the pesticides and herbicides distribution is usually made through hand-operated and sometimes power operated knapsack sprayers.

Drying made through natural methodes and processing are at a primitive stage, excluding some new big mill plants which are developing in the frame of farmers cooperation. Small and old hullers are very popular and cause product losses of about 30%, while the few and recently installed mill plants (all imported) limit their losses between 7 and 12%. Mechanization is till units primitive stage, but it has proved very usefull; where machine are rationally used, there is a yield production increasing of 20-25%, due both to a better soil preparation and to the timeliness in farm practices operations.

2 - Pattern of farm mechanization

2.1 - The level of agricultural mechanization is still very low and this is mainly due to the continous devaluation of currency which does not allow farmers to purchase machines.

The actual tractor population is around 14.000 units with a size of more than 40 HP and more frequently between 70 and 80 HP. Such population corresponds to 1.77 tractors per 1000 hectares and it has doubled in the last five years. This means that only larger farms are mechanized, therefore almost excluding, all paddy areas.

The actual power-tillers population is about 8-9000 units and it has been rising there time since 1961.

It has not been possible to obtain exact data on the population of engines for agricultural purposes but it possible to hypotizize than their total amount is a little larger than the one of pumps and power operated threshers. The centrifugal and deep will power operated pumps population is estimated around 100-120.000 units, while hand or pedal operated models seem to be used only for domestic purposes The power operated threshers population amount to 9-100.000 units. There are also about 2.000.000 plows and 1.500.000 harrows and other implements (puddlers, levellers, etc.) almost all animal drawn and locally manufactured. Only together with tractors and power-tillers sales it is possible to such one are two implements connected with them.

The population of knapsack sprayers (hand or power operated) amount to 80.000 units, while small hand on micro-gasoline engine (1,5-3 HP) operated winders are spreading. Hullers reach around 8000 units, with are average work capacity between 1 and 3 tons.h. Dryers are practically not existent.

It is quite impossible to have sure information on the actual annual demand for these machines, usually imported. Anyway, market is constantly floading and farmers - probably because of their very low education level - don't seem to use the credit facilities given by the Government to purchase machines for more than 15% of the total machines market.

In 1971 some 1800 tractors were sold (1600 in 1968 but some ex-

perts talk about 1029 tractors sold in 1971); 3500 power-tillers, about 20.000 engines (both small size diesel and gasoline); 10.000 pumps; 15.000 sprayers and dusters (2/3 of them hand-operated) and 5000 threshers. 70% of them are power operated and of the some models designed by the Engineering Dept. of the International Rice Research Institute (IRRI). The demand for 6-8 tons per hour hullers is about 800-1000 units per year.

There are no data about other machines animal demand; it is only known that about 1000 plows, 500-600 harrows and 300 roto-tillers to be mounted on tractors and p.t.o. driven are sold a year. There is also a small market for small hand or power operated winders, while dryers demand is practically not existent, except the few ones purchased for the big mill plants whose population is continously increasing in the whole country. There is are almost complete losses of request for equipment for excavating and maintenance of irrigation and dreinage threshers and canals, now completly hand-made, and for big, low prevalence pumps able to avoid or reduce dangers of flood, like the recently happened one.

Because of the broad diffusion of one-room workshops all over the country but especially in the Luzon isle, where the majority of people in concentrated, it is impossible to have any information about locally manufactured animal-drawn implements for soil tillage. Practically every farm is furnished with them.

2.2 - Development of annual demand an increase of mechanization are both depending on the general development policy of the country and on the shifting of agricultural labour to other sectors. The spreading out of irrigation and the consequent two crops per year will force a mechanization development which will go - following local experts feeling - through the stage of power-tillers, being the rising of cooperatives very difficul to obtain. The very simple and low cost models of these machines seem to show their limits; mainly they can't

plow deep enough (less than 8 cm) because of their light weight which inhibits to have a sufficient drawbar pull. They can be very well used, on the contrary, for puddling, and sometimes for levelling and transports.

According to official informations, the demand for 4-wheel tractors will reach, in1975, some 4.000 units (over 50 HP) per year and that for power-tillers will increase up to 7.000 units a year. Such request, considering a replacement market of 8-9%, should reach, in 1980, 6.000 units, as far as tractors are concerned, and 15.000 units of power-tillers. In 1980, there will be a population of 45-50.000 tractors (5,5 tractors per 1000 ha) and of 70-80.000 power-tillers, with an average power loading referred to the total cultivated area, of 0.4 HP per ha.. Such loading will still be a very low one and will mainly be concentrated - rebus sic stantibus - on a small part of the agricultural land. An increased request for pumps - mainly centrifugal model - is sure, in connection with the spreading of irrigation and, more in general, of land reclamation in the different districts. Such spreading should be speed up in order to eliminate or reduce the dangers for floods like the one which happened in the current year. In this case, the request for pumps could reach 15.000 units per year (according to our informations, there are already 20.000 requests for pumps, mostly unanswered because of the gap between demand and production); the size of these units should be carefully selected, depending on their different uses, gradually substituting hand operated models with small power operated ones and providing large pumps to Government organization and peripherical agencies, especially where floods can easily happen. The future population of pumps, therefore, could be doubled compared to the actual one, bringing along a radical change of models.

Considering threshers - more and more sophisticated compared to the horizontal-axle IRRI model which is rather useful at present stage of development, too -, demand should increase of 6-8000 units per

year and reach an average level of one thresher every 40-50 ha.. In consequence, the increase of engines demand is going to be quite a good one; besides the engines needed for tractors, in 1980 the annual demand will amount to some 30-35.000 units, 5-20 HP diesel model, and about the same number of less than 5 HP gasoline ones. Together with this increase, there will be a considerable development in the implements population, especially for primary and secondary tillage, with slow reduction of animal-drawn models.

As far as drying, storing and processing are concerned, there are no sure informations. If the development of service centers for paddy processing and storing, organized in order to furnish the paddy cooperatives with the necessary machines and other inputs, takes place, it will be necessary to study different mechanization models based on more productive machines than the above mentioned ones. This concerns field operations, transports drying, storing and processing.

This possible alternative, which brings along the necessity for exact choises at a political level, on the future of rice-growing, of its mechanization and of the consequent local construction of machines, can be developed in a very long period of time, at least as far as mechanization of agricultural works is concerned. It also depends on the shifting of labour from agriculture to other sectors (no more than 0.4 worker per ha.) and on the rising of wages. A more developed mechanization, with big tractors and consistent equipment, in the actual conditions, could not certainly reduce - generally speaking - the cost of paddy production. On the contrary, some transformations are possible and advisable in the processing field, substituting few hundred of new big mill plants to the thousands of old and small ones now existing in the country.

2.3 - A rational development of mechanization on Wet-land should not be based only on the increase in population of the above mentio-

ned machines. This especially, if the valued trend does not rise from the actual and future farmers needs and a rational choice, but from a free and spontaneous market often imposed by the big international companies to farmers. This is also proved by the gap between the power size of tractors and power- tillers.

Therefore, it is advisable, to conduct a broad analysis on the actual and future mechanical needs for paddy areas, in order to reduce to a minimum production costs, to obtain very small increasement of labour productivity, and to improve and to exploit in time different farm operations. The main lacks, according to analysis recently conducted and foreseing the suggested development of medium and large-scale mill plants able to take care of 400-500 ha. each, are :

- use of a 14-16 HP power-tiller which can be transformed in the time in 4-wheel tractors adding a suitable rear-end frame to be used for transport, and to be connected with sprayers, fertilizer distributors, harrows, puddlers, levellers, and, with threshers and pumps;
- use of 28-32 HP 4-wheel drives tractors, with high clearance from the ground and possibility to have low-pressude tyres to be utilized for primary tillage (plows, spading machines, rototillers), for transport and together with bigger plant protection machines, pumps with a very big delivery capacity and machines for canals and trenches escavation and maintenance;
- use of reaper binders - both self-propelled and tractor driven - able to harvest in time, to reduce losses and, in the irrigated 2 crops per year areas, to make soil rapidly ready for next tillage;
- use of dryers, storage equipments and modern mill plants.

Supposing that a 14-16 HP power-tiller can be fully used on 12-15 ha. area and a 28-32 HP tractor on 20-25 ha., the ideal population for these kinds of machines - referring to the rice growing - should amount to 400.000 units, which means 1-1,2 HP per ha..

The equipment demand should obviously develop, together with power machines, starting from a sale of 2-3 implements for each tractor or power-tillers. The development rythm will obviously depend on the farmers average income and on the incentives which the Government will provide. Right now, the economical situation does not allow farmers to spend more than 400 dollars for each farm. Mechanization will, therefore, be very slow pacing.

It is important to notice that all these machines - and especially dryers - don't have to be completely reprojected, but the most simple and rational solution is to use the experience gained by the more technologically advanced countries, choosing - on the basis of testing - the models which provide the best services in the local conditions. In some cases adaptation will be needed.

In the end, repair and maintenance service - which is quite limited right now - should be reinforced also using mobile workshops for normal assistance.

3 - Manufacturing industries and ancillary facilities

3.1 - The industrial field contributes to G.D.P. for about 15%, and it is supposed to contribute as much as 17-18% in 1975 with an average annual increase of 13%, whose 9% is referred to manufacturing industries and 22% to mining.

The agricultural machine industry is at a very primitive stage and it is mostly constituted by small handicraft workshops with less than 20 workers. Especially for the most complicated machines, assembling is made; local construction is limited to the most simple elements and to semi-precision components and parts as far as agricultural machines, engines and processing equipments are concerned.

Manufacturers looked almost discouraged in their feeling because, of a lack of protection against importation and because they do not have incentives to diversify and expand their production. The Board of Investments declared to accept requests - for

the 1971 investment plan - in order to realize : a factory to manufacture 9500 power threshers per year; a factory to manufacture 2400 plows, harrows and rototillers per year and a fac tory for 750 dryers with a work capacity of 8-9 tons of paddy per day. No requests came so far and this prove the discouragment we were talking about. The situation is the same for realizing a factory which can produce 68.000 gasoline engines up to 15 HP every year, even if annual demand for these kinds of engines - for agricultural and extra-agricultural purposes - amount to about 60.000 units.

3.2 - According to the agricultural machines Manufacturers' association joined by the 25-30 main factories, the industrial situation can be summarized as follows :

- no tractor factories, but only 3 factories for partial assembly of units per year and a production amounting to 40%; a fifth factory for small medium scale tractors can start to work in a few years;
- 3 power-tiller factories, for some 4.500-5.000 units per year, with a 60-80% local content, except for the engines completely imported (there are about 15 foreign companies, at least theoretically exporting power-tillers in the country);
- no engine manufacturers but only few factories where partial assembly of imported parts is realized; these engines are not normally used in agriculture which is furnished by import market;
- 5 pumps factories with a production capacity of 12-13.000 units and a real production of about 5.000 units per year, with 65% local content;
- some power-threshers factories - with unknown capacity - with 40% local conten; production of horizontal-axle power operated threshers very simple and efficient, IRRI model, is starting now;
- some factories of knap-sacks sprayers and dusters (4-5.000 units per year) hand operated model completely manufactured in the country;

- 3 hullers factories with a production capacity of some 1.500 units per year for 0.4-0.8 tons/h of paddy, completely locally manufactured.

By 1975 the local construction of about 10.000 engines per year especially for extra-agricultural uses - manufactured through assembly - will be started; besides hand tools and animal drawn implements realized in one-room workshops scattered in the various villages, about 1.000-1.500 plows and harrows with 45% local content are realized.

3.3 - As far as ancillary facilities and raw materials are concerned we sill are at the first stage of development. All raw materials are practically imported while basic industries are slowly developing; they - even if on a small scale - will be able to furnish, in few years, considerable helps to the development of such sector, such step by step reducing importations. In their development, these industries are helped by the Metal Industry Development Center (M.I.D.C.),well organized and equipped. It is advisable that its collaboration with the production field should become tighter than it is now. This hope finds an obstacle in the small size of 90% factories. There seem to be in fact,- even if some data contradict all this - about 150 foundries with a total production (iron, steel, copper alloy, etc.) of 200.000 tons per year, mostly steel for building industry. Such sector has increased its production about 3 times in the last 10 years. Only few factories produce more than 2.000 tons per year with a very low productivity per worker (between 1/4 and 1/6 of the european average production). They totally lack organized is often very inferior (40-70%) to their production capacity. To solve these problems and to help the rational development of mechanical and metallurgical industries the M.I.D.C., which works together with the Board of Investments, has been strated.

The mine production is very low compared to the country needs;

in 1970-71 it produced about 2 million tons of iron, about 175.000 tons of copper and very small quantities of nickel and zinc.

The increase of this production has been quite low in the last few years, but broad development plans have been set for the next 5 years.

Raw materials are usually exported and exchanged with manufactured products. From 1986 to 1971, the Board of Investments has planned to build :

- 2 primary steel factories for hot-rolled products with a total capacity of 1. 100.000 tons per year;
- 3 cold-rolled steel product facotires for 354.000 tons per year;
- 1 aluminium smalting factory for 36. 000 tons per year.

There are also 3 factories of tyres for cars and trucks, one of electrical equipments for cars (including batteries), very small factories producing gears, cgains, transmission parts for agricultural and industrial tractors. In the future - besides enlarging these production - it should be started the manufacture of more sophisticated parts, like full injection pumps and carburettors and of the most usable metallic products for local construction of tractors and agricultural machines.

It should be noticed the peculiar spreading out of many small and medium scale factories of jeepneys used for public transportation, showing a considerable ingeniousness on the part of local population (many parts are completely realized without any machine tool) and offering an interesting possibility of development and facilities for future construction of agricultural machines and tractors to be realized by small scale factories.

3.4 - The analysis which has been conducted on the country actual situation - while it shows the positive evolution in the last 5 years - points out the lacks of balance still existing in the country and the lack of sure trends to be followed in the agricultural machines production and in the ancillary industries development, which at present are not

supported and protected enough.

This has to be particularly emphasized for small-scale industries, whose production should be encouraged and supported especially from a technical production should be encouraged and supported especially from a technical point of view; models and sizes of machines should be based on standardization and on the best production capacity able to obtain low production costs in the frame of economics of scale.

This can be obtained through a better cooperation among manufacturers and a more specific production specialization. As far as the production of agricultural machines is concerned, it seems useful to recomand the realization of :

- a unit for the production of 14-16 HP power-tillers and 28-32 HP tractors - both 2 and 4 wheel drives - with high clearance, possibly articuled, simple, strong and a low cost, equipped with p.t.o., 3 points linkage mechanical operated, low pressure tyres; such machines should be provided with consistent implements for : primary and secondary tillage, plant protection, maintenance an excavating of trenches and canals for irrigation and dreinage;
- a unit to produce reaper binders - both self-propelled and tractor driven - simple and strong; the self-propelled ones (width of ent 1.50 m); should be furnished with 8-12 HP engines;
- a unit for the production of diesel engines completely standardized on the basis of the concept of design and construction of "engines families", to be used on the above mentioned machines;
- a unit to produce trailers for the above mentioned tractor, mobile dryers and mobile workshops.

It is also suggested :

- a greater technical assistance in the pumps production sector; material control; standardization and size choices on the basis of agricultural purposes, in reference to the dreinage needs and coherent to the above mentioned "engines families";
- a development of facilities for heat treatments and quality control

of production, and cost analysis, in order to define the production capacities in the frame of the more economies manufacturing also in small-scale industries sector.

The annual production capacity of these industries will be naturally decided on the basis of internal requests (connected with the mechanization policy, farms rearrangement; introduction of modern farm practicies which Government will furnish in favour of mechanization development) and of the above mentioned choice of the most economical productions.

4 - Policy toward farm mechanization

4.1 - The actual 4-year plan (1972-1975) is completely reviewing because of the damages due to recent floods. In order to repair these damages an UN help has been asked to realize the broad regimen and water defense plans, in the areas where these phenomenous happen more easily with the use of high capacity and low head pumps and of excavating and maintening canals machines.

The plan itself, anyway, gives the priority to the rural reform that means : to extend crops to new areas, to distribute lands properly, and to increase production (reduction of products losses and timely execution of agricultural operations). All this is leading to a slow but constant development of mechanization, giving a priority to soil tillage, irrigation and processing.

It is planned an increase in the training courses for mechanico-agricultural technicians to meet farmers' necessities. To spread mechanization, money will be lent for no more than 100 dollars per ha., to be paid back in 10 years and at 9% interest. This money can be borrough for developing irrigation, buying selected seeds fertilizers and other inputs.. However farmers use these facilities on a very small-scale.

4.2 - There are about 40 agricultural high schools, 20 colleges and

5 universities specializing in agriculture, but the research in this sector is mainly conducted by the Engineering Division of the College of Agriculture in Luzon (Philippines University) - which is also equipped with a workshop able to manufacture simple prototypes for machines - and by the Central Mindanao University in southern Philippines.

There is also the Engineering Department of the International Rice Research Institute (IRRI), whose staff is composed by 43 people, which is conducting a very interesting and lively activity in the research, prototypes construction, semplification and adaptation of machines to the local conditions and, obviously, to the general conditions of south-eastern Asia. This department is equipped with a section charged to study the economical problems of mechanization.

In the design of machinery, the Institute engages in applied research and in the development of suitable prototypes for rice-growing which, once tested and approved, are released without royalties to interested parties for manufacture. Actually the most important studies concern : threshing; drying through different systems and realization of prototypes of stripper-harvesters. It has been studied how to improve a very simple and light power-tiller, which is already produced, together with the project of a 40-45 HP 4-wheel tractor, mostly utilizing the local extragricultural mechanical products, in order to manufacture a machine as cheap as possible. The level of studies and researches in this Institute is already very well known and its function can not certainly be substituted right now. It could possibly extend its research activity, in cooperation with factories, in order to make local production more rational and to study the problems concerning the economies of scale of the production itself.

4.3 - There is very much to do in the field of technical training of farmers and of the organization, on a broad basis, both of the exten-

sion and after-sales service. Concerning these matters, there are valuable organizations. They should be developed to improve economy.

4.4 - Starting from what we said above, deep studies concerning the possible models of agricultural development should be done, together with the best mechanization levels in order to furnish precise informations to the industrial sectors, also defining priorities. The research and experimental centers, the training courses for farmers, the extension, repair and maintenance centers should be improved.

5 - Policy toward industrialization

5.1 - The Government is interested in developing the industrialization in the country. Anyway,the planned development is difficult to be realized because of the incertainty of the market and the money devaluation going on now.

5.2 - The Government offers big incentives like facilities in realizing new investments with 5 years loans at a very low interest, tax exemptions, anti-dumping protections, accelerated depreciation, custom exemptions for capital equipment and spare parts, remittance of earnings and rempatriation of investment out of the country, deduction of organizational and preoperating expenses, etc.. These facilities vary according to the different industrial fields, and to the fact a factory to be or not to be classified as pioneer. Some of the solutions presented in chapter 3 certainly belong to this category.

The Government wants to help especially small and medium scale industries with very small amount of investments, equipment and which can employ many people, according to vertical integration system. Various forms of cooperation are favoured and, in certain cases, pushed.

5. 3 - To technically and financially help the development of the mechanical industry the above mentioned M. I. D. C. has been started recently; its organization looks complete and efficient, even if the relations among small and medium scale agricultural machine factories are not too close. These relations should be developed, together with the ones with IRRI, in order to make any technical action of improvement and quality control on the production more active and to define, in the different fields, the most economical production dimensions.

6 - Conclusions

It should be reminded the country aspectations for technical supports from UNIDO in order to facilitate the water regimen and the dreinage especially because of the last floods. At the same time it is useful - to help a rational development of mechanization for paddy-growing and to choose the right kinds of machines to be locally manufactured - to reccomand UNIDO assistance in the following specific sectors :

1 - to assist the Government and the manufacturers, in connection with M. I. D. C. in the studies concerning standardization and unification of agricultural machines local production especially for small-scale industries, taking as a basis the need for the most economical production. Team of 2 UNIDO experts : an agricultural machinery engineer and a small-scale industry expert; duration, 6 months each; course of the mission 1973.

2 - to assist the Government, in connection with M. I. D. C., to plan and realize new factories for the production, through joint ventures, of the machines mentioned in chapter 3, deciding the economical scales of production, the models, the standardization level and the local content. Team of 2 UNIDO experts : an agricultural machinery engineer and an industrial economist; duration, 8 months each; course of the mission 1975.

Before sending the above mentioned experts off, it is suggested to

promote 2 fellowships lasting 6 months each, in order to send 2 mechanical engineers abroad to used later as counterpart for the proposed experts.

PERSONS MET

1 - Mr. T.HARDING - UNDP, Res. Rep., Manila

2 - Mr. W JONES - UNIDO Senior Adviser, Manila

3 - Mr. A. V. KHAN - Head, Agricultural Engineering Dept. - IRRI, Los Banos

4 - Mr. F. E. NICHOLS - Machinery Evaluation Engineer- IRRI, Los Banos

5 - Mr. B. DUFF - Agricultural Economist - IRRI, Los Banos

6 - Mr. A. V. ARIZABAL - Acting Director - M. I. D. C., Rizal

7 - Mr. F DUGAL - UNIDO Project Manager - M. I. D. C., Rizal

8 - Mr. R. R. DERRICK - Project Manager - B. O. I. Technical Assistance Project under UNDP Special Funds, Rizal

9 - Mr R. SULIT - Metal Industry Development Center, Rizal (counterpart)

10 - Mr. A. MANDARIN - Metal Industry Development Center, Rizal

11 - Mr. B. De PADUA - Chairman of Engineering Department-College of Agriculture, Los Banos

12 - Mr. S. C. ANDALES - Professor of rice processing plant - College of Agriculture, Los Banos

13 - Mr. R. F. QUEBRAL - Assistant Director - Industry Progr. Office - Presidential Economic Staff, Manila

14 - Mr. A. C. ELEFANO - V. Director National Economic Council, Manila

15 - Mr. E. P. AGRAVANTE - Manager - Rice Central Project - Borromeo Corporation, Binan

16 - Mr. E. A. UICHANCO - V. President Agric. Division - GAMI, Manila

17 - Mr. J. C. CAUBANG - Manager - Marsteel Corp., Manila

18 - Mr. A. A. ABANILLA - Manager Plant Ind. Eng. Dept. - Marsteel Corp., Manila

19 - Mr. R. BOLINAS - Manager - Seacom Ind. Corp., Quezon City

20 - Mr. C. FOLLOSCO - Manager Ford Philippines, Manila

21 - Mr R. LUHOZ Jr. - President Kalayear Eng. Co. Inc., Makati Rizal

22 - Mr. F. N. CERVANTES - President Bormaheco Inc., Makati Rizal

23 - Mr. T. K. KATIGBAK - President Agric. Mach. Distribution Association, Manila

24 - Mr. T. E. PARPANA - Owner of the Parpana Machinery Manuf. Co., Manila

25 - Mr. U. P. SAPTANGCO - President of the Philippines Machinery Manufacturing Association, Manila

26 - Mr. U. VIRAY - Board of Investment, Manila

27 - Mr. R. AQUINO - Agricultural Productivity Commission, Quezon City

28 - Mr. C. VIAPLANA - President Oberly Co. - Manufacturer, Manila

29 - Mr. T. MENDOZA - Administrator Irrigation and Service Unit, Manila

30 - Mr. N. E. MARASIGAN - Manager U. S. Engineering Co., Meycanayon

31 - Mr. A. C. JORDANA - V. Pres. Tropical Distributions Inc., Makati Rizal

32 - Mr. W. COLE - President International Harvester Phil., Manila

33 - Mr. R. A. TULIO - Pres. Mindanao Progress Corp., Quezon City

THAILAND

SUMMARY

1 - The development of rice-growing in the country is proposed, for the most part, in terms of improvement in production (better seeds, wider fertilization, improvement of agronomical practices, better soil preparation) and reduction of losses presently taking place in processing. It seems that it will be possible to double present production in fifteen years.

2 - The present population of tractors is of about 30.000 units and of power-tillers only 4.000 units. Both machines serve essentially for primary and secondary tillage and for transport. Mechanization of the other operations necessary for the development of paddy is practically non-existent.

The development of mechanization of paddy areas is expected to be slow. There is still an excess of labour and the development must come about essentially by forms of cooperative use of machines. Given the emphasis which is intended for double harvests, mechanization must provide mainly for primary and secondary tillage and harvesting, by the spreading of suitable machines. This is so despite the necessity of resolving the problems of drying, storing, processing and transport.

Yet it is possible to predict a yearly demand for tractors of about 8-9.000 units in 1980, and for power-tillers of about 6-8.000 units. The demand for engines and pumps would be much higher. For each of these machines a demand of 150.000-200.000 units a year is foreseen, in 1980.

The low development of the current demand for tractors (which is actually in retrogression) demonstrates the inadequacy of the models on the market to real needs. Therefore, it seems useful to advise that a 8-12 HP power-tiller (simple, durable and p.t.o. equipped) and a 25-30 HP tractor (both two and four-wheel drives, articulated, simple and low cost) be used. Both of these machines would be used

with mould-board plows, harrows, puddlers, levellers, broadcasters, fertilizer distributors, sprayers and trailers. These last machines could be usefully equipped with driving-axle operated on p.t.o. to couple them to the power-tillers. In the fixed equipment sector, the use of power operated threshers of the IRRI model and mobile dryers of small to medium capacity is recommended as well as the diffusion of modern storing and mill plants (not to serve single farms but cooperatives or entire villages).

Finally, it is to recommend the use of small self-propelled reaper binder if possible, to be attached to multipurpose above mentioned power-tillers.

3 - The level of local production of farm machines is low. Industrial activity is in fact limited to three factories for the assembly of tractors, two small workshops for the production of a few hundred very simple 2 and 4-wheel power-tillers, one factory for the manufacture of two cycle engines, and some one-room workshops which produce small equipment providing for single villages. Nevertheless local production is to be encouraged, in connection with wellestablished and reputed foreign manufacturers. Initially they would be involved in assembly only, but progressively would develop local content. These factories would produce 8-12 HP gear-transmissioned power-tillers equipped with p.t.o., provided with plows, harrows, rototillers, puddlers, sprayers and driving axle trailers; 5-30 HP engines, strictly standardized; centrifugal pumps and power operated threshers and dryers.

A study should be made on the feasibility of an assembly plant for a 25-30 HP tractor, both two and four-wheel drive.

4 - Ancillary industries and raw materials are practically on a primitive stage, and there are plan for notable increases, but not such as to render the country self-sufficient within the next 25-30 years.

5 - Research and experimentation in agricultural machines are limited to the Engineering Division of the Rice Department. This department could be very profitably developed to contribute to the rational development of the sector, especially in the area of standardization, prototypes construction, adaptation and testing of machines, making use wherever possible of experience acquired in technologically advanced countries. Finally the development of an efficient organization for repair and maintenance, spare parts production, extension service and technical education for farmers are all essential to progress in this field.

6 - The government grants loans to farmers at low interest rates for the purchase of farm machines and tractors. That policy should be reviewed and better set up establishing precise priorities and allowing longer credit terms.

7 - The government intends to encourage the development of small-scale industries with particular regard to those adapted for location in rural areas and for use of local labor and raw materials. To that end the government grants particular credit and tax facilities.

1 - General pattern of agriculture

1.1 - The total arable area is estimated at about 14.200.000 hectares, 12.170.000 of which are cultivated, representing about 24% of the whole surface of the country.

Cereals cover about 70% of the cultivaed area, and paddy alone covers 55% of the whole.

It doesnt seem that paddy area has increased in recent years, even though rice remains the basic food of the country. However, its production, has increased. Today it reaches 13.000.000 tons in comparison to 9.500.000 tons in 1960. Therefore, the average yeld production corresponds to about 1.6 tons/hectare. In some areas, however, it reaches peaks of about 2.5-2.6 tons/hectare.

Irrigated area covers 16% of the cultivated one. This area is increasing steadely thanks to a vast government development plan of hydraulic works for water-ways regulation during the wet season.

The surface on which two crops (both rice, or rice and another crop) a year are performed covers 10% of the paddy area.

The development of the paddy yeld production is followed by government authorities, and by research centers. The present economic development plan foresees an average annual increase in production of 1.6%, which will decrease to 0.5% from 1975-76 on. On the contrary, the Agricultural Research Center of Chaynat is more optimistic. They predict the possibility of doubling production in a shorter time (10-15 years) if the use of new more productive and capable of a greater response to use of fertilizers varieties becomes general. Fertilizers are now being used at the rate of 15-20 kg/ha.. Their use in rice-growing is much less and depends on the farmers yearly income, which is affected by the influence on the crops of atmospheric conditions. This is true even though the use of fertilizers has increased about seven times in the last ten years.

About 12% of the rice produced is now exported.

Agricultural land is divided up among 3.400.000 farms, 72% of

These have a size of less than 4 ha., though together they cover about 40% of the cultivated area. The average size of farms is of about 4.2 ha.. Paddy area is characterized by a a subsistence income level farming. The average size of a paddy farm is about 3.5 ha.. Fragmentation is not frequent, and on the whole,plots are good-sized at least on the central plain.

1.2 - The total population of Thailand is 37.800.000 inhabitants. More than 38% constitutes the active population.

About 76% of the active population is employed in the primary sector (agriculture, forestry, hunting and fishing). About 70% of the active population is occupied in agriculture, which means 0.9 workers per hectare of cultivated land. In the peak agricultural operations periods, there is a shortage of farm labor.

The population increasing is high. Just begun is a vast family planning programme which should bring the annual increase to not more than 2.5% per year, by 1975. However, for the next five years, it is predicted that there will be an increase in absolute number of active population in agriculture of circa 1.5 million. This, despite the fact that in percentage there will be a decrease.

1.3 - The per capita G.D.P. is about $ 150 per year, whereas the gross average income of rural people seems to be about $ 80 per year. Agricultural production represents 29.5% of the G.D.P., and has increased in the last five years, about 4.1% a year (refering to constant money value). This has come about through the maize and industrial crops development. The 5-years economic development plan foresees, for agricultural production value, an average yearly increase of 4.6%. The increase for the paddy production would be less. For other products, in fact, yearly increases (referring to constant money value) varying from 5 to 24% are predicted. At the same time the average general rate of increase of the G.D.P. is

predicted as 7% per annum.

The plan gives wide priority to the development of agriculture, especially through irrigation plans, spreading of selected seeds and fertilizers. But this especially for areas other than paddy. Hints have been made also to the consequent development of mechanization.

1.4 - Almost all the farm work connected with rice-growing is now performed by hand systems or with the aid of bullocks or buffalos. However, in paddy areas in which broadcasting is practiced (1.200.000 hectares corresponding to about 18% of the whole paddy area) primary tillage is almost completely mechanized, by renting of 60-75 HP tractors. Use of simple power-tillers and small tractors is spreading slowly. They are usually property of single farmers and their main use is for secondary tillage. All other work is performed by hand or with animals aid, threshing included. Drying is carried on by natural methods, and storage is quite primitive. Losses during harvesting, transport, threshing, stocking and processing are estimated at around 25-28%.

Processing is in an evolution stage. Old small hullers, which cause losses valued at not less than 20%, are gradually being substituted with modern mill plants. The solution of that problem has high priority in the government plans.

2 - Pattern of farm mechanization

2.1 - Mechanization of paddy is still at the primitive stage, and particular incentives for its increasing are not planned, outside those formulated in the current 5-year development plan. In addition, many experts are of the opinion that paddy will be the last area to be mechanized, and that as complete mechanization is unthinkable before the next 20-30 years. This is true even though aids to support of the rice price are planned, along with facilita-

ted credits to purchase fertilizers, pumps and other labor-saving equipment. The role of mechanization to improve soil preparation, and timing for seasonability of activities, is recognized, with its consequent economic advantages. To point out this situation , the Royal Thai Government published in 1969 a Coordinated Industry Study Projects, the conclusions of which still seem valid.

Of the total farm population, only 3. 2% normally use machines and tractors, and 11. 6% use either animals drawn equipment or occasionally tractors. The remainder avails itself of hand power. In particular, tractors are used on 5. 9% of farms, threshers on 1. 9% and sprayers on 4. 4%.

The present population of riding tractors is about 30. 000 units (17. 500 in 1967 and 234 in 1957). Each tractor works on an average of more than 1000 hours a year, escpecially in the primary tillage. These tractors are generally rented by the individual farmers. The present tractor density results of two units/1000 ha; the annual demand is valued at 4. 000 units (90% of a medium size 50-70 HP, and the remaining 10% for that of 10-15 HP). These are imported and of 27 different brands, seven suppliers dominate market. The fact that it is tractors of medium size which are presently and increasingly demanded confirms the tendency not to mechanize paddy on the single farms level unless for the far future. It is 10-12 HP tractors (very simple and locally manufactured) that are mainly used in paddy farms.

The population of crawler tractors is estimated at 5000 units. These are used for particular industrial crops for soil preparation, in connection with the irrigation projects development, or for extra-agricultural purposes.

There are about 4000 5-7 HP power-tillers, the annual demand for which is estimated at 1200-1500 units. Most of these are imported from four Japanese manufacturers, while a few hundred units per year are locally produced in a very simple form.

Precise figures for the existing population of engines, pumps and other agricultural machines are not available. However it is known that the demand for 3-10 HP engines was for 60.000 units in 1971, more than 80% for gasoline model. 26.000 pumps were sold in the same year, of which 20.000 were centrifugal-power operated models. Pumps in use are imported, and only partly assembled locally.

In addition there exis the following tractor drawn equipment : 100.000 mould board and disc plows; 35.000 harrows; 1.000 rotary hoes and cultivators and a few thausand trailers, in part locally manufactured. Animal drawn plows, harrows and puddlers locally manufactured and plowing for a depth of not more than 10-12 cm are very popular.

The population of power operated threshers, sowing machines and fertilizer distributors is estimated at a few hundred all together. Yet the use of hand knapsack sprayers seems general.

In 1970 there was a demand for :

- 12.000 imported and 5000 local manufactured plows,both tractor and animal drawn;
- 27.000 hand and power operated knapsack sprayers, and 26.000 dusters, almost all imported;
- 100 power operated imported threshers.

Further, a few tens of seed and fertilizer distributors were imported and there was a demand for 400-500 trailers.

The replacement market is estimated to be about 8-9% per year.

Dryers are practically non-existent. There are only about 20.000 hullers, 5.000 of which work on a good productive and qualitative standards (less than 10% loss). The annual demand for the latter is of a few tens.

A few attempts are being made to employ self-propelled transplanters, reaper binders and combine-harvesters in rice-growing (other than in underwater cultivation in flooded areas). Attempts

(perhaps premature) are also being made at seeds and fertilizers distribution by plain.

On the whole, and in conclusion, it is necessary to note that the above-mentioned machines are most often used for crops other than paddy. Only on the central plain, where farms are fairly big and there is a shortage of labour, the renting of tractors connected with plows and harrows is practiced to some extent.

2.2 - The future development of mechanization and therefore predictions of the demand for tractors and agricultural machines, are uncertain.

According to official estimates, the demand for tractors in 1975 should be almost double, and by 1980 triple the present demand. This would correspond to an annual demand of about 12.000 units and a population more than 120.000 units.

Such predictions seem rather optimistic. More probably there will be approximately 60.000-80.000 tractors in 1980, corresponding to about 5-6 tractors/1000 ha.. Newertheless, the government agencies are thinking of an optimal density of about 8 tractors/1000 ha., corresponding to an average power installation of 0.5 HP/ha.. Just why this density, which seems rather low, was chosen as optimal is unclear. It is held, in fact, that the density at an advanced country development stage, cannot be below 1-1.2 HP/ha.. These figures are derived from the experience of more advanced countries and correspond to about 18-20 tractors (which must be of smaller size than the present ones) per 1000 ha..

Total population which probably cannot be reached before the next 25-30 years, will be of about 300-350.000 tractors. However, given such assumptions, it is to be recommanded that a deep study be undertaken to choose models and sizes of tractors most suitable for the various crops and farm structures, taking into account the strict connection between power of tractors and work-capacity. It is to be

noted, in that regard, that there is a need for small and medium sized models (strong, simple and low-cost) which result optimal(especially in the first stage of mechanization) from a technical and economical point of view, even for primary and secondary tillage, as long as theu have adherence inef.

A few hundred power-tillers presently are locally manufactured in an extremely simple form, but one adapted to the present stage of evolution of paddy mechanization. Future demand for power-tillers is estimated ad 4000 units per year in 1975, and 6000-8000 units in 1980.

Therefore in 1980 there should be a total population of about 30.000-40.000 power-tillers.

The demand for diesel and gasoline engines is increasing, and it is estimated to rise to about 150.000 units per year by 1980. Estimates for pumps are incertain. The annual demand is predicted as of about 200.000 units per year by 1980.

At the same time with the tractors and power-tillers population development, an increase for implements is predicted especially for primary and secondary tillage, seeding, fertilizers and anti-parasites distribution and for transport.

No mention is made, however to the paddy mechanization development. This despite the fact that mechanization seems of primary importance in terms of timing for seasonability and of reduction of losses, especially for the small and medium sized farms which have the highest yield productions.

Notable development is forecast for power operated threshers (a useful model for which is the rotating drive, IRRI type) and equipment for drying, processing and storing of paddy. The goal of this development is reduction of present losses. Government seems particularly interested in the spreading and qualitative improvements of these machines.

For all those machines there are no figures or estimates as to

predictions for annual demand.

After sale service seems neglected and the inefficiency of repair and maintenance and spare-parts supplies are lamented.

2.3 - As has been already noted, predictions for mechanization development pratically ignore paddy areas. The possibility, which exists, of a small to medium scale mechanization to be introduced into these areas should be taken into consideration. This mechanization would be geared toward : improving the work performed, reducing human wireness and increasing timeliness of agricultural practices,making at the same time limited increases in labor productivity. This could be based on the use of power-tillers and of small and medium size tractors, improving on what small, local workshops have already started to produce.

Therefore it seems useful to recommend that use of the following equipment be taken into consideration :

- in the tractor sector : 8-12 HP power-tillers, simple and durable with gear transmission to be usefull for small farmers; 25-30 HP tractors, both two and four-wheel drives, manageable, simple, with p.t.o., mechanical driven three points linkage, high clearance from the ground, and very low pressure tyres and cage-wheels;
- in the agricultural machinery and implements sector, above all a problem of standardization imposes it self for the choice of the following : mould-board plows, harrows, puddlers, levellers, broadcasters and fertilizer distributors, sprayers and trailers, of suitable size to be connected both to mentioned above power-tillers and tractors. Trailers for power-tillers could be conveniently equipped with driving axle operated by p.t.o., by which farmers be provided simple, sufficiently rapid and rational systems for transport of their inputs and outputs. The use of simple self-propelled reaper binders (possibly attachable to power-tillers) is also recommanded. So is the use of power-operated medium size threshers, according

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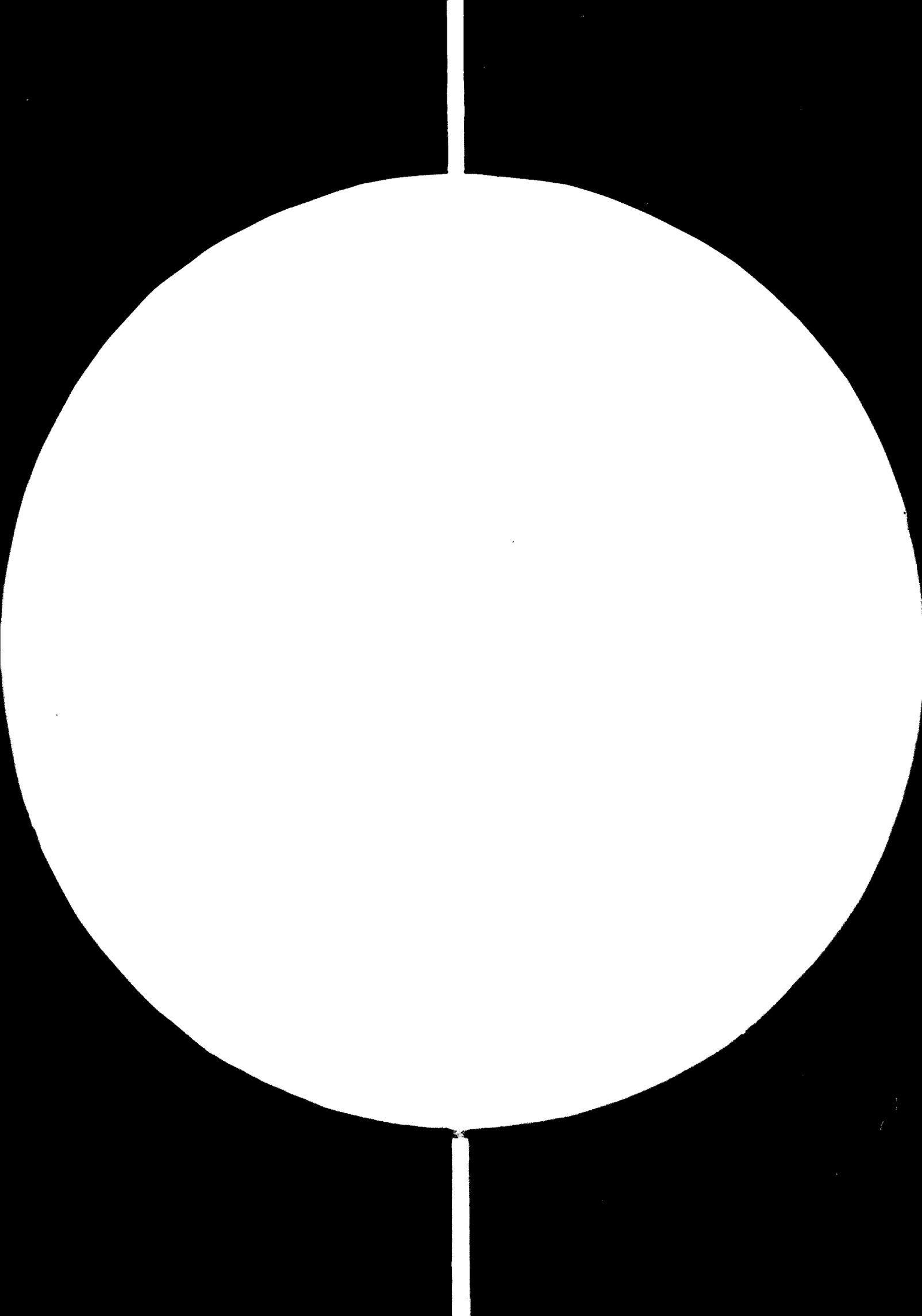

with the models currently under study at the Engineering Department of IRRI. Experiments on spading machines could be carried out profitably, as when they are adapted to soil conditions, these machines can solve many of the traction problems in paddy fields.

Finally, in the processing sector it is to be recommended choice and spreading of mobile small and medium sizes dryers, and general reneval of the existing hullers, creating modern mill centers which would drastically reduce production losses and guarantee efficient paddy and rice conservation.

Simultaneously with the gradual development of this type of mechanization, it is advisable to arrange consistent development of an efficient after-sale service whith particular regard to repair and maintenance and supply of spare parts. Such a service could be provided on the basis of mobile workshops for ordinary operations. These workshops would operate out of completely equipped centers, at which courses for technical training of farmers and tractor mechanics could be carried on.

About the possible increase of the demand for the machines (tractors, etc.), supposing that a rational mechanization based on optimal use of the machines themselves could come about in the next 30 years, it is possible to forsee an initial annual demand of 1800-2000 units per item. This yearly demand would increase to level of 10-12,000 units with a replacement market rate of 10-12%. Each tractor could be initially equipped with two implements.

Machines for irrigation (pumps and machines for excavation and upkeeping of trenches and canals) are very important to be used. Infact does not seem that the sector has been sufficiently studied in terms of rational choice of models and sizes.

A development of such machines seems of highest priority especially with regard to the goals of the green revolution and to the irrigation development programs.

3 - Manufacturing industries and ancillary facilities

3.1 - The industrial sector contributes 16.9% to the G.D.P. An increase to 17.6% is predicted for the end of the current five-year plan, with an yearly increase of 9.2% in the five year period (refering to constant money value).

Essentially that development will be based on private investment, helped by the government which has planned forms of incentives and aids.

Mining sector is predicted to increase 8.1% per year.

3.2 - The sector of agricultural machines and tractors manufacturers is very limited. There are in fact, only two factories for the assembly of tractors. There production has recently decreased to a level of less than 850-900 units per year, though their capacity is of about 3000 units. There is also a third factory for assembly and partial production of : 50-60 HP tractors; gasoline engines up to 6 HP; 3-12 HP diesel engines and water pumps. However, it seems that this plant at present restricts its activity to assembly only a limited number of tractors.

In addition there are two small workshops for the construction of small 10-12 HP tractors, extremely simple, with belt and chain transmission, and two forward speeds. Such machines, which use imported diesel engines, are produced at 200-250 units a year, and can be used most economically in paddy areas precisely because of their simplicity. For paddy they are equipped with small plows, harrows and trailers. However, their sale price is disproportionately high with regard to their effective performance, due to the limited production and the low productivity of labour. Such industries should be encouraged and guided with suitable technical assistence for the improvement and expansion of their output, in the above mentioned directions.

There is also a small workshop for a 9 HP power-tillers manufacturing. This workshops has a production capacity of about 1.000 units per year. This small factory restricts itself practically,like the two preceding tractor plants, to the manufacture of bodies of melded and soldered plate, metal wheels, and steering parts, supplying itself of all the remaining more-sophisticated parts from abroad.

The only existing engines manufacturer produces 2 cycles types with power between 3 and 45 HP, not standardized (each model has different bore and stroke) and rotating at maximum at between 4000 and 5000 r.p.m.. The present production is of about 12.000 units per year, 70% of which are of 10-15 HP sizes. This plant is presently expanding to arrive at a maximum production of 30.000 units per year.

The local production of pumps in small size models reaches 30.000 units per year. There are four mein factories which produce between 3.000 and 6.000 units a year each and another twenty or so small factories (one-room workshops) with a yearly production of 200-1000 units each. Engines to couple with said and also larger capacity pumps are imported.

There are, finally, 16 small factories of hullers for a total production of 2. 500 units per year, other than a few tens of small industries for the production of animal drawn plows and hand knapsack sprayers (1000/year), harrows, puddlers and hand tools. The production capacity in the plows sector is estimated at around 5.000 units per year. To study deeply the problem of rice mills, government already requested the UNIDO assistance.

There are no exact predictions on the development of this sector, all being entrusted to private initiative. However, it is manifest intention of the government policy to help industrial development, especially in the agricultural machines and rice mills sectors, favorising the creation of small-scale industries.

3.3 - Ancillary industries, are practically non-existent with the exception of three tubes and tyres factories. Locally made batteries are available, but not used by the existing tractors.

The production of machine tools is non-existent as well that of basic raw materials (iron, steel, copper, aluminium, coal, etc.) is limited to a few tens of thousands of tons a year. At present, no steel section, sheets or plates are being produced in the country. However, there are a few foundries, in general of small size, apart from two new factories, recent installed in cooproduction with another Asian country. These two steel mills should double their current production by 1976.

The base metal industries represent only 1% of the total value of industrial production, while the metallic industries represent 1.5%.

The five-year development plan foresees an annual increment of about 8% in this sector. In particular, the development will be aimed at the small-scale industries, to be set up outside the greater Bangkok area.

3.4 - There is not in the country, at present, an adequate support for basic industry. However, due to the almost total import of machines, the ingenuity of people and its propensity for mechanical work, it is to be recommended the installation of a few small factories in the sector of small-scale mechanization. Initially, these would be only for assembly, but with a progressive contribution in the time of local content. This could be undertaken, particularly in the sector of : 10-12 HP power-tillers, with plows, rototillers, puddlers, sprayers and trailers of appropriate sizes; 5-30 HP diesel engines, with a deep standardization of single component parts; centrifugal pumps.

Other machines which seem interesting for local production, given also their relatively simple construction, are threshers, mobile

dryers with a production of 6-8 ton per day of paddy, and mobile workshops.

Local manufacture of such machines (studied through beforehand in technical and productive terms) must come about in cooperation with reputed, well established foreign manufacturers.

The development of such production (to which could be added the assembly of a 25-30 HP tractor, both two and four-wheel drives) asks for preliminary analysis of the market and of costs and scales of production. These studies should define the optimum production levels, the needs of investment and the models and sizes of the different machines. In the same time it is necessary to help the development, diversification and production improvement of the existing small manufacturers.

It is possible roughly hypothisize an initial production of 3.000-4.000 power-tillers, 7-8.000 agricultural machines and implements, 10-15.000 pumps, 1000-1200 threshers and 300-400 dryers and mobile workshops a year.

To help manufacturers strengthening the existing research equipment seems necessary to create an agricultural machines and tractors design, standardization, adaptation and testing unit. In this frame it is recommended to use the experience already acquired in various countries technologically developed and to limit the unit's activity to choice and adaptat foreign machines usefull for local conditions.

4 - Policy toward farm mechanization

4.1 - There is no predicted program of land holding rearrangement and the development plan furnishes information only for increases in irrigable areas and in yield production of different crops, with general mention only of mechanization.

To that end, the government intends to promote development of technical training for farmers, both in the agronomical sector and for

the use and repair of agricultural machines. However development of the agricultural sector remains the main strategy of the third five-year plan, currently being carried out.

Initiatives for courses to bring information up to data are being carried out at the Rice Machinery Training Center and the Agricultural Research Center. There is a Farm Equipment Survey as well.

The Bank of Agriculture and Agricultural Cooperatives gives 3 year loans at low interest rate for the purchase of agricultural machines, with preference for cooperatives use.

At present there exist only 991 cooperatives with different purposes, and 4196 farmers groups.

The government intends to provide means for development of renting lands to cooperatives and to aid rice-growing by means of price support systems. For purchase of machines on the part of Cooperatives, the government concedes subsidies up to 50% of the purchase price of the machines.

Wider use of fertilizers is encouraged and new plants are planned for the development of local fertilizer production.

4. 2 - Research in the agricultural machinery sector is carried out mainly by the Engineering Division of the Rice Department, dependent on the Ministry of Agriculture, which is carrying out some research programs especially in the sector of prototypes construction and improvement of small machines adapted to the local agricultural conditions. One such project has been the floating tractor for deep mud design.

The same Institute is divided up into differents sections, among which there is one for extension service. It operates in close coordination with IRRI and has a well-equipped workshop.

A small number of field tests are carried out by the Rice Machinery Training Center. However the exigency is felt for the development of a testing center, which could be supported by the Enginee-

ring Division of the Rice Department. The center should develop its activity in the standardization and prototypes construction sector, to contribute to the rational development of the agricultural machines manufacturers.

Technical education and university instruction are in a development stage both in the mechanical and in the agricultural engineering fields.

4.3 - On the whole, the organization of repair and maintenance and Extension Services seem wanting. These services are entrusted to the above mentioned Engineering Division. The larger manufacturers organize courses of technical instruction and provide the repair and maintenance service, not always meeting the farmers' favour.

4.4 - From the examination of all the above, it is to be recommended :

- the necessity of a deep study to define optimal levels of mechanization, and models of machines consistent with the definition of the priorities truly of benefit to the farmers;
- the provision for the creation of a research, testing, design,prototypes adaptation and quality control center;
- development of technical education of farmers and mechanics, other than repair and maintenance centers;
- granting of greater loans facilities for farmers, widening the terms and defining precise priorities in the choice of the machines for the concession of said loans.

5 - Policy toward industrialization

5.1 - The current third five-year development plan intends to encourage the development of small-scale industriss with particular

regard to those located in rural areas. Industries for the manufacture of agricultural machines could be considered among these, even though it is only in the Bangkok environs that all the necessary facilities and a labour-force oriented toward mechanical work can be found.

There are planned, in fact, incentives for the introduction of industries utilizing local labour and raw materials; capable of supporting the balance of payments; located in rural areas. The creation of heavy industries with considerable local financial and administrative participation is encouraged.

Those incentives consist in the concession of low interest credits, tax holidays and technical assistance. There is much and substantial aid from foreign countries, as well. This aid consists of long term credit at low (or in some cases, zero) rates of interest.

The Industrial Finance Corporation of Thailand grants easy term loans of seven years for investment in the industrial sector, both by private entrepreneurs and for coproduction with qualified foreign industries. The existing law on investments provides for special, substantial facilities in tax exemptions for five-years, and in the possibility of purchase from abroad duty free of raw materials, tool machinery, equipment and special parts not locally manufactured. These facilities apply to industries of manufacture or assembly of tractors (at not less than 100 units per year) and for the construction of agricultural machines, with a capital investment of not less than 2 million bath (about $ 10.000) excluding circulations capital and that necessary for the purchase of soil.

5.3 - University and professional instruction in the mechanical sector is carried on locally through equipment which, on the whole, appears sufficient, though wanting in practical application. In this area, too, the government has planned a strong push toward strengthening the existing structures.

6 - Conclusions

With the aim of aiding a rational (though long term) development of the mechanization and of the local manufacture of machines necessary for the present and future of the paddy areas, as delineated in the previous chapters, UNIDO assistance is deemed useful as follows :

1 - to assist the Government in the development of small-scale industries for the production of power-tillers; motors and implements, within a framework of very deep standardization of models and component parts, and with the carrying out of feasibility studies, definition of models of machines to be manufactured, of possible local content and of the economies of scale. A team of 2 UNIDO Experts : an agricultural machinery engineer and a small scale industries expert; duration, 8 months each; course of the mission 1974;

2 - to assist the Government in strengthening the existing Engineering Division of the Rice Department, with particular reference to test, design, adaptation, prototypes construction and control of materials, for agricultural machines and tractors for paddy areas. One UNIDO Expert, duration, 4 months; course of the mission 1975;

3 - to assist the Government in the organization and the strenthening of the existing facilities for repair and maintenance, for technical training for farmers, and for the extension service. A UNIDO Expert; duration, 4 months; course of the mission 1976.

Before sending on such experts, it is advisable that three fellowships of a duration of 6 months each be granted to send abroad one mechanical engineer, and two agricultural machinery engineers to be used as counterparts by the proposed experts.

PERSONS MET

1 - Mr. T.S. POWER Jr. - UNDP Regional Rep., Bangkok

2 - Mr. WALI-SHAH WALI - UNDP Deputy Reg. Rep., Bangkok

3 - Mr. G. SHUTZ - FAO Senior Adviser, Bangkok

4 - Mr. S. GUPTA - UNIDO Financial Adviser, Bangkok

5 - Mr. R. D. LALKAKA - Industry Division Regional Adviser - ECAFE, Bangkok

6 - Mr. K. KOBAYASHI - Industry Division Consultant - ECAFE, Bangkok

7 - Mr. A. SLAMET - Industry Division Consultant - ECAFE, Bangkok

8 - Mr. G. PADKE - Director general Dept. of Rice - Ministry of Agriculture, Bangkok

9 - Mr. C. KOMCOMPHUNP - Eng. Division-Rice Dept.- Ministry of Agriculture, Bangkok (counterpart)

10 - Mr. S. RUGTRAKUL - Head, Engineering Div. -Rice Dept. - Ministry of Agriculture, Bangkok

11 - Mr. C. SUKSRI - Eng. Division-Rice Dept. - Ministry of Agriculture, Bangkok

12 - Mr. C. CHAKKAPHAK - Assistant, Eng. Div. -Rice Dept. - Ministry of Agriculture, Bangkok

13 - Mr. M. PRASARN - Ministry of Agriculture, Bangkok

14 - Mr. P. KONGSUMRAN - First Grad Eng. Div. of Factory Control - Ministry of Industry, Bangkok

15 - Mr. VICHIT BENTAZIN - Chief, Central Regional Agricultural Center, Chainat

16 - Mr. J. D. F. NORMAN - Colombo Plan Expert, Chainat

17 - Mr. F. PANTUMASON - Manager - The Industrial Finance Corporation of Thailand, Bangkok

18 - Mr. P. FUGKAU - Manufacturer - Sing-Kru Ousahagum Ltd., Prapraden

19 - Mr. T. DILOKE - Manufacturer - Thai Hang Long Co. Ltd., Bangkok

20 - Mr. PHITHOND - Head of Farm Machinery Training Center, Kronglung

21 - Mr. J. CHOA - Manufacturer - Chor - Charoenchai Co. Ltd., Ajudthaya

22 - Mr. M. CHONG - Manufacturer - Ajudthaya Tractor Co. Ltd., Ajudthaya

23 - Mr. C. M. REGNAULT - Gen. Manager Italtai Industrial Co. Ltd., Bangkok

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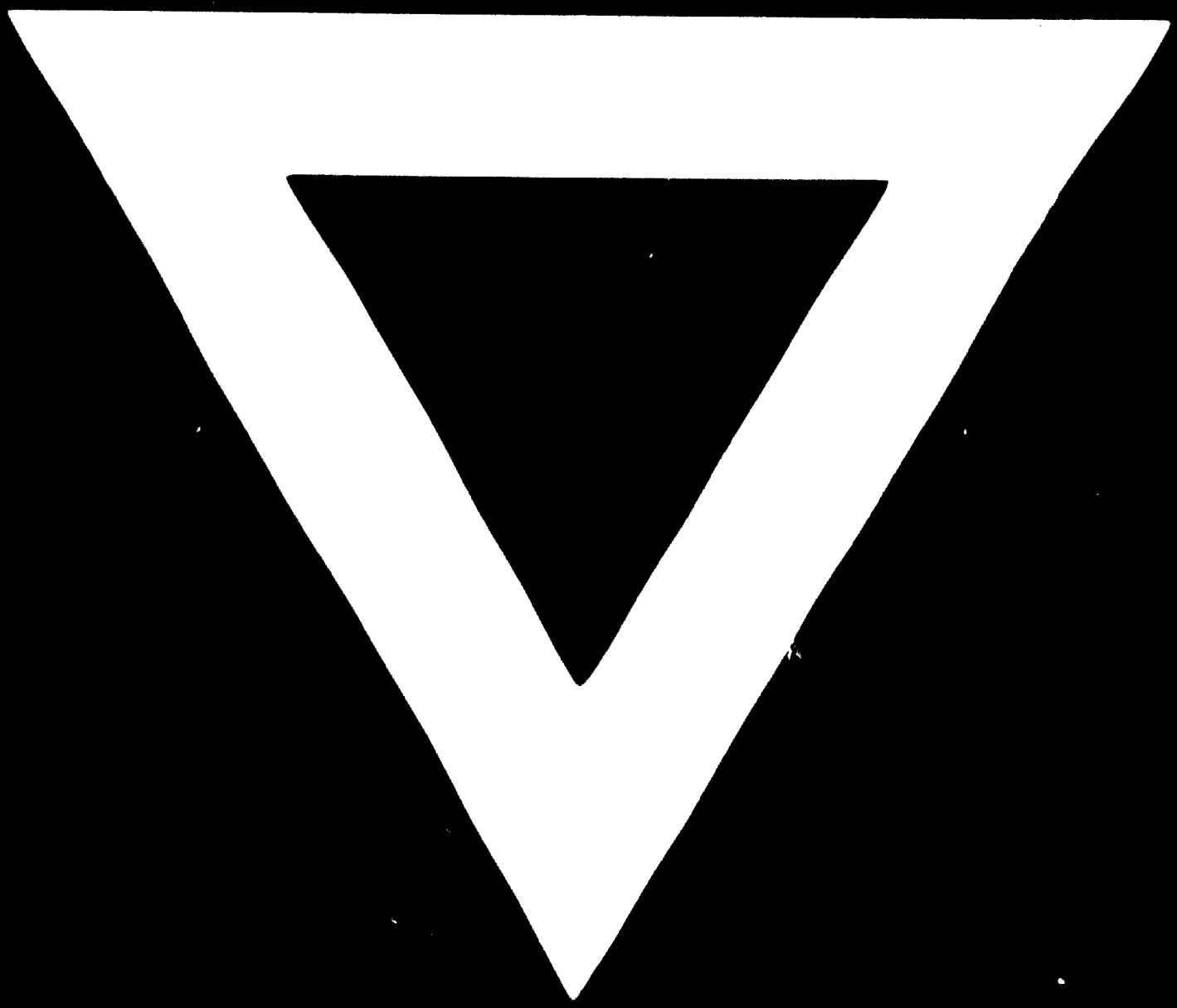

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