OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

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

ph

D04425

United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.142/7
23 January 1973

ORIGINAL: ENGLISH

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

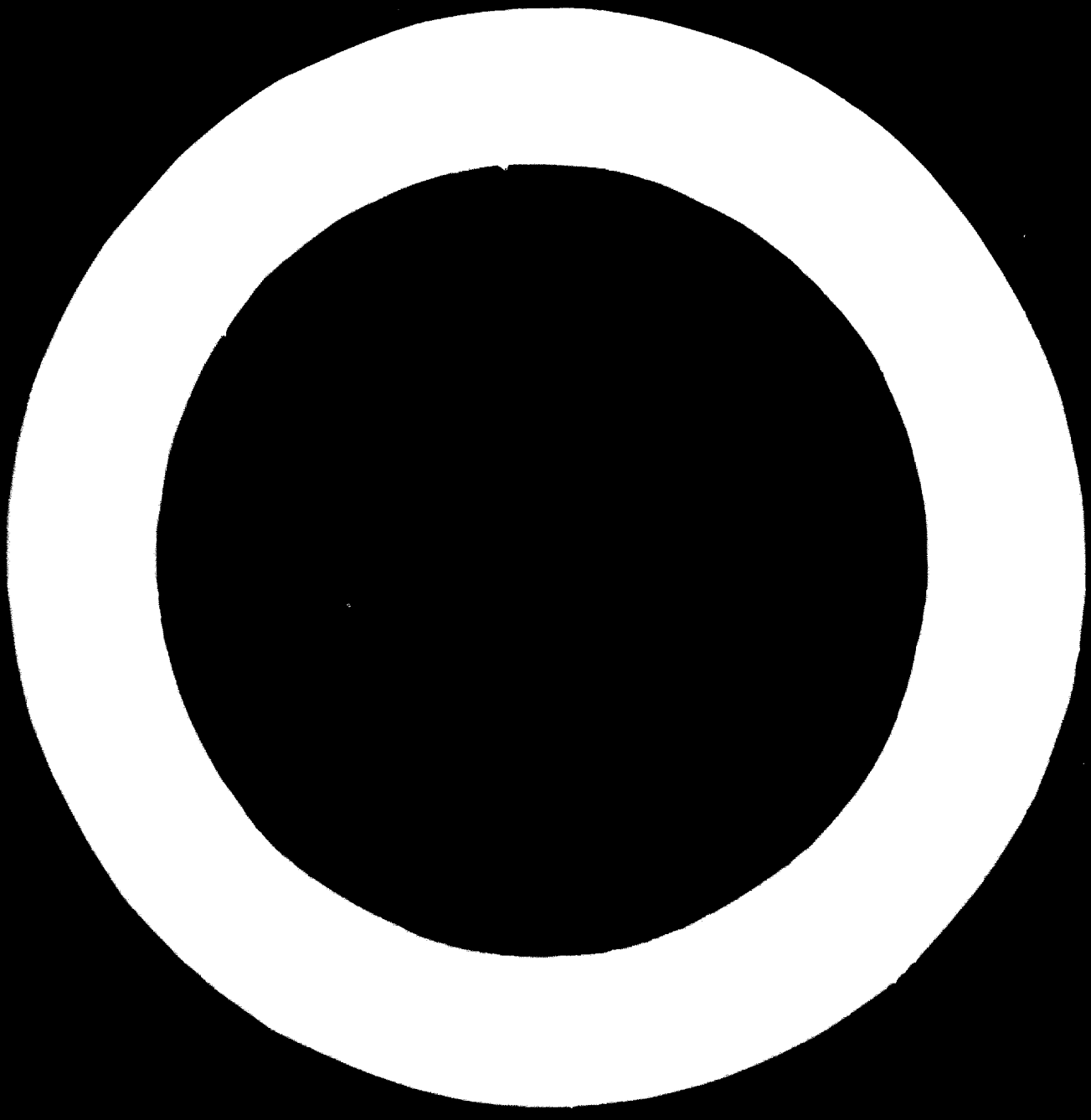
REGIONAL REPORT ON THE RICE MECHANIZATION MACHINERY AND IMPLEMENTS MANUFACTURE IN THE SELECTED NINE COUNTRIES* OF ASIA AND THE FAR EAST REGION[1/]

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

by

Mr. G. Pellizzi: UNIDO Consultant

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.



CONTENTS

SUMMARY

1 - In the 9 ECAFE countries visited during the mission, paddy area covers about 64,000,000 hectares corresponding to 31.2% of the total cultivated area. About 20-30% of paddy area is actually irrigated. According to the different countries' development plans, the irrigated area has to be doubled in ten years time.

Paddy average yield production is about 1.6-1.8 tons/Ha, with a minimum of 1.2 tons/Ha hand a maximum of 3.8-4.0 tons/Ha. In many of the visited countries, population increasing is the main problem, in order to mantain, at least, the actual food standard. According to agricultural experts, this goal is going to be obtained through irrigation development, increasing use of fertilizers and selected seeds, and through slow but necessary and progressive mechanization development which leads to better execution of farming practices.

In the same time, two crops per year are going to be introduced.

2 - The paddy farms average sizes are very small, and never larger than 4 Ha. In many countries it has been introduced a land reform. The average total gross income is about 250 $ per hectare, while on 30% of paddy areas values from 450 $ per hectare are reached. Besides, the idea of machines and plants cooperative use is slowly spreading, especially as far as processing plants are concerned.

Cooperatives are usually encouraged by the different Governments; however their spreading has to face the farmers' individualistic will.

The agricultural active population percentage is going from a minimum of 47% (Korea) to a maximum of 85% (Nepal). In the last ten years there have not been deep changes, but few slight diminishing. Generally speaking, excluding some countries (Iran, Korea and Pakistan) an absolute reduction of agricultural population is not foreseen for the next 20 years. Agricultural labour forces amount to 1.1-1.2

workers/Ha with a minimum of 0.7 (Iran) and a maximum of 2.2 (Korea). The last mentioned country is foreseen to have, in the close future, the highest reduction in the number of agricultural active population.

3 - Agricultural mechanization, especially in the Wet-lands, is at its first steps and has been slow pacing on in recent years; however there are no exact data concerning paddy areas.

The wheel tractor density (between 35 and 60 HP) is about 1 unit per 1000 hectares, with variations going from 0.07 units/1000 hectares (Korea) to 3.5 units/1000 hectares (Iran). Also concerning power-tillers (7-9 HP) values are going from a minimum close to 0 (Pakistan) to a maximum of 7 units/1000 Ha (Korea).

On the whole, different countries keep following two main foreign tendencies : the U.S. one, with the use of medium-big sized tractors, sophisticated, with a low weight/power ratio; the Japan one, with the use of simple, light power-tillers.

The gap existing between these two kinds of power-machines has not been filled up in any country. Existing tractors, even if not often employed on paddy areas, are not always used in the right way and present low coefficients of hours utilization per year and low coefficients(about 0.20-0.25) of power utilization. All this comes from the unsuccessful choice of models and sizes in relation with agricultural structures, works to be done, implements and equipments to be connected to them. Infact, in the paddy growing sector, these tractors are seldom used and especially for primary tillage, while power-tillers are mainly utilized for secondary tillage and sometimes in stationary position, together with pumps and threshers.

The situation of scarce and irrational development can be seen concerning engines, pumps and other agricultural machines too, which are practically limited to sprayers and threshers, both in the hand operated and in the power operated models. Dryers are not commonly used, while hullers population - mostly of old-type, with small output capacity and considerable losses of production - corresponds to

1 unit every 500 Ha.

All this leads to a labour productivity still very low, around 1,400-1,600 hours per hectare per crop.

4 - There is no complete agreement on the goals to aim in order to develop Wet-lands mechanization. On someone advice, it is necessary to go through a period of animal mechanization; according to others, it is important to push toward more advanced levels, introducing the use of power-tillers; a third view-point is to skip the two above mentioned stages and to start using tractors, equipped with consistant sized implements.

No doubt that the last purpose seems theoretically rational, but it should be verified chance by chance, with accurate and realistic researches starting from the farmers' accual and future purchasing capacity. Infact this capacity is not always increasing because of frequent money devaluation. However, its realization would bring along the advantage of allowing - through better working practices, lower losses and higher timeliness - a 10-15% production increase, as it has been demonstrated by specific studies conducted in some countries by some research institutes, and IRRI of them seems the most important.

Priorities given by the Governments concern mechanization development to reduce product losses and to rationalize irrigation and drainage systems. Concerning the first goal, it should be developed the use of : pesticide distribution machines; threshing machines; modern hullers and, on smaller scale, dryers. Only this mechanization spreading seems able to reduce of 50% product losses.

As far as the second goal, it is planned to spread the use of power operated pumps, with small and medium delivery, but the problems of drainage, and cannals and ditches excavation and maintenance mechanization are rarely considered.

Excluding two-crops-per-year areas where timeliness needs it immediately (Korea, Philippines and Indonesia), it is foreseen to

introduce harvesters, starting from self-propelled reaper binders and gradually shifting to combines. Finally, the problem of transplanting mechanization has to be solved in future times, even if its rational mechanization looks extremely difficult.

All this is related to the spreading of tractors, power-tillers and consistant machines for primary and secondary tillage, in addition to a large engines disposing.

These are the tendencies more or less emphasized in the different countries. Annual demand of the above mentioned machines is supposed to increase between 2 and 3 times in 1975, and about 4 times, compared to the 1970-71 situation, in 1980.

5 - Concerning facilities given by the Governments to farmers to purchase machines, shorter and longer loans, at quite different interest rates, are given almost everywhere. However, only few farmers seem to be using these facilities. It is advisable that loans for agricultural machines should be given with 5-7 years term at very low interest rates; moreover Government gift contributions amounting to some % of the machines value, may be necessary. In most cases, repair, maintenance and extension services, technical and mechanics' training for farmers together with training for mechanics and repair-men are not so developed. These services should be improved and should increase together with the spreading of mechanization.

The sector of agricultural machines research is under developed and - even if there are high level scientists - units are not sufficiently provided with scientific and experimental equipments. There is also a complete lack of standardization studies and on mechanization. Anyway the already existing units should be encouraged and developed and their activities should be coordinated both at country and regional levels.

6 - Tractors and agricultural machines production is, in the whole, still very modest, without coordination and clear purposes and it is mainly following the U.S. and Japan experiences. Most of large and medium scale manufacturers hold joint-ventures with foreign companies. Only in very small production the ingenouity of crafts men and local mechanics is fully applied, manufacturing - with a complete lack of modern technical instruments - simple but well-conceived equipments which are completely fitting agricultural needs.

Two elements which have been seen in every country concern : the gap between annual production and production capacity in almost every factory which can be expressed through a 1/2 ratio but, in some cases, it seems to be much higher; the labour's productivity going - as an average index - from 1500 to 2000 $/year per worker.

An analysis of the existing situation shows that :

- total tractor production (26.5-70 HP) is about 25-26,000 units per year, with a foreseen capacity of developing up to 150-170,000 units per year by 1980. The actual production meets 50% of annual demand. Considering the foreseen development by 1980, it should meet 80-90% of official local demand;
- power-tiller production (4-12 HP) is about 11-12,000 units/year with a foreseen expansion capacity up to about 100,000 units/year by 1980. Actual production - which presents a local content value from 30 to 80% - meets 50-60% of annual demand; with the foreseen development, it should meet 70-80% of officially estimated demand by 1980;
- 5 HP or more diesel and gasoline engines production is about 350-360,000 units/year; only a part of this production is used for agricultural purposes. There is a foreseen expansion capacity up to 500,000 units/year by 1980;
- 5 HP or less micro-engines production is made only in 3 out of the 9 visited countries and amounts to 50,000 units/year; a new production is starting in Indonesia. Actual production (who-

se local content value varies from 0 - assembly - to 70%) meets only a 30-35% of the demand. According to the foreseen development, it should meet up to 50-55% by 1980;

- pumps production is rather developed and spread; it is slowly decreasing concerning hand operated models and increasing concerning power operated ones (sizes : 2"-8" Ø). The latter models production capacity is about 120,000 units/year (30-80% local content) compared to a 60-70,000 units demand, for agricultural use;
- sprayers and dusters production is done in 7 out of the 9 visited countries, as far as hand operated models, and in only 3 countries as far as power operated and tractors mounted models are concerned. These models should locally be made by 1980 in almost every country, meeting some 50-60% of 1980 demand;
- threshers production concerning hand operated models, exist in 3 countries and, concerning power operated models, in 7 countries by 150 small and medium-scale factories. Production meets internal demand, which is quite modest, today, and will grow up to 5 times by 1980;
- dryers production does not practically exist. In almost every countries, hullers and other machines for paddy processing (small output capacity less than 1 ton/h) are made.

It can be interesting to express a development index showing the relation existing among production capacity of the above mentioned sectors and countries' needs in terms of mechanization. This index is roughly showing the countries having better facilities for internal development in terms of local production of machines for paddy mechanization and the sectors where an help might be needed. Concerning tractors, Iran is presenting a more advanced situation having an annual production capacity of 1 tractor per every 900 Ha of cultivated area; Burma, India and Philippines have a production capacity about 1 tractor/year per 3-4,000 Ha; Pakistan, 1 tractor/year every 5,500 Ha and Thailand 1 tractor/year every 8,500-9,000 Ha. These relations are almost valid,also

concerning power-tillers production capacity, excluding Korea which has a manufacture capacity of 1 power-tiller per year every 80 Ha.

On engines more than 5 HP, industrial capacities for India and Pakistan have to be doubled, while Iran's capacity is already quite adequated and Korea's one is even overabundant.

Concerning pumps, production should be developed in Indonesia (whose specific capacity is 1/10 of the other countries' one), Burma, Iran, Philippines and Pakistan. Excluding Korea, all countries need a fast development in the power operated threshers sector. The situation is lacking in every country, looks much more serious.

Excluding some peculiar cases, production is made in medium and small-scale industries; technical features look, in the whole, satisfactory even if foundry techniques, heat treatment and quality control do not completely meet requirements.

Another problem which should be reminded concern the lack of spare parts and machines standardization.

Principles of the economies of scale are not practically taken into consideration too, especially in defining single industries production capacities.

7 - All the visited countries are rich of natural resources whose utilization has only recently been started.

According to official sources, good facilities for tyres production are given now only in India and Korea, while their extension is planned to reach Iran, Pakistan, Philippines and Thailand by 1980. Pistons production adequated to internal demand exists only in Pakistan and will be extended to Korea, India and Thailand by 1980, while bearings will be made just in Iran, Korea and Pakistan (only in this last country present production is already meeting internal demand). Fuel injection pumps and carburettors will probably be manufactured by 1980 in India, Korea, Pakistan and Philippines.

Finally, tool machines are actually manufactured in Iran, Korea and Pakistan.

Concerning raw materials and ancillary facilities useful for local tractors and agricultural machines manufacture, their production - even if not always adequated to internal needs - together with the development of foundry, casting, forging and heat-treatments, will be eventually assured in every country, by 1980, excluding - for some products - Indonesia, Nepal, Philippines and Thailand.

8 - To speed up the development and to help new industrial investments in every country, facilities credits at low interest, tax exemptions, duty free, etc. are given.

Incentives are given according to declared priorities concerning choices of the kinds of machines to be manufactured, on the basis of production sizes (the greatest facilities are assigned to small-scale industries, that means to factories which, excluding land and buildings, ask investments less than 100,000 $). This is also depending upon the places where they are going to be installed : rural areas are favoured in comparison with urban ones. Governments usually favour joint ventures with well reputed industries of more technologically advanced countries.

Some countries - say Iran and Pakistan - are presently studing (together with Turkey) common production able to supply regional markets, rather than national ones. Such cooproduction among the ECAFE countries has to be encouraged.

9 - About future, it seems useful to give some indications on how to plan mechanization development on paddy areas. A certain mechanization level corresponds to a particular socio-economical conditions. This can be expressed through a mechanization index I_m comparing the share of machine work in the total human and machine work and represented by a certain group and size of machines. Each

level offers a determinated labour productivity and lows working costs in connection to machines and labour costs.

If different levels of mechanization, bringing over different labour productivities and different costs of equipments, are taken as hypothesis, the optimum levels, able to reduce total costs to a minimum in the different conditions, can be found out, in relation to labour costs.

On these basis, with present labour wages, the minimum cost (as far as machines are completely utilized all through the year and can work on adequated surfaces) is obtained through the use of power-tillers. Only when labour wages will reach about 1.50 $/day it will be use 20-22 HP tractors and only when labour wages will amount to more than 3 $/day it will be convenient to introduce 30-35 HP tractors. Animal mechanization already seems now to be more expensive - excluding particular conditions - than the use of power-tillers. It can also be seen that - at last in a large portion of Wetlands - the use of tractors of bigger size than the indicated ones, more sophisticated and capable of a greater productivity can only make the economical situation worse and increase total production costs, besides increasing to much labour productivity.

Generally speaking and perhaps except in Iran, present period seems to be the best one for using power-tillers equipped with consistant equipments.

To mechanize other works it seems quite important to employ : self propelled reaper binders simple, which can be connected with the above mentioned power-tillers; mobile drum threshers; small dryers, mobile model; bigger and more sophisticated hullers.

The areas to be worked by different mechanization levels are : 12-14 HP power-tiller : 7-8 Ha; 20-22 HP tractor : 9-10 Ha; 30-35 HP tractor : 14-16 Ha. Concerning other practices mechanization figures can be : 1 knapsack power operated sprayer every 2.5-3 Ha; 1 self propelled reaper binder every 14-16 Ha for one crop per year, or every 9-11 Ha, for two crops per year; 1 power operated drum thresher every 50 Ha, for one crop per year, and every 40 Ha, for

two crops per year; 1 mobile dryer every 50 Ha, for one crop per year, and every 40 Ha, for 2 crops per year; 1 mill plant of medium output capacity, every 500 Ha, for either 1 or 2 crops per year.

In consequence the following need of machines for different mechanization levels can be hypothisized : 12-14 HP power-tillers (equipped with plow, harrow,puddler, leveller, pump and driving axle trailer) : 7,500,000 units; power operated drum threshers : 1,300,000 units; mobile dryers : 1,300,000 units; mill plants : 130,000 units; self propelled reaper binders (limited to areas with 2 crops per year or with high output): 1,500,000 units; knapsack power operated sprayers : 22,000,000 units.

Future population of 20-22 HP tractor can be hypothisized around 7,000,000 units and of 30-35 HP ones,around 4,500,000 units.

If now we compare the above mentioned theoretical needs with the future production capacity, it can be verified that no less than 50-70 years would be needed to mechanize paddy-growing.

Finally, it is to point out how much machines for a rational mechanization of paddy areas should cost with reference to the farmers' purchasing capacity. Referring to the conditions in the visited countries, it can be noticed that : in paddy areas whose gross income is about 250 $/Ha, the highest equipment purchase capacity is about 24-28 $ per hectare and per year; in paddy areas whose gross income is about 400 $/Ha, the highest equipment purchase capacity is about 40-50 $ per hectare and per year; in paddy areas whose gross income is about 600 $/Ha, the highest equipment purchase capacity is about 80-95 $ per hectare and per year.

Taking into consideration the possibilities to give 5 years loans at 9% interest rate to the farmers in order to purchase agricultural machines, it is necessary also that Governments should give the following gift contribution : no less than 50% of the total machine price, if gross specific income is less than 250 $/Ha;

between 50 and 10% of the total machine price, if gross specific income varies between 250 and [illegible] $/Ha; between 10 and 0% of the total machine price, if gross specific income varies between 450 and 600 or more $/Ha.

10 - Machines concerning paddy mechanization, which are judged good in technical and economical terms and whose local production seems useful, are :

- 12-14 HP power-tiller, equipped with cages wheel and with the following main implements : plow, harrow, puddler, leveller, rototiller, trailer, pump and drum roller for bunds reconstruction;
- 20-22 HP tractor, 4-wheel drive, articulated, simple and strong;
- 30-35 HP tractor, 2 or 4-wheel drive, strong, equipped with p.t.o., 3 points linkage with hydraulic lift;
- knapsack power-operated sprayer (1-3 HP gasoline engine);
- self propelled reaper binder (1.40 m cut width; 12-14 HP diesel engine);
- drum power-operated threshers (0.4-0.6 tons/hour capacity; 6-10 HP diesel or gasoline engine);
- mobile dryer with 0.6-0.8 tons/hour of average capacity;
- mobile workshop.

These machines could be realized through joint ventures with reputed and well established foreign factories.

The local content amount and its variation in the time should be decided on the basis of realistic technical and economical analysis.

In any case it is difficult to give exact informations on the real possibilities of each country concerning local construction of machines. Some preceeding and specific ECAFE missions, have given informations as far as engines and power-tillers production possibilities.

Of the whole needs of various countries from the manufacturing point of view, it is impossible to start contemporaneously with all the forecast production. In consequence, it seems useful to advise so-

me priorities and to reach to realize some pilot enterprises with international organizations and high capacity experts assistance. These priorities concern :

- Burma : factories for self propelled reaper binders and dryers production;
- India : factories for power-tillers and tractors between 12 and 22 HP manufacture together with consistant equipments for primary and secondary tillage, irrigation, transport and spraying and for mobile workshops production;
- Indonesia : factories for power-tillers and tractors between 12 and 22 HP manufacture together with consistant equipments for primary and secondary tillage and transport, and for threshers and dryers production;
- Iran : factories for 20-22 and 30-35 HP tractors production together with consistant equipments and for less than 5 HP engines manufacture;
- Korea : factories for self propelled reaper binders and mobile dryers production;
- Pakistan : factories for pumps, engines, drainage and spraying equipments and mobile workshops manufacture;
- Philippines : factories to produce spading machines, ditchers, pumps and diesel engines less than 30 HP;
- Thailand : factories for less than 30 HP diesel engines, knapsack sprayers and irrigation pumps production.

INTRODUCTION

1.1 - Social and economical developments are always strictly related, according to the well-known principle of cause and effect.

For example,this can be stated referring to the primary sector development (due either to an increase of products demand or to a larger production or to a progressive reduction of workers). Such development brings along the necessity to spread mechanization, which should become more sophisticated and complete.Referring to the secondary sector, its development depends not only on the possibility to introduce manufactures at competitive and profitable prices, but also on the existence of a real market, on the purchase capacity of people and on their cultural level, on the possibility to provide and process raw materials, on the existence of well-educated engineers, technicians and workers and so on.

As it concerns stock-in-trade production,this subject, related to different socio-economical conditions, has pointed out to the following targets :

- reducing to a minimum manufacturing costs which these goods are realized for;
- increasing labour productivity, according to the above mentioned purpose of reducing costs to a minimum, to mantain social balance and especially total employment amount;
- gradually lowing labour weariness, bringing workers back to intellectual, social and cultural life;
- calling for investments adequated to the country development level and able to absorb proportioned labour.

1.2 - What goes above is true in general terms and it seems to fit especially the development of agricultural mechanization machines production and, particularly, paddy growing mechanization.

Therefore, examining the actual situation and the future development views - as far as it has been seen during the prelimina-

ry mission from July, the 9th to September, the 27th 1972 in nine countries of ECAFE Region - of tractors and agricultural machines for mechanization of Wet-lands manufacture, it is important to start taking into consideration the social, economical and technical situation of paddy areas and their future growth. This should be done in order to find : the optimal, actual and future, mechanization levels, the consistent areas which can be cultivated by the same machines, the technical, functional and operative characteristics of the machines themselves and their total demand. All these elements - together with the evaluation of farmers purchasing capacity, of probable Government contributions, of the maximum cost of machines - are necessary to define a correct and rational development of the industrial sector.

It might be useful to specify what "optimum mechanization level" means.

Everybody knows that the production cost of any good depends on two main factors : labour cost and investment cost. Together with the mechanization level raising by means of more complete, sofisticated and productive machines, it stands by an increase of plants and machines incidence on production costs. In consequence, as labour productivity increases as well the labour cost incidence lows.

Therefore at any wage level, it is possible to find the mechanization level able to reduce total production cost to a minimum. At any increase of work costs, it is possible to define and foresee the mechanization levels and the investments, which can reduce production costs to a minimum. It all varies according to economical and social situations and holds validity in both agricultural mechanization and industrial investments fields.

Once these optimal, actual and future, mechanization levels of paddy growing have been determinated on the basis of the above mentioned criteria (this is valid both in macro-economical terms - as in this report - and referred to single farm situations), it is important to decide which areas can be worked by each agricultural machine in order to completely take advantage of their performances during their technical life. On the basis of what is offered by international market by now, and eventually adapting technical characteristics

to specific local needs, fundamental technical features and total demand can be stated.

Following the same minimum production costs criteria, the industrial production can be determined, shaped on the maximum standardization and taking as a basis the principles of the economies of scale; factories calling for low capital invesment and high amount of labour, like the ones in the ECAFE countries, are not very sensitive toward these principles.

1.3 - The report aims to explain this matter, but it can only give close-by indications, as long as more accurate researches have to be accomplished, and have not been promoted yet.

There are pointed out, anyway, because, on the basis of the experience acquired (but not so well known) by the most technologically advanced countries, developing countries have many chances of :

- not repeating the mistakes made by the previous ones because of a too rapid socio-economical development;
- not paying overwhelming attention neither to unilateral experiences not to foreign helps and advices, not always uninterested;
- caring on problems and their developments in the most rational way which leads to correct and consistant political, economical and technical choises.

2 - GENERAL PATTERN OF AGRICULTURE

2.1 - In the 9 ECAFE countries visited during the mission, paddy area covers about 64,000,000 hectares, corresponding to 31.2% of the total cultivated area. Such percentage varies - in the different countries - from a minimum of 5% (Iran) to 55% values (Indonesia, Korea, Thailand), and reaches a top of 66% (Burma). About 20-30% of paddy area is actually irrigated and there have been considerable developments in the last

TABLE 1 - GENERAL PATTERN OF AGRICULTURE

Country	Total arable area (000 ha)	Total cultivated area (000 ha)	Total irrigated area (%)	Total paddy area (000 ha)	Total paddy area (%)	Average paddy yield production (tons/ha)	Farms population (000 no.)	Farms average size (ha)	Farms more than 4 ha population (%)	Farms more than 4 ha area (%)	Average size of paddy farm (ha)
BURMA	17,500	7,500	10.6	4,625	66	1.6	4,330	1.7	14	43	1.4
INDIA	177,000	133,000	26.2	37,000	22	1.7	50,000	2.6	15	40	2.3
INDONESIA	N.A.	15,000	29.4	8,594	55	2.7	12,236	1.2	7.7	29	0.6
IRAN	22,000	6,850	42.5	360	5	3.8	2,200	3.1	40	N.A.	3.0
KOREA	2,330	2,330	47.0	1,213	55	3.3	2,488	0.9	0.5	3	N.A.
NEPAL	2,185	2,185	5.9	1,100	50.5	1.6	1,700	1.3	5.0	37	N.A.
PAKISTAN	30,660	19,230	65.0	1,600	8.4	1.5	4,800	4.1	31	75	N.A.
PHILIPPINES	10,488	7,900	12.2	3,200	40	2.5	2,166	3.6	26	65	N.A.
THAILAND	14,200	12,170	15.8	6,693	55	1.7	3,400	3 6	28	60	3.5

five years. According to the different countries' development plans, the irrigated area has to be doubled in ten years time.

Paddy - whose average yield production is about 1.6-1.8 tons/Ha, with a minimum of 1.2 tons/Ha and a maximum of 3.8-4.0 tons/Ha - is today the most important food for the 830 million inhabitants of the 9 countries and this situation is not going to change in a longwhile future. In many of these countries, population increasing is the main problem, in order to mantain, at least, the actual food standard. According to agricultural experts - who base their figures on the yield production increase in the last years - this goal is going to be obtained through irrigation development, increasing use of fertilizers and selected seeds, and through slow but necessary and progressive mechanization development which leads to better executions of farming practicies.

In some regions, same problems are going to a rise,anyway, not before the next 5-10 yeras,because of the need to find out and spread varieties given better responses to pedo-climatic conditions.

Two crops per year are going to be introduced, which will bring along - together with an income increase of farmers - the necessity of employing machines able to realise works in time.

2.2 - The paddy farms average sizes are very small, and never larger than 4 Ha, even if there is a certain number, different from country to country, and still constantly diminishing, of very large farms. In many countries it has been introduced a land reform, aiming to grant an almost homogeneous even if quite low gross income to the farmers (depending on crops and on families).

The average total gross income is about 250 $ per hectare,while on 30% of paddy areas values from 450 $ to 700 $ per hectare are reached. Besides, the idea of machines and plants cooperative use is slowly spreading, especially as far as processing plants are concerned. Machines and tractors for particular works and especially for primary tillage can be easily rented.

TABLE 2 - GENERAL PATTERN OF SOCIO-ECONOMICAL CONDITIONS

Country	Total population (000 no.)	Active population in agriculture (%)	Workers per hectare (no.)	Average population growth per year (%)	G.D.P. per capita ($)	Percentage of G.D.P represented by				Prevision of G.D.P growth per year ■	
						agriculture		industry		agriculture	industry
						today (%)	average growth per year (%)	today (%)	average growth per year (%)	(%)	(%)
BURMA	28,200	70	1.0	2.4	85	50	3	15	N.A.	4.0	N.A.
INDIA	560,000	70	1.2	2.6	100	50	2	19	N.A.	5.0	N.A
INDONESIA	124,000	65	1.9	2.7	90	48.7	2.7	9.1	5.7	3.6	8.1
IRAN	36,000	64	0.7	2.9	310	15.5	3.5-4	22.8	12.2	5.5	13.2
KOREA	31,000	47	2.2	1.8	230	28.4	3	29.7	20.6	4.5	13.0
NEPAL	11,300	85	1.7	1.9	70	66	2	7	N.A.	4.0	N.A.
PAKISTAN	61,300	65	0.9	2.7	110	41	2.5	17	7-8	5.5	N.A.
PHILIPPINES	39,000	57	0.8	3.1	219	33	3.5	15	N.A.	5.3	13.0
THAILAND	37,800	70	0.9	2.5	150	29.5	4.1	16.9	N.A	4.6	9.2

■ At constant money value

Cooperatives are usually encouraged by the different Governments, sometimes with reasonable incentives, even if - as mechanization is involved - studies and researches to determine the best sizes of these cooperatives in technical and economical terms and the consistant mechanization are not carried on, but in Iran and Korea. Their spreading has to face the farmers' individualistic will, just as anywhere in the world. Anyway, it seems to the writer, that such form - or a similar one - is the only one to garantee a steady future agriculture development.

2.3 - The agricultural active population percentage is very high, going from a minimum of 47% (Korea) to a maximum of 85% (Nepal). In the last ten years there have not beer deep changes, but few slight diminishing. Generally speaking, excluding some countries (Iran, Korea and Pakistan) an absolute reduction of agricultural population is not foreseen for the next 20 years, considering the annual population increasing rate, even if in some cases percentage reductions are forecast. Agricultural labour forces amount to 1.1-1.3 workers /Ha with a minimum of 0.7 (Iran) and a maximum of 2.2 (Korea). The last mentioned country is foreseen to have, in the close future, the highest reduction in the number of agricultural active population.

As for expanding of irrigation, yield production increasement and, in some cases, cultivated area development, the agricultural labour's income is foreseen to double - at constant money value - in 20 years time; a shifting of youngestes to the industrial sector can be forecast too.

This can be stated along with forecasts of annual increase of G.D.P., both in the industrial and agricultural sectors as shown in table 2.

3 - GENERAL PATTERN OF AGRICULTURAL MECHANIZATION

3.1 - Agricultural mechanization, especially in the Wet-lands, is at its first steps and has been slow pacing on in recent years, and still looks quite limitated. There are no exact data concerning paddy areas, which are actually taken into exam by an international organization. Anyway, general situation is clearly showed in tables 3 to 10; some comments on the reported figures and some other considerations seem to be useful.

The wheel tractor density (table 3) - normally of size between 35 and 60 HP - is about 1 unit per 1000 hectares, with variations going from 0.07 units/1000 hectares (Korea) to 3.5 units/1000 hectares (Iran). Also concerning power-tillers (7-9 HP; table 4) values are pretty the same, going from a minimum close to 0 (in Pakistan, where this kind of machine is considered too expensive compared with both anomal drawn and tractors drawn implements) to a maximum of 7 units/1000 Ha (Korea). Total density of tractors and power-tillers or, as a plainer index, existing power per hectare results rather omogeneous in the different countries.

On the whole, it is interesting to notice how different countries keep following two main foreign tendencies :

- the U.S. one, with the use of medium-big sized tractors, sophisticated, with a low weight/power ratio, equipped with 3 points linkage, p.t.o., high number of gears, etc.; from a rational point of view this sort of tractors is useful for works with p.t.o. driven equipments;
- the Japan one, with the use of simple, light power-tillers with limited use possibility and not very hight performances.

The gap existing between these two kinds of power-machines has not been filled up in any country, because power weights, mechanical and functional features of simple and strong framed, low priced tractors, which fit better to the agricultural, economical and social conditions in the different countries have not been taken into consideration. Existing tractors, infact, even if not often employed on paddy

TABLE 3 - RIDING TRACTORS : country, demand and manufacturing schedules

Country	Population (mn.)	Density (units/1000 ha)	Average size (HP)	Annual demand (no.)	Projected annual demand: year	Projected annual demand: units (no.)	Manufacturing capacity: manufacturers (no.)	Manufacturing capacity: % of local content (%)	Manufacturing capacity: annual production 1971 (no.)	Manufacturing capacity: capacity 1971 (no.)	Manufacturing capacity: power range (HP)	Foreseen development
BURMA	3,390	0.46	50	N.A.	1975 1980	2,000 4,000	1	70	1,000	2,000	50	4,200 units per year of 50 and 85 HP in 1975
INDIA	150,000	1.13	40	30,000	1974 1980	90,000 130,000	5	30-80	17,000	34,000	26.5-45	125,000 units/year in 1980
INDONESIA	4,000	0.25	N.A.	400-500	-	N.A.	3	assembly	200-300	N.A.	30-50	N.A.
IRAN	24,000	3.50	60-70	4,000	1975	8,000-9,000	1 2	45 assembly	3,000 1,000	5,000 26,000	45-65 50-70	Foreseen a regional cooproduction with Pakistan and Turkey
KOREA	150	0.07	35	20-30	-	N.A.	1	20	300	3,000	50	Problem is under study to find optimum size
NEPAL	900	0.40	50	200	1975-80	400-500	NIL	NIL	NIL	NIL	NIL	N.A.
PAKISTAN	25,000	1.30	55	1,200-1,400	1976	10,000	2	assembly	1,000	3,500	40-65	New factory for 2000 units/year,45 HP - International tender call for a production of 7000 units/year (35-45 HP) by 1974-75 - Foreseen a regional coproduction with Iran and Turkey
PHILIPPINES	14,000	1.77	55	1,000	1975	4,000	3	assembly	1,200	3,000	60	N.A.
THAILAND	30,000	2.40	50	4,000	1975	8,000	3 2	assembly 40	1,100 300	3,000 300	50-60 10-12	N.A.

Around 40% is imported - Indian Association of Agricultural Engineers predicts 52,000 units in 1974 - 15-20% are tractors between 35-40 HP; few tens less than 25 HP - Especially used for extra-agricultural purposes - Other estimates give an annual demand of 4,000-5,000 units per year - Other estimates give an annual demand of 1028 units/year - Sized more than 50 HP - 90% between 50 and 70 HP; 10% between 10 and 15 HP.

areas, are not always used in the right way, with low coefficients of hours utilization per year (ratio between the average number of usage per year and the optimal number of hours corrisponding to their technical life, which is not less than 1,000-1,200 hours/year) and with low coefficient (about 0.20-0.25) of power utilization (ratio between average power utilized in different works and engine maximum power). All this, meaning variations of the using cost of tractors themselves in the ratio from 1 to 3, comes from the unsuccessful choice of models and sizes in relation with agricultural structures, works to be done, implements and equipments to be connected to them. Infact, in the paddy growing sector, these tractors are seldom used and especially for primary tillage, while power-tillers are mainly utilized for secondary tillage (handing, puddling, levelling, etc.) and sometimes in stationary position, together with pumps and threshers. These machines, connected to trailers, are scarcely used for transports as well as for all the operations needed by the paddy cultural cycle, from transplanting to harvesting. A great obstacle to the development of a rational mechanization is given by the existing agricultural structures, the small size of fields (it seems, for example, that it has never be planned - for easing the use of machines - to destroy bunds and to reconstruct them mechanically with special plows and compressor drums), the lack of a road system and of a good hydraulic reclamation (use of drainage and irrigation machines is practically unknown), etc..

The situation of scarce and irrational development, which has been above mentioned about tractors and power-tillers, can be seen - as far as it is possible to know, because there is often a lack of complete data - concerning engines, pumps and other agricultural machines, which are practically limited to sprayers (whose use is not spread in all the paddy areas in the different countries and is limited to knapsack hand operated models) and threshers, which are unpopular yet, both in the hand operated and in the power operated models. Dryers are not commonly used, while hullers population - mostly of old-type, with small output capacity and considerable losses of pro-

TABLE 4 - POWER-TILLERS : quantity, demand and manufacturing schedules

Country	Population (no.)	Density (units/1000 ha)	Average size (HP)	Annual demand (no.)	Projected annual demand: year	Projected annual demand: units (no.)	Manufacturing capacity: manufacturers (no.)	Manufacturing capacity: % of local content (%)	Manufacturing capacity: annual production 1971 (no.)	Manufacturing capacity: capacity 1971 (no.)	Manufacturing capacity: power range (HP)	Manufacturing capacity: foreseen development
BURMA	500	0.07	7	N.A.	-	N.A.	1	70-80	700	1,200	7	N.A.
INDIA	15,000	0.11	10	4-5,000	1980	60,000	7	50-70	1,200-1,500	50,000	-	50,000 units in 1980
INDONESIA	1,000	0.06	7-9	400-500	-	N.A.	NIL	NIL	NIL	NIL	NIL	assembly of 1500-2000 units/year in 1975
IRAN	15,000	2.2	8-10	4-5,000	1975	10,000	1	60	3,000	6,000	4-12	N.A.
KOREA	17,000	7.3	7-9	4,000	1975 1980	10,000 28,000	3	60-65	5,500	28-30,000	5-9	28,000 units/year in 1980
NEPAL	few tens	0.04	8-9	N.A.	-	N.A.	NIL	NIL	NIL	NIL	NIL	N.A.
PAKISTAN	few tens	0.00	8-9	N.A.	-	NIL	NIL	NIL	NIL	NIL	NIL	NIL
PHILIPPINES	8-9000	1.14	7	3,500	1975	7,000	3	70	N.A.	5,000	5-9	-
THAILAND	4,000	0.33	7-8	1,200-1,700	1975 1980	4,000 6-8,000	2	30-40	800	1,000	5-9	N.A.

■ Power-tillers are considered not unsuit and more expensive than tractors, in local conditions - ■ Engines are imported

Table 5 - DIESEL AND GASOLINE ENGINES OF MORE THAN 5 HP : quantity, demand and manufacturing schedules

Country	Population (no.)	Density (units/1000 ha)	Annual demand (no.)	Projected annual demand		Manufacturing capacity					
				year	units (no.)	manufacturers (no.)	% of local content	annual production (no.)	capacity (no.)	power range (HP)	foreseen development
BURMA	N.A.	N.A.	N.A.	-	N.A.	1	N.A.	2,000	N.A.	7-9	N.A.
INDIA	300,000	2.3	70-80,000	1974	80,000	100	N.A.	300,000	300,000	5-80	N.A.
INDONESIA	N.A.	N.A.	6-7,000	-	N.A.	2	assembly	NIL	NIL	3-140	N.A.
IRAN	28-30,000	4.3	2,000-2,500	1975	5,000	4	65-75	20,000	50,000	more than 7	Future capacity : 80,000 units/year
KOREA	98,000	42,0	9,000	1975 1980	18,000 50,000	N.A.	20-70	12,000	83,000	N.A.	50,000 units/year in 1980
NEPAL	N.A.	N.A.	N.A.	-	N.A.	NIL	NIL	NIL	NIL	-	N.A.
PAKISTAN	48,000	1.8	N.A.	-	N.A.	36	40-70	11,000	25,000	more than 10	15,000 units/year in 1980 for agricultural use only
PHILIPPINES	120-130,000	15.2	20,000	1980	30-35,000	NIL	NIL	NIL	NIL	-	60,000 units/year in near future of less than 15 HP. gasoline model
THAILAND	N.A.	N.A.	60,000	1980	150,000	1	70	12,000	12,000	3-45	30,000 units/year in 19[illegible], same factory

Diesel and gasoline engines of every size - Only 30% used for agricultural purposes - Including micro-engines - Progressive increasing of local content in the time - Production starting in 1973-74 with 6500 units/year - 90% between 5 and 20 HP - Three factories manufacture stationary engines (30-240 HP) or diesel engines for trucks with a mentioned capacity of 20,000 units/year - Engines for power-tillers are not included - Plus 144 small sized units - Only 50% used for agricultural purposes - Population estimated with reference to power operated pumps and threshers population - From 3 to 30 HP - 80% between 10 and 30 HP.

duction - is adequated to local needs, even if official data report a population of 1 unit every 500 Ha.

Therefore, we can not talk about complete and rational mechanization for any work; primary and secondary tillage are mainly done by animal drawn implements and all the other works are hand made or accomplished by animal help. This leads to a labour productivity still very low, around 1,400-1,600 hours per hectare per crop. It may be interesting to point out that, in the Italian paddy areas, productivity varies from a minimum of 200 hours/Ha , in farms covering less than 10 hectares, to a maximum of 80 hours/Ha, in big farms. The average wage of agricultural workers is 10-12 times superior to the average one in ECAFE countries, and this asks a well developed mechanization.

3.2 - According to official informations and to national and international experts opinions, there is no complete agreement on the goals to aim in order to develop Wet-lands mechanization. For someone advice, it is necessary to go through a period of animal mechanization; according to others, - even if they recognize that paddy areas mechanization has to be developed very slowly - it is important to push toward more advanced levels, introducing the use of power-tillers; a third view-point is to skip the two above mentioned stages and to start using tractors, equipped with consistant sized implements. Motivations of these different purposes come from different considerations; animal mechanization stage is considered necessary especially for social reasons, in order to mantain the employing level in primary sector and not to increase labour productivity,tendency toward an higher level of mechanization comes from the need to improve works (deeper plowing, higher timeliness in practices execution, lower losses) and to free women and school age youngestes from continous land work. This means to take the risk to slowly increase labour productivity in agriculture and to develop local construction of tractors and agricultural machines, so to speed up the shifting of active population from the agricultural to the industrial sector.

No doubt that the last purpose seems theoretically rational, but it should be verified chance by chance, with accurate and realistic researches starting from the farmers' actual and future purchasing capacity. Infact this capacity is not always increasing because of frequent money devaluation. However, its realization would bring along the advantage of allowing - through better working practices, lower losses and higher timeliness - a 10-15% production increase, as it has been demonstrated by specific studies conducted in some countries by some research institutes, and IRRI of them seems the most important.

It should also be taken into consideration the priorities given by the Governments concerning mechanization development. It seems, infact, that these priorities concern the need of reducing product losses and of rationalizing (where they are already existing) irrigation and drainage systems.

Concerning the first goal, it should be developed the use of :
- pesticide distribution machines;
- threshing machines;
- modern hullers and, on smaller scale, dryers.

Only this mechanization spreading seems able to reduce of 50% and, in some cases, more, product losses, which are actually amounting to about 30%.

Concerning the second goal, it is planned - in coherence with the foreseen irrigation development - to apread the use of power operated pumps, with small and medium delivery, to be used both by cooperatives and by single farms. The problems of drainage, and cannals and ditches excavation and maintenance mechanization are rarely conaidered.

Excluding two-crops-per-year areas where timeliness needs it immediately (such aa Korea, and, on a smaller scale, Philippines and Indonesia), it is foreseen to introduce harvesters, starting from self-propelled reaper binders and gradually shifting to combines, according to different countries' socio-economical development. Finally, the problem of transplanting mechanization has not been taken

TABLE 6 - MICRO GASOLINE ENGINES (LESS THAN 5 HP) : quantity, demand and manufacturing schedules

Country	Population (no.)	Density (units/1000 ha)	Annual demand (no.)	Projected annual demand		Manufecturing capacity					
				year	units (no.)	manufacturers (no.)	% of local content (%)	annual production (no.)	capacity (no.)	size	foreseen development
BURMA	N.A.	N.A.	N.A.	N.A.	N.A.	NIL	NIL	NIL	NIL	-	N.A.
INDIA	700,000	5.3	70-80,000 ■	1974	80,000 ■	15	60-70	40,000	N.A.	1,2-5	N.A.
INDONESIA	N.A.	N.A.	6-7,000	N.A.	N.A.	1	assembly ■	NIL ■	NIL ■	-	N.A.
IRAN	N.A.	N.A.	6-8,000	1975	90,000	NIL	NIL	NIL	NIL	-	Foreseen but not specified
KOREA	59,000	25.0	6,000	1975	18-20,000 ■	15	N.A.	11,500 ■	124,000	N.A.	80,000 units/year in 1980
NEPAL	N.A.	N.A.	N.A.	N.A.	N.A.	NIL	NIL	NIL	NIL	-	N.A.
PAKISTAN	few hundreds	N.A.	few tens	N.A.	N.A.	NIL	NIL	NIL	NIL	-	7,500 units/year in 1975 and 10,000 in 1980
PHILIPPINES	N.A.	N.A.	N.A.	1980	30-35,000	NIL	NIL	NIL	NIL	-	68,000 units/year in near future, less than 15 HP (see table 5 , gasoline model
THAILAND	N.A.	N.A.	60,000 ■	1980	150,000 ■	1	70	12,000	12,000	3-45 ■	30,000 units/year in 1974, same factory

■ Including diesel and gasoline engines more than 5 HP - ■ Progressive increasing of local content in the time - ■ Production starting in 1973-74 with 4,000 units/year in the range between 3 and 10 HP (see table 5) - ■ 50% used for agricultural purposes - ■ From 5 to 30 HP (see table 5) - ■ 3-4% less than 5 HP.

TABLE 7 - PUMPS : quantity, demand and manufacturing schedules

Country	Population		Density (ref. irrigated area)	Annual demand		Projected demand			Manufacturing capacity						
	hand operated (no.)	power operated (no.)	(units/1000 ha)	hand operated (no.)	power operated (no.)	year	hand operated (no.)	power operated (no.)	manufacturers (no.)	% of local content (%)	Hand operated		Power operated		foreseen development
											production	capacity	production	capacity	
BURMA	N.A.	N.A.	N.A.	N.A.	3,300	-	N.A.	N.A.	1	70	NIL	NIL	3,300	8,000	N.A.
INDIA	N.A.	1,400,000	40	N.A.	N.A.	1974	-	250,000	100	60-80	-	-	300,000	300,000	N.A.
INDONESIA	20,000	1,000	4	N.A.	3,000	1975	-	DEV	1	N.A.	N.A.	N.A.	2,000	N.A.	New factory for 1000-2000 units/year starting in 19
IRAN	80-90,000	14-16,000	34	N.A.	2,000	1975	N.A.	19,000	N.A.	N.A.	N.A.	N.A.	2,000	10,000	10,000 units/year in 19
KOREA	62,000	65,500	100	4,000	4,500	1980	10,000	9,000	13	60-80	5,000	-	2,600	130,000	10,000 hand and 9200 power operated units/year in 198 plus 1000 deep wells
NEPAL	N.A.	N.A.	N.A.	N.A.	N.A.	-	N.A.	N.A.	NIL	NIL	NIL	NIL	NIL	NIL	N.A.
PAKISTAN	500,000	84,000	48	N.A.	N.A.	1975	25,000	23,000	20	60-80	10,000	15,000	19,500	37,000	30,000 hand, 13,300 centrifuge and 1,700 deep well units/year in 198
PHILIPPINES	N.A.	100-120,000	140		10,000	1975	-	15-20,000	5	65	-	-	5,000	13,000	13,000 units/year in 19
THAILAND	N.A.	N.A.	N.A.	N.A.	20,000	1980		200,000	24	30-40	-	-	30,000	N.A.	Foreseen but not specified

Both hand and power operated models, 80% of which for agricultural use in the size less than 5 HP - Government foresees a big development for 8" Ø models to reach a density of 1 pump each 40 ha - Both hand and power operated models - [illegible] than 1500 deep well units in 1969-70, with a functionnal capacity of 5000 units/year - Hand operated models only for domestic use - Both hand and power operated models - Small sizes are only assembled.

into consideration yet and it should be solved in future times. However, a transplanting rational mechanization looks extremely difficult and, on present knowledges, successes obtained in realizing transplanters have been small. For this reason may be useful considering a gradual spreading of broadcasting, which is already practised on a certain extension of Wet-lands (from 10 to 18%) and successfully used in other parts of the world and particularly in Europe.

All this is related to the spreading of tractors, power-tillers and consistant machines for primary and secondary tillage, in addition to a large engines disposing.

These are the tendencies more or less emphasized in the different countries, to develop mechanization. However, on the basis of the collected informations, it does not seem possible to conduct a deeper analysis on future demands, following informations officially furnished by the countries themselves. These informations are, infact, rather uncertain (future demand of some machines is often valued in a 1 to 2 ratio), because, only in a very few cases it is based on a broad analysis.

The obtained figures are reported in table 3 to 10 which a general indication can be taken from : annual demand of the above mentioned machines is supposed to increase between 2 and 3 times in 1975, and about 4 times, compared to the 1970-71 situation, in 1980. In some countries, however, it can already be seen a clear tendency to reach a first target mechanization development for pesticide distribution, threshing and irrigation.

For this reason and considering how uncertain the situation looks, it is better to give indications on the optimal mechanization level and on the consistent machines population, rather than trying to guess - close by - the actual situation. This also because today situation does not look too good as far as models and sizes choises are concerned.

TABLE 8 - SPRAYERS AND DUSTERS : quantity, demand and manufacturing schedules

Country	Population			Annual demand			Projected demand											
	hand operated (no.)	knapsack power operated (no.)	tractor mounted (no.)	hand operated (no.)	knapsack power operated (no.)	tractor mounted (no.)	year	hand operated (no.)	knapsack power operated no.	tractor mounted no.	manufacturers (no.)	hand operated annual production no.	hand operated capacity no.	knapsack power operated annual production no.	knapsack power operated capacity no.	tractor mounted annual production no.	tractor mounted capacity no.	Manufacturing specifications
BURMA	27,000	500	NIL	N.A.	N.A.	N.A.	-	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	Nil.	Nil.	N.A.	N.A.	Foreseen but not specified increasing
INDIA	300,000		NIL	20,000		NIL	1974	N.A.	30,000	N.A.	40			30-40,000		N.A.	N.A.	Foreseen but not specified increasing
INDONESIA	60,000	18,000	N.A.	5,400	2,000	N.A.	1975	N.A.	N.A.	N.A.	4-8	1,200-1,500	1,500	Nil	Nil	N.A.	N.A.	Foreseen but not specified increasing
IRAN	130-150,000	22-24,000	N.A.	15-20,000	N.A.	N.A.	1975	30,000	15-18,000	N.A.	NIL	NIL	Nil	Nil	Nil	N.A.	N.A.	Foreseen but not specified increasing
BURMA	365,000	96,000	3,300	95,000	20,000	1,500	1975	130,000	25,000	1,500	17	80,000	120,000	14,300	81,300	NA	NA	Foreseen but not specified increasing
NEPAL	few hundreds	N.A.	NIL	N.A.	N.A.	N.A.	1975	300	200	N.A.	NIL	NIL	NIL	Nil	Nil	N.A.	N.A.	N.A.
PAKISTAN	50,000	10,000	100	N.A.	N.A.	N.A.	1975	NIL	30,300	1,400	8							Foreseen but not specified increasing
PHILIPPINES	80,000		N.A.	10,000	5,000	N.A.	-	N.A.	N.A.	N.A.	6-8	4-5,000	4-5,000	Nil	N.A.	N.A.	N.A.	Foreseen but not specified increasing
THAILAND	N.A.	N.A.	N.A.	27,000		NIL	-	N.A.	N.A.	N.A.	3-4	1,000	1,000 qy	Nil	N.A.	Nil	Nil	N.A.

■ Foreseen but not specified increasing - ■ Production and capacity meet local demand.

3.3 - Concerning facilities given by the Governments to farmers to help purchasing of machines, table 13 clearly shows that shorter and longer loans, at quite different interest rates, are given almost everywhere. However, only few farmers seem to be using these facilities, because of lack of knowledge of the facilities themselves and lack of money. It is advisable that loans for agricultural machines should be given with 5-7 years term at very low interest rates; moreover Government gift contributions amounting to some % of the machines value, may be necessary. Of course machines have to be really useful, well used and consistent with the farm's needs, so that there should be a careful control of loans, these to be especially given to cooperatives and according to the gross output value. Studies should be conducted to determine the optimum mechanization levels and to certify the performances of machines to give loans for.

To complete shaping the actual situation it should be reminded that, in most cases, repair, maintenance and extension services, technical and mechanical training for farmers together with training for mechanics and repair-men are not so developed (table 14). These services should be improved and should increase together with the spreading of mechanization; researches on the standardization of models, machines sizes and their parts should be conducted, too, in order to obtain the minimum costs and the greater semplification of after-sale service. These should be accomplished by mean of an organization based on main centers, for deep revisions, divided in sub-centers equipped with mobile workshops for everyday maintenance.

It should also be mentioned the sector of agricultural machines research, which belongs to different Universities or to the Ministries of Agriculture. This sector is under developed and - even if there are high level scientists who often studied abroad - the units are not sufficiently provided with scientific and experimental equipments. Not always, infact, modern researches really useful for a rational development of agricultural mechanizations are conducted and some types of research already performed by most technologically advanced countries are often followed. There is also a complete lack of standardization

studies and, besides very few cases, of mechanization. The already existing units should be encouraged and developed - because of their very important function - and their activities should be coordinated both at country and regional levels.

4 - PRODUCTION AND SUPPLY OF AGRICULTURAL MACHINERY

4.1 - In the 9 visited countries, the development level of tractor and agricultural machines factories is very low and does not seem up-to-date compared to the general industrial development of the countries themselves.

While in some cases agricultural machines production is going through an almost static phase, in other countries initiatives rise, incentives and facilities are given by the Governments and the whole situation seems to be quite a dynamic one. On the other hand it should be said that not always developments are coordinated and oriented, choices coherent, priorities clearly stated and technical assistance assured. The last one, infact, is seldom conducted through specific study and research centers (often known as Metal Industry Development Centers) having precise functions in helping planning, choices of materials and quality control. Anyway, these centers are not always connected with agricultural machinery research centers, so that choices of machines, models and sizes to be made are sometimes insicure and not rewarding. In other cases, on the contrary, this strong coordination exists and the activity - which is starting right now - is following correct and rational trends.

Tractors and agricultural machines production is, in the whole, still very modest, without coordination and clear purposes and it is mainly following the U.S. and Japan experiences. Most of large and medium scale manufacturers hold joint-ventures with foreign companies. Only in very small production the ingenouity of crafts

TABLE 9 - THRESHERS : quantity, demand and manufacturing schedules

Country	Population		Annual demand		Projected demand			Manufacturing capacity					
	hand operated (no.)	power operated (no.)	hand operated (no.)	power operated (no.)	year	hand operated (no.)	power operated (no.)	manufacturers (no.)	hand operated production	hand operated capacity	power operated production	power operated capacity	future development
BURMA	N.A.	N.A.	N.A.	N.A.	-	N.A.	N.A.	1	NIL	NIL	1,000	2,000	Foreseen but not specified
INDIA	500,000		20,000		1974	N.A.	50,000	80-100 ■	N.A.	N.A.	N.A.	N.A.	Foreseen but not specified
INDONESIA	2,500	500	N.A.	500	-	N.A.	N.A.	2	NIL	NIL	200-300	600-800	In a 4-5 years foreseen a doubling of production
IRAN	NIL	1300-1500 ■	NIL	500-800	1975	NIL	15-18,000	2	NIL	NIL	1,200	N.A.	Foreseen but not specified
KOREA	400,000	41,000	10,000	7,100	1975	N.A.	10,000	48	14,000	20,000	8,600	14,800	Foreseen but not specified
NEPAL	N.A.	NIL	N.A.	NIL	-	N.A.	N.A.	NIL	NIL	NIL	NIL	NIL	N.A.
PAKISTAN	few tens	800 ■	N.A.	N.A.	1975	4,500 ■	6,000 ■	10	NIL	NIL	3,000	10,000	Foreseen but not specified
PHILIPPINES	N.A.	9-10,000	1,500	3,500	1975	N.A.	8,000	3-4	■	■	■	■	Foreseen but not specified
THAILAND	N.A.	N.A.	NIL	100	-	N.A.	N.A.	NIL	NIL	NIL	NIL	NIL	N.A.

■ Very small scale factories - There are also 4 manufacturers of combine harvesters - ■ Paddy threshers - ■ For wheat and, subsidiary, for paddy -
■ Capacity and production are not certainly known but they seem to meet annual demand; local content 40%.

men and local mechanics is fully applied, manufacturing - with a complete lack of modern technical instruments - simple but well-conceived equipments which are completely fitting agricultural needs. This is done, for example, by very small factories as the ones of power-tillers, in Thailand, and of threshers, seeders and cleaners in Philippines, etc..

It is interesting to point out two elements which have been seen in every country :

- the gap between annual production and production capacity in almost every factory can be expressed through a 1/2 ratio but, in some cases, it seems to be much higher;
- the labour's productivity is going - as an average index - from 1500 to 2000 $/year per worker, and it seems is due to low wages and to low capital investments for equipments.

4.2 - On these premises basis, now it seems useful to examin the production capacities of the 9 visited countries. An analysis of the existing situation shows that :

- total tractor production (26.5-70 HP) is about 25-26,000 units per year, with a foreseen capacity of developing up to 150-170,000 units per year by 1980. The actual production - which consists of simple assembling in Indonesia, Pakistan and Philippines, of assembling or local making in 2 other countries and reaches in the remaining ones a 80% value of local content - meets 50% of annual demand. Considering the foreseen developments by 1980, it should meet 80-90% of local demand, as stated by the Governments; these data, anyway, can't be completely taken for granted. There are about 20 factories with a production capacity going from a minimum of 1,000 assembled units per year (Indonesia, Korea, Philippines, Thailand), to a maximum of 15-20,000 units/year (India);
- power-tiller production (4-12 HP) is about 11-12,000 units/year with a foreseen expansion capacity up to about 100,000 units/year by 1980. Actual production - which presents a local content value

TABLE 10 - DRYERS AND HULLERS : quantity, demand and manufacturing schedules

Country	Population		Annual demand		Projected demand			Manufacturing capacity			
	dryers (no.)	hullers (no.)	dryers (no.)	hullers (no.)	year	dryers (no.)	hullers (no.)	manufacturers (no.)	dryers (no.)	hullers (no.)	future development
BURMA	NIL	2,000	N.A.	N.A.	-	N.A.	N.A.	1	NIL	50	Foreseen but not specified, both for small and big capacity plants
INDIA	few hundreds	50,000	N.A.	N.A.	-	N.A.	N.A.	40	N.A.	N.A.	N.A.
INDONESIA	600	28,000	few tons	1,000	-	N.A.	N.A.	2	NIL	700-800	Priority in the Government programmes
IRAN	NIL	3-3,500	NIL	3-400	1975	N.A.	800-1000	N.A.	N.A.	N.A.	Foreseen but not specified, both for small and big capacity plants
KOREA	350	17,800	300	2,000	1975	3,000	5,000	12	500	5,000	Production meets demand
NEPAL	NIL	1,800	N.A.	N.A.	1980	3-400	300-400	NIL	NIL	NIL	Priority in the Government programmes
PAKISTAN	few tens	few hundreds	N.A.	N.A.	-	N.A.	N.A.	N.A.	NIL	N.A.	Foreseen but not specified, both for small and big capacity plants
PHILIPPINES	few tens	8,000	NIL	800-1000	-	N.A.	N.A.	3	NIL	1,500	Foreseen but not specified, both for small and big capacity plants
THAILAND	few tens	20,000	NIL	50-80	-	N.A.	N.A.	16	NIL	2,500	N.A.

Average work capacity : 0.9 tons/h - Use of bigger and bigger plants - 80% with a work capacity of more than 5 tons/day - Priorities in the Government programmes of development - Average work capacity:1 ton/h; models with 3-5 tons/h capacity are considered of interest in the future - Work capacity between 1 and 3 tons/h - Work capacity:0.4-0.8 tons/h.

from 30 to 80% - meets 50-60% of annual demand; with the foreseen development, it should meet 70-80% of officially estimated demand by 1980. There are about 20 factories, with a capacity going from 400-500 units/year (Thailand), to 10,000 units/year (Korea);

- 5 HP or more diesel and gasoline engines production is about 350-360,000 units/year; only a part of this production is used for agricultural purposes. There is a foreseen expansion capacity up to 500,000 units/year by 1980. The production is divided into a great number of factories some of which are very small and completely lacking in quality control. Only in one case, is consisting in simple assembly, with a foreseen progressive increase of local content (Indonesia). Infact, in the other cases, average value of local content is about 50-70%. The gap between production and demand varies from one country to the other : in Indonesia, Nepal and Philippines, agricultural engines are almost totally imported; in Thailand, demand is 5 times larger than local production while, in all the other countries, production and demand are practically standing by;
- 5 HP or less micro-engines production is made only in 3 out of the 9 visited countries (India, Korea, Thailand) and amounts to 50,000 units/year; a new production is starting in Indonesia. Actual production (whose local content value varies from 0 - assembly - to 70%) is very inferior to demand, meeting only a 30-35% of it. According to the foreseen development, it should meet up to 50-55% by 1980.There are about 30 factories, with a very limited production capacity; only 3-4 factories manufacture more than 5,000 units/year.

If this is a short summary concerning tractors and engines manufacturing,there are only very uncertain data concerning the main categories of agricultural machines for rice-growing production. It often consists of very small factories scattered all over the countries,which are very difficult to control. This is true especially as far as hand tools, plows and other implements for secondary tillage are concerned; they are mostly locally produced for animal-drawn. On the contrary, the same implements (mechanically drawn) are either imported or made (with variable local content) in existing factories as second

or third product. Besides these specific sector, the manufacturing situation of paddy-growing machines can be summarized as follows :

- pumps production is rather developed and spread; it is slowly decreasing concerning hand operated models and increasing concerning power operated ones (sizes : 2"-8" Ø). The latter models production capacity is about 120,000 units/year (30-80% local content) compared to a 60-70,000 units demand, for agricultural use. The foreseen development has not been clearly stated (excluding some countries as Iran, Korea and Philippines) as well as future annual demand. Factories are valued around 160-170 units, all small-medium capacity, besides 3 or 4 plants in India;
- sprayers and dusters production is done in 7 out of the 9 visited countries, as far as hand operated models, and in only 3 countries (India, Korea and Pakistan) as far as power operated and tractors mounted models are concerned. According to the Governments' plans, these models should locally be made by 1980 in almost every country, meeting some 50-60% of 1980 demand;
- threshers production concerning hand operated models, exists in 3 countries (India, Korea and Philippines) and, concerning power operated models, in 7 countries by 150 small and medium-sca'e factories. Production meets internal demand, which is quite modest, today, and will grow up to 5 times by 1980. For this production a future development of p.t.o. driven models is forecast, but not clearly specified;
- dryers production - whose utility has been never taken into consideration except in Korea and India (manufacturing countries) - does not practically exist. In almost every countries, by 60 small-scale industries hullers and other machines for paddy processing (small working-capacity less than 1 ton/h) are made.

It can be interesting now to express a development index showing the relation existing among production capacity of the above mentioned sectors and countries' needs in terms of mechanization and cultivated areas. This index is roughly showing the countries having better facilities for internal development in terms of local production of

machines for paddy mechanization and the sectors where an help might be needed. Concerning tractors, for example, Iran is presenting a more advanced situation having an annual production capacity of 1 tractor per every 900 Ha of cultivated area (average of the European Common Market : 1 tractor/year per every 200 Ha); Burma, India and Philippines have a production capacity about 1 tractor/year per 3-4,000 Ha; Pakistan, 1 tractor/year every 5,500 Ha and Thailand 1 tractor/year every 8,500-9,000 Ha. These relations are almost valid, also concerning power-tillers production capacity, excluding Korea which has a manufacture capacity of 1 power-tiller per year every 80 Ha. This high capacity is 6 times bigger than annual production.

The above mentioned figures mean that if, for example, the tractor production capacity of a country (excluding the problems of choice of models, local content etc.) is 1 unit per year every 4,000 cultivated Ha and it is going to remain the same in the future, to reach a complete and rational mechanization of agriculture no less than 150 years will be needed. From this comes the necessity to plan production developments, in times and ways to be defined only through accurate and deep studies.

On engines it can be said that, for the 5 HP or more ones, industrial capacities for India (1 unit/440 Ha) and Pakistan (1 unit/770 Ha) have to be doubled to adequate them to the development needs, while Iran's capacity is already quite adequated and Korea's one is even overabundant. At the same time, Burma and Thailand present the necessity of a big production development, as well as the other countries lacking of engine factories. Micro-engines (less than 5 HP) are produced only, on a very small scale, in India, Korea and Thailand and there is complete lack of production capacity in all the countries.

Concerning pumps, production should be developed in Indonesia (whose specific capacity is 1/10 of the other countries' one), Burma, Iran, Philippines and Pakistan. Excluding Korea, all countries need a fast development in the power operated threshers sector. The situation of knapsack power operated sprayers, dryers and hullers, whose production is lacking in every country, looks much more serious.

All this does not fully present the development situation of tractors and agricultural machines local construction, but it is useful to emphasize some aspects. The mentioned needs, disaggregated per country and per machine's size and model, will be discussed later in this report, following the analysis on the optimum mechanization of paddy areas.

It now seems more useful to conduct an exam on the present situation, as it has been seen, and on its future development, according to official plans. It should be pointed out that, excluding some peculiar cases, production is made in medium and small-scale industries; technical features look, in the whole, satisfactory even if foundry techniques, heat treatment and quality control do not completely meet requirements. All these 3 sectors need to be developed and improved.

Another problem which should be reminded concerns the lack of spare parts and machines standardization; such standardization is necessary to reduce both production and maintenance costs. Factories often present a very large products diversification, even operating onsmall scale. Typical is the example presented by a factory which will manufacture 2,500 engines per year in the range between 10 and 140 HP. This large diversification increases : costs for raw materials, finished and semifinished products supplies; need of large store-houses for spare parts; production costs because of a considerably reduced labour productivity.

According to researches conducted in many European countries it can be said that models and parts standardization brings along an increase of work productivity (for example, saving of time needed for changing tools in the machines) which is about 10-15%, with a consistent cost reduction. If we add by this, advantages coming from reduction costs for semifinished products, raw materials and spare parts semplification, it is possible to reach a production cost reduction of about 15%. This, of course, is true on european conditions where the average productivity of agricultural machinery manufacturing labour goes up to 12-13,000 $ per year and therefore is 8 to 10 times

higher than the average one in the visited countries.

In consequence, stated the differences existing between the 2 situations, especially concerning investments for equipments, it can be said that standardization could bring, in the ECAFE countries, 8-10% rating economical benefits, without charges in other production parameters. The problems of raw materials supplies and spare parts storehouse still remaining the same.

Attention should be also given to casuality through which productions and machines to be made are planned.

It seems advisable that the Governments on the basis of data and researches, lead and guide production decisions which aim to finalize production efforts and industrial development according to priority criteria. For this purpose - besides supporting small industries. which are not equipped with technical staff, to improve productions - organizations such as the Metal Industry Development Centers or similar ones, whose goal of technical assistance seem foundamental, should be enlarged and developed.

On organization and facilities in technical and productive terms, the visited factories present considerable diversifications: in some cases - especially the largest and the most modern ones - there are well equipped and organized workshops. As examples we can mention : Rana Tractors and Beco in Pakistan; Escort, Vicon and V.S.T.Tillers Tractors in India; Dae Dong in Korea; Thais Hang Long Co. in Thailand; Marsteel Corporation and Bormaheco Inc. in Philippines; Quick in Indonesia; Ashtad Icon Mfg. in Iran. However, generally speaking, most factories are scarsely furnished with facilities and tool machines are often too old; for this reason, this production has to be limited to carpentry and assembly, by purchasing many parts abroad. Some factories also support themselves, according to old fashioned production concepts, on a small foundry for their needs. Anyway all industries have capable and skilled workers, most of whom acquired their experience in the factories themselves because of technical schools lacking. Owners present big contractor capabilities which deserve to be protected, encouraged and coordinated, in the frame of the actual labour producti-

vity level and foreseeing slow and long term increases. The problem is to choice the right machines to be manufactured, to see how to make them and which local content with , to find out annual production in relation with market' needs, aiming at the most economical production.

Principles of the economies of scale are not practically taken into consideration, especially in defining single industries production capacities. This problem - even if, as mentioned above, low investments industries are not so interested as the ones with high investments - looks more and more important every day. As it has been proved by american and european experiences, if production in a mechanical factory doubles, costs will have only a 40-60% increase, depending on the investments and on the kind of production. As investments weight on production between 6 and 15%, all this will carry along saving in production costs not inferior to 3-9% of total value.

4.3 - The situation concerning raw materials production and ancillary facilities is not far different from the tractors and agricultural machines one but usually a little more advanced and constantly developing. This situation is summarized in tables 11 and 12, showing, for some main products actual local production and its correspondence to the present and future manufacture of tractors and agricultural machines.

In general terms, it can also be said that all the visited countries are rich of natural resources which have not been completely explored and whose utilization has only recently been started; factories for raw materials production are slowly developing. In some countries, the development plan for this sector is only presented in general terms and it does not seem to be based on a precise programme of the development itself, according to coordinate priorities and in connection with other economical sectors.

According to official sources, good facilities for tyres production are given now only in India and Korea, while their extension is

TABLE 11 - **AECILLARY PRODUCTS : local production adequate (A) or inadequate (I) to tractors and agricultural machinery manufacturing needs**

Country	Tyres		Pistons		Gears		Bearings		Chains		Batteries		Fuel injection pumps		Carburettors		Tool machinery	
	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980
BURMA ■	NIL	I	N.A.	N.A.	N.A.	N.A.	NIL	N.A.	N.A.	N.A.	NIL	N.A.	NIL	NIL	NIL	NIL	NIL	I
INDIA ■	A	A	I	A	NIL	I	NIL	NIL	A	A	A	A	I	A	N.A.	1	I	A
INDONESIA ■	I	I	NIL	I	I	A	NIL	I	N.A	I	I	A	NIL	NIL	NIL	NIL	NIL	I
IRAN	I	A	NIL	I	NIL	A	NIL	A	NIL	A	A	A	NIL	1	NIL	A	1	A
KOREA	A	A	I	A	A	A	A	A	A	A	A	A	NIL	1	NIL	I	NIL	I
NEPAL	NIL	NIL	NIL	NIL	NIL	I	NIL	NIL	NIL	I	NIL	I	NIL	NIL	NIL	NIL	NIL	I
PAKISTAN ■	1	A	A	A	A	A	A	A	I	A	A	A	NIL	N.A.	NIL	N.A.	I	A
PHILIPPINES	I	A	NIL	NIL	I	A	NIL	NIL	I	A	I	A	NIL	I	NIL	I	NIL	I
THAILAND	I	A	I	A	NIL	I	NIL	NIL	NIL	I	I	A	NIL	NIL	NIL	NIL	NIL	I

■ In 1980 production will meet 60-70% of local needs - ■ In 1980 production will meet 80% of local needs - ■ In 1980 production will meet 70% of local needs.

TABLE I2 - RAW MATERIALS AND ANCILLARY FACILITIES : local production adequate (A) or inadequate (I) to tractors and agricultural manufacturing needs

Country	Hot-rolled carbon steel		Hot-rolled alloy steel		Cold drawn carbon steel		Hot-rolled shapes, sheets and strips		Gray iron malleable		Rubber parts and gaskets		Hydraulic parts		Foundry		Steel casting		Non ferrous casting		Steel forging		Heat treatments	
	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980	actual	1980
BURMA	I	A	NIL	I	NIL	I	I	I	NIL	I	NIL	I	NIL	NIL	I	I	I	A	NIL	I	I	I	I	A
INDIA	I	A	NIL	I	I	A	A	A	I	A	I	I	I	I	I	A	I	A	I	A	I	A	I	A
INDONESIA	NIL	I	NIL	NIL	NIL	I	NIL	A	NIL	A	NIL	I	NIL	NIL	NIL	I	I	A	NIL	I	I	A	I	A
IRAN	I	A	NIL	A	NIL	A	A	A	I	A	I	I	NIL	I	NIL	A	I	A	NIL	A	NIL	A	I	A
KOREA	I	A	NIL	I	I	A	I	A	NIL	I	I	I	NIL	I	I	A	I	A	NIL	I	I	A	I	A
NEPAL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	I	I	A	NIL	NIL	NIL	I	I	A
PAKISTAN	I	A	NIL	I	I	A	I	A	I	A	I	A	NIL	I	I	A	A	A	A	A	A	A	I	A
PHILIPPINES	NIL	I	NIL	I	NIL	I	I	A	NIL	I	NIL	I	NIL	I	NIL	I	I	A	NIL	I	I	I	I	A
THAILAND	NIL	I	NIL	I	NIL	I	NIL	I	NIL	I	NIL	I	NIL	NIL	NIL	I	I	I	NIL	I	I	I	I	A

planned to reach Iran, Pakistan, Philippines and Thailand by 1980. Pistons production adequated to internal demand exists only in Pakistan and will be extended to Korea, India and Thailand by 1980. Gears, chains and batteries will be probably manufactured in every country by 1980, while bearings will be made just in Iran, Korea and Pakistan (only in this last country present production is already meeting internal demand). Fuel injection pumps and carburettors will probably be manufactured by 1980 in India, Korea, Pakistan and Philippines.

Finally, concerning tool machines, they are actually manufactured - even if quantity and models are not always adequated to local needs - in Iran, Korea and Pakistan. At least concerning the most comon models, other countries will soon be producing the same sort of machines too.

Concerning raw materials and ancillary facilities useful for local tractors and agricultural machines manufacture, their production - even if not always adequated to internal needs - together with the development of foundry, casting, forging and heat-treatments, will be eventually assured in every country, by 1980, excluding - for some products - Indonesia, Nepal, Philippines and Thailand.

It can be pointed out that, in the next 10 years, it will be possible to obtain a considerable development in the local construction of tractors and agricultural machines with local content not inferior to 50-60%, in comparison with a 15-20% present average value, on reference to all countries and all products.

Such perspective seems to be a really good one, even if there are doubts that such increase can be obtained insuch a short period of time, considering the present average level of industrial development. This development, in any case, will bring along increase and springing up of organizations and centers for materials control, size unifications, study and research.

4.4 - To speed up the development and to help new industrial investments in every country, facilities credits at low interest, tax exemptions, duty free, etc. are given, as shown in table 13. There are no

TABLE 14 - OTHER GENERAL CONDITIONS AND FACILITIES WITH REFERENCE TO AGRICULTURAL MECHANIZATION

Country	Research	Testing	Standardi-sation of local pro-duction	Schools for skilled wor-kers	Schools for technicians	University	Technical training for farmers	Training for repairmen and mechani-cians	Extension Service	After sale service
BURMA	I	I	I	I	A	NIL	NIL	I	NIL	I
INDIA	I	A	A	I	A	I	I	I	I	I
INDONESIA	I	I	I	I	I	NIL	I	I	I	I
IRAN	A	A	I	I	A	NIL	I	I	I	I
KOREA	A	A	A	I	A	NIL	I	I	I	I
NEPAL	NIL	NIL	I	I	I	NIL	NIL	I	NIL	I
PAKISTAN	I	I	I	I	I	NIL	I	I	I	I
PHILIPPINES	I	I	A	I	A	NIL	I	I	NIL	I
THAILAND	I	I	A	NIL	A	NIL	I	I	NIL	I

Including NRRI

I = inadequate to local needs A = adequate to local needs

precise informations on the facilities given by the Government of Burma, while, as far as Nepal is concerned, the actual plan does give priority not to the mechanical sector development but to agricultural products processing plants.

In all the other countries, on the contrary, incentives are given according to declared priorities concerning choices of the kinds of machines to be manufactured, on the basis of production sizes (the greatest facilities are assigned to small-scale industries, that means to factories which, excluding land and buildings, ask investments less than 100,000 $). This is also depending upon the places where they are going to be installed : rural areas are favoured in comparison with urban ones. Governments usually favour joint ventures with well reputed industries of more technologically advanced countries; in some cases, profits can return to the joining country.

Some countries - say Iran and Pakistan - are presently studying (together with Turckey) common productions able to supply regional markets, rather than national ones. The goal is to obtain a greater annual production and a greater specialization in each factory, which brings economical benefits coming from the economies of scale.

Such cooproduction among the ECAFE countries has to be encouraged through proper incentives, once productions and priorities have been fixed.

To complete drawing the whole situation, it should be said that researches in the mechanical sectors are insufficiently developed, often not too strictly related to real problems and they have to be improved and coordinated. Same things can be said about technical assistance for factories, quality control and technical training at different levels. The technical assistance conducted by centers and industrial corporations in the different countries, in favour of manufacturers, seems to be quite useful. Anyway the just mentioned centers should operate in strict connection with the agricultural machines research and testing units. They also need to be coordinated and improved; big progresses have to be obtained in the technical training sector.

Universities hold a good role even if, for unavoidable reasons

TABLE 13 - GOVERNMENT FACILITIES FOR AGRICULTURAL MECHANIZATION DEVELOPMENT

Country	Agricultural machinery purchases			Agro-industrial investments					
	loans		particular conditions	loans		tax exemption	customs exemption	minimum local content requested at starting	particular conditions
	term (years)	interest rate (%)		term (years)	interest rate (%)	(years)	(years)	(%)	
BURMA	N.S.	N.S.	Maximum help to cooperatives	N.S.	N.S.	N.S.	N.S.	N.S.	—
INDIA	5-7	5	Difference in interest rate payed by Gov. on 75% of value	5-7	N.S.	N.S.	N.S.	30	Only for plants requiring less than 100,000 $ of capital investment - Government gives technical assistance
INDONESIA	3	12	—	N.S.	N.S.	N.S.	N.S.	assembly	—
IRAN	6	7.15	—	5	9	5	*	assembly	Possibility to transfer profits abroad - incentives granted only for plants more than 120 km far away from Teheran
KOREA	5 ■ 3 ■	9 9	On 70% of value On 50% of value	7	10	N.S.	N.S.	N.S.	Incentives granted for joint ventures to produce only machines of Government recognized priority
NEPAL	5-7	9	Cooperatives are favoriesd	N.S.	N.S.	10	10	assembly	Possibility to use 65% of the foreign exchange earned by export
PAKISTAN	5	8	—	5	N.S.	N.S.	N.S.	assembly	Incentives are different according to priorities stated by Government and to areas where factories will be installed
PHILIPPINES	10	9	Maximum loans of 100 $/ha	5	N.S.	N.S.	N.S.	assembly	Antidumping protection, accelerated depreciation, remittance of earnings and repatriation of investments-Facilities vary according to the fact if a factory is or not pioneer. Maximum facilities to small scale industries
THAILAND	3	9-10	The Government gives a 50% contribution to cooperatives	7	9-10	5	5	assembly	Maximum facilities for plants installed in rural areas far from Bangkok, with a production capacity of not less than 100 tractors/year or requiring minimum investment of 10,000 $

■ To purchases power-tillers, plows, rotavators, trailers and power operated sprayers - ■ To purchase other machines

N.S. = Incentives are greater but not specified

they sometimes are too far from practical application.

5 - OPTIMUM MECHANIZATION PLANNING AND CHOICE

5.1 - The analysis conducted in the first part of this report was only be meant to point out different aspects of the present situation, its faults and its positive elements, without deeply penetrating into the foreseen development of mechanization and tractors and agricultural machines local construction. This has been purposely avoided because in the different plans some contradictions, concerning supply and demand and the ralation between their increasement, have been detected.

Therefore, it's quite difficult to give precise indications on the future. They can be formulated only in a wide range of hypothesis and after long researches on local conditions and real avolution possibilities. It seems more useful, to give some indications - mostly from a methodological point of view - on how to plan mechanization development on paddy areas. Such development should become a foundamental basis to forsee a rational and coherent evolution of manufacturing industries. It should also be said that a certain mechanization level - as we have already written - corresponds to a particular socio-economical condition. This can be expressed through a mechanization index I_m comparing the share of machine work in the total human and machine work and represented by a certain group and size of machines. Each level offers a determinated labour productivity and lows working costs in connection to machines and labour costs.

If different levels of mechanization, bringing over different labour productivities and different costs of equipments, are taken as hypothesis, the optimum levels, able to reduce total costs to a minimum in the different conditions, can be found out, in relation to labour costs.

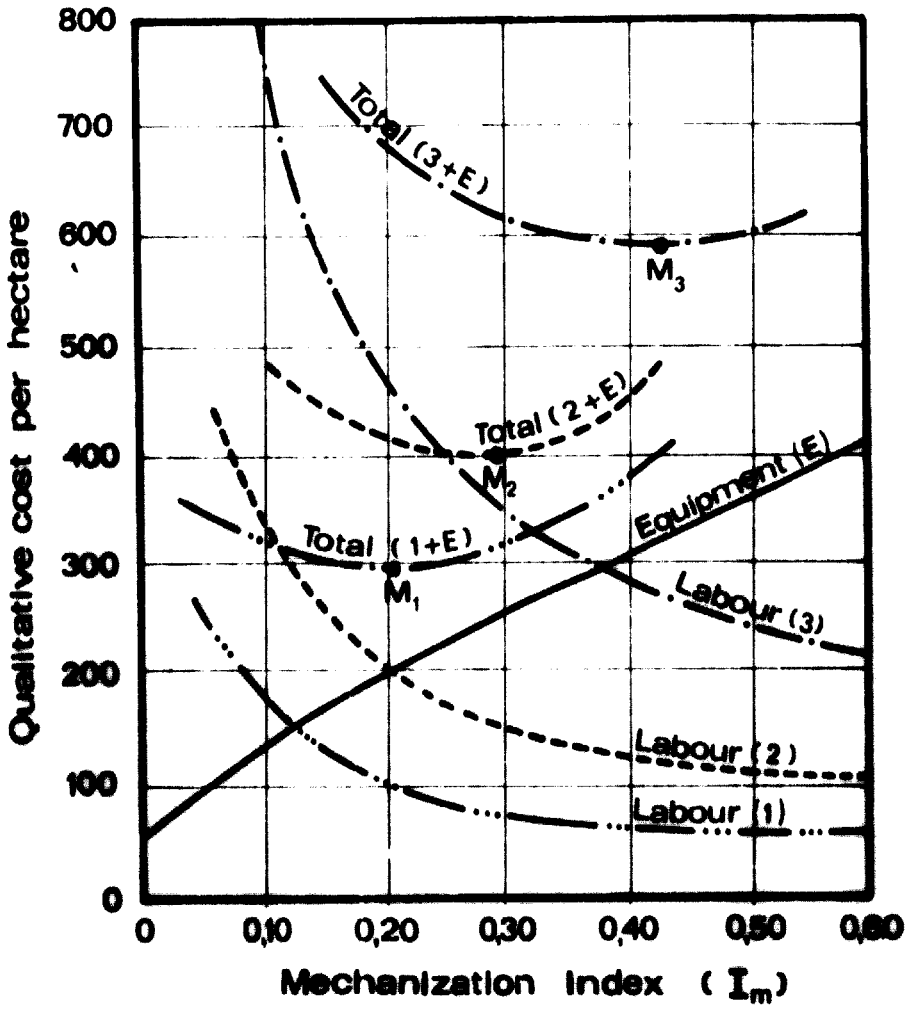


Fig. 1 - Relation among mechanization index, machine costs, labour costs and total costs (machines + labour) per Ha. Points M_1, M_2, M_3 represent the minimum total costs, when wages are 0.75, 1.50 and 3.50 $ per day. In such cases, optimum mechanization index results : I_{m1} = 0.20, I_{m2} = 0.30; I_{m3} = 0.42.

5.3 - On such a basis - which has been developed for the first time in an organic and complete way by Mr.T.Nowacki some years ago - it has been looked for a solution to our problems, considering : 4 different mechanization levels (by manual and animal means; by using 12-14 HP power-tillers; by using 20-22 HP tractors, 4-wheel drive; by using 30-35 HP tractors - the last machines, equipped with consistant implements for primary and secondary tillage, for bunds reconstruction, ditches escavation and maintenance, irrigation and transports) and 3 different wages levels, 0.75 $/day, 1.50 $/day and 3.50 $/day. These three levels, compared to the first level called = 1, based on animal drawn equipment and having a mechanization index I_m = 0.12, permit to reach a productivity increase on the total work, as follows :

12-14 HP power-tiller : I_m = 0.20 productivity index = 1.15

20-22 HP tractor : I_m = 0.30; productivity index = 1.40

30-35 HP tractor : I_m = 0.42; productivity index = 1.65.

Considering that with animal drawn equipment paddy asks about 1,400 man.hours/crop, with power-tillers such work goes down to 1,200-1,250 man.hours/crop, with 20-22 HP tractors to 950-1,000 man.hours/crop and with 30-35 HP tractors to less than 850-900 man.hours/crop. The last figure, by way of mechanizing other practices (such as fertilization, pesticides distribution, broadcasting and transplanting) can be considerably reduced in further times.

On these basis graphics of figure number 1 clearly shows that, while with present labour wages the minimum cost M_1 (as far as machines are completely utilized all through the year and can work on adequated surfaces) is obtained with I_m = 0.20 (power-tillers).Only when labour wages will reach about 1.50 $/day (curve :Labour 2)the mechanization index will be I_m = 0.30 (20-22 HP tractor) and only when labour wages will amount to more than 3 $/day it will be convenient to introduce I_m = 0.42 and then to use 30-35 HP tractors.According to the graphic curves, animal mechanization already seems now to be more expensive - excluding particular conditions - than the use of power-tillers.It can also be seen that - at last in a large portion of Wet-lands - the use of

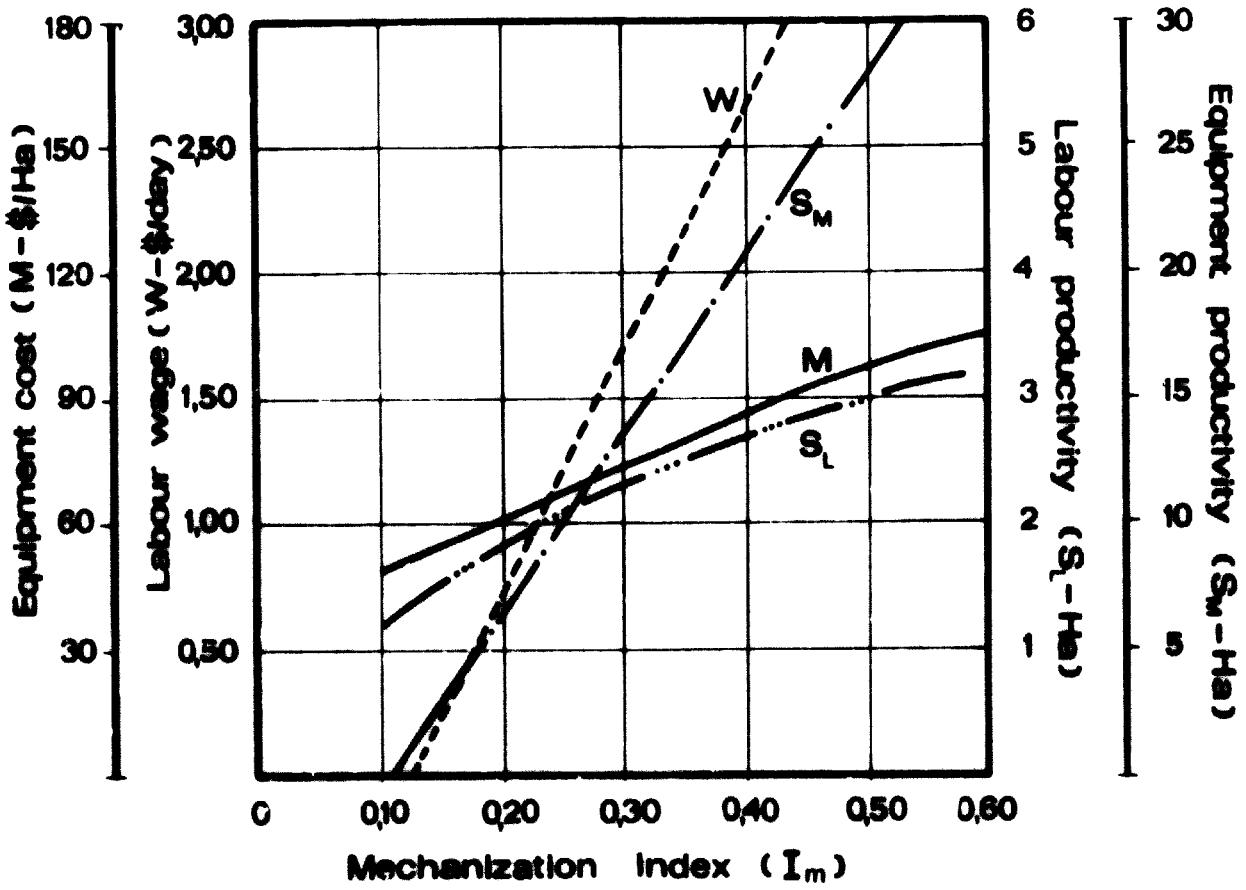


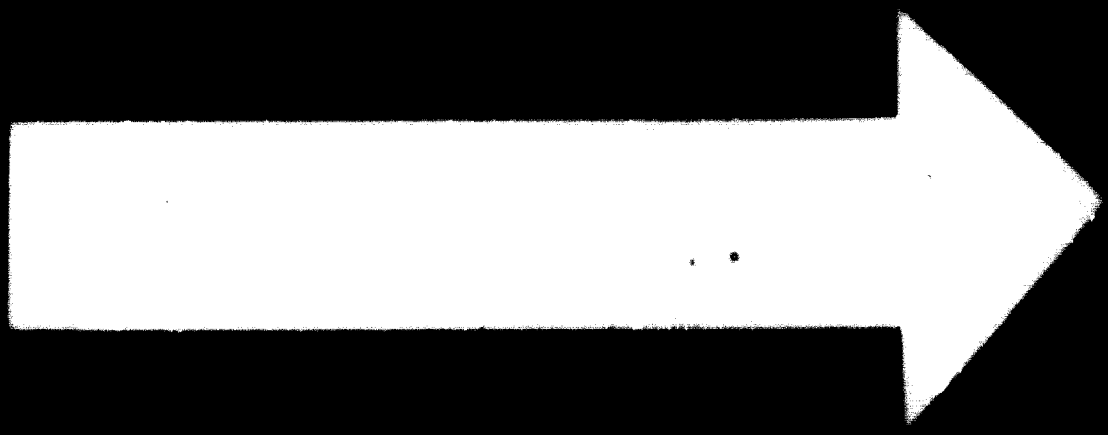
Fig. 2 - Variations of the optimum mechanization index, depending on labour wage (straight line W). For the different I_m the equipment cost vary according to curve M; labour and machines productivities vary according curves S_L and S_M.

tractors of bigger size than the indicated ones, more sophisticated and capable of a greater productivity, as the ones actually realized and sold in the ECAFE countries, can only make the economical situation worse and increase total production costs, besides increasing to much labour productivity.

It is not possible to indicate when social conditions which will bring 3-3.5 $/day will be reached. It could happen in 10 or in 20 or even in 30 years. It is sure, anyway - as clearly shown by the line W in fig. 2, which relates labour wages with I_m, and by the curve M, which relates mechanization index with equipments costs - that the use of more than 30-35 HP tractors will not be convenient until that time.

Generally speaking and perhaps excepting Iran, present period seems to be the best one for using power-tillers equipped with consistant equipments. Their use brings along a 15% productivity increase compared to the actual situation. This means that, if ever power-tillers would be generally used, only 87 out of 100 agricultural workers could find a rational employement in agriculture. The remaing 13 should settle on new activities such as manufacturing, selling and after sale servicing of power-tillers and equipments. The above mentioned percentage seems to be quite close to reality.

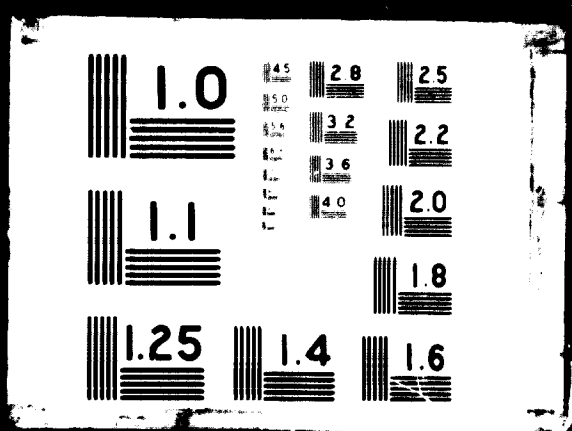
That is true only concerning mechanization of some works related to paddy growing and especially primary and secondary tillage, irrigation and transports, and does not take into account all the advantages coming from the improvements of works in consequence of a rational machines use. What we have said is not the whole problem. Infact, it seems useful to think about the mechanization development for paddy harvesting and threshing and the spreading of dryers and modern hullers, besides mechanization of pesticides distribution through knapsack power operated sprayers. This should be done in order to remarkably reduce losses of product which depend from the way treatments are conducted, and in order to conduct treatments themselves in time. Such are the advantages coming from a mechanization consistant with the above defined level, that they simply overcome the just mentioned economical problem. Infact, it has to be considered



7. 8. 74

2 OF 2

04425



that - excluding harvesting - machines can operate on rather large areas, considerably reducing their cost incidence per hectare or per ton of product.

It seems quite important to employ :

- self propelled reaper binders simple, strong and low cost - which can in case be connected with the above mentioned power-tillers - utilizing also for other crops;
- mobile drum threshers working on stationary position, power operated, as the very good model recently realized by IRRI;
- small dryers, mobile model, able to serve few tens hectares area each;
- bigger and more sophisticated hullers, able to serve few hundreds hectares area each.

It should be added that, while there are no problems for spreading threshers, dryers and hullers, 10-14 HP self propelled reaper binders can increase 5-6 times hand labour productivity. So that,at least at the beginning, their introduction should be limited to areas with 2 crops per year and having an average yield production not inferior to 2 tons/ha.

5.3 - The problem, now, is to see which surfaces can be worked by each farmer and by the different tractors, considering, on one hand, the needs to have timely practices execution and,on the other hand,their useful life. In consequence, the amount of machines necessary for a complete mechanization and the machines cost in connection with the output value can be easely calculated, compared with the farmers' purchasing capacity.

It is well known that the useful life of a tractor is about 8-10,000 hours. Technical obsolescence is reached in 8 up to 10 years time.Consequently,to completely use a power machine in its possibilities, it should be employed not less than 1,000 hours/ year.For a tractor or a power-tiller, equipped with the implements necessary for primary and secondary tillage, bunds reconstruction,

irrigation and transport and, in case, for ditches maintenance, the following average use and productivity can be foreseen, considering one crop per year (fig.2 - line S_M) :

Mechanization index (I_m)	Average use (hours/Ha)	Equipment productivity (Ha)	Specific power loading (HP/Ha)
0.20 = power-tiller 12-14 HP	120-140	7-8	1.7-1.8
0.30 = tractor 20-22 HP	100-110	9-10	1.9-2.0
0.42 = tractor 30-35 HP	70-80	14-16	2.3

In the case of two crops per year, the area goes down : to 5-6 Ha, for power-tillers; to 7.5-8.5 Ha, for 20-22 HP tractors and to 12-13 Ha, for 30-35 HP tractors. This especially occurs because of better timeliness in working practices.

Concerning other practices mechanization and considering that the useful life of machines goes just about up to 3,500 hours, figures can be :

- 1 knapsack power operated sprayer (which can be substituted in future with power-tiller or tractor mounted models) every 2.5-3 Ha;
- 1 self propelled reaper binder (1.40 m cut width) every 14-16 Ha, for one crop per year, or every 9-11 Ha, for two crops per year;
- 1 power operated drum thresher (0.4-0.6 tons/hour operated by the power-tiller p.t.o.) every 50 Ha, for one crop per year, and every 40 Ha, for two crops per year;
- 1 mobile dryer (0.6-0.8 tons/Ha) every 50 Ha, for one crop per year. and every 40 Ha, for 2 crops per year;
- 1 mill plant of medium output capacity, every 500 Ha, for either 1 or 2 crops per year.

All this, while (fig.2 - curve S_L) labour productivity varies from 1.2 Ha per worker and per crop, with animal drawn mechanization, to 1.9 Ha/worker per crop with I_m = 0.20 and to 2.7 Ha/worker per crop with I_m = 0.42.

Referring to a paddy area of about 64,000,000 Ha (20,000,000 Ha

irrigated or with two crops) the following need of machines for different mechanization levels can be hypothisized :

- 12-14 HP power-tillers(equipped with plow, harrow, puddler, leveller, pump and driving axle trailer) : 7,500,000 units;
- power operated drum threshers : 1,300,000 units;
- mobile dryers : 1,300,000 units;
- mill plants : 130,000 units;
- self propelled reaper binders (limited to areas with 2 crops per year or with high output) : 1,500,000 units;
- knapsack power operated sprayers : 22,000,000 units.

Of course, these figures stand by more to theory than to practice. Infact the above mentioned population will be reached in no less than 30 years, when the social-economical development of some countries - and perhaps all of them - will need a more sophisticated mechanization. These new levels correspond to the mechanization index I_m = 0.30 (20-22 HP tractor - which could be the power-tiller itself transformed in a 4-wheel drive tractor) and I_m = 0.42 (30-35 HP tractor). Thei population - valued with the above mentioned criteria - should reach 6.5-7,000,000 units (22 HP model) and 4,500,000 units (30-35 HP model).

If now, we compare the above mentioned theoretical needs with the future production capacity, according to official data for the 9 visited countries, it can be verified that, whenever there are no production increases, no less than 50-70 years would be needed to mechanize paddy-growing, which covers only 31-32% of the total cultivated area (of course, a 10% average replacement market should be taken into consideration).

The needed time, even considering the most pessimistic opinion, seems to be too long. It is, therefore, stated :

- the necessity of a development with manufacturing sector, greater than it has been foreseen up to now;
- an accurate choice of models and sizes, really useful to agriculture, which are not produced today;
- the necessity to foresee a manufacturing evolution in the time, according to agronomical, social and economical development.

It could be convenient to plan for enlarging and improving the al-

ready existing factories to a higher production of the present machines, and, especially, tractors for crops different from paddy. It should be started, now, the organization of a big plan, considering a broad regional cooperation, for manufacturing tractors, power-tillers and agricultural machines, useful for paddy areas, according to the above mentioned criteria.

5.4 - Taking into consideration the mechanization development, we should now point out how much machines for a rational mechanization of paddy areas should cost with reference to the farmers' purchasing capacity.

By the way it should be reminded that farmers' purchasing capacity represents a part of gross income per hectare and depends, at constant income value, on socio-economical conditions. According to many countries' experiences, the equipment purchase capacity varies from a minimum of 5-7% of the gross income, when it is less than 200 $/Ha, according the S curve of table 3, up to about 13-17%, when the gross income is about 600 $/Ha and up to 18-23%, when it is about 1,000 $/Ha. Referring to the conditions in the visited countries, it can be noticed that :

- in paddy areas whose gross income is about 250 $/Ha, the highest equipment purchase capacity is about 24-28 $ per hectare and per year;
- in paddy areas whose gross income is about 400 $/Ha, the highest equipment purchase capacity is about 40-50 $ per hectare and per year;
- in paddy areas whose gross income is about 600 $/Ha, the highest equipment purchase capacity is about 80-95 $ per hectare and per year.

Taking into consideration the possibilities, which are already existing in almost every country, to give 5 years loans at 9% interest rate to the farmers in order to purchase agricultural machines, each farmer has the following capital in hand : 90-100 $/Ha, in the

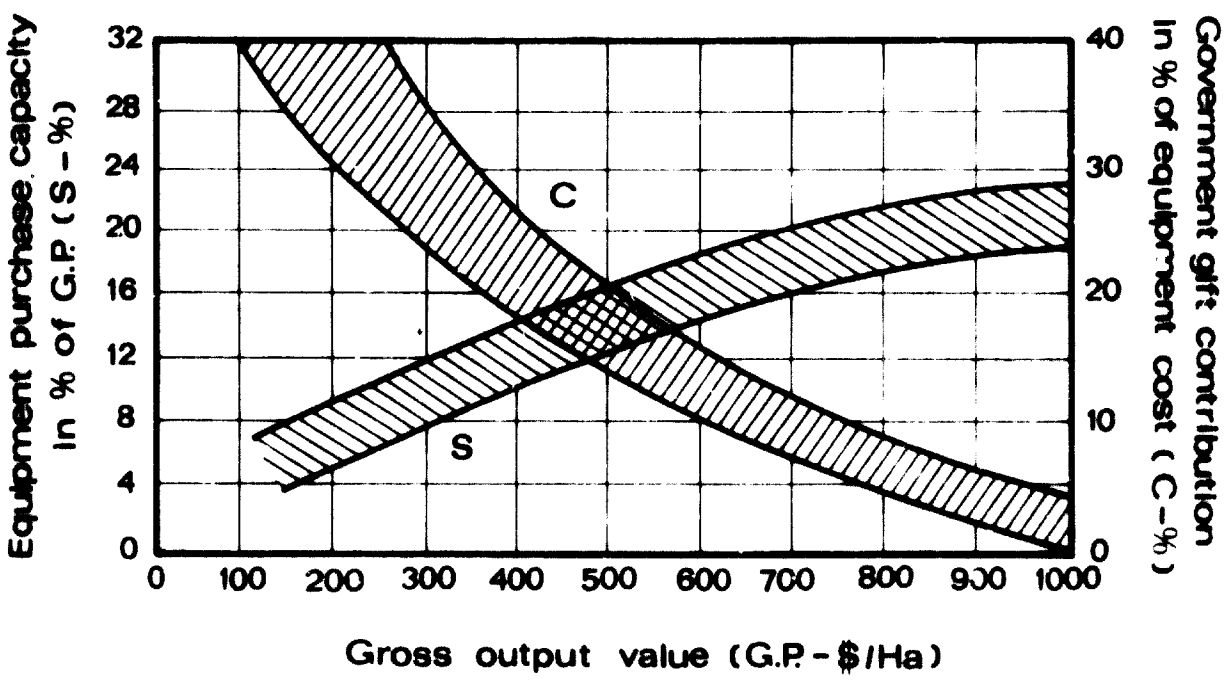


Fig. 3 - Gross output value per Ha and farmers' purchase capacity ratio (curve S). According to the different mechanization index and to the gross output values per Ha, in order to grant to farmers to mechanize their farms or their cooperatives, gift contribution in % of equipment costs should be given by the Government, following the curve C.

first case; 160-180 $/Ha, in the second case and 310-350 $/Ha, in the third one.

With this amount of money, could it be possible to purchase machine according to the $I_m = 0.20$ mechanization index, considering the optimal areas machines should serve?

On the standpoint of present prices on the market and existing kinds of machines, the answer can only be negative, so that the first effort should be, once the most useful and interesting models have been choosen in accordance with local conditions, to semplify them as most as possible (following the principle started from IRRI and from some other visited research units) and to foresee a standardize production, in order to reduce production costs at minimum.

According to very approximated data, which would need a deeper cost analysis, it can be said that a machine stock as the one foreseen in the mechanizatin index $I_m = 0.20$ (including sprayers, threshers, dryers and hullers) will need about 190-210 $/Ha to be purchased. Consequently, if a complete mechanization could theoretically be realized, Governments should give the following gift contributions :

- no less than 50% of the total machine price, if gross specific income is less than 250 $/Ha;
- between 50 and 10% of the total machine price, if gross specific income varies between 250 and 450 $/Ha;
- between 10 and 0% of the total machine price, if gross specific income varies between 450 and 600 or more $/Ha.

All this is valid in the hypothesis of the first mechanization index. If social changes bring along a fast salary increase and, therefore, higher mechanization index are needed, it would be necessary to modify the above mentioned figures, which are in the area defined by C curve in figure number 3.

6 - ADVICES ON TRACTORS AND AGRICULTURAL MACHINES LOCAL PRODUCTION DEVELOPMENT

6.1 - Machines concerning paddy mechanization, which are judged good in technical and economical terms and whose local production seems useful, are :

- 12-14 HP power-tiller, equipped with cages wheel and with the following main implements : plow, harrow, puddler, leveller, rototiller, trailer, pump and drum roller for bunds reconstruction;
- 20-22 HP tractor, 4-wheel drive, articulated, transformed from above mentioned power-tiller, simple, strong, with a weight/power ratio no lower than 45 kg/HP, equipped with : low pressure tyres and cage wheels, 3-4 forward and 1-2 backward gears, p.t.o. and three point linkage with mechanical lift and the above mentioned implements, on consistant sizes, plus spading machines, ditchers and sprayers;
- 30-35 HP tractor, 2 or 4-wheel drive, strong, equipped with p.t.o., 3 points linkage with hydraulic lift, 4-6 gears forward, weight/power ratio no less than 40 kg/HP, and the above mentioned implements on consistant sizes;
- knapsack power-operated sprayer (1-3 HP gasoline engine);
- self propelled reaper binder (1.40 m cut width; 12-14 HP diesel engine) which could eventually be applied to power-tiller; only on further time it will be possible to forsee combine harvesters;
- drum power-operated thresher (0.4-0.6 tons/hour capacity; 6-10 HP diesel or gasoline engine);
- mobile dryer with 0.6-0.8 tons/hour of average capacity;
- huller with 0.6-0.8 tons/hour of average capacity;
- mobile workshop.

On this basis, it seems useful to conduct a short analysis on the different countries' capabilities from an industrial development point of view. Considering the above mentioned machines local production, and G.D.P. per capita differences - to which wages differences corres-

pond - existing among the visited countries, it can be said that, already now in some cases and in the other countries in the range of few years, power-tillers age has been overcome and it should be started, from now on, the manufacturing of larger size machines, corresponding to higher I_m values. This seems to be the present situation in Iran. The same level will be reached in a near future in Korea and, in maybe 10-12 years, in Philippines and Thailand.For this reason, the adviced method, to use power-tillers to be transformed in further times in small tractor, which can be manufactured with good results, as far as standardization and economy of scale are concerned, by the same factory, seems to be quite interesting. Such factory should have a diagram of production as shown in table 4, which can be varied according to the reached economical level. The same can be said about the adviced tractors models (20-22 and 30-35 HP). The adviced choice of a 20-22 HP tractor, heavy and 4-wheel drive, will certainly started discussions, being in open contrast with the tendency of the main manufacturers in the world and with the most common experience. This has been done in order to realize a tractor, simple and economical, able to have high draw-bar pull and, in the same time, easy to be locally manufactured because not requiring sophisticated foundry works. Infact, this tractor has a draw-bar pull as high as a 35 HP one (2-wheel drive and 35 kg/HP weight) and it would meet all actual and future paddy growing needs in the ECAFE countries. At the same parameter production cost, this size of tractor can be realized with a total cost 20-25% less than a 35 HP one. Besides, in 1945-1950 period, was it not the same kind of machines used in Europe?

6.2 - If a complete paddy area mechanization could be realized in the next 30 years, local production capacity foreseen in 1980 should be doubled, starting from now, and probably this development would not in many cases and for many items enough. This development, of

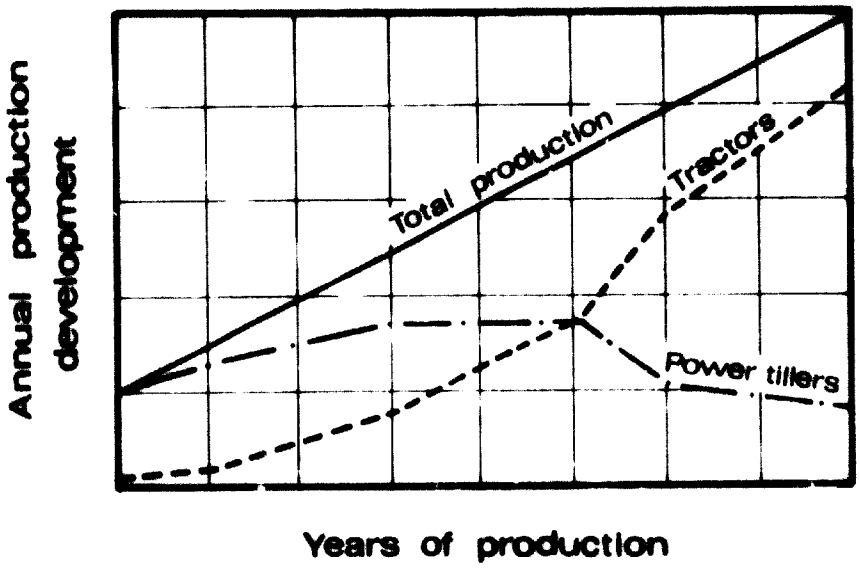


Fig. 4 - Curves showing the qualitative relation between the development of power-tillers and 4-wheel drive tractors productions in the same factory having a fixed annual growing production.

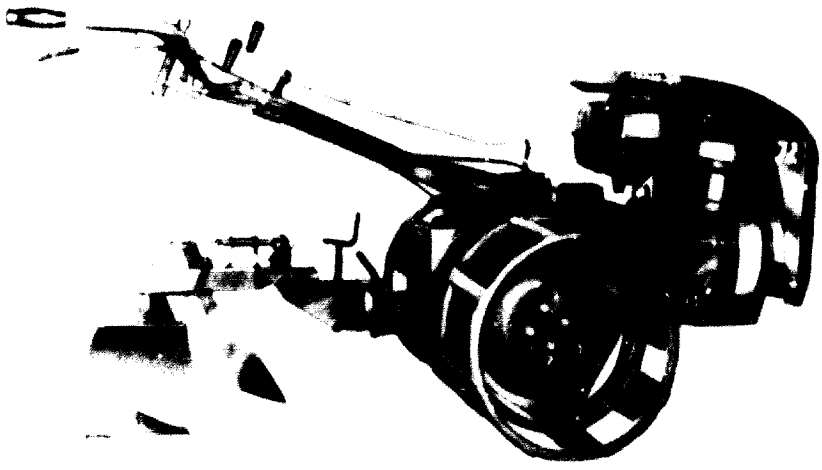
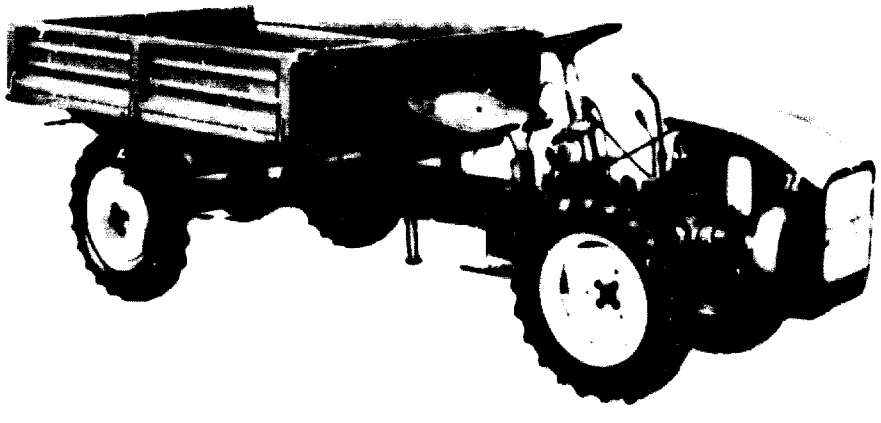


Fig. 5 - Example of a modern 10-14 HP diesel engine power-tiller equipped with cage wheels (weight : 140 kg), 4 gears forward (2 x 2), from 0.8 to 10 km/h, and 2 backward. P.t.o. has double control for implements connection, with authomatic disconnection at reverse gears. Guide levers may be taken off and it is possible to install a stearing wheel (below) and a driving seat and to connect the power-tiller with a small driving axle trailer able to transport 1 ton of products.



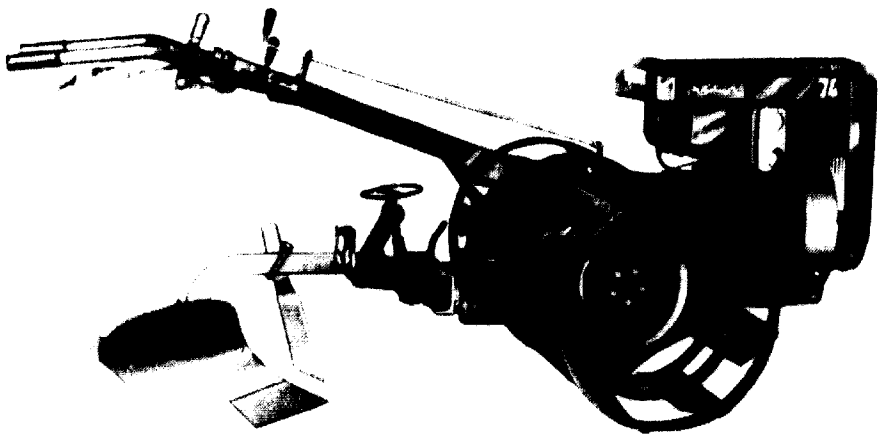
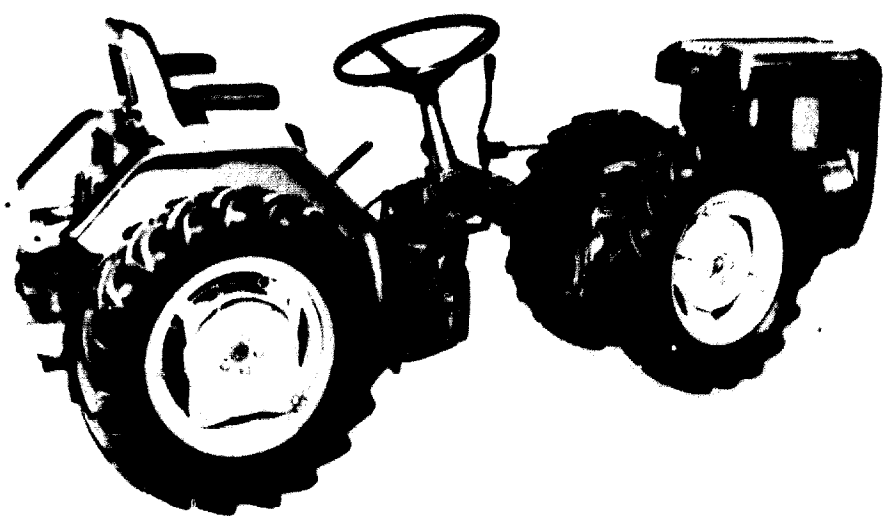


Fig. 6 - Example of a modern power-tiller with 18-22 HP diesel engine, equipped with cage wheels fitting paddy growings (weight about 350 kg), 6 gears forward (3 x 2) from 1.0 to 14.5 km/h and 3 backward. Such machine, adding a driving axle trailer and substituting guide levers with a stearing wheel (below) can be transformed in 4-wheel drive tractor, articulated and easy to handle, strong, equipped with p.t.o. and 3 points linkage.



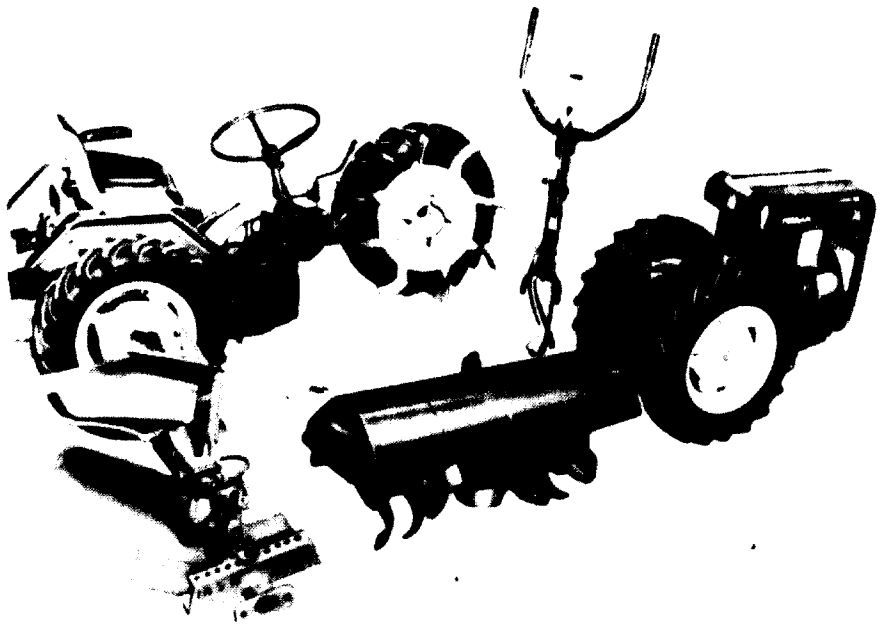
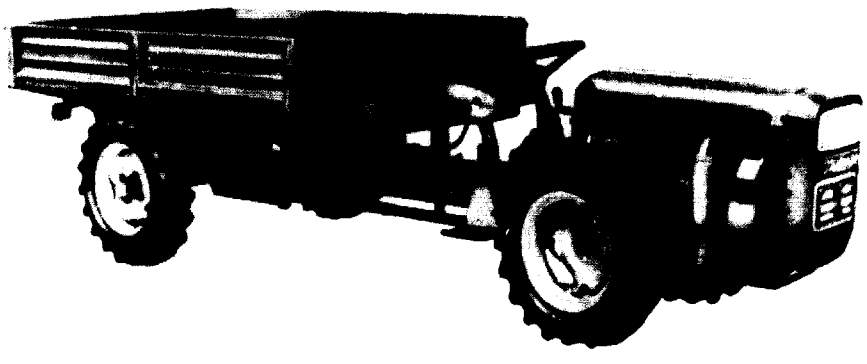


Fig. 7 - The same example of a 18-22 HP power-tiller, convertible in a tractor, equipped (below) with a driving axle trailer able to transport 1.6 tons of products.



course, seems not be possible.

However, this report does not certainly aim at formulating evolution long term plan. Infact, it seems more useful to point out machines which can be locally manufactured and according to which priority, on the basis of actual and future situation foreseen for the basic industries and ancillary facilities and to formulate some considerations on the investment problems.

The above mentioned machines could be realized through joint ventures with reputed and well established foreign factories. The main problem is, changing actual trend, to choose cautiously not only the factories which to organize such cooproduction with, but the most useful and interesting models and sizes and to impose the necessary semplifications and adaptations needed by the agricultural and industrial situation of each country, determing also the local content percentage in the time. Of course, not every power-tiller, or tractor, or plow or reaper binder - in the above indicated sizes - can be useful and can be locally manufactured. An accurate, comparative testing will allow to choose the best models and a broad cost and local production possibilities (raw materials, equipment, labour technical training, ancillary facilities) analysis will allow to introduce the modifications and adaptation needed because of commercial reasons and existing technical capabilities. It happens very often that - as it has been recently pointed out by an UNIDO Expert in Ceylon - some parts are less expensive if imported rather than locally manufactured.

The local content amount and its variation in the time should be decided on the basis of realistic technical and economical analysis. An industry starting today with a simple assembly - especially on a small scale - can not seriously forsee its local content increase up to 100% only in 4-5 years, if its country does not offer very good basis facilities. Infact, in many cases, it has been seen that the plan concerning local content increase has not been proved successful and that local content is not as large as expected. Considering the whole of the visited countries, local content can be va-

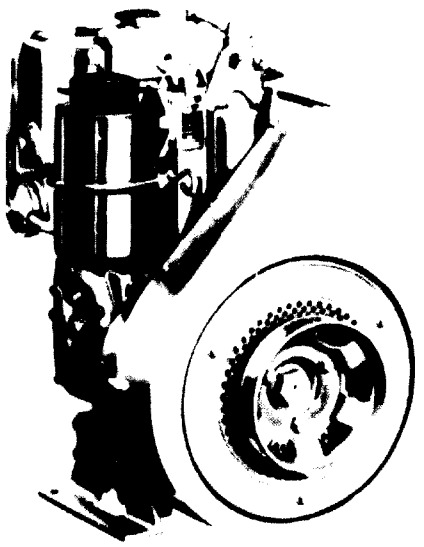
lued - as said in chapter before - about 15-20% of the whole production value and it is difficult to plan to reach 90-100% before 1990.

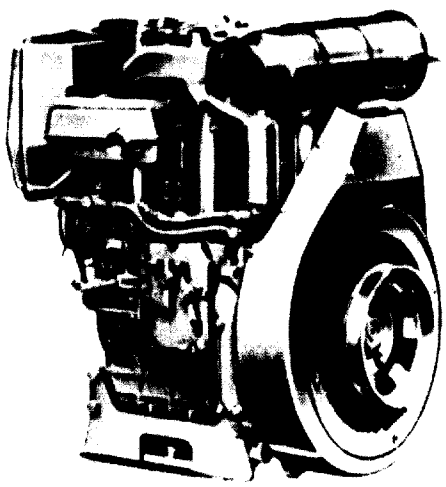
In this context, it seems particularly useful to extend regional cooproduction criteria, which consist in assigning to each country a specific production and protecting it from imports, in order to obtain : good production economy; complete technical staff assistance and well equipped centers for production control; real possibilities of production standardization; spare parts and storage houses problems semplification. These are problems very difficult to be solved; but it can be interesting to notice the initiative of Iran, Pakistan and Turkey for a tractors and agricultural machines regional cooproduction and the ECAFE one to give life to an agricultural machinery research, design, testing and prototypes construction regional unit.

6.3 - It is obviously difficult to give exact informations on the real possibilities of each country concerning local construction of machines. Some preeceding and specific ECAFE missions, have given informations as far as engines and power-tillers production possibilities. The exposed points of wiew can be completely shared.

In any case, however, it should be encouraged local production of :

- 12-14 HP power-tillers : initial assembly and gradually increase of local content in Burma and Indonesia; immediate production with 20-30% of local content in India, Korea, Pakistan, Philippines and Thailand; assembly in Nepal starting not before than 1980;
- 20-22 HP tractors : production with starting about 30% of local content in Iran; initial assembly and gradually increase of local content from 1977/78 in Korea, Philippines and Thailand; in the other countries assembly and production with 20-30% of local content not starting before 1980;
- 30-35 HP tractors : immediate assembly and starting of production





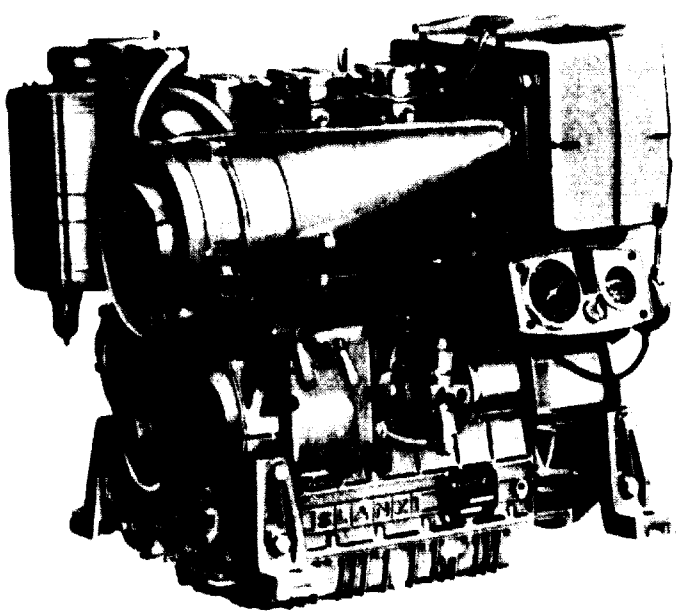


Fig. 8 - Example of a "family" of 8.5, 17 and 25.5 HP air cooled diesel engines with 1, 2 and 3 cylinders, all with the same stroke, 88 mm, and bore, 82 mm. In manufacturing these kinds of engines for agricultural purposes even if they are realized with modern techniques and sophisticated materials (crank case in high strength light alloy, pistons in alluminium alloy, valves forged from chrome-silicone steel, etc.) which allow 4 kg/HP weight, it is very important - for an economical production - the highest standardization of single parts. This considerably simplifies organization of spare parts and after sale service.

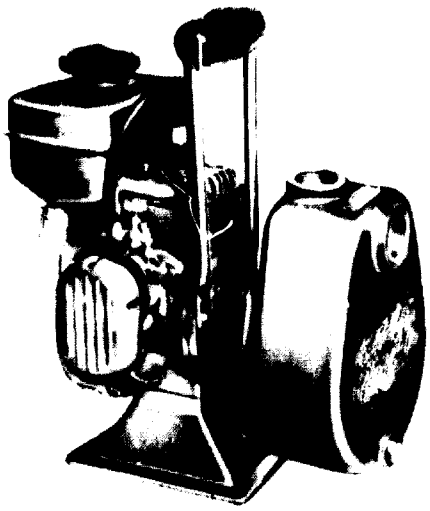
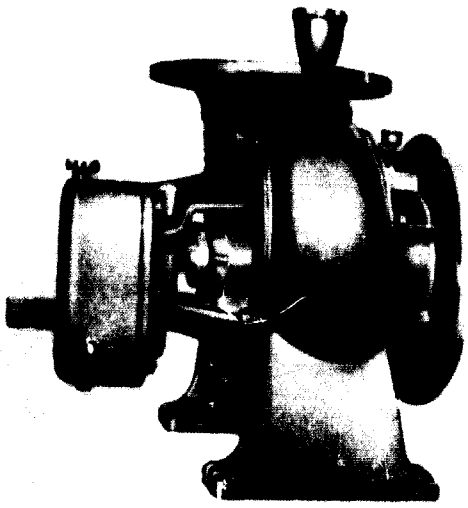


Fig. 9 - Example of a centrifugal pump, flanged with 1.5-2 HP gasoline engine (total weight 8-9 kg). Strong and easy to mantain this pump, with Ø = = 1.5", can offer deliveries between 80 and 200 litres/ min with 30-10 m heads. To the same "family" belongs the pump (left) with Ø = 4", driven by tractor p.t.o., with deliveries between 1000 and 2500 litres/min and heads corresponding to 11-9.60 m. It requires 10-15 HP power.



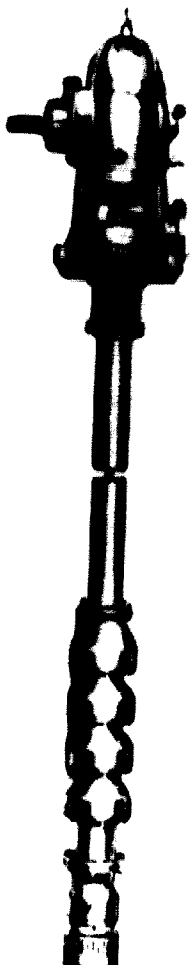


Fig. 10 - Example of a deep well pump, multistage with bronze impellers, driving group and bottom valve for depth up to 100 m, with Ø = 3" tubes and deliveries up to 950 litres/min.

with 30% local content from 1980 in Iran and Korea; in other countries production should be only started in further time; in India a larger coordination of present production should be planned;

- diesel and gasoline engines (more than 5 HP) : improvement, standardization, quality control and production development in all the countries where manufacturers are already existing; new production with starting 20-25% local content of sizes less than 30 HP in Philippines;
- gasoline engines (less than 5 HP) : production with starting 20-30% local content in Burma, Indonesia, Iran, Philippines and Thailand; improvement, standardization, quality control and production development in India, Korea and Pakistan;
- pumps of different sizes, between 1" and 8" Ø : improvement, standardization, quality control and production development in Burma, India, Indonesia, Iran, Korea, Pakistan, Philippines and Thailand; simple assembly starting not before than 1985 in Nepal;
- equipments for primary and secondary tillage (consistant with the above mentioned power-machines) : improvement, standardization, quality control, coordination and production development in every country;
- spading machines : immediate manufacture with initial 40% local content in every country, but Nepal;
- trailers consistant with the above mentioned power-machines : production with 40-50% local content in Pakistan, Philippines, and Thailand; assembly in Nepal; improvement, standardization, quality control and production development in the other countries;
- knapsack power operated sprayers : immediate production with 40-50% local content in Burma, Indonesia and Thailand; improvement, standardization, quality control and production development in the other countries, but Nepal;
- self propelled reaper binders : immediate manufacture with 30% local content in India, Iran, Korea, Pakistan and Philippines; simple assembly in Burma and Indonesia, with a foreseen local content of about 30-40% not before than 1985;

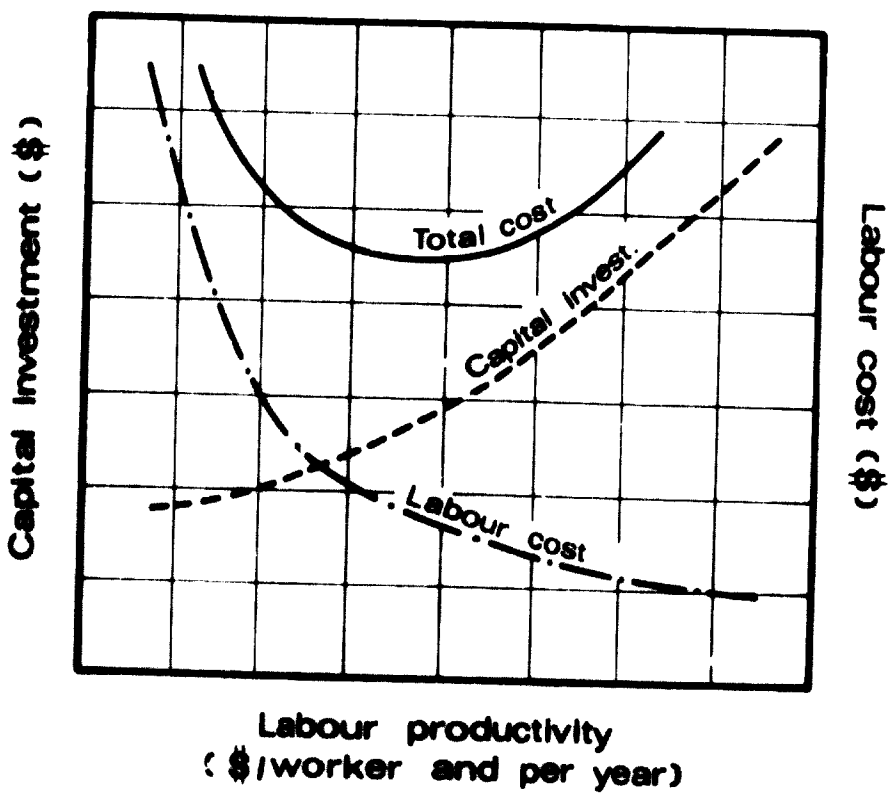


Fig. 11 - As labour productivity increases, the incidence of investments on the production cost increases too, while the labour's one decreases. At every wage level, we can have such investments so to reduce total costs to a minimum. If labour costs are low, minimum costs can be realized at very low levels of productivity and of investments. The lower limit is expressed by the technical possibility to conduct certain treatments without particular equipments or by the local production costs compared with market prices. In this case, an analysis on the costs-benefits ratio at a national level should be taken into consideration.

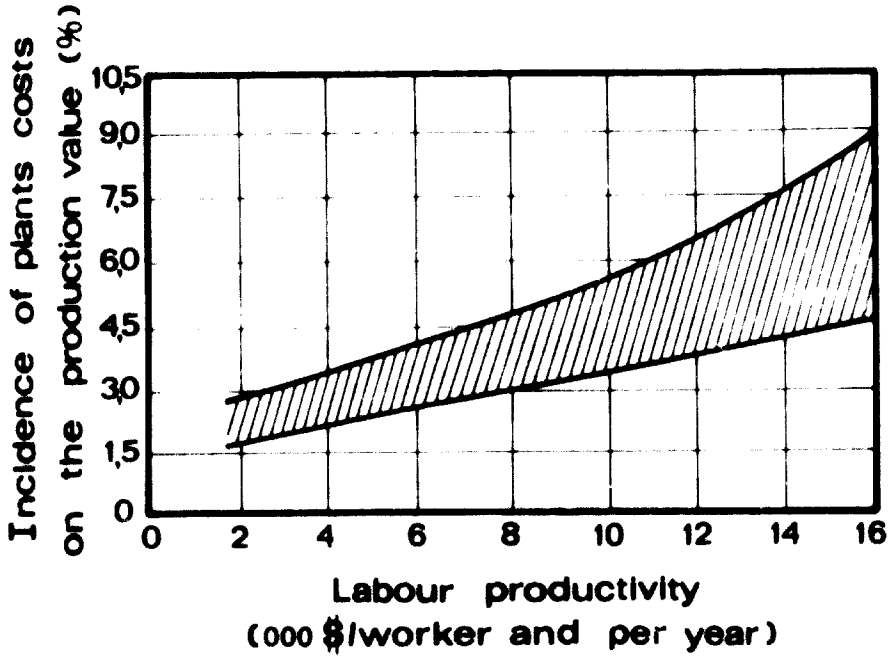


Fig. 12 - Percent incidence of investments for plants and equipments according to different labour productivity levels.

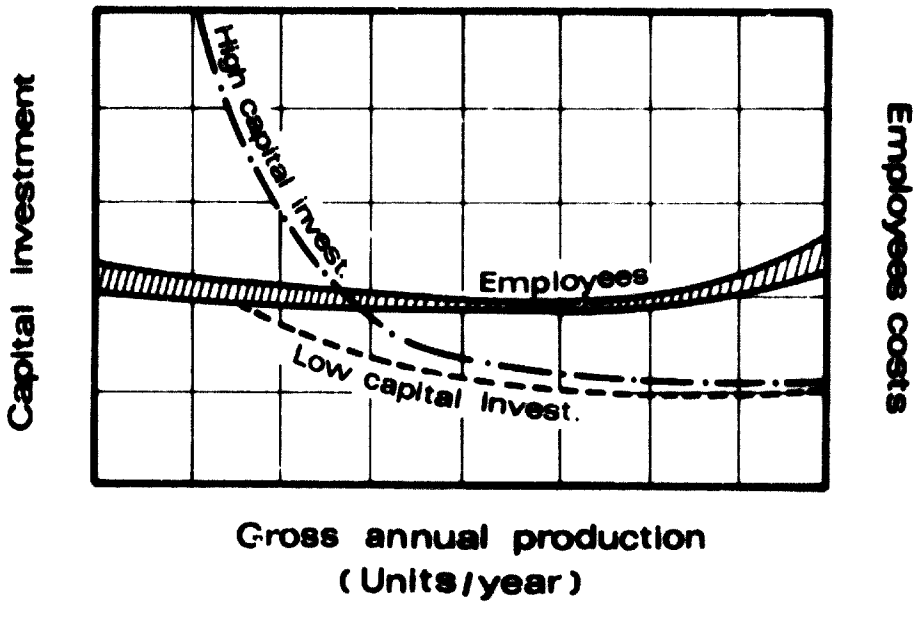


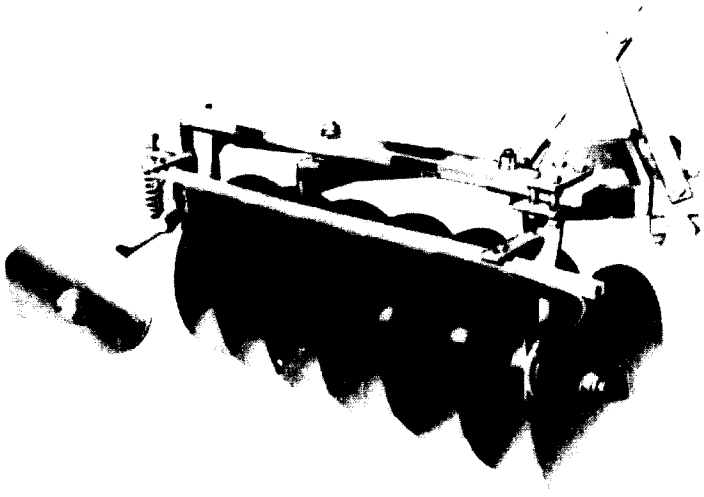
Fig. 13 - Production costs of a single unit vary, at the same investment levels, according to the gross annual production, following curves more or less close to the abscissa axis. Factories with small capital investments are little sensitive to economies of scale and their curve are quite horizontal one. The curve slowing labour cost per unit is, theoretically, almost an horizontal one, practically varies following the hatched zone.

- power operated drum threshers : immediate production with 40-50% local content in Thailand; assembly in Nepal from 1980; improvement, standardization, quality control and production development in the other countries;
- mobile dryers : immediate production with 30-40% local content in Burma, India, Indonesia, Korea, Pakistan, Philippines and Thailand;
- hullers : improvement, standardization, quality control and production development in all the countries where it is already existing;
- mobile workshops : immediate production with 30-40% local content in Burma, India, Indonesia, Iran, Korea, Philippines and Thailand; assembly, not starting before 1985, in Nepal.

Further in the times and probably not before 1985 it could be taken into consideration the problem of paddy combine harvesters local production.

If these are the whole needs of various countries from the manufacturing point of view, there is no doubt that it is practically impossible to start contemporaneously with all the forecast production. In consequence, it seems useful to advise some priorities - to be discuss during the expert group meeting - and to reach to realize some pilot enterprises with international organizations and high capacity experts assistance. These priorities concern :

- Burma : factories for self propelled reaper binders and dryers production;
- India : factories for power-tillers and tractors between 12 and 22 HP manufacture together with consistant equipments for primary and secondary tillage, irrigation, transport and spraying and for mobile workshops production;
- Indonesia : factories for power-tillers and tractors between 12 and 22 HP manufacture together with consistant equipments for primary and secondary tillage and transport, and for threshers and dryers production;
- Iran : factories for 20-22 and 30-35 HP tractors production together with consistant equipments and for less than 5 HP engines manufacture;



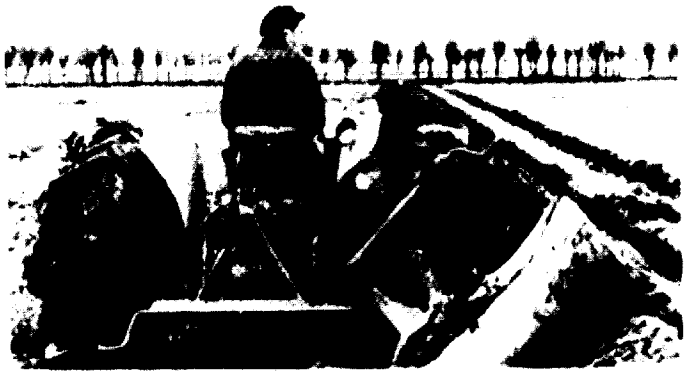


Fig. 14 - Tipical implements for primary and secondary tillage in paddy areas. Below, a drum roller for bunds reconstruction, asking 20-22 HP tractor.

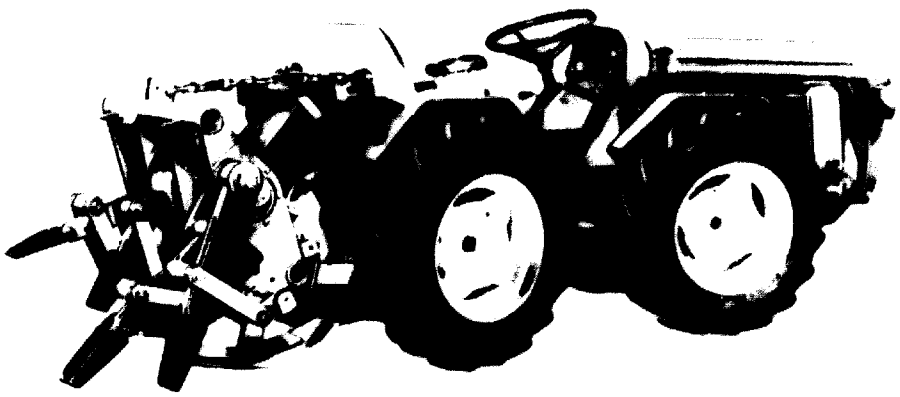


Fig. 15 - Spading machine is judged interesting for primary tillage in paddy areas. Above, we can see a 4 spades p.t.o. driven model, 1 m work width for a 20-22 HP tractor, of about 320 kg weight; below, a 10 spades model (2.17 m work width; 850 kg weight) for a 60 HP tractor. Tillage depth can reach 25-30 cm, with a working speed of about 2 km/hour. Its use considerably simplifies secondary tillage practicies. About 70% of its parts ask for particular heat treatments.

Fig. 16 - Example of rotary ditchers with double (above) and simple (below) wheel. These machines escave trapezoidal ditches with depth going from 0.40 m to 1.35 m and width on the top between 0.60 and 1.25 m. Their weight varies from 240 to 1200 kg. They can be applied on more than 30 HP tractors and their highest working speed is 1.5 km per hour. Wheels,equipped with strong knives, are p.t.o. driven at 540 r.p.m., through a gleason trasmission. Knives and the gear teeth are realized with thermically treated manganese silicone steel.

- Korea : factories for self propelled reaper binder and mobile dryers production;
- Pakistan : factories for pumps, engines, drainage and spraying equipments and mobile workshops manufacture;
- Philippines : factories to produce spading machines, ditchers, pumps and diesel engines less than 30 HP;
- Thailand : factories for less than 30 HP diesel engines, knapsack sprayers and irrigation pumps production.

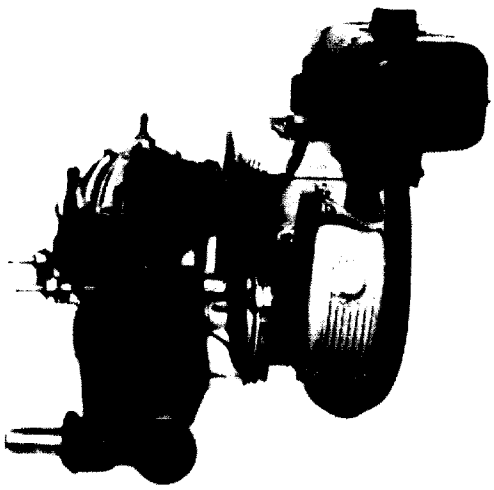
All this should be done considering the possibility to mutual export and in the frame of a coordinated production.

It is impossible to state, now, the percent of local content in the different productions and the most economical capacity production for each factory. This could only be done after a broad analysis.

Anyway, as far as the first mentioned subject, on table 15 some data on the incidence of different materials used for manufacturing some of the above mentioned items are reported. It is clear to understand that it is possible to start from a simple assembly and to reach a percentage of local content no less than 60% in the next 10 years, according to the real technical and productive capacities of the single countries and to production costs.

About the second problem, it is impossible to give general indications. It should be defined - as it has been done concerning agricultural mechanization - the more productive level (equipments and machinery, especially) depending on the equipments and on the labour costs. If the values of plants mechanization index are reported referring to their costs and to the labour cost, the diagramms of fig. 11 very similar to the ones in fig.1, are obtained. If labour cost is very low, investments and the labour productivity will be very low too. This also means that, if investments are low, the amount of imported parts (completely finished or semifinished) will be higher and local content considerably lower.

In addition, it should be taken into consideration the annual production which makes the better use of investments reducing pro-



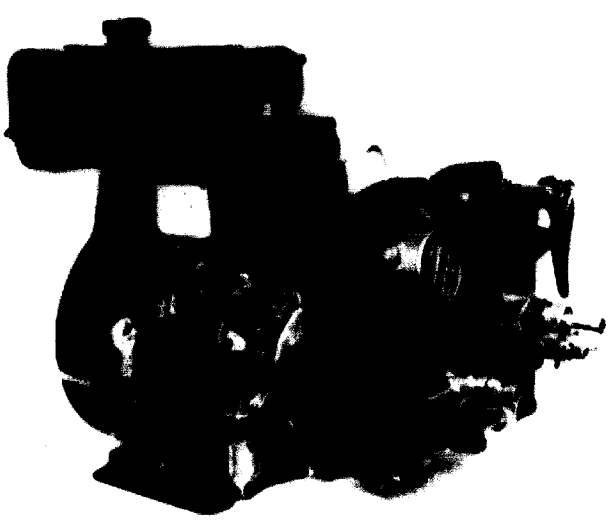


Fig. 17 - Examples of pump-engine assembly for pesticides distribution. Above, small portable size with 3 HP engine, diaphragm pump with a 22 litres/min delivery at 25 kg/cm^2 pressure. Below, medium size with 4.5 HP engine, diaphragm pump with a 30 litres/min delivery at 40 kg/cm^2 pressure.

Table 15 - PERCENTAGE USE VALUE OF MAIN MATERIALS AND COMMODITY GROUPS FOR MANUFACTURING SOME AGRICULTURAL MACHINES

Materials and commodity groups	Manufacturing of						
	engines	power-tillers ■	tractors ■	pumps	self propelled reaper binders ■	dryers	tillage equipments
	% use value by materials						
Ordinary steel	30 - 35	20 - 25	15 - 20	25 - 30	10 - 15	45 - 50	70 - 80
High-carbon steel	3 - 5	35 - 40	45 - 50	1 - 2	20 - 25	25 - 30	14 - 18
Cast iron	30 - 35	25 - 30	22 - 28	50 - 60	6 - 10	2 - 4	3 - 6
High alloy steel	0 - 2	2 - 4	5 - 10	3 - 5	1 - 3	8 - 12	-
Ordinary non ferrous material	4 - 8	-	-	1 - 2	-	4 - 6	-
Non ferrous alloy	20 - 25	1 - 3	2 - 3	4 - 6	30 - 35	4 - 6	-
Plastic material	0 - 2	0 - 1	0 - 1	-	3 - 5	-	-
	% use value by commodity groups						
Foundry and casting products	30 - 35	25 - 30	25 - 30	50 - 60	18 - 22	2 - 4	9 - 10
Forging products	25 - 30	25 - 30	20 - 25	15 - 20	15 - 20	2 - 5	20 - 25
Shapes	8 - 10	10 - 12	12 - 15	6 - 9	14 - 16	28 - 32	30 - 32
Sheets	5 - 7	6 - 8	4 - 7	0 - 1	4 - 6	35 - 40	7 - 10
Special finished products	15 - 20	10 - 15	15 - 20	15 - 20	20 - 25	14 - 18	25 - 30
Other	8 - 12	8 - 10	6 - 8	8 - 10	18 - 22	8 - 10	2 - 3

■ Engines are excluded

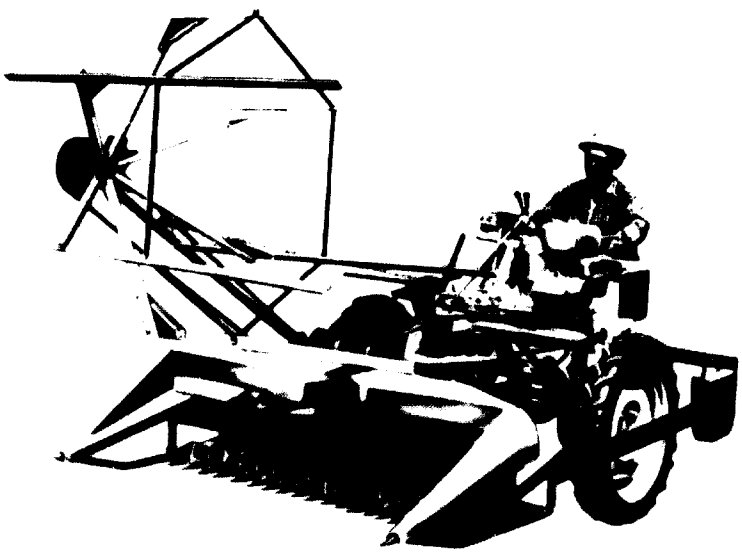


Fig. 18 - Example of self propelled reaper binder, simple and strong, with a 1.40 m cut width and equipped with 12-14 HP engine. For paddy, special cage wheels can be mounted. The same machine, without binder, can be used as self propelled mower too.

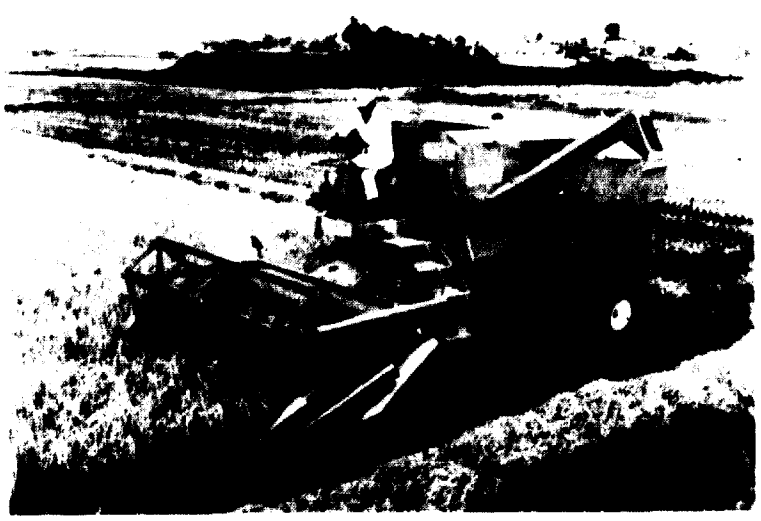


Fig. 19 - Combine harvester realized for paddy harvesting, equipped with crawler tracks should be introduced in further times. This example, having a cutting width between 2.60 and 3.60 m, ask from 80 to 120 HP engines.

duction costs to a minimum. As to this subject, it should be reminded that :

- investments, which particularly mean installed plants, should be utilized no less than 80% of their capacity;
- investments incidence on the production costs approximately depends on labour productivity (fig.12);
- the larger production scale is, the lower investments incidence for equipments and machinery is on it.

What just said is shown in fig.13 for two different values of investments. It is always valid even if low investment industries are less sensitive to economies of scale. For this reason it might be important to value, at least as far as some machines are concerned, if it is right to limit Government incentives only to small-scale factories, or if it is more convenient to give them according to stated priorities, not taking into consideration size of factories and basing any judgement on the incidence of investments on production costs.

It should be reminded that - at the same production level - investments necessary to a factory for simple assembling represent about 10% of the ones needed for local manufacturing with about 50% local content. This average figure is widely varying according to machines models, from 1% to 15-20%.

It can also be useful to mention the interrelationships between industrialization (in this case manufacturing of tractors and agricultural machines) and employment. Opportunities offered by the tractors and agricultural machines local construction development should be valued in the context of the national level cost-benefit ratio, including social costs and taking into account the probability of displacement of labour at the farm level and creation of employment opportunities in industry. In the "UN profiles of manufacturing establishments" the possibilities of employment in different industrial sectors, including the agricultural machinery manufacturing one, are evaluated in general terms.

These evaluations are shown in table 16 publied in a recent re-

Table 16 - DIRECT EMPLOYMENT IN MANUFACTURING AGRICULTURAL MACHINERY

Production Enterprise	Units produced per employee per annum	
	General figures (*)	Average figures estimated for ECAFE countries
Iron Foundry	30 tons	18-22 tons
Tractor Manufacture	2 units	1-1,3 units
Tractor Assembly from imported components	6 units	4,5-5 units
Implements for tractors	20 units	12-14 units
Power-tillers	17 units	10-12 units
Implements for power-tillers	50 units	25-28 units
Medium size angines	-	10-13 units
Self-propelled reaper binders (without engine)	-	13-15 units
Pumps	20 units	16-18 units
Hand operated sprayers	140 units	90-100 units
Power operated sprayers	100 units	60-70 units
Seeders and cultivators	40 units	25-30 units
Structural steel	50 tons	35-40 tons
Hand tools	15 tons	10-12 tons

(*) Source : UN Profiles of Manufacturing Establishments

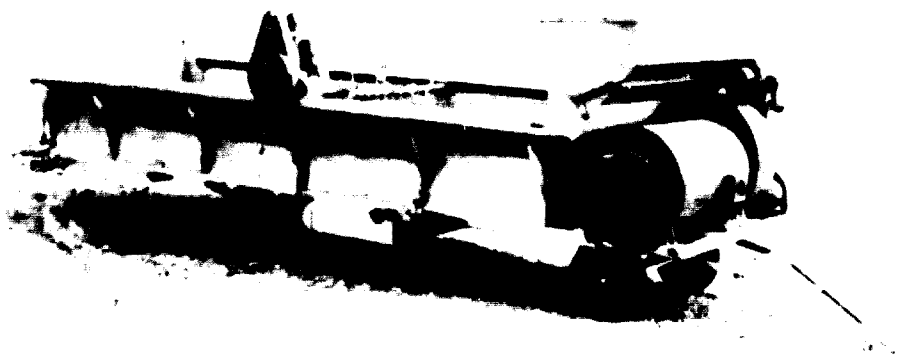
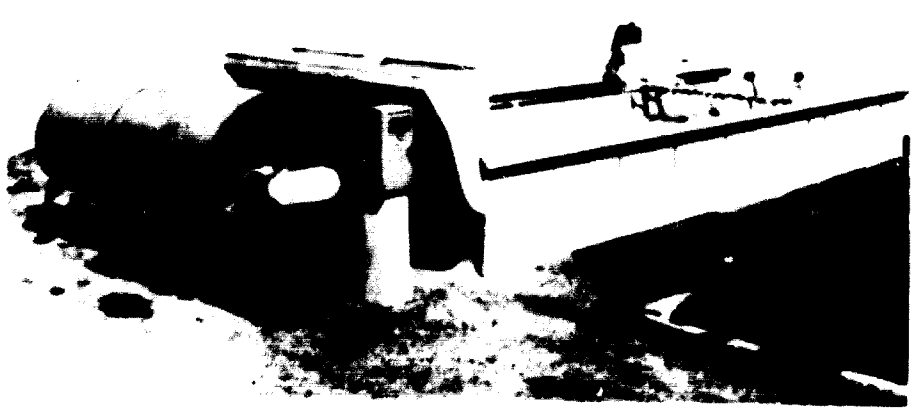


Fig. 20 - Examples of horizontal dryers with authomatic mixer, working with low temperature air, realized in the frame of the highest standardization of common parts. The mobile model (above) has a drying surface 5 m length and 2 m width and a gasoline consumption of less than 28 kg/hour; it needs 10-12 HP power, coming from p.t.o. of the tractor. Its drying capacity for paddy is about 10 tons/24 hours going from 23 to 14% of moisture content. An other model stationary (below) has a drying surface 14 m length and 2 m width and a drying capacity for paddy of 65 tons/day.



port by Mr.Swamy Rao. On one side, figures which we consider coherent with the productivity levels in the different visited factories and best fitting actual situation in the ECAFE countries, are shown. Nevertheless data given in table 16 are referred only to direct employment utilized for manufacturing; if all other employees related with production itself are added to this, the stated figures can be doubled or more. This means that, for example, a factory which manufacture 3,000 tractors per year will need creating no less than 6-7,000 new jobs. Therefore, it can be reached the conclusion that, a shifting of labour from the agricultural to the industrial field due to a growing development of mechanization, could be easily absorbed by industries manufacturing machines needed for the mechanization development itself.

7 - CONCLUSIONS AND RECOMMENDATIONS

The conducted analysis has tried to point out actual situation and its future development, as it appeared during the mission. On the basis of this experience, on the noticed lacks and on what happened in some european countries which went through the same evolution experience in recent times, a method of research has been proposed in order to study mechanization development and improvements in the tractors and agricultural machines manufacturing sector. This method tries to assure a balanced development, with as small waste as possible.

These are, of course, only general indications which can be developed only through a broad analysis in the countries themselves and a good knowledge of the real possibilities.

Such analysis is necessary and it should be conducted in the different countries with the technical assistance of UNIDO Experts concerning : the best mechanization level,the manufactuing and feasibility studies,the production rationalization and standardization,the

pre-investments analysis, etc.. More specific subjects have to be examined closely too, and this, particularly, regards the development and the organization of design, testing, research, technical training, repair and maintenance facilities, the improvement of particular processing, etc..

Of course, it is not possible to face everything in the same time; general indications on the assistance proposed in the country reports, in the frame of a deep coordination at regional level have to be given, in order to better develop different activities.

The suggested assistance concerns :

- studies on rationalization, quality control, standardization and development programs in the production of tractors, agricultural machines and implements, in order to reduce production costs to a minimum, especially concerning small-scale industries : 64 months-experts (10 experts) in : Burma (1976), India (1973-74), Korea (1975), Philippines (1973-74) and Thailand (1973-74);
- feasability studies of agricultural machinery manufacturing, especially concerning future trends in design and market potential : 10 months-experts (2 experts) in : Burma (1973-74) and Thailand (1973-74);
- studies for installing or developing and coordinating research units for design, prototypes construction, adaptation, standardization and testing of agricultural machines and tractors : 20 months-experts (5 experts) in : India (1974), Indonesia (1973-74), Korea (1974), Nepal (1974-1975) and Thailand (1975);
- studies for creating or improving centers for technical training and repair and maintenance services : 8 months-experts (2 experts) in : Indonesia (1975) and Thailand (1976);
- studies on projects formulation for manufacturing tractors, implements and allied engineering industries : 22 months-experts (14 experts) in : India (1974-1975) for manufacturing power-tillers and 12-22 HP tractors; Indonesia (1974-1975) for manufacturing power-tillers and 12-22 HP tractors; Iran (1975) for manufacturing 20 and 30 HP tractors and micro gasoline engines; Korea (1974-1975) for

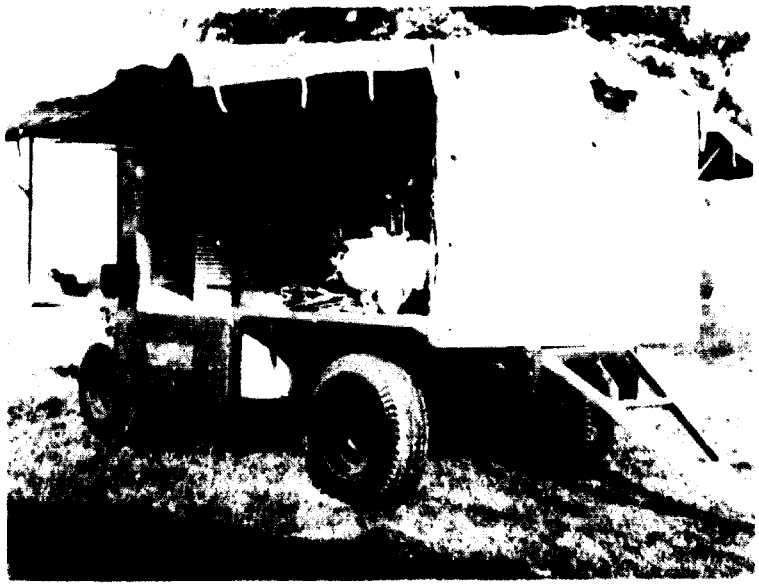
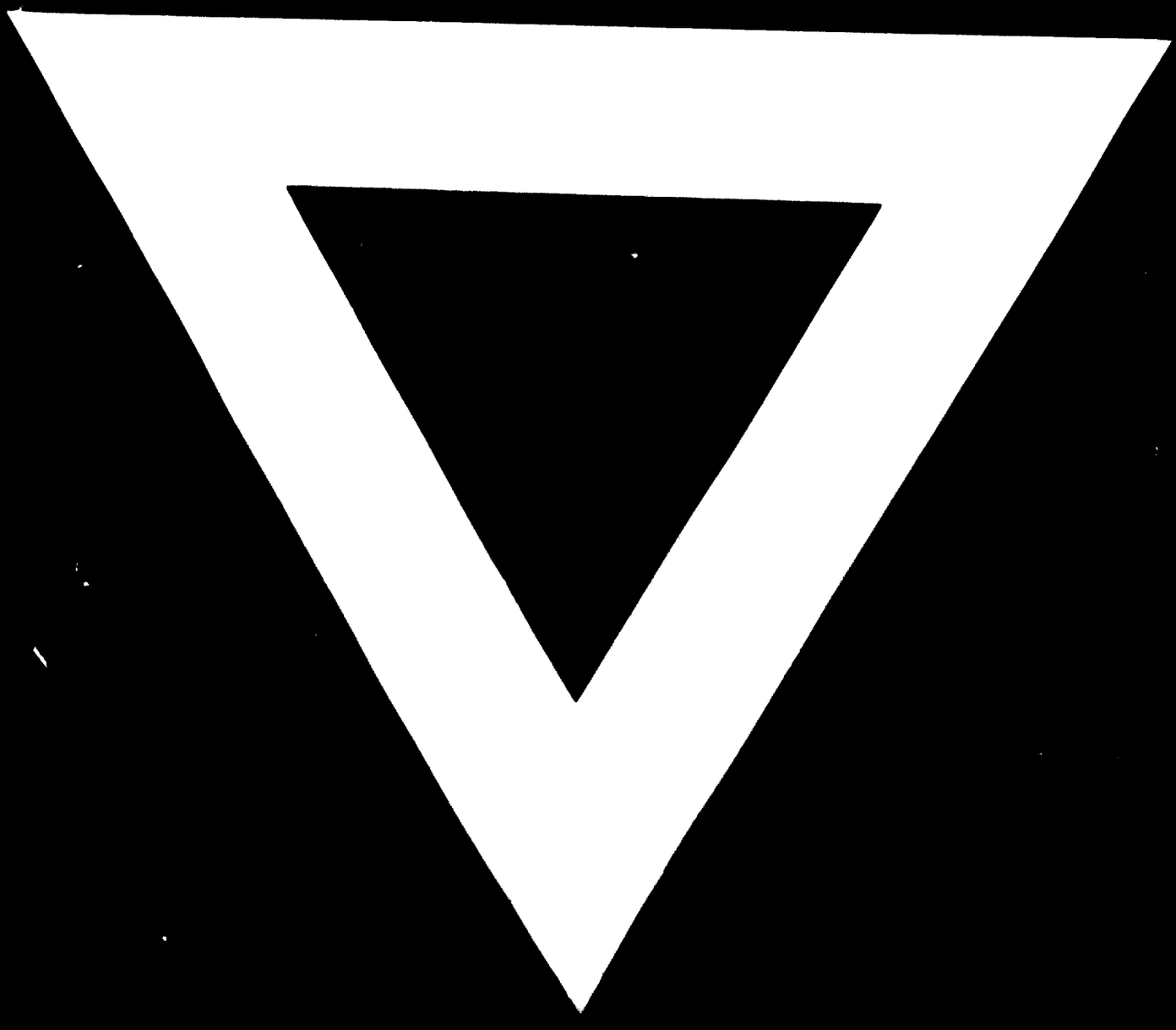


Fig. 21 - Example of mobile workshops for small and urgent repairs of agricultural machines at farms, equipped with : fuel tank, spare parts locker , compressor, manometers tool-box, greasing and washing pumps, oil pumps and instruments to check cylinder pressure, injectors, injection pumps, etc..

manufacturing self propelled reaper binders; Pakistan (1975, engines and pumps); Philippines (1975, spading, ditchers and engines less of than 30 HP); Thailand (1976, micro engines, pumps and sprayers);

- studies for developing and coordinating researches and improving the existing facilities in forging, casting and heat treatments sectors : 6 months-experts in India (1976).



7. 8. 74