Agricultural Mechanization
in ASIA Vol. 2

How to Grow Agricultural Machinery Industry

[I] Production Problems

1971, AUTUMN

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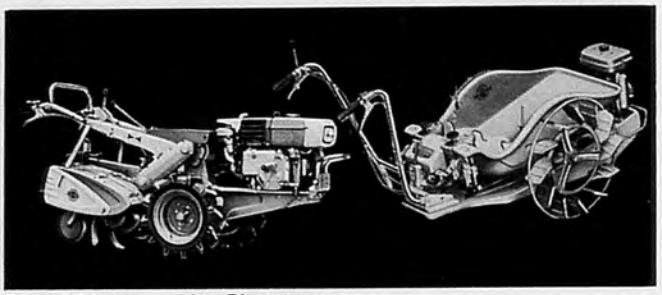

Diesel Tillers Rice Planters

Under a full favor of sun, Asia is blessed with many rivers possessing the potential energy of a several billion kilowatts. Besides, there is abundance of petroleum, coal and other natural resources. Most of them are still undeveloped.
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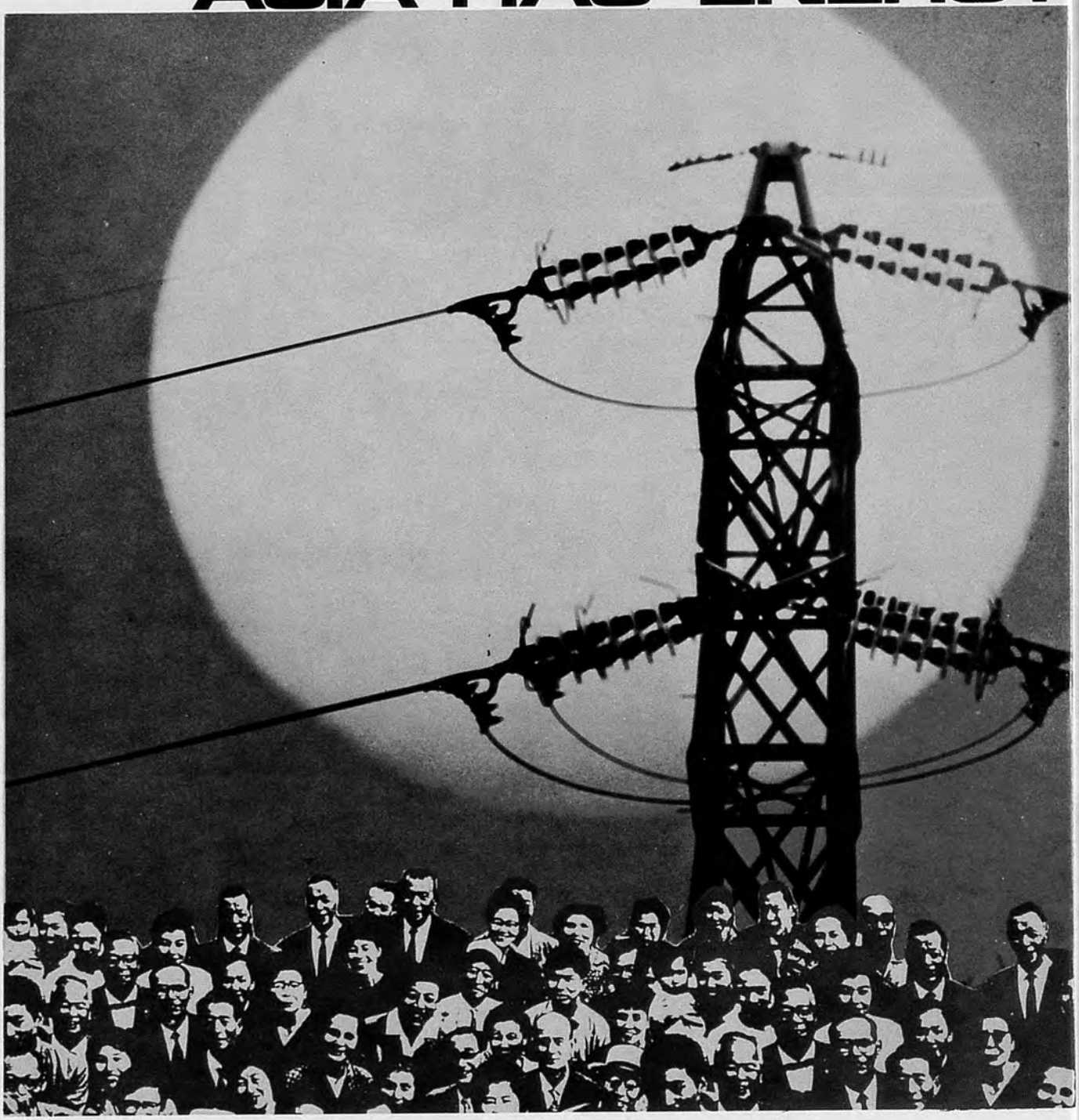
ASIA HAS ENERGY A



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You can find beauty in gay festivals as well as monotonous daily life. This is a wonderful aspect of Asian traditions.
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For relieving people from heavy labors and enabling people to direct energy and interest in pursuit of much splendid things, Yanmar products are displaying a large force today in various parts of Asia.
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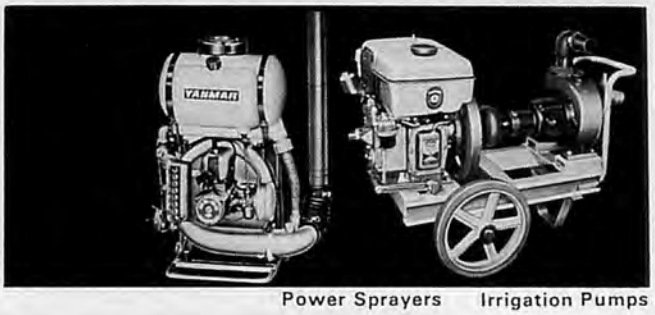

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Y ASIA HAS BEAUTY

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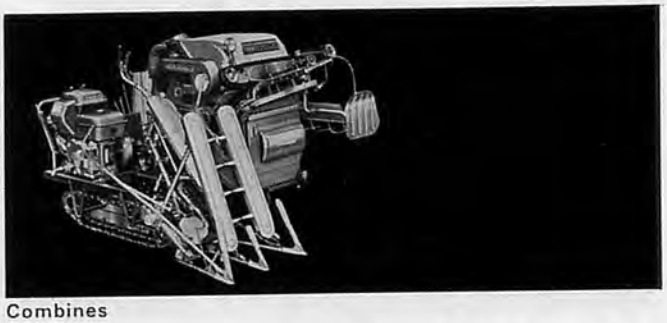

Combines

In moderately speaking, the problem of Asian population becomes a subtle problem once in a while. Because theproblem of Asian population has been discussed intensely from various points of view of faiths, traditions and values, thus when this problem is taken up, a delicate consideration is required. Yet, on the other hand, this is a potentially abundant natural resource. And in it a element common to all Asian people lies. That is the necessity of education. Necessity of teaching people to learn how to solve problems about land, energy, water machinery and people itself.
Yanmar's training centers in Japan and overseas are serving Asia in this regard at this very moment.

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ASIA HAS PEOPLE A

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Agricultural Mechanization in ASIA

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How to Grow Agricultural Machinery Industry

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Edited by

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Preface

Last April we published "Agricultural Mechanization in South East Asia" as the first issue. It was the purpose for me to start establishing a specialized media for the peoples who are promoting agricultural mechanization for Asia through research & development, production, distributing, teaching & training, extension, finance, policy making and other essential activities.

It was welcomed by many peoples in the world from whom I got so many letters telling me to continue this trial. We would like to do our best to grow this media for everybody with big cooperation.

To form better information network, I am now looking for several co-editors or communicators in each country. I am very glad if you can join this information network as an active communicators.

Now, the last issue was a kind of general approach to the mechanization problems. There are already many discussions on the mechanization problems in developing countries. Among them, I feel that we need most to establish effective agricultural machinery industry in Asia as the continuous process to develop, produce, distribute, provide good after service get quick feed-back and provide newly improved machinery for farmers.

This continuous process is the active line of mechanization and the other factors are a kind of functions as staffs. Soft-ware is needed with the system to realize it as hard-ware. I can say that the procedure to establish the continuous process and the continuous process itself are the most needed soft-ware to promote the mechanization at present.

Industrial power is an essential factor which creates profit. This is the reason why we published this issue with the theme of "How to Grow Agricultural Machinery Industry in Asia—"〔I〕Production Problems". The marketing problems will be published in February, 1972 as winter issue.

By the way, you have already noticed that we expanded the title of this publication from "Agricultural Mechanization *in South East Asia*" to "Agricultural Mechanization *in Asia* ", because I got a letter from Iran to include also that area.

Your response will surely be considered to grow the better media which can effectively connect essential factors in the world. I also welcome articles and corresponding from you. Lastly I deeply appreciate every author's kind devotion for this issue.

Yoshisuke Kishida

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A PROPOSAL for Agricultural Machiney Industry in the Region of Asia

Makoto Saito

Vice-Chairman, The International Farm Mechanization Research · President, Agr'l Credit Insurance Assn. and Japan FAO Service Assn Former Vice-Minister for the Ministry of Agriculture and Forestry.

As pointed out by FAO, it is all-important problem how to sustain the momentum of the so-called green revolution and further it in the developing countries of Asia. For this purpose, they are requested to promote problem-oriented activities for the planning and implementation of known research results. In the light of these problems, it is clear that the application of modern technology such as mechanization is essential to foster agricultural progress in the Region and that for this, it is desirable to move evolutionally towards domestic manufacturing of agricultural machinery and implements.

In this connection, it is deemed necessary and will be desirable to consider the following points, in principle, in order to promote mechanization in agriculture as well as growth of the agricultural machinery industry in the developing countries of this Region.

Firstly, the overall approach of mechanization should be one which will lead to a more productive agriculture through mainly high utilization of land and high yield. In most of countries in the Region which is faced difficult problem of employment to be solved under the conditions of labour surplus, and still increasing under-employed rural workers and widespread small holding, the role of mechanization would not be to displace labour, but to increase yields within the existing framework of small scale farming, through breaking seasonal work bottle necks to contribute to multi-cropping, and through permitting better soil preparation, timely cultivation, improved methods of row seeding or weed control to meet the more precise requirements of the high-yielding varieties.

Therefore it will be a most pressing problem facing the developing countries to grasp accurately these points, that is, what machinery and implements are most available for production increase in accordance with stages of agricultural development and with various conditions surrounding agriculture in the developing countries, what can be manufactured or should be developed within a country and what should be relied upon importation. It is hoped, if possible, the government, researchers and manufacturers would take establishment of guide line of mechanization, in cooperation, for this purpose into consideration.

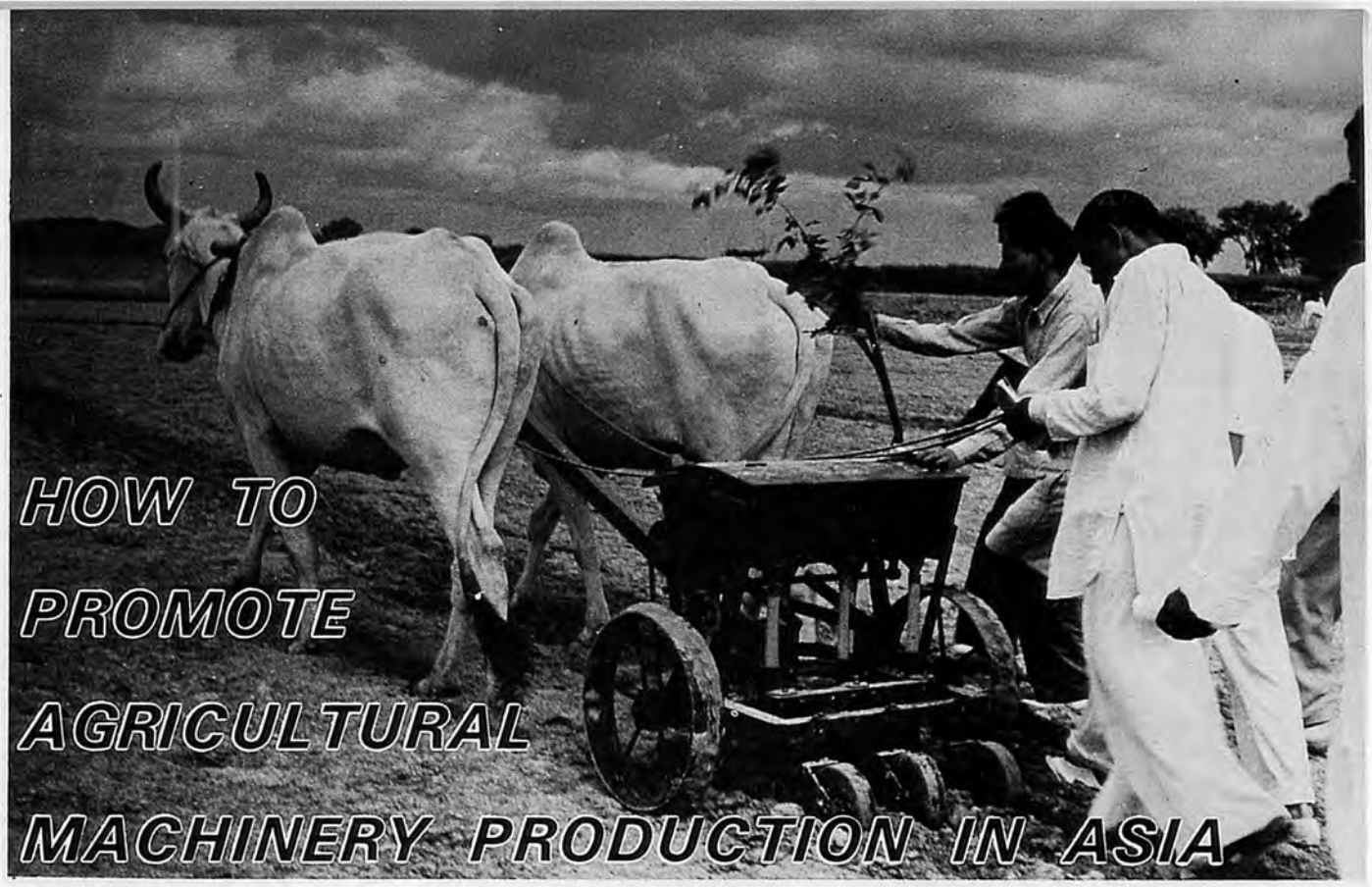
Secondly, I suppose evolutionary approach is necessary to develop agricultural machinery and implements industry in the developing countries. One reason is that the development of agricultural machines industry depends on internal demand for machinery and implements, which is evolutionary itself, since agriculture is conservative per se for changes. The other reason is that technology is introduced from the developed countries in many cases in promoting growth of machinery industry in most of countries in the Region, hence a considerable period of time is needed to introduce and fix it in a suitable form for the condition of countries.

Consequently, machinery industry may be necessary and possible to grow and develop out of an existing manufacturing plant that meets a local need. Moreover it may be necessary to promote possible combination and assembly of imported components and domestically manufactured ones. But this does not mean establishment of so many small scale plants. The evolutionary approach means that the facilities should be suitable to the probable size of the market and would not be stressed on a demonstration effect of the industrialization by setting up a large new plant. It is essential for manufacturers to produce acceptable machinery and implements. For this purpose they are to let farmers co-operate in formation of new machinery and at the same time they are requested to act as demonstrators through mechanization to introduce new techniques among farmers.

Thirdly, we can expect further development of the machinery and implements industry from cooperative efforts of a groupe of neighbouring countries in the Region. Namely exchange of knowlege, technical inteligence, skill and experience, and cooperative research by seminar and symposium on manufacturing and import of machinery and implements which may contribute to increase of agricultural production are effective means for development of machinery industry in every countries. It is important, I think, that manufacturers, advisers and specialists may institute non-governmental association on the voluntary base, promote co-operative action more powerfully and develop machinery industry in the Region.

Part I

GENERAL REMARKS



HOW TO PROMOTE AGRICULTURAL MACHINERY PRODUCTION IN ASIA

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THE key to increased machinery production is to create a market……a demand……via DEMONSTRATIONS. When there is a demand manufacturers will respond with production. This answer sounds simple. But it is very difficult and involved to carry out successfully.

The simple answer given above is based upon the fact that one cannot separate the **performance** of a product from its **production.** This means that the manufacturer must be involved in the field performance of his machine.

The word performance encompasses many things. First, one must have a good product, that is it must do a job for the farmer in a desirable and economical manner. The machine need not be in a highly refined state of development. But the design of the machine offered to the farmer must be basically sound in that it serves ecnomically and acceptably. The manufacturer is expected to improve his machine over time. It is a continual actvity. A machine is never perfect.

Second, the word performance implies that local services in the way of repair part and maintenance is readily available. Componets of machine, even the best and under good care, will break or wear out. A machine cannot perform if those parts and repair services are not available.

In essence the manufacturer must do three things:

1. Have a product whose use will benefit the farmer,
2. Demostrate the performance qualities of the machine, and
3. Provide local repair and maintenances services.

For Asia the real key however is effective demonstrations, and much of this paper will be devoted to it because it is least understood and utilized. The procedure for promoting machinery as suggested and described herein is not theoretical and untried. It was used in India in the case of a seed-fertilizer drill[1], which is illustrated in the title photo. The success of this endeavor attests to the soundest of the producedure. It will be used as an example in this paper.

Yield Increasing and Peak Labor Decreasing Machines

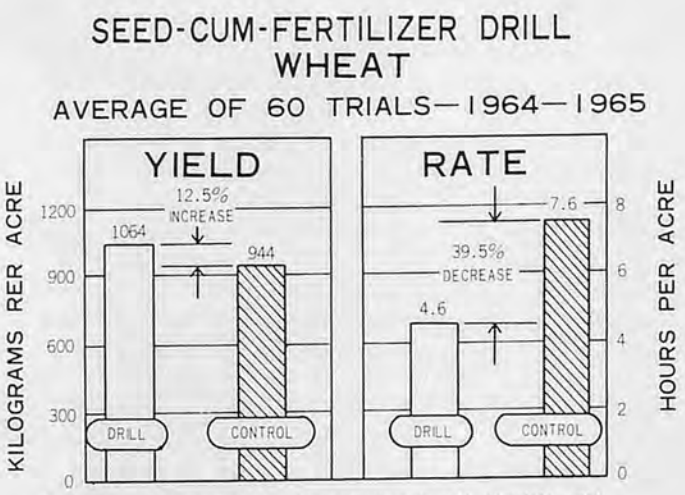

Figure 1. The machinery demonstration is not complete until the yield compared with the conventional practice is determined. The graph above gives the values of yield and rate of the three-row drill shown in Figure 2 over the desi method.

There is little disagreement with the fact that sound promotion depends first on having a product that the farmers need. One must have a saleable product.

For Asia two basic requirements stand high compared to all others; the machine should contribute to increased yields and food production; the machine must help to eliminate the high labor inputs of the peak periods.

The grain drill as mentioned above met those two requirements. The time required to prepare a good seedbed and drill the seed and fertilizer is short particularly where multiple cropping is practiced. There is no question in that seed and fertilizer precisely metered and placed, along with good seed-soil contact will give high yields. That is the yields are high compared with drilling by hand or with a desi plow.

Some sixty trials were conducted in the wheat growing area of India in 1964 using the animal drawn three-row drill illustrated in the cover photo[1]. The average of the wheat yields in kilograms per acre and of the rate of drilling a field in hours per acre as compared with the conventional famer method (desi plow) is illustrated in **Figure 1.** The date are statistically significant.

It should be pointed out here that the principles incorporated in the drill made possible the yield increased achieved. These principles were: (1) precise metering of both the seed and the fertilizer, (2) placement of the seed in depth and spacing in the row to give the highest yields, (3) placement of the fertilizer with respect to the seed to give maximum growth, particularly early, and (4) good soil-seed contact to promote quick germination.

These principles were used in the development of the three-row unit,and were demonstrated. Because the demostrations were so successful, and farmer demand resulted, larger units were subsequently developed and manufactured. Thus, mahinery production was promoted.

These larger units, of course, were tractor mounted. But, it must be pointed out that they employed the same good principles and thus gave the same good performance in terms of yield increases and elimination of high peak labor demands. The tractor units, of course, had higher capacities and helped to satisfy a wider range of farmer needs.

The Opportunity of Multiple--Cropping

In connection with achieving higher yields and production of-food grains one must not overlook the opportunities of multiple cropping thru mechanization.

No where in the world are the opportunities greater for food production increases thru multiple cropping than in Asia. It is possible to produce three and four crops per year from the same land. However, to do this successfully will require management and selective mechanization. It is simply not feasible for a farmer to produce say three crops per year per unit of land without a judicious use of machines. The time available for the harvest of one crop and the soil preparation and seeding of the next is much too short to depend on hand operations. Furthermore, labor is quite undependable and becoming increasingly so. The rising cost of that labor is also acknowledged.

In one study in Ludhiana, India, the combination of multiple cropping and selective mechanization increased the labor input per year per unit of cultivated land[2) 4)]. In effect mechanization contributed to increased employment.

It is suggested therefore that one of the greatest opportunities in Asia to increased machinery production is to demonstrate the combination of selective mechanization and multiple cropping. Demonstrate the kinds of machines that will make multiple cropping possible. Teach the farmer how to do this, and the results in term of increase yields and returns. Also show him how the labor will be more efficient, and of the justification of the higher wage rates that are being demanded in the advancing Asian countries.

Training Demonstrators

Having a good product the next step is to train men who can demonstrate well the machine on farmer's field, and importantly

teach the farmer to operate the machine. A good demonstration involves the farmer operating a machine on his own field. A neighbor who witnesses a farmer operating a machine successfully is subtitely challenged to do likewise. He can't rely on such excuses as "the machine is too complex" or "it won't work on my farm".

Training the men who will acompany, operate, and teach operation of the machine on a farm is time consuming. An entire seeding season is a minimum requirement. This basic fact is missed or overlooked so often in Asia and elsewhere, too. We sometimes get the notion that all one needs to do is hear a lecture and see the machine in operation to understand it and be an expert. Nothing could be further from reality.

The demonstrator should operate the machine himself for a full season. In the case of the drill there were many skills to be mastered. The demonstrator had to learn how to calibrate both the seed and fertilizer metering mechanisms, adjust the depth of the seed and fertilizer, hitch and drive the bullocks and/or tractor,plant the field handle the turning areas, and space the rows of one trip with those of a previous trip. There were other skills but the afore were most important to the successful performance of the drill. These simply could not be mastered in a short time.

It is important to re-emphasize that a demonstrator **must** have these understandings and skills. He cannot rely on telling the farmer how to do it. He must show the farmer. A farmer is very preceptive in detecting a phoney. A phoney is one who acts like he knows it all but in actuality cannot do the job himself.

We, of course, are speaking of the requirements of conducting a successful demonstration. There is no short cut. It takes practice, more practice, and still more practice.

Pre-démonstration Trial and Adjustment

Have you ever attended a demonstration where the manufacturer's representative arrived at the farm with his machine on the scheduled day? I have and I have yet to see a machine, under such circumstances, perform well.

The demonstrator and his machine shoud be there at least two days in advance. The machine should be tried, adjusted, and the farmer given a few lessons in advance on some unused land. This recommendation should be followed regardless of whether the demonstration is for the farmer alone or an invited public.

Carry to the Final Yield Stage

It was stated earlier that yield per unit area and economics are factors that influences farmers to buy and use a new machine. Where these factors prevail the demonstration should be carried to the final yield stage. In instances where labor reduction is the only factor there is some justification in omitting the yield measurement. It should be mentioned in passing, however, that such instances in Asia are few.

Certainly economics is a factor in farmers decisions to buy or not. How can one realistically determine the economics of a new machine unless one knows the increases or decreases in yields as a result of using the machine?

In the case of the three-row drill, the economics worked out to where a farmer could pay for the drill if he used it for as much as 15 acres. He could do this largely because of the yield increases achieved, an average of 12.5 percent. Some farmers who managed the drill well got as much as a 50 percent increase in yield over what they were getting with their desi methods.

The capacities and economic benefits can be quite substantial with proper management. A shining example of what is sometimes possible can be cited with respect to a Punjab, India, farmer, Mr.-Jagjit Singh,He used his tractor, plow and disc to prepare the seedbed, followed immediately with the three-row drill pulled by a pair of bullocks (see **Figure** 2). He put in something like 100 acres of wheat, doing his own fields and some of his neighbors. Think what this means to his economically, and of the impact such performan ce will have on the farmers of that area.

Think also of what this kind of performance will have on the potentials of multiple cropping and of the resulting benefits to the farmer. If multiple cropping is to be demonstrated then the demonstration should include the final-yield stage of each crop.

It is acknowledged that the demonstration of the machinery-multiple cropping combination is most complex and difficult to do successfully. But the payoff in terms of demand of machines is tremendous. Remember Asia is uniquely adapted to multiple cropping and machinery manufacturers would be foolish not to take advantage of it, if they are truly interested in increasing production of machinery.

A Comparison is Essential

If a machine is to be effectively demonstrated there should be a comparison. A comparison is absolutely essential if labor, yield and economics are factors of selection. The comparison should be with what the farmer is now using.

The following is the basic procedure for conducting the comparative demonstration.

- Select a farmers field that is uniform in soil fertility, physical properties and drainage. Avoid fields with trees along any portion of the border, as they detract from crop performance in the immediate vicinity.
- Divide the field in half, one

half for the new machine-method and the second for the conventional.

- Keep all operations, cultural practices, and inputs such as fertilizer and pesticides the same on the two halves. The only exception is the machine-method being demonstrated and compared with what the farmer is now using.
- Develop a simple proform so the farmer can keep the essential data. Emphasis should be on keeping few data. The farmer simply will not use a complex one.
- Harvest the two plots at the same time on the same day. keep the product from the two plots separate and weigh at the same time.

There is another type of comparative demonstration. It is one in which one companies machine is operated side by side with a machine manufactured by another. These competitive brands are tried at the same time on the same day in the same field. It should also include a comparison with the local practice.

This type of comparison is beneficial in several respects. It gives the farmer an opportunity of making a more valid appraisal of brands than would otherwise be possible. Particularly is this true if the demonstration is carried to the final yield stage. Some weaknesses in a machine will not show up except in the final yield of the crop. For example, uniform metering and placement of the fertilizer would be in this category.

Most importantly comparative demonstration of brands provides the greatest incentive for manufacturers to improve their product. A manufacturer whose machine shows up poorly in direct comparison to another brand will not be content and will usually work hard to improve its competitiveness. In these kinds of demonstrations the farmer is the judge. Because the farmer is the customer the manufacturer whose machine shows up poorly certainly cannot voice displeasure or get mad. It is a quiet persuasive tool that is unsurpassed world wide in its effectiveness. It follows, obviously, that this tool would be ineffective in instances where a brand is subsidized and where the market is not free.

The management of comparative demonstrations involving brands is very difficult. It must be handled by an independent and unbiased organization and individual. The management of such demonstrations is a role that public officials can best perform.

Public officials can arrange with a farmer for a comparative demonstration of brands. He can help decide on the time and selection of the field. He can contact manufacturers, and solicit their entry. He can measure off and stake out the plots, and make unbiased allocations to the entrees. Remember the field should be uniform in soil characteristics, fertility and drainage. He can arrange for pre-preparation of the field when necessary. For example in the case of grain drills the entire field must be slowed, disced and harrowed uniformly in advance. Where yields are taken the public official should supervise the harvest and weighing.

There is one thing that the manager of the demonstration should not be involved in--the operation of the machine. The machine must be adjusted and operated by the representative of the factory. Only the factory representative understands and is an expert in making the machine perform as it was intended. If it dose not perform satisfactorly only company is to blame. The machine-method of the local practice should be done by the farmer on whose field the demonstration is held.

The latter recommendation relative to the operator of the machine is contrary to demonstrations on farms involving only one brand in comparison with the conventional practice. In such instances it is best to teach the farmer how to run the machine and let him, with helpful supervision, do his own field.

Harvest is a Part of the Demonstration

The final act in case of most comparative demonstrations is harvesting and weighing the resulting yield. Of course, if harvesting, threshing, etc. is the operation to be demonstrated, it is done at the same time. However, in all other demonstrations a return of the audience to witness this final act is necessary. At the time that the machine is demonstrated one should make a tentative date with the audience whether of one or more farmers.

Among other reasons the return for the harvest gives the demonstrator a second opportunity to attract and contact prospective buyers. Weighing the two plots provides an attraction that probably cannot be excelled.

Limit the Number of Demonstration

It should be clear to the reader by now that the number of demonstration any one individual can do well is very much limited. It takes time to help select a field, see that the other essential inputs like seed, fertilizer, or water are available in the right amount at the right time. It takes time to teach the farmer to operate the machine well. It takes time to return periodically to check crop performance, to harvest and weigh the crop, and to contact neighbors, etc. The same can be said where comparative demonstrations involving brands are to be conducted. The activities are different but the amount of time required is considerable.

I should think around five demonstrations per year is a reasonable upper limit to the number per individual.

Remember a good demonstration brings in customers. A bad demonstration drives them away. It is better to put on one good convincing demonstration in a season than a number of poor ones. It is contended that a **good** demonstration is the path to sound machinery production.

In-use Services Must be Made Available

Nothing is quite so disconcerting to a farmer as to find that it is difficult or even impossible to get repair parts expediciously.

And, there are some who prefer to have the local shop do the complete maintenance job. Both types of services should be readily available with a reasonable distance of the buyer.

The afore mentioned means that a manufacturer, seriously interested in promotion, must establish local services facilities. Such facilities can be owned by the manufacturer or a license extended to a local agency.

Providing such services is an obligation that any reputable company who plans to grow and continue in business must provide. The very word promotion carries with it the requirement of local services. Initially such service need not be superior, nor is such expected. The customer knows that in the initial stages, where the sales are few, that a superior service facility is out of the question. He is usually understanding in this regard. What he dose expect, and rightly so, is a continual improvement in such services as the market potential is exploited. Remember we are speaking of promoting the kinds of equipment that are agriculturally sound and do in fact have a soild and sure market.

Direct "Factory to Buyer" Policies are Subsiding

In Asia much of the agricultural equipment has moved from the factory to the farmer without local or regional representatives. In

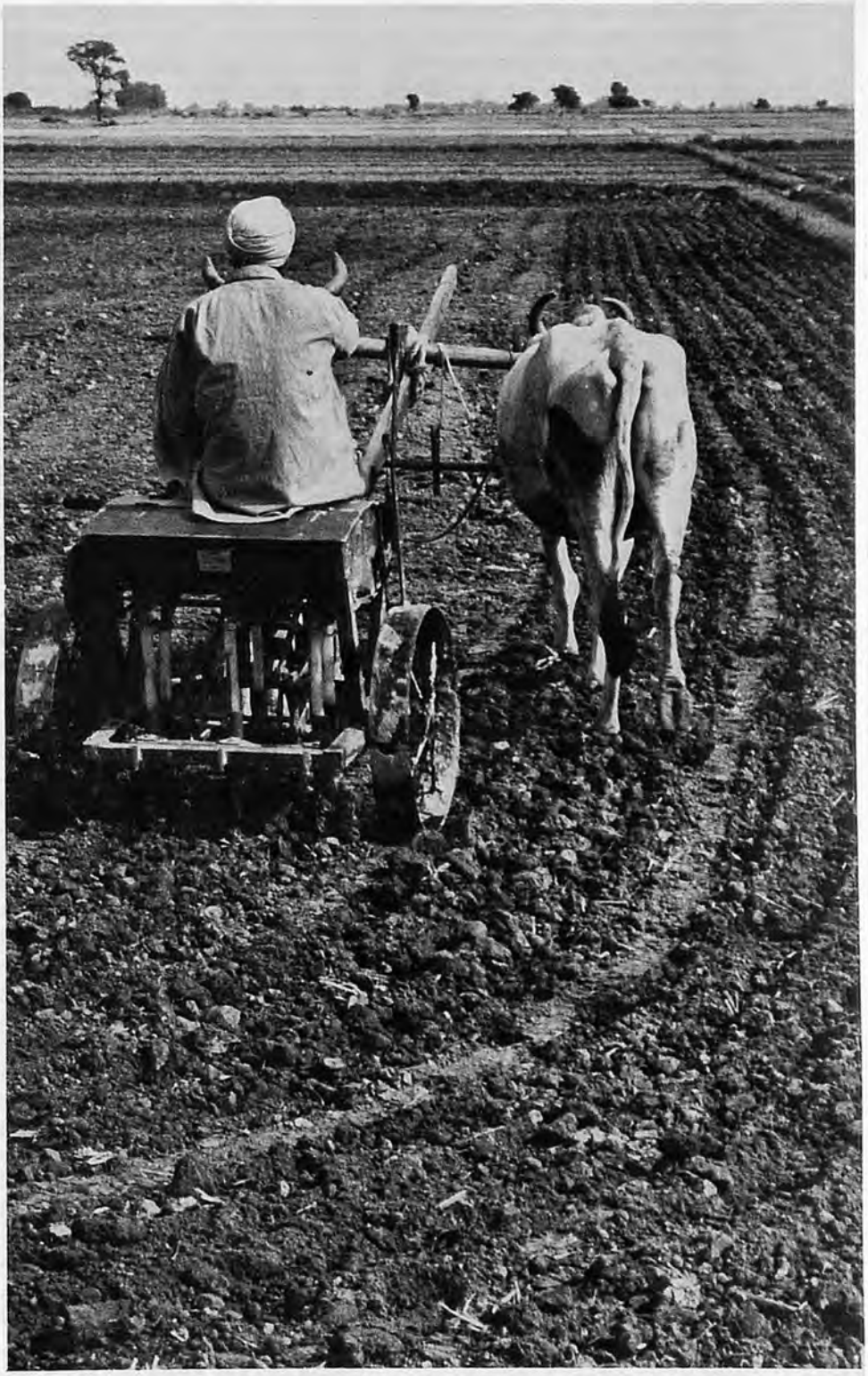

Figure 2. Jagjit Singh,a farmer of Punjab, India, seeded 100 acres of wheat in one season with this modern three-row drill. The seedbed was prepared by tractor power. A good demonstration of the blending of animal and tractor power.

some instances the agricultural equipment has been purchased by goverment agencies and moved to the farmers under various schemes, such as subsidies. Sometimes government officials collect orders and act as the local salesmen. In the latter case the equipment is probably manufactured by a government owned and operated factory.

There is nothing wrong with having public sponsored and managed manufacturing facilities providing they adhere to the same good principles of promotion that this paper teaches. That is, (1) have a good product that will benefit the farmer, (2) conduct effective demonstrations, and (3) provide local repair and maintenance services.

Too often however these three elements of good promotion is lacking in the case of public manufacturers. It is acknowledged that all too often the incentive for accomplishing these elements is lacking or at least not strong.

Irrespective of whether the manufacturers are public or private, it is respectfully submitted that the the industry must do away with the direct factory to buyer policy. Rather the policy should be one that involves local and regional representatives in demonstrations and service. The focus must be on these aspects as the promotion technique of the future. The manufacturer must be intimately involved with their machine after it leaves the factory. The manufacturer must know how it performs by a farmer on his field. He must be ready to note its weaknesses and to make improvements. He must be ready to back-up his products with adequate and timely services.

Summary

This paper has suggested that the future successful promotion of agricultural machinery production is thru effective demonstrations of a good machine that the farmers need, and by providing adequate and timely repair and maintenance services. Increased machinery production will come about only when the farmers need and demand the machine. The farmers will demand the machine more quickly when it is convincingly demonstrated. And the machine will continue to be in demand if the after-sale services are satisfactory.

For Asia the machines that will be in demand in the future are those that will make money for the owner and user and that will make farming more dependable and convenient. Increased returns will come about because of increased yields and production resulting from the use of the machine. Dependability and convenience will come about if the machine allows one to do a better job on time, without the pressure of long hours.

The seed-cum-fertilizer drill used as an example in this paper accomplished all of the above. The growth in sales in India attests to the soundest of the approach.

Initially, pioneering work was with one manufacturer. This one manufacturer was convinced that the modern principles to be incorporated in the new drill were sound and worth the investment. Today some seven manufacturers are engaged in manufacturing various versions of the principles in both animal and tractor-drawn units.

In all fairness it cannot be said that the services, both before and after sales, of these Indian manufacturers are satisfactory. Public officials are not conducting as many good comparative demonstrations of brands as they should. Some do not demonstrate or cooperate in comparative demonstrations involving brands. But it is acknowledged that the demonstrations and after-sales services are steadily improving.

Manufacturers, and others concerned, are recognizing more and more that a machine is much more than merely a labor saving tool. More and more demonstrations of the kind described herein are being put on. Local dealers are on the increase. The end result will be increased production of agricultural machinery.

References

1) Taneja, M. L. and Giles, G. W. *"Field Evaluation /Demonstration of Seed-Cum-Fertilizer Drill"*. The Ford Foundation, New Delhi 1, India. 1965.
2) Giles, G. W. *"A Guide to Planning and Managing Agricultural Operations--For National Demonstrations"*. Indian Council of Agricultural Research. Khrishi Bhavan, New Delhi, or The Ford Foundation, New Delhi, India. 1971.
3) Morse, Richard and Giles, G. W. *"A Farm to Factory Program for Modern Agricultural Equipment"*. Unpublished paper prepared for The Ford Foundation, New Delhi, India. June 15, 1965.
4) Giles, G. W. *"Ongoings of Agricultural Men and Machines in India"*. End of Tour Report to The Ford Foundation, New Delhi, India. May 1, 1971. ■ ■

Outline of the Government Policy for The Development Agricultural Machinery Industry in Asian Developing Countries

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I. Introduction

THE government policies introduced in this paper cover mainly measures to attract foreign capital, incentives for investment, tax concessions, customs tariff etc.

The developing countries in Asia are at different stages of development in engineering and general economy and the degree of development of their agricultural machinery industry is generally similar to the relative degree of industrialization reached in each country. By world standards, with a few exceptions, the production of agricultural machinery and implements in these countries may be considered insignificant. Viewed, however, from the stand point of overall industrial growth in Asia, significant progress has been made in the production of farm machinery and implements during the last decade.

Particularly, manufacturing and /or assembling of power tillers and tractors are widely expanding in this region through the foreign collabolation. Export capacities have also developed slightly in China (Taiwan), India and Thailand. This progress has raised industrial output and increased employment in these countries.

In combination with other measure for promoting the growth of engineering industries including agricultural machinery industry, government policies in most of the countries are included incentives such as tax holidays, import restrictions on indigenous products, tariff protection, manufacturing subsidies and provision of industrial estates.

II. Measures, Incentives, and Policy in Selected Asian Countries

The lack of adequate information about the policy and financial or investment statistics of the agricultural machinery manufacturing industries in most of the countries of the region does not permit an exhaustive review of these sectors. Some features of the policy made by the governments and plans for developing them are described here on a country-by-country basis.

CEYLON

There is no exclusive privilege given to agricultural machinery manufacturing industries. The general investment incentives given to other industrial enterprises cover the agricultural machinery manufacturing industry.

However, the general industrial investment incentives offered consist of (a) protected market, (b) tax concessions, (c) industrial estate facilites, (d) wider promotion functions of the Industrial Development Board and (e) export promotion incentives.

1. Protected market

When local products are available, it is the policy of government to either ban imports of the particular product or subject it to a tight quota. This appears to be a much more efficient encouragement for industrial development than high tariff protection.

During the middle of part of 1968, Government included tractors and farm machinery under open general licence program under "Foreign Exchange Entitlement Scheme" which enables to procure foreign exchange for import of farm machinery. The custom duty is nil, and import duty which is less than 10% on farm machinery and spare parts is levied.

2. Tax concessions

The profits from a newly established industrial undertaking is exempted from Income Tax for period of five years, also dividends paid to share holders are exempted from Income Tax.

The following concessions are also permitted:

(i) Lump sun depreciation is granted in respect of plant, machinery fixtures and certain buildings,

(ii) A development rebate of 20% is also allowed as business profits, and it is increased to 40% in the case of Ministry approved projects,

(iii) The salaries and other income of foreign exports not paid in Ceylon are free from Income Tax for three years, if they work for industry entitled to a five-year tax free holiday.

3. Industrial estate facilities

The Government encourages the establishment of small and medium-size industries through industrial estates. The Industrial Estate Corporation established in 1960 provide local manufacturers suitable factory buildings and sites at low rent within easy reach facilities, like transport, water, power, banking. There is already one such estate established near Colombo. It is proposed to set up three more in Galle, Kandy and Jaffna.

4. Industrial Development Board

The Industrial Development Board of the Ministry of Industries will set up new agencies such as Investment Information Centres and Industrial Supply Agency; Management Development and Productioning Centre. All with the idea of industrial promotion.

5. Incentives to foreign investors

Assurance given to private Foreign Investors are as follows:

(i) Government assurance that foreign investors will enjoy without discrimination all the advantages and incentives open to local interest through an approved investment,

(ii) Remittances can be made freely of (a) profits and dividends accruing to foreign investors, (b) interest owing to the non-residents on debentures, preference shares, over-drafts,etc., (c) proceeds of sales or liquidation of investments, (d) maintenance for families of foreign personnel on retirement, and (e) resonable royalty payments, technical services fees.

(iii) Foreign investors will be secure from expropriation or nationalization. Investment guarantees have been singed with the U.S.A. and West Germany, and the Government is prepared to negotiate similar agreements with other capital-exporting countries.

6. Export promotion incentives

Industrialists are given special incentives like: (i) tax holiday for three years on profits derived from export business, (ii) income tax rebate of 5% on the F.O.B. value of goods exported, if the export bring in 25% earning in foreign exchange, (iii) priority issue of foreign exchange for import of raw material required for carrying out of export orders, (iv) full rebate on customs duty on imported raw material used for export manufactures, (v) waiving of business turn-over tax and excise duties on exported goods, and (vi) permission to offset advertising expenses abroad for export produce from tax.

CHINA(Rep.of)

1. Customs duties and other charges

There is regulation on the parcentage and value of imported components for local assembly. Overall customs duty is 15%. There is no sales tax on sale of agricultural machinery.

2. Incentives for Investment

The tax and other benefits for investment is favourable. The China Development corporation a private institution specializes in medium and long-term loan to private industry. The Taiwan Land Development Company finances land reclamation, construction of industrial estates, and development of eastern Taiwan. The Land Bank of Taiwan, one of the largest agricultural banks in Taiwan, has a significant share in the agricultural machinery manufacturing industry.

3. Incentives to foreign investors

Favorable elements include liberal lows regarding ownership and transfer of capital and earings, tax incentives and special promotional measures such as: (a) permission for 100% foreign ownership. (b) remission of 100% of annual net earnings, and after two years, 15% of invested capital each year, (c) gurantees against expropriation for 20 years after commencement of business if foreign ownership is 51% or more and reasonable compensation for oxpropriation of businesses with less foreign ownership, (d) five-year business income tax holiday, (e) duty-free imports of machinery, if capital is in excess of US$2.25 million, (f) maximum business income tax of 18%, provided that the business enterprise conforms to the criteria stipulated in the Statue for Encouragement of Investment-all other enterprises are subject to a maximum income tax of 25%, (g) specific exemptions from other taxes, (h) Investment Centre established in 1959 to provide many services, including making recommendations to authorities for improving lows and procedures affecting investore, (i) several industrial sites and a duty-free export processing

A small pump makes farmer's income double with multi-cropping.

zone in Kaoshinng, etc.

INDIA

1. Although the Government of India has not formally enlarged its program of incentives for investment, nearly most of the recent changes in the economic policy have contributed to the formation of a better climate for the foreign and domestic investment. Some of the more rigid controls on private enterprise have been lifted and administrative procedures are being speeded up. Although industrial licence is the basic requirement, under 1966 reform, licences are no longer required for many industries including internal combustion engines and agricultural equipment, tractors and power tillers.

2. industrial licencing system has been relaxed further the allows firms to set up out put to a maximum of 25% without prior government approval and also allow diversification into new fields except for presented items which are manufactured by small scale record.

3. The incentives include 5 years tax holiday for selected industries, rebate, on electricity, sales tax, etc. in selected location. There are attractive corporate tax incentives which allows tax exemption on income up to 6% of the capital employed for 5 years after the start of production and in each of the 5 years, the amount by which profits lag behind 6% of the capital employed may be carried forward to the succeeding years. Manufacturers in priority industry may deduct an amount equal to 8% of their profits when computing taxable income.

4. Another major tax relief is the development rebate, a deduction from taxable income of 20% to 35% of the value of the newly installed machinery or plant provided it is not sold for 8 years. Second hand plant and machinery, provided it is imported may also qualify for the development rebate.

5. The effect of the rebate is to allow depreciation of 120 or 135% of the cost of new plant and equipment. However, 75% of this tax savings must be put into a reserve for 8 years or until it is used for acquisition of new assets or other investment. The balance of rebate may be carried forwards for a maximum of 8 years, if the total pre-tax income falls short of the full amount of the development rebate. The development rebate on plant and machinery for scientific research facilities installed after 1961 is 35% and all capital expenditure for scientific research after that date may be deducted in full.

6. Personal income tax benefits for foreign technicians approved by the government - may be from 3 to 8 years. The various states have industrial development banks that extend medium and long term loans 免nd some times take equity in new projects.

INDONESIA

1. Incentives by the Government

About 80% of the manufactur-

ing industries at present are controlled by the state enterprises. According the Five-Year National Reconstruction Plan (1969-1973), the overall policy will give top priorty to food supply and input for agricultural production.

Manufacture of agricultural machinery, especially hand tools, sprayers, pumping sets, rice processing machinery etc. are to be encouraged. The steps encouraging manufacture are: (a) credit facilites to local manufacturers, (b) higher tariff on imports, (c) import planning - emphasis on import of raw materials and (d) technical assistance.

2. Credit and Loans

The term of credit to private manufacturers are of many types. For food sector "soft" loans carry 3% interest per month (market rate 10% per month) and for investment credit the rate of interest is 1.5% per month and on working capital 3%. Regarding pure public companies, the participation by private and public foreign and domestic participation with the government is encouraged.

3. Duties on Components and Manufactur's Engineering Items

(i) on import of completely assembled units such as engines, etc., the customs duty is nil and import duty is 10% of landed cost.

(ii) on imported CKD items such as diesel engine, truck, bike parts, etc., the customs duty in nil and import duty is 10%. Sales tax of 20% is levied on assembly cost including labour cost on engines and 10% on pumps.

(iii) on import of raw material such as steel etc., the customs duty is nil, import duty is 10% and sales tax of 20% levied on the total finished component value.

IRAN

1. Government Policy

(i) Import duties: As of 1969, there are no import duties on farm machinery and spare parts.

(ii) Protection to local manufacturers:

(a) No policy is formulated towards protection to be granted to local power tiller industry.

(b) Normally toractors in horse power range of tractor 45-65 which is to be produced by the State Tractor factory is not permitted to be imported expect by state run "Institute for Farm Machinery Development."

Small black-smith in the Philippines. They are important to repair machinery and produce simple implements.

(c) Import of implements and other equipment is allowed freely by any agency for the present.

2. Incentives for Investment

(i) Government encourages foreign investment. There is no requirement for equity participation by Iranians, although government prefers joint ventures.

(ii) Normally investment in all fields expect oil, tobacco, and cigarette are open for foreign private participation.

State enterprise are engaged in machine building, tractor manufacture and metallurgical and engineering manufacture. Normally, the policy of the government is not to enter manufacturing activities expect steel, aluminun and petrochemicals.

List of projects for foreign investment in Iran is publised by the Investment Promotion Section of the Research Centre for Industrial and Trade Development, Ministry of Economy.

(iii) The government controls on investment, local content requirments, mandatory membership, establishment of company are fairly liceral and prices control on engineering manufacture goods do not exist.

The lows regarding royalty, remittability of funds repatriation of funds are fovaurable for foreign investment. The tax structure is fairly liberal.

(iv) Tax incentives for progressively locally manufacturing industries exemption of custom duties on imported, machinery and spare parts for negotiated periods (usually 10 years) for new investments are provided.

(v) Although it is said that money is usually tight in Iran for investment, short term credit for working capital is available from commercial banks, the largest being the government owned Bank Melli Iran.

The interest rate about 8-12% good investment. Medium and long term loanes are obtainable from privately owned Industrial and Mining Bank of Iran for pe-

riod 2-10 years at an interest rate of 7 to 8% and Industrial Credit Bank which grants 3-10 years loans to finance small industries and also for working capital.

(vi) Information on investment is provided by the centre for the attraction and protection for foreign investment in Iran, Bank Markazi Iran,Tehran.

MALAYSIA

1. Measures to attract national and foreign capital

(i) In view of the favourable domestic and export market prospects for manufactured goods, the First Malaysian Plan (1966-1970) has targetted a rate of increase in industrial output to the extent of 10 per cent per annum. Basic metals and machinery manufacturing are among the industry groups in respect of which a production rate of more than 10 per cent per year is expected. To attain these objectives the government will follow a purposeful policy of sustained encouragement and assistance to private entrepreneurs.

(ii) As the First Malaysian Plan observes, "Foreign entrepreneurs will be accorded the same incentives as local industrialists and, in addition, will continue to be given guarantees regarding the security of foreign investment. An additional measure of protection to foreign investment is accorded by Malaysia's accession to the World Bank-sponsored Convention of International Investment Disputes, wich permits foreign industrialists to resort to an International Arbitration and Conciliation Centre to settle disputes, should any claims against the Malaysian Government arise.

2. Investment incentives

Under the Investment incentives Act of 1968 the Malaysian government offers to national and foreign investers basically tow types of incentives:

(i) Incentives for the initial setting up of manufacturing establishments in Malaysia. These are as follows:-

(a) Pioneer status

Tax relief period

A two-year tax relief will be granted to companies that are declared pioneer. There will be no minimum amount of investment level required to attain the initial two years of tax relief.

Additional extensions

In addition to five years tax relief which firms can be granted for attaining qualifying fixed capital expenditure levels, extentions of a futher three years are provided for firms meeting each of the definite provisions

Capital allowances

Where losses incurred every year throughout tax relief period allowed to be notionally calculated and aggregated as deduction in postpioneer period.

(b) Investment tax credit

The rate of Investment Tax Credit given will not be less than 25% of the capital expenditure incurred on a factory, plant or machinery for the approved project.

If the approved company has set up its factory in (i) a development area; or (ii) produces priority product or products; or (iii) incorporates the required percentage of Malaysian content, an addtional Investment Tax Credit of 5% will be given for each of the three conditions fulfilled in the basis period.

(ii) Incentives for existing and new Malaysian manufactures to export their manufactured products. These include:

(a) Deductions for promotion overseas

(b) Accelerated depreciation allowances

(c) Export allowance

(d) Payroll tax refund

3. Industrial finance

(i) Malaysian Industrial Development Finance Organization is assisted from Government, private and World Bank funds and is one of the main financing bodies for private industrial growth through loans, underwriting and participation.

(ii) Madjlis Ammanit Rayat (MARA), Council of Trast for Indigenous People, is a special body created to promote commerce and industrial activity and participation among indigenous people by the Parliament in 1966. Its activities due to provide (a) credit facilities; (b) advisory services; (c) training; (d) establish or expand existing commercial units and to (e) operate road transpors and thus import initiation and participation in "Bhumiputras" in the field of commerce and industry.

As of 1968, about M$ 15 million has been invested in all activities including farm machinery manufacturing participation. A sum of M$ 30 million has been authorized to MERA in 1968.

NEPAL

1. The first priority has been given to the manufacturing industry for agricultural machinery in the current national development plan. Keeping the facts in mind, the agricultural tools and implement factory has been set up at Birganj through an aid by USSR. There is government budget to this agricultural tools and implements factory at Birganj since last four years.

2. Measure to attract national as foreign capital into this field inculuding export incentives;-

(i) No income tax is levied for such industry for the first 10 years.

(ii) The industry can utilize 65% (average) of the foreign exchange earned by export.

3. No custom duty is levied on agricultural tractors and implements imported.

PAKISTAN

1. Government policy towards manufacture

The ultimate aim of the Government of Pakistan is to develop sufficient manufacturing capacity, subject to feasibility. To fulfill this objective the government of

Allocation of Funds for Farm Machinery Manufacturing Sector

(1965–70)

S.No.	Eri of description of the industry	Amount of investment (Rs. million)	Capital allocated (Rs. million)
1.	Agricultural tools. and implements.	400	147
2.	Diesel and other internal combustion, engines	514	318
3.	Agricultural machinery and equipment	360	210
4.	Tractcrs and components	315	190
5.	Pump and parts	344	211
6.	Trailers, trolleys, bus bodies	140	76
7.	Service Workshops	529	270
	Toral	2, 602	1, 422

Pakistan, has allocated funds as per the following table for the development of such industries in private sector during the third plan (1965-70) of the Industrial Investment.

Out of the total allocation 5200 million rupess, 867 million rupees (467 million in public sector and 400 million rupees in private sector) has been allocated for development of agriculture. This figure works out to 15% of the total expenditure:

The general policy of the Government regarding the general engineering industries are that it is to be versatile enough to be adopted for the manufacture of any item in the allied field including items for the use of farm machinery manufacture.

Out of the total provisions earmarked for the investment during the Third Plan Period the Government has approved a Priority List of Industries.

2. Import Duties

There are no import duties on tractors and general implements. However imports of new items is subjected to alleviate of foreign exchange. Government of West Pakistan-directorate of industries - is also considering relief on import duty on raw material for farm equipment manufacture.

3. Incentives for Investment

The policies for incentives for investment is available with the "Investment Promotion Bureau" of the Department of Investment, Promotion and Supplies, attached to Ministry of Industries at Karachi.

(i) All now investments and expansions are to be approved and supervision of Department of Investment Promotion and Supplies.

(ii) No formal rules on local content are issued. Tax holidays normally cannot be obtained unless the value of local content in the production can approach 50%

(iii) Tax holiday upto 6 years (negotiable) if progressive local manufacturing program, location in a underdeveloped area, export potential is approved.

(iv) Freedom to sell without price control exists at present, although government can exercise controls.

PHILIPPINES

1. Incentive for investment

The following is a listing of organizations providing incentives in one way or another towards the establishment of industries, whether large or small scale.

(i) The Board of Investment. It was recently established to develop and promote under incentives pioneer or non-pioneer areas of investment. Depending upon the type of investment, a registered enterprise, having at least 60% Filipino capital participation is entitled to such protection and privileges such as:

(a) Tax-free importation of capital equipment and spare parts.
(b) Remittance of earnings and repatriation of investment out of the country.
(c) Anti-dumping protection
(d) Accelerated depreciation
(e) Post-operative tariff protection
(f) Net operating loss carryover
(g) Deduction of organizational and pre-operating expenses.
(h) Net operating loss carryover
(i) Tax credit on domestic capital equipment to user and manufacturer.
(j) Deduction for expansion of reinvestment.
(k) Employment of foreign nationals
(l) Deduction of organizational and pre-operating expenses.
(m) Tax credit for withholding tax on interest.
(n) Exemption from all taxes under the Internal Revenue Code except income tax on a gradually diminishing percentage from registration up to December 31,1981.
(o) For export-oriented industries: - Double deduction of promotional expenses, double deduction of shipping costs on Philippine vessel,- 150% of shipping cost on foreign vessels, and special tax credit on raw materials.

Investors on registered enterprises are also given tax exemptions on capital gains and sale of dividends within a prescribed period. Philippine nationals who are members of the social security systems are provided loans to purchase shares of stock in any registered enterprise.

(ii) Regional Authorities. Recently established were regional development authorities to engage autonomously in developing prescribed areas. Any enterprise which becomes a subsidiary of regional authorities may avail itself of the tax incentives enjoyed

by said authorities.

(iii) Agricultural co-operations. Registered co-operatives are entitleted to tax exemptions including tax-free importations of agricultural supplies.

(iv) Registered cottage industries. Registered small-scale manufactures are granted certain tax exemptions.

2. **Priority Investment Areas**

There are about 56 industrial projects requiring an aggregate capital investment of 3.75 billion Pesos proposed to be undertaken for the five year 1968-1973 period. Seven are in mining involving 403 million Pesos and the rest are in manufacturing, of which included are the following fields of agricultural machinery and their ancillaries:

1. Manufacture of power tillers at a starting rated capacity of 10,000 units.
2. Manufacture of small diesel engines at a starting rated capacity reported to be 3,000 units.
3. Manufacture of machine tools at a rated capacity of 6,000 units of drills, lathes, etc. Estimated project cost is 156 million Pesos.

3. **Taxes**

Tariffs vary within the range of 5-10% of the C.I.F. value depending upon the category of farm machinery. Power tillers and tractors below 50 Hp are reported to have a 5% duty. Higher tariffs are to be expected when there are local firms producing products identical to the ones being imported. There is a sales tax to be within 7-10% of the commodity price.

SINGAPORE

1. **Policy Toward Manufacturing Industries**

Today there is no existing industry manufacturing agricultural machinery except underplanning plant of a small engines for multipurposes. In order to promote "mnufacturing activities in general, many industrial estates have been planned and Jurong Industrial Estate is one of the largest. Textile, electronics, sports goods, fabrication and other engineering industries have already functioning in these estates. Regarding policies towards manufacture of agricultural machinery, the government, in general, places emphasis in promoting new industries with mechanical engineering bias. The government is prepared to render the following incentives and assistance for setting up of an agricultural machinery industry viz:

(i) Tax holiday up to amaximum period of 5 years.

(ii) Export incentive where only a 4% tax payable on profit accrued through export for a period of 15 years.

(iii) Services in promoting export rendered by Government Export Promotion Centre.

(iv) Liberal loan for purchase of plant and machinery.

(v) Equity participation by the government.

(vi) Pre-education training of skilled workers and technicians by the government.

There is no fixed allocation of budget to the industrial sector during the development period. However, the government is flexible in meeting the requirement as circumstances demand.

2. **Incentives for Investment**

(i) Singapore adopts a policy of free enterprise with no descrimination between foreign and local manufacturing. The foreign investor can have up to 100% or majority shares, and no special approval for establishing manufacturing is not necessary except with respect to a less than dozen industries under the control of manufacturer ordinance act, or if the manufacturing company applies for pioneer status.

(ii) There is no corporate tax as such. The present company tax is withholding tax against dividends.

(iii) Pioneer industries are completely exampted from company tax for a period up to five years. There are other tax benefits regards investment of profits from approved expansion productive capacity, depreciation of capital equipments, interest paid to overseas companies, income from royalities, etc.

3. **Industrial Financing**

Development Bank of Singa-

Plowing by a power tiller in Thailand

Demonstration of rotary tillage by a power tiller in Vietnam

pore plays a significant role in assisting the establishment of industries. The following are some of the general broad facilities available:

(i) Long term loan

(a) Investers, foreign or local who invest in manufacturing industries in Singapore may secure loans from the Bank up to 50% of the cost of machinery and equipment and 70% of the value of the factory building. The payback period on equipt is 3-10 years and on building up to 15 years with a rate of interest from 7 to 8% per year.

(b) Towards working capital, based on current assets, a liberal loan may be obtained on a rovolving credit basis on a rate of interest of 9-9.5%

(c) There are facilities for banking to finance the working capital at the interest rate of 7 - 7.5% from Commercial Banks.

(ii) Short term loans

These are mainly aimed at encouraging industries in the 12 industrial estates.

(a) Ready built factories are sold or rented to the industries. Loans up to 80% may be obtained at a rate of interest of 8-8.5% for a period of 4 years and over respectively.

(b) Developed lands with roads, electricity and water may be taken on lease up to a period of 60 years - first lease of 30 years - and 30 years on water front areas. The rental value is normally 6% of the value of the land.

(c) Low cost continuous supply of electricity is available.

The Development Bank of Singapore has a paid up capital of S$100 million, and loans from Government, lines of credit of S$130 million at an interest rate of 4%, 49% of capital is from the government and the balance from Commercial Banks, insurance and members of public.

THAILAND

1. Development priority

The farm machinery industries have been given promotional status by the Board of Investment. The industries have been classified into three categories as follows:

Category A: 1. Tractor producing or assembling industries

2. Agricultural machinery industry

3. Water pump industry

Category B: 1. Agricultural machinery assembling industry

2. Water pump assembling industry

Category C: 1. Agricultural tool and implement industry

2. Modern rice mill industry

The Board of Investment can add more industries to the list of industries oligible for promotional privileges either or their own justification or by requests of potential investors. Several firms have been granted promotional certificates since the establishment of the Board in 1959. Many of these firms, however, have not yet started operation. There are also firms wich are producing farm machinery or implements without receiving promotional privileges from the Board of Investment.

2. Budget alloeated to the farm machinery industries

The Government has no intention to invest in farm machinery industries and therefore no allocation from the national budget is made directly for these industries. There is however a small fund allocated for the development of the industries through the research and development work of the Division of Industries and Division of Engineering of the Rice Department.

3. Measures to attract national as well as foreign capital into the agricultural machinery industry

The most effective measure used to attract capital into the agricultural machinery industry so far is the Industrial Promotion Act which is administered by the Board of Investment. Although the main incentive provided by this Act is import duty exemption or reduction, the existing import--duties on agricultural machinery and equipment are so low that the incentive offer does not give much advantages to promoted enterprises in this field. Moreover, present import duties for some raw materials, such as steel products or finished components still required for agricultural machinery industry are higher than these for some completed or built up agricultural machinery.

Several firms which pioneered

in manufacturing of farm equipment are not eligible for promotion privileges because their operations are small or the investment for projected expansion is below the limit set by the Board. At the same time rapid expansion of these firms in the near future is not likely in view of the smallness of the local market. The firms which now assemble tractors still operate far below their designed capacities. Many firms which have already been granted promotional privileges to manufacture farm machinery or assemble diesel or petrol engine still have not started any operation.

4. Credit facilities

The industrial Finance Corporation of Thailand charges an interest rate of 9.5% per annum and the Loan Office for Small Industry sets the interest rate at 9% per anum. Nonetheless many small industrial manufacturers still have to pay in some cases a discount rase of as high as 3% per month. Legelly the commercial banks can charge manufacturers an interest rate of up to 15% only.

VIETNAM(Rep.of)

1. Priority

In the first plan of national development, the priority is on fertilizers, cementy etc. The priority in the second plan is, along with others, on the manufacturing industry of farm machinery.

2. Measures to attract national and foreign capital

For the purpose of encouraging and protecting private investments, the fiscal advantages and guarantees instituted by the 1963 Decree-Law are granted to enterprises whose activity contributes to the fulfilment of the objectives of the economic development. Foreign investors are generously granted the benefit of investment advantages as follows:

(i) Exemption from import duties on equipment and spare parts.

(ii) Exemption until the third year, from the real estate tax.

(iii) Exemption from profit tax for 8 years.

(iv) Guarantee against nationalization of enterprises, for a minimum period of 15 years.

(v) Foreign investments will be treates on a basis of equality with Vietnamese enterprises.

(vi) Loans of various terms helping investors to cover construction and equipment expenses.

III. Conclusions anb Suggestions

1. Generally speaking, it is evident that a proper assessment of the existing social economic conditions, the present indutrial status and other inherent problems must be made in order to achieve the best results. An exhaustive analysis of government policies and programme and of a host of techno-economic factors must be undertaken before making decisions as to what kinds of farm machinery industry enjoy the best prospects for growth of both agriculture and engineering industries in the coming decade.

2. The rate of growth of farm machinery industry in Asian developing countries has been reflected in corresponding changes in the economic structure of some of these countries. Clearly in many of them the limitations of the domestic market represent a factor inhibiting their industrial growth of farm machinery. The creation of large markets through such means as economic development policies and development of types of suitable machinery, therefore, represents opportunities for encouraging the growth of industrial output on agricultural machinery.

3. In most of the countries in Asian developing region, the industries manufacturing agricultural machinery and implements in given priority and certain incentives provided. However, the incentives for investment in the manufacture of farm machinery are not special since they were similar to those offered for investment in other industries that the governments are promoting.

The government subsidies are not provided directly for the production of farm machinery except state enterprises in Ceylon, Indonesia, Iran, and Nepal.

The industrial estates have been provided by the governments in Ceylon, China (Rep. of), Malaysia and Singapore.

4. Past experience has also demonstrated the importance of the love that international technical co-operation can play in prompting industrial growth of farm machinery. While shortage of capital has been singled out as one of the most important factors hindering industrialization, attention has been focussed in recent years on certain other factors such as lack of trained manpower, insufficiencies of technical know-how, and necessity of engineering research and development facilities.

5. Obviously these problems could be solved by international cooperation. This could include financial equity participation, licensing agrements, technical assistance, consultant services, are examination of international trade and investment policies accordance of preferential duty treatment etc.

In addition to the above farms of assistance, advantage may be taken of offers of assistance from countries outside and within the region, in the form of consortiums, aid programmes and loans from Governments and other international financial institutions such as the Asian Development Bank and the World Bank.

6. Many of the countries in Asian have plans for the development and expansion of their farm machinery industries. Economic of scale should not be lost sight of when setting up plants which

(Continued on page 52)

Historical View of the Development of Agricultural Machine Industry in Japan

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1. Preface

THERE are several problems in developing agricultural mechanization. The kinds and varieties, physical conditions, the scale of farming, education and so one are mentioned as important factors. Besides them, demand for agricultural machnes differs from district to district so I belive it would be most ideal to promote domestic production as much as possible. In this respect, the planning of mechanization should be made by the experts of each country so that it can fit for the situations of respective countries. The industrialization for the production of agricultural machines must be designed according to the technical level of the country. It would also be most ideal to encourage domestic production in order to get the information on the situations of respective countries and develop what they need as well as possible. The industrialization, however, includes some stages from primitive one to highly progressed one that has high level of technique. For example, woodworking, forging, casting. cut-processing, moulding as well as the production of parts for special purposes can be mentioned as the requirements for technique. The specialized knowledge is also required along with a certain level of technique for production. But there are some which could be produced with the most primitive tehcnique as well as some which require innovated facilities to produce them. Of course, whether one is needed or not, should be decided according to the kind of machine to be produced. Now, in promoting the industrialization of Southeast Asian countries, the most important thing is to raise the level of industrial technique, especially how to promote forging skill matters much.

In Asian countries, there are many which depend on the import even for the supply of hoes and reaping hooks. But these tools can easily be produced domestically with the most simple facilities, technique and guidance. The supply of materials must be considered when promoting domestic production. But it would be the easiest way to use wood at the primary stage. Wood working facilities, which does not require big capital, count for much in this case. The economic condition of farmers matters next. If governmental aid is not available, it would be quite difficult to introduce an automatic complicated machine. Naturally some of the factories make the production with capital equipment but in most cases the people of these countries depend on import even for the supply of farm tools and machines.

Korea,Taiwan. India, Thailand and Iran are mentioned as the countries which have domestic production of substantial level. The industrialization plan, a basic factor to promote mechanization, must include the orderly stage along which the production of agricultural tools develops from those of manpower, animal power, power machines by engines through automatic complicated machines. In the light of the history of Japanese agricultural machine industry which developed from the primitive stage of forging and wood working, casting through the high stage of cutting and cleaning of iron, heat treatment and sheet metal processing. You will easily find that it has an orderly course which

could be referred to in developing industrialization of developing countries. In this essay, I would especially like to explain the Japanese agricultural machine industry from the view point of the historical development of technique.

2. The view of the historical development of Japanese agricultural machine industry

The Japanese ancient literature shows the existence of forging technique 2000 years ago at the latest. You can learn it from the excavated swords of those days. In those days, they processed iron from iron sand, which was used for casting or used as an material of forging. But there were a great deal of years before it was used for farm tools. The ancient farm tools of Japan were introduced mainly from China and Korea. You can find their influence on hoes, reaping hooks, plows, grain fans and hullers. Among them, hoes and reaping hooks were the ones in which they succeeded in domestic production even at the primitive stage.

You may have an idea that the agricultural tools of Japan found at an old mound were the cast ones if it is termed from the standpoint of technical history. Those tools were used as old as 644 B.C. It is also assumed that people used animal power for the operation of plows, which were made by local smiths. We have a record that plows were displayed at an agricultural ceremony in honor of the Emperor in 758.

The primitive plow was operated by two mens; the one drew it with a rope and the other supported it. Later, how to operate plow was changed to cattle-drowing method. The improvement of it was started about 100 years ago and since then it has been made better gradually. But almost all of the plows of early days were the ones made by forging. So you may see that Japan has forging technique which has been fostered since the ancient days. Forged iron of fine quality was used for a material iron make comb threshers or a ancient type of rice-shuttering tool, hoes and reaping hooks. They had been developed into various types according to the demands of farmers of various districts. Until 1870, farm implements were produced by making use of the tech-

Table 1. Historical Changes Of Farm Machinery Production Technique in Japan

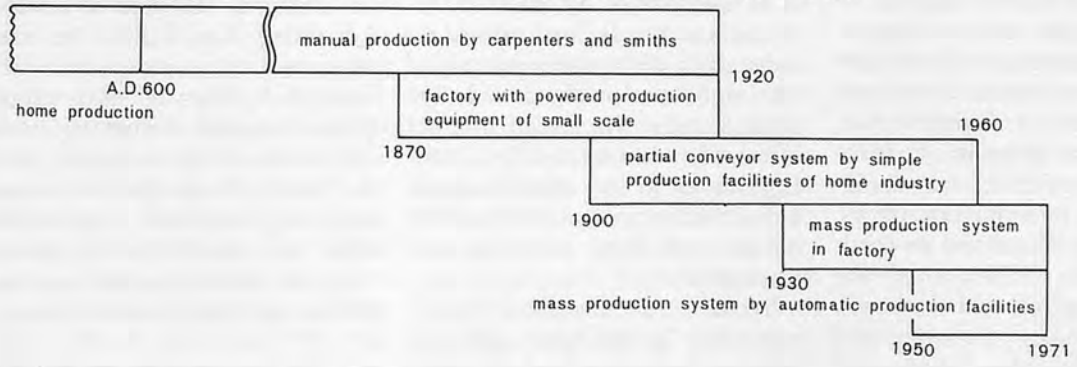
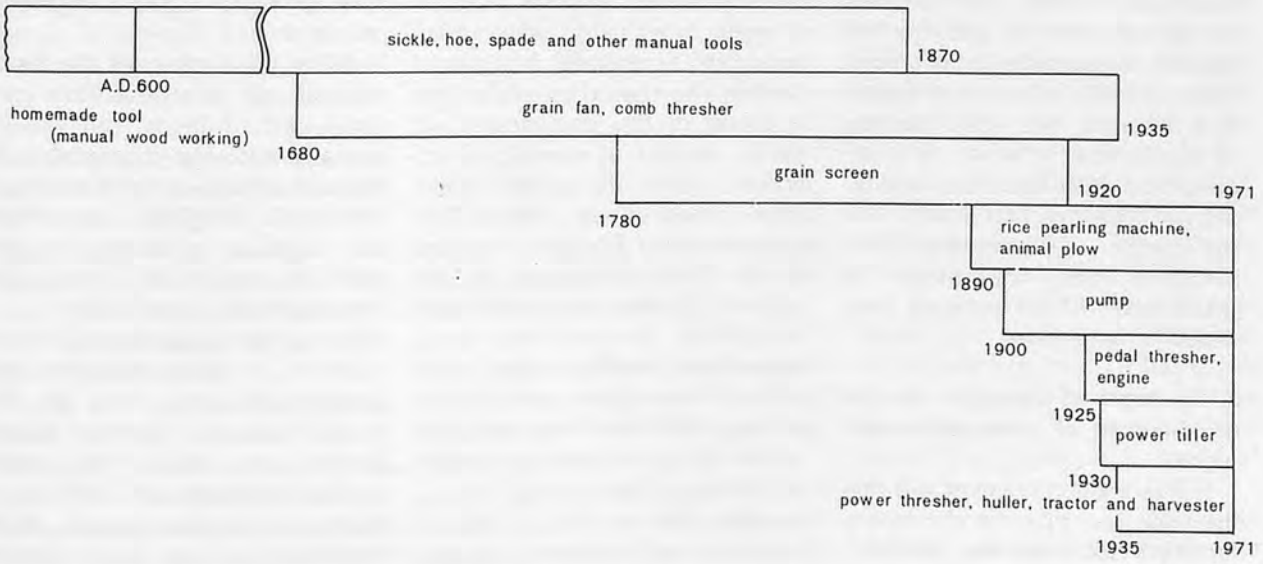


Table 2. Historical View Of Farm Machinery Production



niques of carpenters and smiths. Since the political revolution staged 100 years ago, cultural inter courses with western countries started which gave influence on Japanese industry and gradually changed the way of production. As a result powered farm machines were begun to use. The history on the development of agricultural machines could be devided into several parts. The tables that follow show the course of development.

The two tables show that the production technique and development of agricultural implements and machines have kept the space with each other. The development of production technique enabled the farm implements and machines, which had been difficult to produce before, to be produced easily. It brought about a new demand, on the other hand. It is an interesting fact to us. The progress of farm machines and implements. China and Korea are mentioned first from the standpoint of foreign influence on the progress of Japanese agricultural machines and implements. Grain fans, hullers, plows, hoes, reaping hooks and so forth underwent the influence of the both of them at their primary stages. They were of casting and wood working when they were termed by the point of production technique. These are engines, pumps and powered spraying and dusting equipments which have undergone the influence of Europe and America. The scale farming of Japan was, however, so small compared with European and America countries that Japan took the course of developing farm machines and implements of small scale. This tendency continued up to present.

3. A couple of examples for the development of production technique

It was about 100 years ago that the time got ripe for the manufacturers to start the improvement of farm machines which had been operated by man power over one thousand years. In other words, it was after the establishment of a new government by *Meiji Restoration*. This historical event put everything which had been governed by *Samurai* or knight class, under the control of a new state with a parliamentary system found in Europe or America. It also gave people the freedom to choose their occupations. The government invested one third of the budget to the promotion of education as the demand for education was intense. As a result, the production of farm machines and implements developed gradually along with the improvement of farms works. In those days, the industry of farm machines and implements, which was at an early stage of industrialization, was attractive enough. It is also proved by the fact that inventions or devices related to farm tools and machines occupied the largest part in the period soon after a patent regulation was put into effect. It may not be an exaggeration to say that Japanese industrialization started from the industry of farm machines and implements.

Social conditions cannot be overlooked in the observation of technical development of farm machines and tools. The study of farm machines and tools in Japan changed drastically when manpower was replaced by animal power. The typical example of it is found in the improvement of plows. In fact, a number of improved plows of animal power were produced in 1900's. The Japanese reversible plow invented by Mr. Genzo Matsuyama in 1903 and the Japanese plow with short sole by Mr. Yonejiro Ohtsu of the same days should be noted especially. These plows are not are not so different from the most advanced ones of today in respect of technique. In the case of reversible plow by Mr. G. Matsuyama, the great demand switched its production method to massproduction and then replaced the cast blade with that of steel.

There is an interesting story related to this; the trial product of steel plow by John Deere Company was made by a saw while Mr. Matsuyama also made use of a saw as he could not get steel. The steel blade for plow requires heat treatment, so Mr. Matsuyama had introduced the technique of heat treatment. Of course, heat treatment had been applied for the forging of hoes, reaping hooks and so forth but it was he who modernized the technique of heat treatment for the purpose of massproduction. Not being a technologist but a *farm-improving guide*, he did not have any knowledge of techniques at all. He travelled from village to demonstrate his plow while he gave guidance on farming method. That was the way he adopted for selling them. All of the manufacturers of plows of that time were also guides of cattle-tillage. It was only *farm improving guides* who were accepted by people in the farm village. In this respect they must have had more knowledge of agriculture compared with the technicians of farm machines and implements of today.

4. The development of factories which produce a man-powered and powered grain threshing machine

When you look back the development of farm machines and implement of Japan, you will especially note the massproduction method for a foot thresher adopted by Mr. Minowa. The number of machine produced reached 50,000 a year in five years after the beginning of production.

It was the largest factory of the factories of farm machines and implements at that time. Mr. Minowa founded a company named *Saiosha*, after which were founded several manufacturers with the ability to produce around 20,000 machines a year. He improved

massproduction method further by devising an automatic machine which drives in threshing teeth on a wooden drum. There were many carpenters among the employee at first, for the frame of machine, which was the main part of it, was usually made of wood. Power grain threshing machine followed the same course. The manpower thresher encouraged people to devise a power grain thresher. The modern type of it was completed in 1928.

Mr. Tomiji Yoshida was one among those people. He was engaged in the sales of general goods. Mr.Kihachiro Ii also contributed much to the improvement and completion of it. Although the type was different, the efficiency of thresher itself had alreaday reached nearly its highest level. For this reason, it required a great deal of difficulties to complete a power thresher. For example, Mr. Ii was absorbed in thinking even when he were walking and thought of a great idea; he made a discovery that it was important to keep the balance of machine to prevent its vibration. Nowadays anybody could think of the balance of the suction body of power thresher if he has some knowledge of machine. But at that time, there was nobody who knew it.

Mr. Ii was from a farmer's family and scarcely knew anything about industrial knowledge except for the experience of working in a farm tool factory for a year. His factory for power threshing machines developed by an efficient massproduction system after the end of war but it was merely a gathering of carpenters at the beginning. There was also a man who equipped a sixfoot fly wheel in order to produce foot threshers.

You will find the fact that almost all farm machines and implements manufacturers of Japan,when classified by their previous occupations, were the ones from carpenters and smiths of farm villages or the ones who changed their occupations from salesman of farm machines to producers of them. There was scarcely anybody who came from a modern industry. That was quite the same in the case of the inventor of *subber roll type husker*.

Threshers made the basis of farm mechanization firm in Japan. This thresher is almost wooden

In the case of Mr. Rinzaburo Miyazaki, who invented a straw cord twisting machine overcoming his blindness, was also from a farm family. As you may see from the above explanation, almost all the inventions of farm machines and implements were made by the people from farm villages. Even today, there are many ideas of farmers which have been applied to modern machines. In the agricultural machine industry of Japan there are two lines; the one is from a machine industry whose technique was very precise and the other is originally manufacturers of farm machines and tools. Generally speaking, the manufacturers started by people who were from farm families attained a great development.

5. The relations between the promotion of farm machines and implements, and the policy of the government

The government was also concerned with the development of agricultural machine industry. In 1869,it practised *Farm Tool Act* for the farmers of small scale. In 1870, a mission to the U.S.A. bought plows and other animal-power farm tools. In 1874, a technician in charge of agriculture was sent to the U.S.A. for the study of them and the government bought a number of samples. In 1875, the government appointed Mr. Kanezo Ikeda to the post for agricultural machine which was set for the first time. In 1876, a western type of plow was displayed in the World Exposition held in the U.S.A. along with other agricultural machines. In the same year, the government bought a rice-cleaning machine of spiral type from the U.S.A. later largesized, rice-cleaning machine was completed after the type of it.

In that manner, the government promoted an agricultural policy as soon as it was established. Especially in order to save the immaturity of production technique, the government founded *Mita Farm Implement Manufacturing Company* in Tokyo in 1879 investing a governmental capital. Iron plows or hand type threshers were produced for trial there. But owing to the difficulties in getting materials and the immaturity of production technique, it was sold to a private company in 1887.

The application of power to farming started from a pump in

Japan. The drainage working in Niigata prefecture which was carried out by the pump with engine power was the first case.

Later on, the government held exhibitions on the agricultural machines or contests on the skill of operating farm machines and implements. Especially the contests gave encouragement to both manufacturers and farmers in various senses through their attendance to the contest as well as the technical competition by new type of machines. Because machines which scored an excellent marks at the contest sold very well, every manufacturer made every efforts in making more efficient machines.

Another thing which should be marked among governmental policies was to have instituted a prize contest in order to encourage the development of new machine.

A prize was given to the excellent machines according to the achievement at the contest. Thanks to this policy, new machines were developed. The technical developments were made very quickly on such machines as a drier, huller, power thresher and so on. In 1928, a comparative test was practised. As the efficiency of each machine was made public along with its ranking, it was a great encouragement to the unknown manufacturers.

In that manner, the encouragement policy by the government played an important role in the history of agricultural development of Japan, which even acted as a motive power for industrialization. After the end of World War II, the government promoted the popularization of farm machines and implements through various administrative measures such as the structural improvement plan, the enactment of *Quarantine Regulation* for the extermination of diseases and insect pets on farm products and so on. Further to these encouraging measurers, an official in charge of farm machines and implements was appointed to every prefectures and practised operational test on the field. On the other hand, the efficiency of machines was analized at the central institutes. The department of agricultural engineering was also set up in some universities. As a result, these measures act as promotional power in the farm machines and implements industry of today.

Harrowing and leveling in submerged paddy field in a mountainous region. A small power tiller is still playing an important part in Japanese agriculture.

6. The development of farm machines and implements, and the role of relevant associations

There was a guild about 100 years ago where the manufacturers of comb threshers cited. There was also a sort of a guild at the production cite of hand tools for farm, which exchanged information on the market. At first, not only the manufacturers but wholesellers had the membership. They made the estimation of demand, studied the policy of the government or made advice to the government. In 1926, a cooperative association of farm machines and implements manufacturers was set up in Tokyo. After that, the movement of that sort became active but they were the free movements which were not restricted by the legislation.

In the period between 1937 and World War II, cooperative associations of farm machines and implements manufacturers, and marketing cooperative associations of dealers were organized. When Farm Machines and Implements Association was established, not only the manufacturers and dealers but agricultural cooperative associations, which were groups of users, took part in it. During World War II, it was transformed to a distributing company. Nowadays, there are many associations such as *Japan Agricultural Machinery Manufacturers Association* formed by manufacturers, *National Federation of Agricultural Machinery Retailers Association* by dealers, *Agricultural Mechanization Association* and *National Association of Safety in Agriculture* which were designed for the promotion of agricultural mechanization and *National Purchase Federation of Agricultural Cooperative Association* for the joint purchasing on behalf of member users. As to the international associations, there are some which are designed to

strengthen the relations with Asian countries like *International Committee for Research of Farm Mechanization* which is specialized in farm machines and implements. These organizations are playing an important role through their activities such as taking part in the government policy, requiring the exemption of tax for the agricultural modernization, exchange of market information, settling the troubles related to patent, studying of new farm technique and so on. Especially governmental institutes tried to find out the problems by analysis on the efficiency of machines.

These organizations are run by the membership fee; *Japan Agricultural Machinery Manufacturers Association* for instance, have adopted a membership fee system which consist of the basic fee by member manufacturers for the first place, the fee in proportion to the turnover of a member and the income of each committee formed by the kind of machine (power tiller or harvester, etc.) which pays the necessary charges of it. In the case of *Farm Agricultural Mechanization Association*, it is run basically by the membership fee from member manufacturers but it receives some governmental aid. From the view of administration, *Japan Agricultural Mechanization Association* is under the control of the Ministry of Agriculture and Forestry, while *Japan Agricultural Machinery Manufacturers Association* is under the control of the Ministry of International Trade and Industry. Of course, *Japan Agricultural Machinery Manufacturers Association* keep close relations with the Ministry of Agriculture and Forestry and exchanges information with each other. There is an export section in *Japan Agricultural Machinery Manufacturers Association* which is mainly composed of big manufacturers. The governmental aid to these associations is, however, so small that the member manufacturers must be responsible for its management.

7. The relations between the development of farm machines and implements, and technical advance of agriculture

You may have a substantially clearcut idea on the relations between the Japanese agriculture and industry, and the changing of agriculture as well as farm machines and implements industry.

Generally speaking, farm machines and implements industry repays their investment in five to ten years. The repayment is included in the price of the products. Consequently it is payed by the purchasing expenditure of farmers. The total amount of the demand for agricultural machines of Japan is now 36 billion yen(the price of engines inclusive). So the average purchasing amount is only 200 dollars a year. But thanks to the wide spread use of agriculture machines, they can earn 55 percent of their total income by part-time work other than agriculture.

When the relations between agriculture and industry is observed synthetically, the labour power with which agriculture supplied other industries has exceeded 10 thousand million so far. Thus when you think about the production in the sense of social effect, you will find that the development of farm implements and machines industry has much with the development of other industries. It has contributed greatly to the economic development. But to our great regret, many people are apt to look highly of ordinary industry while they do not place so much emphasis on farm machine and implement industry. It may be a wrong way of thinking. The role or effect of farm machines and implement industry cannot be estimated merely from the achievements in the agricultural field itself such as agricultural productivity or farmers' income. It should rather be estimated by the effect on gross national product or national economy.

To be brief, Japanese farm family bears about 70,000 yen in average for farm machines and implements at present. It is equivalent to about 3,600yen per capita, by which Japanese agricultural machine industry is maintained.

The labour productivity(in the case of rice) per farm labourer has become more than five times in the past twenty years while the percentage of the price increase of farm machines and implements has stayed at eight percent. Despite the fact, the income per farm labourer has doubled. It shows that the expenditure for farm machines and implements has been reduced to fifty percent.

For another example, the tractorization of Japan is staying at such a level of 0.3 H.P. per capita. This figure is too low when compared with 1～1.2 H.P. of America. But the H.P. per hectar has reached about 3 H.P., which is the world highest figure. Still more, you should note that the productivity per H.P. is the highest in the world in terms of calory. This is because Japan has been putting an emphasis on the intensive farming and promoted the mechanization system of a small scale which meets the scale of farming.

As a result, Japan has come to an unique position among the countries in the world. In the development of agricultural mechanization and the advance of farm machines and implements, sales agents have played an important role. They gave instructions to farmers on how to handle a new machine or extended cooperation to them in the repair of machines. The 40 percent of sales margin is given to these activities. In the case of manufacturers, 40 percent of sales expenditure is also given to technical guidance. These are about 30,000 persons who are in charge of marketing in the Japanese agricultural machines industry. It is needless to say their liv-

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KEY ROLE

of

Implement manufacturers

--- *from American experience*

Harold B. Halter

Member ASAE

RECENTLY the President of the American Farm Bureau, one of the largest organizations of farmers in the United States, remarked that American agriculture had just passed through the age of mechanization and was entering the age where marketing food and fiber from the land would be the next great advance.

Assuming that many of the countries of South East Asia are in some stage of farm mechanization that would parallel what agriculture in the U. S. passed through at some time during the last 100years···or more specifically, during the last 50 years···it is possible that the history of the Farm Equipment Industry here may indicate developments to come in South East Asian countries.

Although the author's knowledge is limited to relatively brief visits in the islands north of Australia, Borneo, the Philippines, and Japan, agricultural development must have many parallels with what we observed in more recent and lengthy visits in Mexico and other Central and South American countries.

Within the limitations stated above, and lack of a full current knowledge of agriculture in South East Asia, we have some thoughts about how items of farm machinery compatible to the land, climate, labor situation, distribution and farm size conditions may find their way to South East Asian farms in the next ten to twenty years.

TRACTOR IS PORTABLE POWER SOURCE

First,it is generally recognized that the farm tractor is nothing more than a portable power source; mobile, steerable, and with provision to push, pull, lift, power and mount hundreds of implements which will do the actual job of replacing hand labor, doing the job more efficiently, and faster.

The tractor unit in itself can do little more than provide a not--too--comfortable ride for the operator to the fields.

Couple the tractor to implements which till the soil,plant it, fertilize or chemically treat it, harvest it, transport it to storage or market, process it---and the value of the unit increases wonderfully.

Tractors of a size to best fit the agriculture and crops of the South East Asian nations are now, we assume, readily available from producers in the area from exporting countries around the world.

Specific implements to work wiht, or in many cases without the tractor may have to be either developed; modified from existing designs; built under license from exporting firms; or out-right imported---depending on several variables.

DEVELOPING AN INDUSTRY IS COSTLY

Research, design and production of entirely new machines is "easier said than done". This is a costly method no matter which country attempts it, although countries developing their agricul-

ture would like to see this as a solution to mechanization and to provide jobs in their own countries. Pride in producing their own equipment is an understandable factor.

This desire for pride of one's own factory product can be costly beyond expectations, although there may be a partial answer in securing permission from foreign farm equipment producers to build their machines, or parts of them, under license agreements.

And, in our opinion, there will be many cases where outright importation of equipment will be the obvious answer. For example,Japanese tractors of relatively small horsepower range are being successfully exported to the United States, but recently. Japanese tractor manufacturers expressed no interest in developing and producing large 100 horsepower or larger tractors for the Canadian market.

Countries more advanced agriculturally already are producing these large tractors in economical volume-oriented factories and to try to compete wiht them, especially by smaller South East Asian countries, would, in our opinion, be folly at this time, spespecially when such an effort and capital could be put to better use on smaller, more limited production, specialized equipment to fit the country's specialized crop or farming practices.

S.E.A.COUNTRIES HAVE ADVANTAGES

South East Asian countries, it appears, would have some great advantages in the development, modification or production under license of machines to service exotic crops which are produced in limited quantities and would not offer an opportunity for volume production by a farm machinery factory serving the U.S. or European markets.

If, for example, a special harvesting machine unlike anything in existence today were required for the passion fruit crop, it is highly unlikely that any European or North American company would be able to invest in the research, development, production and marketing of an implement with such a relatively limited market.

The organization which I serve, the Farm Equipment Manufacturers Association, has more than 250 "Shortline" farm equipment producers as members who are the innovators of the industry in North America.

SMALL MANUFACTURERS ARE THE ANSWER

These firms are small in comparison to the seven large tractor producing companies, yet they develop nearly 100% of all new ideas in fram equipment.

All the tractor companies now find it more economical to purchase certain machines from the members of our organization than to develop and produce them in their own plants, even here in this highly developed, easy-to-reach market.

It would appear that South East Asian countries would likewise find it feasible and more economical to import or produce under license machines which would require little or no modifications, for the same reason.

After reading the excellent articles in the Spring,1971 issue of *Agricultural Mechanization in South East Asia,* it appears that many years will transpire before the farmers in South East Asia will change their methods of farming to the degree that would allow them to benefit from much of the large, sophisticated farm equipment now in use on the North American continent,where approximately five million tractors are on farms, or in Europe, where a like number of tractors are available.

MECHANIZATION CAME SWIFTLY IN THE U.S.A.

Farm mechanization in the United States came swiftly if you realize that had a farmer who

This 4,600-pound hydraulic contrfolled tillage tool with 19 disc blades and nine shanks is produced by Portable Elevator Mfg. Co., Bloomington, Illinois, U.S.A., in the heart of the corn and soybean country where the average size farm is 500 acres. This equipment requires a very large 100 horsepower or larger range tractor, eliminates old moldboard type plows.

lived 2,000 years ago returned to any place on earth in 1850, he would have recognized and been able to use any implment on the fdrm.

Mechanization has progressed in the United States to the point where less than one in 20 citizens are required to produce food and fiber for those of us no longer connected with farming. 150 years ago, just the reverse was true, with 19 persons working on farms to allow one person to provide other goods and services.

For the most part, farm mechanization progresses at a rate in relation to its ability to economically replace hand labor, although some forms of mechanization are dictated by the need to eliminate crop disease, livestock disease, or do jobs which cannot be done by hand.

Still, it must be recognized that with all its efficiency, where farm labor remains so overly-abundant and cheap, it will be some time before farm equipment for all jobs will be practical.

As an example, the use of animal power in any type of farming practice in the United States is a rarity today and the farmer who does keep animals for farm work is most usually an older farmer who does so for sentimental reasons--no other logical reasons are left.

Yet, in a thirty minute jet flight across the Mexican border, tractor power is a rarity, and oxen and hand laborers are common sights. Most Americans today 25 years old or younger have probably never seen an animal used for farm work. Yet Mexico is first country in Central or South America able to produce enough food for its own citizens.

Some members of the Farm Equipment Manufacturers Association (FEMA) whose firms are 100 years old, or older, started producing equipment for animal power. We continue to receive many inquiries from around the world asking for animal powered equipment, but are unable to refer the inquirer to any U.S. firm still producing horse drawn equipment.

MR.OGURA SEES THE PROBLEM

We were very much impressed by the deep understanding of the problems of mechanizing South East Asia agriculture expressed by Mr. Takekaza, Ogura, Chairman, Agriculture, Forestry and Fisheries Research Council in the Spring, 1971 issue of this journal.

Mr.Ogura wisely noted: "The very first step to promote agricultural mechanization is the improvement and consolidation of land. But the program calls for a large investment and requires so many years. So the realization of such a program cannot be expected in full scale in most of the Asian countries. Accordingly, a realistic approach is to develop agricultural machinery which can fully display its efficiency under the existing conditions in Asian countries."

It would be foolish, however, to dwell entirely on the problems and obstacles to the development of farm mechanization in South East Asia. South East Asian agriculture will progress, because it must. Every citizen of the world must soon realize that every tillable plot of land must be made productive to produce the food and fiber the growing world population must have to survive.

At the proper time, there is no doubt that a farm implement manufacturing industry will develop to supply the needs---it is only a matter of time, and as Editor Yoshisuke Kishida pointed out in the Spring issue, "Time is Life" and humanity needs more time for using talents other than for producing food.

WE CAN LEARN FROM EXPERIENCE

As the time for a farm equipment industry to produce equipment locally comes, it will be well to remember the hard lessons learned from experience by manufacturers in other countries. We have some little knowledge of pitfalls to avoid from the experiences in our industry here in the United States.

All farming implements, like machines in other types of industry, are subject to wear, breakage and eventual obsolescence. It only follows that to place a farm machine on a farm---especially one in a developing country where transportation and communications are not sufficient---without providing replacement parts and mechanical service within the local trade area is disastrous.

We were told of one South East Asian country which, prior to 1940, placed an order for 20,000 walking-type small horsepower garden plows---but did not order a single replacement part, and none was available closer than several thousand miles.

The result was obvious.Before long,many of the machines were completely useless, sometimes for want of a single small part.

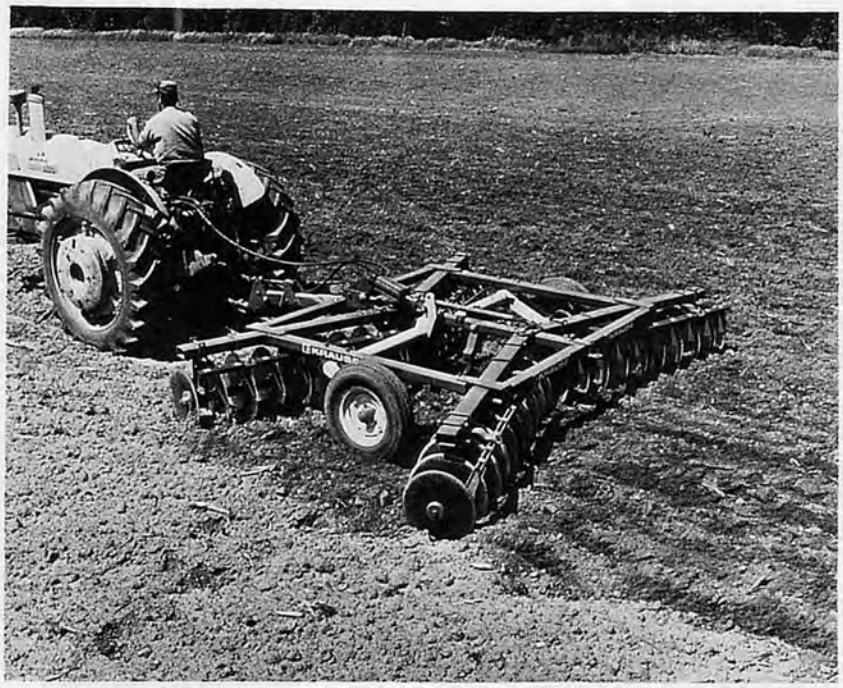
19,000 RETAILERS SERVE NORTH AMERICA

Today in the United States and Canada there are approximately 19,000 farm equipment dealers (retailers) to service the farm equipment they have sold, with parts and mechanical repair. The large majority of American farmers are within only a few miles of one or more of these retailers.

The retailer is available by telephone and generally is connected to the farmer by a surfaced, all-weather road.

Even with such good communications and transportation, needed repairs can present a great problem during harvest season when heavy rain, or hail, may threaten an entire crop of wheat or other grain if a machine develops mechanical trouble.

Most people realize that farming is not only an industry where the risks can be great from



Produced by the Krause Plow Corp., Hutchinson, Kansas, U.S.A. this disc harrow can be modified to cover widths from 10 1/2 to 18 feet and the disc blades can be Spaced either 18–20 or 22 inches. This tool is used extensively in the great wheat fields and in other crops as well.

weather, pests or disease, but is one which is as seasonal in nature as can be imagined. Time is of the essence in planting, cultivating, chemically-treating harvesting, storing and processing.

As a result, any machine which might appear to a university college professor of economics to not be feasible because of the few hours of annual use,may in reality save the results of an entire season of work and investment for the farmer.

At this time it would not seem prudent for most South East Asian countries to try to develop such extensive distribution systems. In fact, every segment of the farm equipment industry in this country---retailers, wholesalers, and manufacturers---is striving in every way to become more efficient in order to maintain the present system which farmers need in the face of inflationary forces of all kinds.

LOCAL LEADERS KNOW BEST

Agricultural leaders---and certainly the farmers themselves----know in South East Asian countries the extent to which it is practical to develop their own farm equipment manufacturing industry.

Especially, they are in the best position to know which general types of equipment they can afford to research, develop, produce and distribute within the limits of their economic assets.

NEAREST THE PROBLEMS OF S.E.A.

As far as the possibility of modifying equipment from North America, or producing it under license arrangements is concerned, we feel certain the greatest number of possibilities would lie with the members of our organization simply because they thrive on the production of new ideas and new machines for new methods of farming, and to solve new problems in the production of foods, fibers and livestock.

Although there are important differences, fortunately land is land, water is water, sunshine is sunshine, and a grain of rice or wheat is basically the same, whether in the state of Kansas, U.S.A. or beyond the International Date Line.

It will be a pleasure in the years ahead to see the progress that will come in South East Asian agricultural mechanization, and to know that farm equipment will help lift the burden from the backs of men; help provide more abundant life; and free men for more of the joys of life which the results of his labors should entitle him. ■ ■

Some Points to Improve Machinery for Rice Production in Asian Developing Countries

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IT is still very difficult for us to find reasonably improved machinery which fit to the agricultural conditions in developing countries. Good design engineer's strong action is now most needed for these countries where they are now developing domestic production of agricultural machinery.

I pointed out in this paper severl requires for future design of rice production machinery in developing countries in Asia from my experience. I would be very happy if this paper could help manufacture's development activity especially in adbanced countries.

Basic Design Needs

First of all agricultural machinery for developing countries in Asia should be designed as follows.

1〕 They have to be fited to the agricultural conditions on the spot like, climate, soil and nature of plants.

2〕 The design should be simple to use, repair and produce in these countries.

3〕 Machinery should endure for continuous and long use and over load. The general structure should be tough and the capacity should be much room.

1. Engines

There are many kinds of engines by fuel, cooling systems, cycles and ignishions like diesel, gasoline kerosene, air cooled, water cooled, two cycle, four cycle, hot bulb or semi-diesel etc. They have each special feature or good points. We have to select most suitable engines for each machinery. Diesel engines are welcomed generally for *multi-purpose use* as power source for tillage, pumping, threshers, hullers, rice polisher, etc.

Air-cooled diesel engines are seemed to be better for power tiller or pumping during dry-season operation because they does not need supply cooling water which take time and make engine heavy, but water cooled engines come to have near characteristics of air-cooled type with a compact radiator or condenser.

It is very important to consider that agricultural engines for these areas are used during rainy season and also dry-season.

The environment for an engine is quite different between two seasons.

Especially improvements are needed for dry-season and upland operations like cultivating in corn, sugarcane, cassava, cotton and coffee production, transportation job with trailers or harvesting of peanut. Mechanical weeding operations is increasing every year because of labor shortage and cost of the operation.

This operation is done now in the midst of dust which causes several trubles in engines. Design requirements on this are as follows.

1) Air cleaner

The intake tube should be long as possible, the inlet should be placed in high position as possible. The cleaners or filters should be doubled.

2) A fuel filter has to be also

Production of parboiled rice with stem

improved to get higher filter capacity.

3) The material of wearing parts should be strengthened like a cylinder liner, a piston ring, a fuel nozzle, a nozzle body, bearings, etc. Of couse seals against dust should be improved.

The other general requirements are as follows.

1) Easy to start without complicated design.

2) It can be used under overload operations.

3) This is important caution for users. The lubricating oil should be all drained and should not be partially added. The used drained oil can be re-used by settling.

Low-speed engines should be more studied in these areas. It is easy to use and produce in these countries.

It will be a cheep power source in the future.

2. Pumps

There are several types of pumps in Asia, which are small travelling pumps, big size (10 ~60hp) pumps for stationary use, and pumps for deep wells.

Small size (5~6hp) travelling pumps are at present most popular in Asia. But pump stations for 100~200 acre will be common in future.

The pump production is developing especially in Taiwan, Thailand, Burma and India, because it has big demand and easy to produce among other agricultural machinery.

Several requirements for designers and users.

1) Muddy water.

In many cases when they use pumps in Asia, the water usually contains much of mud or soil. It damages several parts of a centrifugal pump. They are a runner, a shaft, seals and metals. Following improvements are needed.

(a) The inner propellar should be designed as open-type.

(b) Its mechanical seals should be super alloyed metal.

(c) Its shafts should be stainless steel.

(d) Its material should be selected to prevent damages during storage in high humidity.

When farmers use pumps in a muddy river, following considerations are essential.

(a) The strainer should be suspended above the bottom of a river. Don't lay it on the bottom.

(b) The strainer should be surrounded by a bamboo-net or a wire-net.

2) Changable water level

The water level of a river in Asia is very changeable. Then, they set pumps on a boat or a raft in a river which is moored by a chain or a rope to the bank. A part of the water pipes should be flexible to be adapted to changeable water levels. The suction pipe should be put into water through a hole inside of the boat. Don't lay it outside of a raft or a boat to prevent the pipe damaged by the bank or floating other materials.

3) To use a sleeve valve

It is recommended to set sleeve valve for the use of a big stationary pump. It should be also layed at the lowest places to decrease the suction head.

4) High humidity during rainy season.

The quality of materials of a pump and storage method should be considered to prevent gathering rust during storage especially in rainy season. Oils should be painted before storage.

5) Vertical pumps

Vertical pumps are most convenient, ecomomical and easy to use in the places where water level is enough high. It is also easy to produce in developing countries. A good example we can look in Thailand.

6) Hydraulic ram

It utilizes water hammer action without power source. It is suitable for local area where it is difficult to get electricity or fuel.

3. Tractors

I want to describe a little on the relationship between tillage operation and the nature of soil in South East Asia before describing a tractor or a powertiller itself as a tillage machine.

In the area like Java island where they don't want to use machinery power for tillage befor trasplanting because there are prenty of labor power, yield of rice cultivation during dry season is less than the yield of rice cultivation during rainy season.

Usually the yield during dry season is much better than that of rainy season. So we can say that it is unusual result.

The less yield comes from the lack of oxygen in the soil for rice plants.

Oxygen in the soil is very important for growing rice. Usually oxidization of soil is done through many deep cracks during dry seasons. Deoxidization is proceeded through plants growth during rainy seasons.

This is the reason why we need to use mechanical tillage for double cropping of rice through a year. Natural oxidization through cracks can not be expected when the paddy field is always irrigated for double or multicropping operations. In these cases we need enough tillage by machines which help rapid oxidization of soil. It means that simple tillage by human power is not enough to help oxidization of soil.

The mechanical tillage is essential in Asia for multi-cropping with irrigation because of the nature of soil and busy labor peak problems.

Another important point is related to sole pan in paddy field, which is essential for growth of rice plants. Sometimes a present big tractor beaks it completely. We need a tillage machinery which does not break sole pan in wet paddy field.

1) Big tractors above 35hp

Big size tractors were used for long years in plantations of a coconut, oil palm or in up-land farming. But it is very recent years when they started to use big tractors for paddy field operations. Burma is the first country who decided to use big tractors in paddy field as a government policy. Cambodia, Malaysia and Thailand followed it after Burma. The biggest reason why big tractors were introduced into rice cultivation is that big tractors could directly till hard soil after harvesting of rainy season rice crops. This is very difficult by animal plowing or small power tillers without introducing water into the field to make soil soft.

It is said that big size tractors are also suitable for one cropping of rice during a year with another one cropping of up-land farming.

The problem for big tractors occur when they want to use them for double cropping of paddy. In this case soil is always soft during a year.

Soft and wet soil is not fitted to prevent big and heavy tractors. It means that we need to develop big size tractor specialized for wet field with following conditions.

(1) Traficability in wet and soft field is good.
(2) Easy to operate in muddy field.
(3) It does not break down the sole pan.
(4) Good water proof.
(5) It can till head soil during dry seasons without introducing water.
(6) It can be attached various implements such as a transplanter, puddlers.
(7) It can be used for contractors.

2) Tractors, 35 ~25hp

It is suitable for up-land farmers with 10~15ha land.

Though it is good for paddy field in Japan, in the case of South East Asian paddy field, it is too big for a private owner and also too small for contractors.

3) Small Tractors under 25hp

Among tractors, it is only Japanese small tractors that can well work in wet paddy field because it was originally developed for wet paddy field operation.

This is good for double cropping of rice. It is also welcomed because it is easy to operate. These tractors need more development of implements like a special discplow which can till hard soil during dry seasons.

This size of tractor is suitable for 4~5 ha paddy farmers.

4) Power tillers for rotary tillage.

It gave big influence on modernization of rice farming in Asia. It can do tillage and harrowing at one time. It is easy to use in small section of field. It is easy to operate. It is easy to transport.

These are the reason why farmers welcomed the power tillers.

It is most evaluated with connecting the irigation farming dur-

Riding two-wheel tractor attached with puddling rotor.

ing dry season.

Speedy oprations are most needed for irrigation farming during dry season because strong sunshine causes high evaporation and big loss of water. It means that manual or animal operation can not pay for irrigation farming. The power tiller solved this. It is also balanced with the capacity of pumps of 5~6 hp.

Of course present power tillers have so many points to improve as follows.

(1) To design more simple. Especially to make simple gear mission and cluch mechanism. Belt and tension pulley cluch is recommended.

(2) To make more stout

(3) To make more cheap

(4) To make shapes of blades more simple.

(5) To develop suitable attachments.

Driven type power tiller has two way to dry drive rotary.

Side drive type is suitable for flat plowing. Outer drive type is suitable for special plowing such as ridging in up-land cropping.

5) Multi-purpose power tiller

Japanese power tiller revolution was done by developments multi purpose power tiller (which is also called as pull-type) not by driven type. Pull-type tiller is small, light and cheap comparing with driven type.

Multi-purpose tiller needs various kind of attachments which is most important.

This type of tiller is most important for Asian farmers and also easy to produce in each countries.

For operations during dry seasons, implements are required special improvements as follows.

(1) plowing without turnover of soil to prevent moisture evaporation.

(2) harrowing with a roller

(3) seeder with a lister, fertilizing implements, covering soil and a roller.

(4) cultivators which does not remove surface soil and only cut roots of weeds.

Multiple cropping is becoming very important in Asia. In this case a farmer can increase his income in his small holdings only with a multi-purpose power tiller which needs various kinds of attachments and an irrigation pump.

4. Transplanting machine

The rice transplanter mainly developed in Japan has several types according to the types of transplanted seedlings, which are a long seedling with more than six leaves, a middle seedlings with four or five leaves and a short seedlings with two or three leaves

1) Transplanter using long seedlings.

This type of rice transplanter is most needed in Asia where they have labor peak to do double cropping. For example, in Burma they cultivate jute in paddy field after rice and during July to August jute free beating operation and rice transplanting is done at the same time.

The length of seedlings is changeable.

Transplanters have to manage long seedling of 18 inches.

To increase capacity, four or six row transplanters are needed to develop.

It is also needed to develop a machine which mechanizes the operation of taking seedling from seed beds. This operation takes so much time at present.

2) Transplanter with middle and short seedlings

These seedlings are grown in small boxes without usig usual seed beds.

This method can eliminate the operation of taking seedlings from seed beds and also complicated mechanism of transplanter.

As the preparation of seedlings for dry season rice is needed during harvesting and processing operation of rainy season rice if they want to grow to finish harvesting and processing operations of dry season rice before rainy season starts. They cannot grow rainy season rice in a part of the field for using as seed beds of dry season rice. We can grow rainy season rice using whole of the field if we use seedling growing boxes.

When they use this method, the problems are mainly in the field where short seedlings are transplanted. Water level must be severely controlled. Leveling and puddling operations should be alone well.

5. Drilling machine

Thresher manufactured on the spot

Drying place of parboiled rice. Dryers are expected because it needs vast space

Multi-row seeders are needed for direct seeding rice cropping, because they save rice seeds comparing with broad casting method.

Eight and six rows seeder were developeded at IRRI in the Philippines for dry season rice cultivation with irrigation. These seeders have already been produced by local manufactures.

6. Fertilizing machine

Fertilizing for rainy season rice cultivation is increasing every year in Asia.

But it results much loss of fertilizer because it is applied in deep water.

It is needed to develop a fertilizing machine which can lay fertilizer into the soil under the water to increase efficiency of fertilizer.

7. Weeder

It has three effects which are to kill weeds, to take out bad soil gas and take oxigen into soil by mixing soils and to increase fertilizing efficiency by push floating fertilizer back to roots of rice. Simple handy power weeders were developed in IRRI and produced in Japan and the Philippines.

To use this they need to regulate the way of transplanting.

8. Pest control machines sprayers

Pest control machinery has most international nature. But this is the machine which has so many varieties of types by kinds of pest, chemical, plants, fields labor conditions and etc.

The basic understanding about needs of pest control became popular in Asia. The use of a power sprayer or a mist blower or a duster is rapidly increasing.

Power sprayers are mainly used where cooperative pest-control operation is popular. But manual sprayers are still most popular in Asia.

Horizontal lever type hand sprayer made in U.S.A. or Europe is most used because it is easy to operate, cheap and reliable.

They are made of iron plate.

Most of farmers who want to buy next machines, they buy sprayers made of brass which has much longer life and is economical.

Domestic production should be started from manual semi or full automatic type and horizontal lever type using brass.

9. Reaper & binder

Reaper & binder are now very popular in Japan. Japanese type binders can be used in another countries in Asia.

In the case of Indica variety, the use of Japanese binder is very difficult because the pickup mechanism causes big head loss during harvesting. It can be used for IR type, because it is hard to thresh.

Traficality and pick-up units sould be improved.

10. Threshers

There are several types of threshers in Asia which must be selected to fit conditions as follows.

1] Variety

Indica type which is for rainy season occupies about 80 percents of total production of rice in Asia.

It falls down when they harvest it. So they have to scoop it up and cut it short as possible as they can do by a curved sickle to decrease loss because Indica variety very easily drops its paddy.

It means that Indica type is very easy thresh. After threshing it, threshed rough rice with a small stem is very rare. They can easily thresh it by manual operations or animal treading or tractor treading. By these methods threshed grain are mixed with soil, sand, animal waste or several bacteria which sometimes causes yellowed rice during storage.

Use of threshers can eliminate these problems. They don't like brown rice in rough rice and rough rice with a stem after threshing. Brown rice causes damage by a not during storage. The stem attached to rice affects the efficiency of husking operation.

IRRI type variety is generally not easy to thresh by traditional methods, so they need powered threshers.

This variety does not fall down. It also change harvesting style. They can cut it with long stalk. It means that they can use Japanese type threshers which do head threshing.

2] Traditional harvesting operation

In the case of head harvesting, they cannot use Japanese type threshers.

3] Rice processing methods

4] Traditional methods of using rice stalks.

1) Manual threshers

Japanese type pedal threshers are most convenient for threshing rice with long stalks. It is easy to produce and use.

It is very light and easy to transport. It means that they can thresh in the field travelling place to place.

But it causes rough rice with a stem when they thresh Indica

Operation of maize thresher by contractor

type rice.

In the case of IR type there is no problem. We need to improve it not to remain a stem with threshed rice. This thresher can also use for threshing pulse.

2) Japanese type power thresher.

It is compact and easy to use and very efficient compared with traditional methods. There are several points to improve.

(1) To increase life.

(2) Grain throwers should be strengthen.

(3) Concave net should be strengthened.

3) Japanese type power thresher with chain feeding units

This is more safety and speedy than usual power threshers because of chain feeding unit.

Separation and threshing performance are also better. It is the most important to endurance of machine.

4) Throw-in-type thresher

This type is most needed for Asia, especially suitable for Indica variety.

Big Mccomick type is common in Asia, but it is very expensive.

We need to develop a compact and ecomonical one.

5) Winnower

A winnower is very useful for Asia. Still farmers use much of time for separating operation of rice by natural wind.

This is also important for separating other crop like pulse. It is easy to produce.

11. Combine harvester

A combine harvester is very important not only for increasing labor productivity but also for preventing loss of yields.

In Asia sunshine is very strong to cause broken rice. Effective combine harvesting easily increase yields by 20-30%. Important points are as follows.

1] Small and compact to be also used in small section

2] Good traficability

3] Small head good design to prevent head loss because head rice of indica variety is very easily fallen by shocks.

4] Especially good combine harvesters for rainy season rice are needed.

1) Japanese type combine

In Japan these types are recently produced about 40,000 units a year.

It is very compact and economical. But it is very difficult to harvest rainy season indica variety. It is needed to improve much more the pick-up mechanism. It can be used for new variety like IR type which does not fall down. But IR type is sometimes too short to fit the present machines.

2) Conventional type combine

Present one is generally very large and expensive. It is needed to improve traficability. Development of a more compact and cheap one is most important. Development of new strip combine is now going on at IRRI.

12. Paddy cleaner

Paddy cleaners are essential under the traditional threshing methods which cause much mixing of soils, stones, stalks, etc. About eighty percent of rice in Asia is cleaned by paddy cleaners settled at rice mills. Recently small scale compact type is needed with small rice hullers and polishers.

Paddy cleaner is especially important to increase efficiency of a rice huller of schule-type and a dryer of circulating type. A paddy cleaner of manual type which can also use for another crops will be erlcomed. A simple rotary-type cleaner was developed at IRRI.

13. Hullers

There are mainly three types for husking rice. They are Schule-type with two motors. Japanese type with rubber rolls and impact type by centrifugal face.

1) Schule type

The adjusting of space between two motors are very difficult. During operation they need to stop a machine to read just the space. If they adjust the space to fit to long grain, short grains are not well husked and long grains are damaged if they adjust it to fit to short grain. So short grain un-husked by one pass through come back again. But recently they use combination of rubber roll type for the un-husked grain which once passed the huller.

It is very efficient and useful to decrease broken rice.

2) Rubber roll type

This type has very good point not to cause broken rice. But the problems are life of rubber rolls, because rice husk in Asia is very hard and temperature is very high. It is needed to improve

quality of rubber roll and design to be replaced easily rubber rolls.

3) Centrifugal impact type

It accelerates rice grains by centrifugal force, hits them on the plate and husks them by the impact. It is the very good point that it can husk short and long grain at the sametime without any adjustment though Schule type is influenced by sizes of grain. This is very simple designed, easy to produce, compact, small power requiered and cheap.

It is suitable machine for Asia.

14. Separator

Separators are needed for separating brown rice and unhusked rice after husking.

1) Grain Screen (Mangoku)

This is most simple to use and efficient. But in Asia several kinds of variety are mixed when they want to separate.

It is needed to use two kinds of mesh and separate three times.

Stainless or nylon wire are recomended as the screen.

2) German type separator

It can separate every kind of variety at the same time. But it is very large and only can be used in rice mills.

15. Dryer

Harvesting of rainy season rice are always in dry season. It is the reason why demands of dryer came after another machinery. But dryers are now needed with duble cropping of rice. They have to harvest rice during rainy season. Dryers are especially needed in Malaysia. The Philippines, Taiwan and East Pakistan where they crop rice named "aus". Dryers are also needed for another crops like corn, sorghum, etc. Especially corn is needed for drying rainy season crop.

There are many types of dryers. Big rice centers or rice mills are settled in many countries. For this place they need big drying capacity. The biggest problem is how to decide the problem is how to decide the maximum capacity and how to gather uniform quantity of rice to dry.

It is also needed for individual farmers. Most simple and suitable dryer for this purpose is a box type-flat batch dryer. It is easy to use, cheap and to produce. It can be also used for another crops. The cost of fuel is important. In the Philippines a dryer which uses the husk as fuel was developed manufactured.

16. Rice polisher

There are abrasione roll type and friction type.

The abrasione roll type needs small pressure and gets good yield rate, but the brightness of polished rice is not so good. The friction type needs big pressure and get lower yield rate, but the brightness of polished rice is good. Schule type and big rice mill mainly use the abrasione roll type. Schule type use vertical type of it. Japanese type uses vertical or horizontal.

The combination of two types is good.

The good point of Schule type is simple to use and repair and to be able to be operated by a steam engine using husks as fuel. It can be settled at every places.

Good points of Japanese type are small rate of broken rice and high yield rate.

Small polishers in many cases are not used with a separator.

Engerberg type do husking and polishing at one time. It is also very popular in Asia but there are much of broken rice. A paddy cleaner is also needed for a small rice polisher. It is recommended that a part of winnower of huller would be designed to use as a paddy cleaner.

Use of dryer with a polisher is also needed especially in East Pakistan, Malaysia, Taiwan and the Philippines for the polishing operation in rainy season.

17. Design and domestic production

As to the domestic production, it is most important to establish new design considering agricultural conditions, level of users, availability of after service facilities, level of manufacturing, available parts and material for the production, annual demaned, etc.

"Cheaper by a dozen". This is the basic thought of main agricultural machinery produced in developed countries. But it is not the truth in every place. We have to find the optimum design in the spot.

Design is the vital seed of domestic production.

Many kinds of agricultural machinery can be produced in each country with a groupe of small scale factories.

There are so many machinery to develop and produce without using complicated precise parts like hydrauric system or complicated gear mission.

It is highly needed that good design engineers and production engineers cooperate to develop and produce new machinery with local blacksmiths. ■ ■

(Continued from page 33)

are capital intensive and which require large markets. Their establishment may require assistance from other countries inside and outside the region. It is therefore very important that co-ordination and harmonization of these various plans should be attempted at this stage, particularly in respect of specialization in the production of types of machinery and equipments, if operations on an economic scale are to be achieved.

It would be advantageous if plans for harmonization are agreed upon early, before plant design and lary-out are finalized and funds committed for the purchase of capital equipment. After that stage, it will be too late to make changes. ■ ■

The views expressed in this paper are those of the auothor and do not necessarily reffect those of the Council or of the ECAFE Secretariat.

Some Critical Steps in Achieving Agricultural Mechanization in Developing Countries

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INTRODUCTION

AGRICULTURAL mechanization is a goal toward which every developing country aspires. Mechanization often appears to offer the solution to many of the problems which plague the agriculture of developing countries. In reality it does offer much promise for progress to be made, but there are many pitfalls associated with attempts to achis papen is nization. These pitfalls must be understood, lest the agricultural mechanization efforts will not achieve the advantages imagined. The purpose of this paper is to identify some of these problems so that they can be considered by those responsible for government programs to facilitate agricultural mechanization in developing countries.

It is desirable to first identify the advantages and the disadvantages which accrue from an intensive effort to accomplish mechanization. Looking at this in another way, one might think of the problems solved by mechanization and the problems created by mechanization. This is viewed not from the context of the individual farmer or even the agricultural economy of the country, but rather from the point of view of the overall economic growth and development of the country. For example, if mechanization of agricultural production leads to a critical labor surplus and widespread unemployment, agricultural problems may be solved but the overall problems of the country may be aggravated.

I hasten to add that any technological development will lead to some adjustments. These adjustments are usually temporary and lead to a general improvement in the living conditions of the people. Therefore, it is essential to recall that the objective we seek is long term and permanent progress.

Agricultural mechanization must be viewed as one part of an overall agricultural production system. It can have enormous impact on the agricultural economy by offering opportunity for greater production through such things as double or even triple cropping. Mechanization can reduce the human drudgery often associated with farming. Conversely, if all the related factors required for widespread mechanization of agriculture, such as adequate maintenance and repair, are not present, agricultural failure can result. Similarly, if labor displaced through mechanization cannot find employment elsewhere, then conditions for many of the people may not be improved.

To appraise the value of mechanization requires a look at the costs. Usually economic consideration will be the determinant controlling the success of agricultural mechanization in any country. An exception might be where mechanization offered the best opportunity to increase food production and government subsidy or outside support was judged desirable. Still, in the long run, the success of increased agricultaral mechanization will be determined on the basis of economic factors.

Advantages of Mechanization

There are many benefits which result from agricultural mechanization. Many of these are listed here and briefly discussed. It must be recognized that all degrees of mechanization could be discussed ranging from simple mechaniza-

tion of tillage alone, to complete mechanization of planting, cultivation, harvesting, and processing such as might occur in the technically advanced countries. This discussion is restricted to the more simple mechanization that would be likely in developing countries.

Double or triple cropping. In many parts of the world double or triple cropping is feasible if the crops can be planted and harvested quickly. With mechanization of production and drying of grain the potential to double or triple agricultural production is realized.

Timely harvest. A frequent problem when harvest is by hand labor and slow is for crops to become overripe resulting in field losses due to shattering or shedding of grain causing excessive field losses. Often a rainy season begins before the crop can be harvested and it is lost. Rapid mechanical harvesting can eliminate these potential production losses.

Reduced labor required. The total labor requirement for agricultural production is reduced. Also the labor requirement is more stable with the peak demands of planting, weeding and harvesting reduced. Much of the drudgery type work is also eliminated.

Difficult soils can be farmed. Many soils are difficult to farm without power machinery for tillage. With power tillers good seed beds can be prepared and these hard soils brought into production.

Production systems can be optimized. A highly efficient agricultural production system requires that many factors be controlled. Water must be controlled through irrigation or drainage, seeds and fertilizers applied at the proper time and in the proper place, insects and other pests controlled, and the crop harvested and processed quickly. All of these factors can be controlled better through mechanization than by hand labor.

Disadvantages of Mechanization

Mechanization of agricultural production has many advantages resulting in a compelling argument in its favor. However, there are certain problems associated with mechanization which must be considered. These problems actually do not arque against agricultural mechanization in concept, but rather point to problems associated with mechanization.

For mechanization to be successful in a country several related things must happen. Mechanization cannot suddenly develop as a result of external technical assistance without certain internal changes evolving in the country.

Initially machines are generally imported from developed countries. Often these machines are too complicated and the farmers are not trained in their operation and maintenance. The machines are not sufficiently durable and simple to repair to repair. Repair parts are often not available and extended periods of breakdown of the machines result. The machines are frequently not suited to local conditions without modification.

For effective mechanization a good supply and maintenance organization with an inventory of spare parts is essential. Applied research on proper cultural practices with machines is needed and sometimes new crop varieties are required. It is essential that provision be made for all these requirements.

The capital requirements for supporting a mechanized agriculture are great. The economy of farming small farms requires special consideration. Often special machines for small farms will be required and the capital will have to be provided for the farmers to purchase these machines. In some cases agreements for cooperation among farmers will provide the best answer.

In developing countries most of the labor force is involved in agriculture. Often these laborers are not trained for other jobs and if displaced from the farm will not readily find employment elsewhere. Provision must be made to retrain these displaced workers for other jobs. The fact that workers are displaced should not be a persuasive argument against mechanization since mechanization leads to greater per capita productivity. The displaced workers are available for other work in the nations economy. This will help achieve the goal of economic development and improved standard of living provided other segments of the economy are able to use the labor free from agriculture.

The remaining sections of this report discuss some of the critical steps in achieving agricultural mechanization in developing countries in a satisfactory way.

PHASING INTO MECHANIZATION PROGRAMS

For a developing country to successfully mechnize their agricultural production, several things must happen. Success should not be expected if one or more of these nessary elements do not develop. For example, mechanization cannot be successful with out an adequate repair and maintenance program. There is a necessity for those responsible for planning agricultural mechanization to assure that all necessary elements are properly phased into the program.

Farmers must be educated in the care, maintenance and safe use of machines. Financial institutions must be organized to provide capital for the purchase of agricultural equipment. A sales and service network must be established and a good repair parts inventory maintained. Mechanics must be trained for major repair and overhaul of machines.

Significant increases in agricultural production shiould be expected with a mechanized agri-

cultural production system. But this increase may not be realized if all the necessary production inputs are not provided. Good water control is needed along with good seeds, fertilizers and pest control. Since the cost of production inputs is increased, greater production is necessary for an adequate economic return. Therefore, it is essential that the total production system be considered and all production inputs increased in proper balance.

Markets for increased production must be developed and appropriate transportation and storage facilities provied. In some cases storage facilities will have to include equipment for drying grain.

The important point to remember is that while mechanization offers a great opportunity to improve agricultural production and lessen the drudgery associated with agricultural work, it cannot emerge alone. Complementing factors must evolve and develop in balance with mechanization.

EDUCATIONAL NEEDS

Three kinds of educational needs are assoiated with developing agricultural mechanization. These include education of the farmers, training of mechanics and maintenance personnel and, finally, training of engineers and technicians. Often programs to meet these needs will not already exist and will, therefore, have to be established.

First, there is a need for extension type education for the farmers. This should be done with practical demonstrations covering the care of equipment including lubrication, adjustment and simple repair. Farmers also have to be educated on safety procedures around machines. Demonstrations should be arranged to illustrate proper cultural practices for best mechanized production. Special visual aids should be prepared to teach farmers, particularly if their education level is such that many of them cannot read.

There is also a need to train mechanics for major machine repair. These mechanics would be located in the service centers which should be established throughout the farming region of the country. Provision should be made so that mechanics can travel to the field for minor repair jobs that can be handled there. Above all, it is very important that machines needed in the field not be in operative for extended periods of time because of inadequate repair facilities and trained repair personnel. This has often happened in the past when developing countries attempted to mechanize their agriculture.

Agricultural engineers and agricultural mechanization technologists must be trained in the universities. The technologists are required to perform the extension education functions and to work in adapting imported machines to local conditions. These persons would often be in charge of the sales and service centers for agricultural machinery. The training of these technologists should provide a good background in machinery as well as broad training in agricultural production.

Agricultural engineers would be needed, but not in large quantities initially. Most engineering designs for machines will be imported from the more technically developed countries. So there isn't a need for complex designs initially. However, because imported machines are often too complex and expensive, local engineers can often improve the machines to better adapt them to local conditions.

Agricultural engineers will be needed for research in many areas related to mechanized farming. When a significant amount of machinery is produced within the country, there will be a need for engineers to work in design and manufacture. Initially, when most equipment is imported, there will not be a great need for original

Small factory for jeepny production in the Philippines. 11 people make 5~6 units of jeepny body for a week.

engineering designs from with in the developing country. In a later section the role of the local machinery industry is discussed.

RESEARCH NEEDS

Developing countries should not plan to immediately attempt a sizeable basic research program related to agricultural mechanization. Rather they should undertake adaptive research using as much information as possible from other countries. This adaptive research program can be related to the extension program to farmers. Special demonstration farms should be established to demonstrate mechanized production and to test machine modifications to make them more suitable for local conditions.

In many cases the research should be to develop simple implements adapted to local conditions. These implements should help in the transition from dependence on animal power and human labor to mechanization. In my view, few developing countries could afford to undertake a sizeable basic research program in agricultural mechanization. Their efforts will be better spent in adaptive research and extension programs to educate the farmers.

DEVELOPMENT OF THE LOCAL MACHINERY INDUSTRY

The question of whether agricultural machinery for developing countries should be imported from other countries requires considerable attention. There are many factors involved and no single answer is applicable to all situations. Some of the important factors which should be considered are discussed here .

Initially, there is no choice but to import machines since no local industry usually exists to manufacture agricultural machines. There are often many problems encountered with imported machines because they often are not ideally suited to the local conditions. Also, the repair and service facilities are frequently inadequate and parts are not available. The machines may be to complex for use by local farmers. The imported machines are usually quite costly. However, foreign aid from developed countries may help defray the cost of these machines.

Advantages of imported machines include better designs which are often standardized to use implements manufactured by other companies. Machines are usually well designed and high standards are maintained in their manufacture. Mass production of machines lowers the cost, but import duties and transportation costs may offset this advantage.

Mechanization in developing countries can be visualized as progressing through three stages. These stages are given only to illustrate the kinds of developments which will occur as a country from no mechanization to total mechanization. The stages are:

Stage I *Start of Agricultural Mechanization.* In this stage there are very few agricultural machines in use and these are almost all imported. Frequently, foreign aid is involved in providing funds to purchase the machines and to provide technical assistance concerning the use of the machines. Adequate repair and service facilities do not exist, so repair problems are quite severe. This is a period of experimentation and education in terms of use of agricultural machines. Inadequacies of exisiting machies are identified and thought given to how they might be improved. In some cases, modifications of machines are made in local shops so they better meet existing needs.

Stage I may last from 5 to 15 years depending on the emphasis placed on agricultural mechanization by the nation's government.

Stage II *Progress in Mechanization.* Most machines are still imported, but some simple implements are manufactured locally. The possibility of assembly plants being established in the country should be explored so that imported parts can be assembled into machines. Ideally, some of the parts will be manufactured locally. This is the beginning of a significant machinery industry in the country. Technical assistance from the more technically advanced countries, perhaps through some of the companies with international operations, is still needed.

The educational programs for mechanics and the extension education program for the farmers should now be organized. Also the institutions should now be training some agricultural mechanization technologists and perhaps agricultural engineers, but the output will not yet be great.

Stage II is simply the second stage in the evolving agricultural mechanization in the country. Depending on local problems and the interest and support of the government in agricultural mechanization, Stage II may last from 10 to 20 years or longer.

In Stage II, the agricultural machinery industry of the country starts to develop. In my judgement, it is desirable that some machines for agriculture be manufactured in the country if the resources and related industrial capability are available. Although imported machines can satisfy the machinery needs, agricultural mechanization will progress better if there is some local manufacturing. The question of the government's role in the machinery industry is discussed later.

Stage III *Toward Total Mechanization.* In this stage in the development of mechanization, the path to be followed is well defined. The needs of the country have been determined. While at the beginning of this stage mechanization is far from complete, the education, research and necessary service organizational structures have been defined and should be

in operation. The sales and service networks will be developing. Also the relative role of local manufacture as opposed to imported machines will be clearer in that the economic potential for local manufacture will have been established. The financial institutions to help farmers buy machines will have been established by this stage; otherwise progress in mechanization will not have progressed this far.

The above three stages have been identified in a somewhat arbitrary manner solely to stress that mechanization development in countries does go through steps. Furthermore, these steps can be characterized in that certain kinds of things can be expected to occur before the process can continue to the next higher level of development. In general, these steps will have to occur before a developing country can expect to have a fully mechanized agriculture.

ROLE OF THE GOVERNMENT

The government of a country plays a dominant role in determining the progress that a developing country makes in terms of agricultural mechanization. Mechanization cannot be expected to be successful without the government being committed to help in providing for research, education, and the necessary related servides one of the most promising ways in which a government can help her people.

There are several things that government leaders must consider when the decision is made to promote agricultural mechanization. First of all, the government must understand all the factors which have been discussed in terms of related services required if success is to be achieved. There must be a clear understanding that mechanization is one of the necessary factors for a highly productive agriculture using such methods as double cropping. But mechanization does not occur overnight, so long term support must be committed to this objective. The dividends returning to the economy from success are indeed great.

Several of the more important considerations to which the government leaders should give attention are briefly discussed. It is recognized that every government is unique and faces different problems. Yet, there are some considerations sufficiently common to be worthy of brief discussion.

The government should not understimate the capital cost of large scale agricultural mechanization. While external financial support may be provided initially from other countries, this cannot be expected to continue indefinitely. The government must establish programs of loans to farmers for purchase of farm machines. This could be government loans or from private capital, but financing with reasonable interest rates will be essential. This is particularly true when mechanization is just beginning to develop.

If agricultural machines are to be supplied through imports, the import duty on these machines should be minimal, if any. Also the government leaders should be certain that the companies importing machines are providing the necessary supply of repair parts and technical support so their machines can be repaired and maintained.

The government must consider the foreign exchange balance in considering whether to support local manufacture of machines as opposed to imports. I believe that most developing countries will find it necessary to import many of their machines, particularly the tractors and more complex pieces of equipment. This is simply based on economic considerations and anticipated industrial capacity. Yet, I think it is highly desirable for the government to encourage some local manufacture of equipment if at all feasible. The existance of a farm machinery industry in the country will help the agricultural economy of the country grow and will provide an area of stable industrial activity.

Farm machinery manufacture in the developing countries should first concentrate on a few items which have great demand. These might include planters, simple power tillers, pumps, simple spray equipment and threshers, for example. Later, after there is acceptance of the items manufacturered, the companies can expand to new items.

In most cases, it is advisable for the governments to encourage foreign capital to be invested in their country for agricultural machinery manufacture and other agricultural production inputs such as fertilizers. This can facilitate the rate of progress because of the technological inputs brought in with the foreign capital.

The problems of displacement of labor when agriculture is mechanized has been discussed before. The leaders in a country must arrange to provide other job opportunities for those displaced workers. It is certainly to the advantage of a country to reduce the number of workers required to provide their food and fiber needs. In a highly mechanized agriculture, such as in the United States, one agricultural production worker can produce enough for 50 people. In other countries, where mechanization and other advanced agricultural technologies are not practiced, one worker may produce enough for only two or three people.

Mechanization can lead to unemployment and the government must provide for programs so that displaced workers can be trained for new jobs. It is most desirable that progress toward total mechanization be orderly rather than too rapid which might result in serious surplus labor problems.

In most developing countries the farms are very small. This

Demonstration test conducted at the premises of the department of agriculture & natural resouces, Diliman, Quezon City, Philippines in the presence of the Hon. Fernando Lopez, Vice President of the Philippines. Ricemillers and other interested parties.

means that very little can be afforded for investment in machinery. This presents serious problems in terms of mechanization. Mechanization is more compatible with large farms. Yet, when there isn't sufficient land for the farmers, there are advantages in having the farmers own their small farms. The so-called land to the tiller programs which have been successful in increasing production per hectare in Taiwan are good examples.

The existance of many small farms causes some special problems in agricultural mechanization. Two considerations are appropriate. First, there must be an emphasis on small inexpensive machines for these small farms. This may be the best solution in some cases. But, in the long run, I expect the emphasis to be toward larger more powerful machines as has been experienced already in many countries. The larger machines are inherently more efficient and can do many jobs better. For example, the plowing of hard clay soils can best be done with powerful equipment. Other examples could be given to illustrate the advantages of larger machines.

The best solution might be cooperative agreements between groups of farmers. For example, through such an agreement a single tractor would do the plowing for several farms. In effect, the machinery would be owned by a group of farmers which would share its use and cost. Such cooperatives are not likely to exist except when the government provides assistance in their establishment and makes certain they operate fairly and satisfactorily. In general, I believe the government's role in agricultural mechanization should be to anticipate problems which might occur and to find means to solve these problems. Few, if any, of the developing countries will become agriculturally mechanized without interest and support of the government.

AN EXAMPLE

The agricultural mechanization program in South Viet Nam can be used to illustrate how agricultural mechanization might progress in a developing country. South Viet Nam has little mechanization at the present time. However, the Agricultural Machinery Directorate of the Ministry of Agriculture has recongnized the need to increase produc-

tion through mechanization and has started a very modest research program on agricultural machinery. They are developing simple farm implements which will reduce the human power requrired in farming. They are also evaluating all agricultural machines imported into the country.

Because of a severe manpower shortage, there is an urgent need for mechanization in South Viet Nam. The Agricultural Machinery Directorate will do research on agricultural machinery to the extent their limited resources permit, but there is a deficiency of trained personnel for this purpose. The National Agricultural Center under the Ministry of Education will undertake to train agricultural engineers to help with the mechanization program, but it will be some time before enough agricultural engineers or agricultural mechanization technologists can be provided to meet the needs. Therefore, progress in mechanization will be slower than desired. It has not been possible to get at the problem of farmer education or to provide mechanics for agricultural machinery repair because of manpower and resource limitations as well as the war.

South Viet Nam at one time had a government policy of depending totally on imports for their agricultural machines. This has changed and Japanese manufacturers are building assembling plants in South Viet Nam to manufacture certain machines such as power tillers and pumps. Most of the parts are initially to be of Japanese manufacture, but some parts will be made in South Viet Nam. Ultimately more and more of the parts are to be manufactured in South Viet Nam.

This new government policy shifting from total dependence on imports is probably a result of their expected large requirement for machines in agriculture in the future. I believe having an agricultural machinery industry in South Viet Nam will help the country achieve its goal of agricultural mechanization, even though the agricultural machinery industry initially is rather small.

South Viet Nam is ready to begin Stage II (according to the categories given earlier) and see increasing progress in mechanization.

CONCLUSIONS

The following are my conclusions concerning mechanization of agriculture in developing countries:

Mechanization offers real opportunity to contribute to increased agricultural production in developing countries. It will reduce the labor requirement and can contribute to improving the standard of living in these countries.

For the benefits of mechanization to be realized, it must be recongnized that mechanization is only one input into a highly efficient and productive agriculture. All these inputs must be kept at an appropriately high level.

Mechanization will not succeed unless some important related services are developed. This includes farmer education, establishment of service centers with adequate repair parts and skilled mechanics, and agricultural engineer and technician training for research, education and work in the manufacturing industry.

The government of the developing country must be completely committed to the objective of agricultural mechanization and see that the necessary services are supplied. This includes factors such as arrangements for capital for farmer loans to buy machinery.

The labor displaced must have opportunities for being trained for work elsewhere. Mechanization must not proceed so rapidly so as to create adverse unemployment problems.

Above all, it must be realized that total mechanization of a developing country cannot happen overnight. The process must be orderly if all the benefits which can accrue to the agricultural industry in developing country are to be realized. ■ ■

(Continued from page 39)

ing is also supported by the expenditure of farm machines and implements by farmers. The amount is, as was explained before, only 200 dollars. But the achievement is shown in the fact that it contributed to the economic development of the nation in supplying other industries with labour powers along with the fact of the improvement of the standard of living of farmers them selves.

Like this, when you think about the agricultural mechanization from the standpoint of national economy, the idustry of farm machines and implements must make precedent investment. For this purpose, the government must give informations pursuasive enough to make industrialists take part in it. ■ ■

Basic Index for System Analysis of Agricultural Mechanization in Japan

(Farm Machinery Industrial Corp.)

1. Status of Agriculture

Items	Year	1945	1950	1955	1960	1965	1966	1967	1968	1969	1970
Gross national products and agricultural products											
Gross national products	100mill. ¥	('47) 13,087	39,467	88,646	162,070	326,504	381,179	447,668	527,803	624,330	727,177
index no.	'60=100	(8.8)	(24.4)	(54.6)	(100)	(202)	(245)	(276)	(326)	(384)	(448)
Gross agricultural 〃	100mill. ¥	···	8,056	13,480	14,740	23,034	27,081	30,835	32,678	34,452	···
index no.	'60=100	···	(54.5)	(91.2)	(100)	(156)	(183)	(208)	(221)	(233)	···
Distribution of agriculture	%	···	20.5	15.2	9.1	7.1	6.8	6.9	6.2	5.5	···
Economic active population											
Total	10,000	('47) 3,333	3,563	4,122	4,465	4,754	4,844	4,944	5,018	5,059	···
Agriculture	〃	1,662	1,610	1,370	1,184	981	940	930	904	862	···
Ratio of Agriculture	%	49.9	45.2	33.3	28.0	20.6	19.4	18.8	18.0	17.0	···
Labor productivity by industries (production per active population)											
Average	1,000 ¥	···	···	···	297.0	549.0	629.0	729.0	848.0	978.0	···
Agriculture	〃	···	···	···	113.4	220.0	258.0	323.7	348.5	375.9	···
Maker	〃	···	···	···	405.8	625.5	722.5	826.7	978.5	1,116.5	···

2. Trend of Agricultural Production

Items	Year	1945	1950	1955	1960	1965	1966	1967	1968	1969	1970
Number of farm households											
Total farm households	1,000	('46) 5,698	6,176	6,043	6,057	5,665	5,500	5,419	5,351	5,342	···
	%	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	···
Full-time 〃	1,000	3,056	3,086	2,105	2,078	1,219	1,153	1,151	1,071	832	···
	%	(53.5)	(50.0)	(34.5)	(34.3)	(21.6)	(20.9)	(21.2)	(20.0)	(15.6)	···
Part-time 〃	1,000	2,641	3 090	3,938	3,979	4,446	4,347	4,268	4,279	4,510	···
	%	(46.5)	(50.0)	(65.5)	(65.7)	(78.4)	(79.1)	(78.8)	(80.0)	(84.4)	···

Items	Year	1945	1950	1955	1960	1965	1966	1967	1968	1969	1970
Agricultural land use											
Cultivated land area	1,000ha	...	...	6,062	6,071	6,004	5,996	5,938	5,897	5,852	5,796
paddy field	"	...	...	3,114	3,381	3,391	3,396	3,415	3,435	3,441	3,415
Planted area	"	7,200	7,719	8,088	8,129	7,430	7,312	7,112	6,979	6,807	6,311
rice	"	...	3,036	3,108	3,308	3,255	3,254	3,263	3,280	3,274	2,923
Rice production											
Total production of rice	100mill.¥	...	...	8,550	8,987	13,453	15,079	18,665	19,671	19,414	...
Ratio of rice production	%	...	...	(63.5)	(62.3)	(58.6)	(55.6)	(60.6)	(60.6)	(56.3)	...
Yield per 10a	kg	320	383	396	401	390	400	453	449	435	...
Labor hour per 10a	hr	...	205	192	174	141	139	139	133	128	...
power utilized hour	"	...	...	...	7.6	14.4	15.6	17.4	18.1	18.9	...
Production per hour	kg	...	1.8	2.0	2.3	2.8	2.9	3.3	3.4	3.4	...
Rice production cost (per 150kg)											
Total cost	¥	...	4,014	5,443	5,936	9,847	10,583	12,057	13,428	15,622	...
Agr. machinery cost	¥	...	...	355	545	1,334	1,469	1,554	1,831	2,395	...
Labor cost	¥	...	...	2,832	2,978	5,263	5,650	5,836	6,337	6,969	...
Producer prices of rice (per brown rice 150kg)											
Average price	¥	...	6,350	10,261	10,405	16,345	17,850	19,493	20,640	20,640	20,681
index no.	'60=100	...	(61)	(99)	(100)	(157)	(172)	(187)	(197)	(197)	(199)

3. Present Status of Agricultural Mechanization

Items	Year	1945	1950	1955	1960	1965	1966	1967	1968	1969	1970
Agricultural fixed assets investment (national total)											
Total	100mill.¥	...	658	1,982	3,337	6,895	7,937	9,463	10,539	11,722	...
	%	...	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	...
Agricultural machinery	100mill.¥	...	171	535	1,124	2,135	2,427	2,823	3,139	3,670	...
	%	...	(26.0)	(27.0)	(33.5)	(31.0)	(30.6)	(29.8)	(29.7)	(31.3)	...
Farm building	100mill.¥	...	169	397	637	1,561	1,766	2,208	2,538	2,745	...
	%	...	(25.7)	(20.0)	(19.1)	(22.6)	(22.3)	(23.3)	(24.0)	(23.4)	...
Land	100mill.¥	...	260	653	1,041	2,201	2,614	3,135	3,443	3,801	...
	%	...	(39.6)	(33.0)	(31.1)	(31.8)	(32.8)	(33.1)	(32.6)	(32.4)	...
Animal	100mill.¥	...	38	300	365	503	596	701	821	871	...
	%	...	(5.8)	(15.1)	(10.9)	(7.3)	(7.5)	(7.4)	(7.8)	(7.4)	...
Plant	100mill.¥	...	20	97	170	495	534	596	598	636	...
	%	...	(3.0)	(4.9)	(5.1)	(7.2)	(6.7)	(6.3)	(5.7)	(5.5)	...
Agricultural material investment (national total)											
Total	100mill.¥	...	1,403	3,075	4,351	8,199	9,427	10,372	11,047	12,091	...
	%	...	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	...

Items	Year	1945	1950	1955	1960	1965	1966	1967	1968	1969	1970
Fertilizer	100mill. ¥	...	753	1,313	1,436	1,705	1,856	1,971	2,039	2,050	...
	%	...	(54.6)	(42.7)	(33.0)	(20.8)	(19.7)	(19.0)	(18.5)	(17.0)	...
Pesticide	100mill. ¥	...	48	151	259	547	655	809	873	987	...
	%	...	(3.4)	(4.9)	(6.0)	(6.7)	(7.0)	(7.8)	(7.9)	(8.2)	...
Feed	100mill. ¥	...	122	659	1,279	3,474	4,098	4,232	4,575	5,188	...
	%	...	(8.7)	(21.4)	(29.4)	(42.4)	(43.5)	(40.8)	(41.4)	(42.9)	...
Other	100mill. ¥	...	480	952	1,377	2,473	2,818	3,360	3,560	3,866	...
	%	...	(33.3)	(26.0)	(26.6)	(30.1)	(29.8)	(27.4)	(27.2)	(26.8)	...
Index of agricultural fixed assets investment											
Total	'60=100	...	20	59	100	206	237	283	314	350	...
Agricultural machinery	〃	...	15	47	100	189	216	250	278	326	...
Farm building	〃	...	26	62	100	244	277	346	398	430	...
Land	〃	...	25	63	100	212	251	302	331	366	...
Animal	〃	...	10	82	100	138	163	193	215	238	...
Plant	〃	...	12	57	100	291	314	350	351	374	...
Index of agricultural material investment											
Total	'60=100	...	32	71	100	186	216	238	253	278	...
Fertilizer	〃	...	52	91	100	119	129	137	142	143	...
Pesticide	〃	...	19	58	100	211	253	312	337	378	...
Feed	〃	...	9	51	100	271	320	330	358	405	...
Ave. investment for agr. machinery per farm household	1,000 ¥	...	2.8	7.6	16.7	32.1	36.0	41.0	46.2	53.1	...
No. of agricultural machinery on farms and tractor hp.											
2-wheel tractor	1,000	7	13	89	746	2,489	2,725	3,021	3,030	3,269	...
4-wheel tractor	〃	...	...	...	...	...	39	58	124	180	...
Power sprayer and duster	〃	...	...	87	328	836	1,126	1,630	1,939	2,172	...
Power thresher	〃	352	828	2,038	2,641	2,983	3,100	3,297	3,100	3,000	...
Dryer	〃	...	...	...	...	860	1,073	1,367	1,457	1,228	...
Huller	〃	177	...	690	...	...	...	1,008	...	...	...
Binder	〃	...	...	...	...	12	24	42	117	306	600
Head feed combine	〃	...	...	...	...	...	...	1	15	46	86
Rice transplanter	〃	...	...	...	...	...	...	12	37	82	150
Total tractor hp.	10,000ps	...	7	49	416	1,418	1,576	1,780	1,923	2,171	...
Ave. tractor hp. per ha	ps	...	...	0.1	0.7	2.4	2.6	3.1	3.3	3.7	

4. Agricultural Machinery Industry

Items \ Year		1945	1950	1955	1960	1965	1966	1967	1968	1969	1970
Outline of farm machinery makers											
Enterprises	no.	1,009	1,105	1,789	1,842	1,859	1,933	1,866	1,966	...	...
Employees	1,000	29.0	22.0	28.3	44.9	47.9	53.3	50.7	58.2	...	...
full-time employees	〃			27.0	43.3	44.8	51.4	48.9	56.3	...	...
Employees per enterprise	person	29	20	16	21	25	28	27	30	...	...
Production : total	100mill. ¥	4.1	71.1	214.4	745.6	1,310.7	1,635.8	1,492.8	2,353.0	...	...
: per employee	1,000 ¥	...	...	757	1,660	2,730	3,070	2,940	4,030	...	...
Fixed assets investment	100mill. ¥	...	...	6.0	35.6	43.2	68.8	80.7	153.1	...	...
Outline of agricultural implement makers											
Enterprises	no.	...	...	2,220	2,053	1,752	1,755	1,656	1,653	...	...
Employees	1,000	...	...	6,693	6,804	5,431	5,581	5,106	4,947	...	...
full-time employees	〃	...	...	3,423	3,876	2,728	3,017	2,648	2,449	...	...
Production	100mill. ¥	...	...	6.6	22.9	25.1	31.5	30.0	24.4	...	...
Fixed assets investment	〃	...	...	0.3	1.1	1.4	1.8	1.8	1.8	...	...
Outline of distribution system											
Annual total sales	100mill. ¥	...	...	535	1,124	2,135	2,427	2,823	3,139	3,670	...
dealer	〃	...	...	489	969	1,682	1,876	2,120	2,269	2,707	...
agr. coop. assn.	〃	...	...	90	223	605	736	920	1,115	1,239	...
		(Sale by dealer includes the sale to agr. coop. assn.)									
Total no. of dealers	no.	...	...	...	12,828	...	11,800	...	11,659	...	...
wholesalers	〃	...	...	...	2,053	...	2,301	...	1,922	...	...
retailers	〃	...	...	...	10,770	...	9,499	...	9,737	...	...
of which : specialized shops	〃	...	...	...	8,888	...	8,851	...	8,482	...	...
wholesalers	〃	...	...	...	885	...	1,519	...	1,010	...	...
retailers	〃	...	...	...	8,003	...	7,332	...	7,472	...	...
Annual net sales per wholesaler	10,000 ¥	...	...	...	2,003	...	10,560	...	17,900	...	...
〃 〃 per retailer	〃	...	...	...	495	...	1,640	...	2,350	...	...
Annual net sales per employee (retailer)	10,000 ¥	...	...	('56) 151	187	...	413	...	543	...	...
Employees per retailer	person	...	...	('56) 2.8	3.0	...	4.2	...	4.8	...	...
Ave. of inventory per wholesaler	10,000 ¥	...	...	...	175	...	1,120	...	...	...	...
〃 〃 per retailer	〃	...	...	('56) 64	86	...	326	...	433	...	...

Items	Year	1945	1950	1955	1960	1965	1966	1967	1968	1969	1970
Outline of agr. coop. assn.											
No. of assn. : total for machinery	no.	...	...	36,120	...	23,846	21,327	20,651	19,772	18,401	17,605
sales	"	...	...	12,832	12,050	9,135	7,320	7,209	7,074	6,470	6,185
Service stations	"	...	...	...	402	2,378	2,692	3,078	3,182	3,135	3,106
Tractor and service centers	"	...	...	...	71	165	178	195	177	175	173
Technical leaders	person	...	...	...	1,936	...	8,763	9,470	10,262	11,192	11,829
Guidance engineers	"	...	...	...	...	...	...	...	...	231	288
Management index of farm equipment maker (medium and minor maker)											
No. of investigated maker	no.	...	...	39	33	32	...	46	50	45	29
ave. no. of employees	person	...	...	149	183	125	...	125	130	125	129
Working capital turnover		...	...	2.3	1.6	1.5	1.5	1.4	1.4	1.4	1.4
Fixed assets turnover		...	...	9.2	7.7	7.6	9.9	8.2	7.9	5.2	5.8
Annual production per employee	1,000 ¥	...	...	...	...	2,510	2,688	2,981	3,336	3,662	4,073
Annual manufacturing "	"	...	...	411	371	1,044	1,148	1,199	1,355	1,446	1,680
Machinery equipped value "	"	...	...	...	107	213	206	224	243	308	323
Management index of farm equipment dealer (medium and minor dealer)											
No. of investigated dealer	no.	...	...		12	24	...	17	29	31	26
ave. no. of employees	person	...	...		...	12	...	18	17	22	22
Working capital turnover		...	...		2.6	1.8	1.8	1.7	1.7	1.7	1.6
Fixed assets turnover		...	...	...	...	15.3	14.4	16.2	13.6	12.7	11.5
Annual sales per enterprise	mill. ¥	...	...	...	30	55	130	121	113	128	132
" per employee	1,000 ¥	...	...	...	2,848	4,795	5,229	6,689	6,494	5,937	6,135
Tangible fixed assets "	"	...	...	...	...	317	360	317	415	490	480

5. Farm Household Income

Items	Year	1945	1950	1955	1960	1965	1966	1967	1968	1969	1970
Total income (national total)											
Total	100mill. ¥	...	10,556	19,141	25,210	42,714	47,929	54,462	59,927	67,084	...
	%	...	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	...
Agricultural income	100mill. ¥	...	6,983	11,840	12,623	19,611	22,445	26,414	28,040	29,572	...
	%	...	(65.7)	(61.9)	(50.2)	(45.9)	(46.9)	(49.5)	(46.8)	(43.1)	...
Non-agricultural income	100mill. ¥	...	3,573	7,301	12,587	23,103	25,484	28,048	31,887	37,512	...
	%	...	(34.3)	(38.1)	(49.8)	(54.1)	(53.1)	(50.5)	(53.2)	(56.9)	...
Average income per farm household											
Farm household income	1,000 ¥	...	207.2	358.1	409.5	760.8	861.4	1,029.7	1,135.2	1,261.1	...
index no.	'60=100	...	(50)	(87)	(100)	(185)	(209)	(251)	(276)	(306)	...
Agricultural income	1,000 ¥	...	147.4	255.6	225.2	365.2	413.3	510.1	527.0	529.3	...
index no.	'60=100	...	(65)	(113)	(100)	(162)	(183)	(226)	(234)	(235)	...
Non-agricultural income	1,000 ¥	...	59.9	102.5	184.3	395.6	448.1	519.6	608.2	731.8	...
index no.	'60=100	...	(33)	(56)	(100)	(214)	(243)	(282)	(330)	(397)	...

6. Diffusion of Durable Goods

Items	Year	1960	1965	1966	1967	1968	1969	1970
In Farm village								
Television	10,000	173	515	···	523	523	512	489
Color television	〃	···	···	···	3.3	14	33	96
Refrigerator	〃	15.2	148	···	271	343	366	439
Washing machine	〃	88	338	···	416	455	462	478
Vacuum cleaner	〃	···	61	···	120	165	200	255
Motor cycle and scooter	〃	121	267	···	296	296	269	274
Auto-mobile and light van	〃	···	···	···	80	104	147	213
Comparison of diffusion rate of city and farm village								
Television								
Farm household	%	28.5	89.2	···	94.9	96.6	95.7	91.6
Non-farm 〃	〃	···	90.3	···	96.7	96.3	94.5	89.8
General salaried 〃	〃	59.7	···	···	97.4	96.7	94.8	90.6
Color television								
Farm household	〃	···	···	···	0.6	2.6	6.2	18.1
Non-farm 〃	〃	···	···	···	2.0	6.3	16.0	28.6
General salaried 〃	〃	···	···	···	1.1	3.9	12.6	24.8
Refrigerator								
Farm household	〃	2.5	25.7	···	49.3	63.3	68.6	83.1
Non-farm 〃	〃	···	62.4	···	76.9	82.2	88.2	90.8
General salaried 〃	〃	13.2	···	···	76.8	84.0	89.2	91.7
Washing machine								
Farm household	〃	14.5	58.6	···	75.7	83.9	86.4	90.6
Non-farm 〃	〃	···	72.7	···	81.3	85.1	88.9	91.6
General salaried 〃	〃	46.7	···	···	81.0	85.0	89.1	92.6
Vacuum cleaner								
Farm household	〃	···	10.6	···	21.9	30.5	37.5	48.3
Non-farm 〃	〃	···	41.4	···	56.1	61.4	69.5	73.8
General salaried 〃	〃	13.8	···	···	55.8	59.8	69.6	73.8
Motor cycle and scooter								
Farm household	〃	20.0	45.9	···	53.8	54.6	50.3	51.9
Non-farm 〃	〃	···	20.4	···	19.5	20.5	19.7	20.4
General salaried 〃	〃	57	···	···	15.8	17.5	16.7	18.5
Auto-mobile and light van								
Farm household	〃	···	···	···	14.6	19.2	27.4	40.4
Non-farm 〃	〃	···	9.1	···	16.9	20.8	27.1	32.0
General salaried 〃	〃	···	···	···	9.6	14.0	18.4	22.9

References

Annual Report on the state of Agriculture, Ministry of Agriculture, Forestry and Fishery (MAF)
Statistical Yearbook of MAF
The Farm Household Economy Survey, MAF
Agricultural Survey, MAF
Agricultural Census, MAF
Social Accounting in Agricultural and Farm Household Economy, MAF
Sur ey on Production Cost of Agricultural produce, MAF
Commercial Statistics, Ministry of Industrial Trade and Industry (MITI)
Industrial Statistics, MITI
Annual Report on National Income Statistics, Economic Planning Agency
Labor Force Survey, Office of the Prime Minister

Outline of Selected Machinery, Prevailed Quantity and Production in Asian Countries (1968)

Countries	Tractors	Power tillers	Engines		Pumps			Sprayers and dusters		Paddy threshers	
			gasoline	diesel	hand pumps	power pumps	deep-well pumps	hand operated	power operated	pedal operated	power operated
Prevailed Quantity (Number of units)											
Burma	('67) 4,511	('68) 177	–	–	–	–	–	–	–	–	–
Cambodia	('61) 1,158	('61) 751	–	–	–	('61) 1,292	–	–	–	–	–
Ceylon	12,000	3,200	–	–	3,000	5,000	–	43,300	1,600	200	60
China, Rep. of	90	('70) 28,292	45,000		('70) 52,794		–	('70) 207,670	('70) 17,820	('70) 186,398	
India	75,000	4,000	150,000	1,000,000	–	1,500,000	–	200,000	100,000	300,000	50,000
Indonesia	5,000	3,000	–	–	31,000	30,600	–	700	–	–	–
Iran	20,000	15,000	25,000		70,000	–	12,500	100,000	18,000	–	1,000
Korea, Rep. of	100	('70) 12,822	25,000		46,500	('70) 57,447	–	187,000	('70) 44,807	900,000	('70) 26,675
Laos	('66) 66	–	–	–	–	–	–	–	–	–	–
Malaysia	('69) 1,529	('69) 1,923	30,000		–	55,000	–	–	–	–	1,800
Nepal	700	15	500		50,000	–	–	500	–	200	10
Pakistan	22,000	2,500	500	–	–	–	60,000	25,000	2,000	300	50
Philippines	12,000	7,500	20,000	4,000	50,000	40,000	1,000	–	20,000	6,000	200
Singapore	110	10	100	200	–	–	–	–	–	–	–
Thailand	28,000	2,800	–	–	–	–	–	–	–	300	250
Viet-Nam, Rep. of	('63) 969	('67) 904	–	–	–	–	–	–	–	–	–
Production (Number of units)											
Burma	–	–	–	–	–	–	–	–	–	–	–
Cambodia	–	–	–	–	–	–	–	–	–	–	–
Ceylon	1,200	500	–	–	–	300	–	3,000	500	–	250
China, Rep. of	–	('69) 3,208	10,000		–	7,000	100	25,000	3,500	10,000	10,000
India	('69) 15,000	300	38,000	210,000	–	300,000	30,000	150,000	15,000	15,000	5,000
Indonesia	–	–	500	–	–	500	–	5,000	–	–	–
Iran	400	3,500	–	–	–	4,200	600	–	–	–	1,200
Korea, Rep. of	–	5,371	8,200			9,300		75,300	13,062	29,500	1,800
Laos	–	–	–	–	–	–	–	–	–	–	–
Malaysia	–	–	–	–	–	200	–	–	–	–	–
Nepal	–	–	–	–	–	–	–	–	–	–	–
Pakistan	1,700	–	–	11,500	–	12,500	3,000	8,500	2,500	500	–
Philippines	1,000	–	–	–	–	6,000	250	–	–	500	250
Singapore	–	–	–	–	–	–	–	–	–	–	–
Thailand	2,600	–	–	–	–	5,000	–	1,000	–	–	–
Viet-Nam, Rep. of	–	–	–	–	–	–	–	–	–	–	–

References : Report of the United Nations ECAFE/AID-UNIDO Fact-finding Team on Industries Manufacturing Agricultural Machinery, 1969

Agricultural Mechanization in South East Asia, 1971—spring, Farm Machinery Industrial Corp.

APO Expert Group Meeting on Agricultural Mechanization, 1967

Present Situation and Future Problems of Farm Mechanization in South-East Asia, Symposium on Farm Mechanization of Tropical Agriculture in Tokyo, 1970

ADC East-Asian Regional Research Workshop on : Economic and Social Aspects of Farm Mechanization, Tokyo, August, 1971

ELTA has opened a new field of agricultural machinery.

ELTA CARRIER SERIES

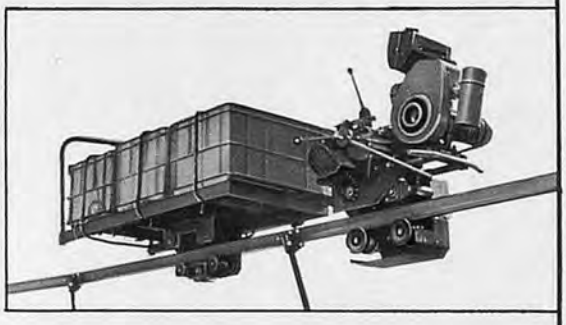
ELTA produces carriers in a serial form from mono-wheel carrier to monorail type.

ELTA WAMULASS CARRIER (Patent pending)

ELTA WAMULASS CARRIER applies ultra low pressure Wamulass tire and screw action automatic disk brake which enables safe and easy carrying on the slope land. This mono-wheel power carrier has made it possible to carry on the stairs as well as the swampy, sandy and snowy lands.

ELTA WAMULASS LINE CARRIER

This is an improvement of WAMULASS CARRIER. The screw action automatic disk brake works on both forward and backward movement (which serves also as the automatic speed governer) and the guide rail keeps the proper direction. 2-wheel type with two 16-inch-Wamulass tires (2-wheel drive; 2 speed changes: 3 km/h and 1 km/h for both forward and backward movement). Mono-wheel type with one 22-inch-Wamulass tire (speed change : 3 km/h for both forward and backward movement).



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ELTA LINE CARRIER is a monorail typed self-propelled carrying machine which warrants safe and secure carrying of yields and materials on the steep slope land. KC-10 is a self-propelled type which holds a square pipe with four urethane rubber rollers. RC-10 is a self-propelled type which fits rack to a square pipe and drives with the rack and pinion gear system.

ELTA CARRIER SERIES has completed the full choice system with which you can select proper machines according to your purposes, uses, establishment conditions and estimations.

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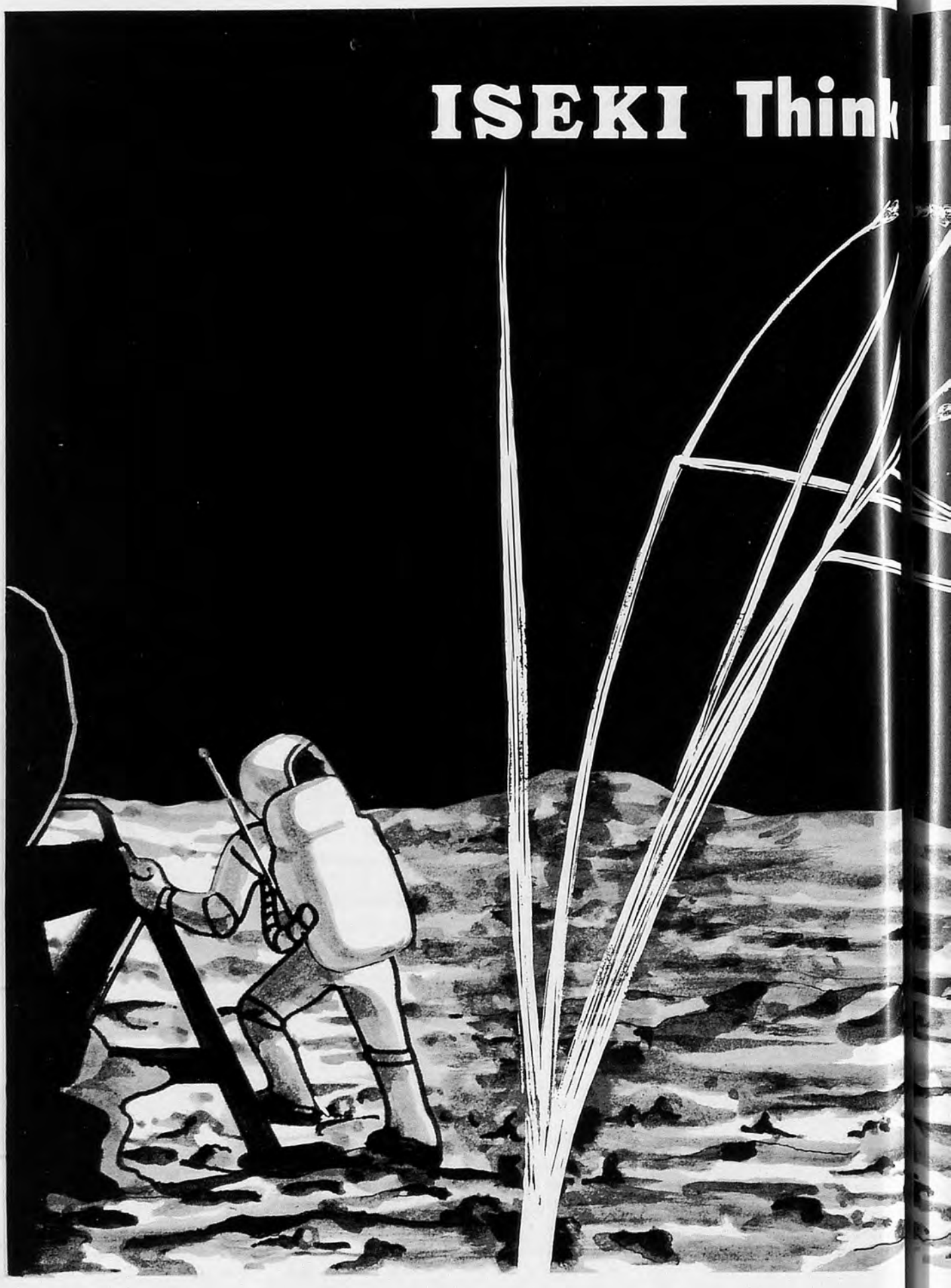
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ISEKI has been contributing to agricultural mechanization and modernization through the development reserches of agricultural machinery.

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Our accumulated research developing power will surely be of service to promotion of agricultural mechanization of each country.

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ISEKI has a history of over 40 years. Now, it has 3000 employees in four factories where they produce excellent articles with the automated modern facilities and superior production techniques.

.We hope we can help each Asian country to accomplish its agricultural industrialization by making the most of our experiences.

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ISEKI has succeeded in establishing the remarkable overall distribution system in Japan. It includes technical and farm management guidance for users and management guidance for dealers as well as the rational distribution system of products.

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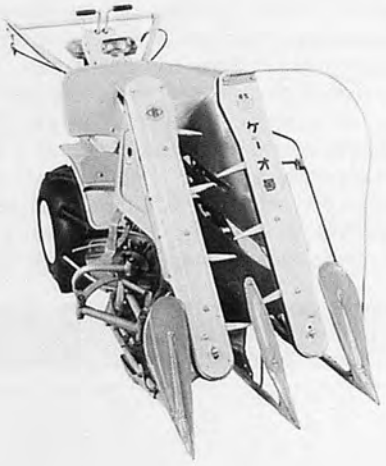
ISEKI

ISEKI brings more efficiency to your farms.

K-O Agricultural Machines

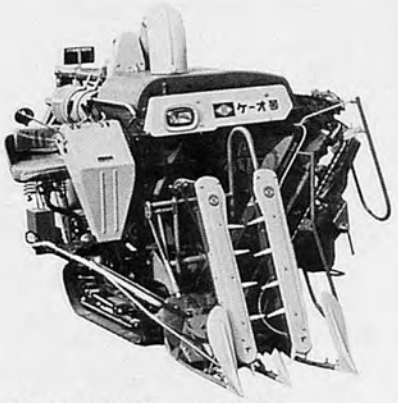


BINDER BS60A

The plants are binded at the central part and discharged from the right side. Full cutting width enables medium reaping and right angle reaping, no need for head-land reaping.

simple mechanism and easy to handle.

The unique pick-up mechanism enables to reap even the inclined stalks.



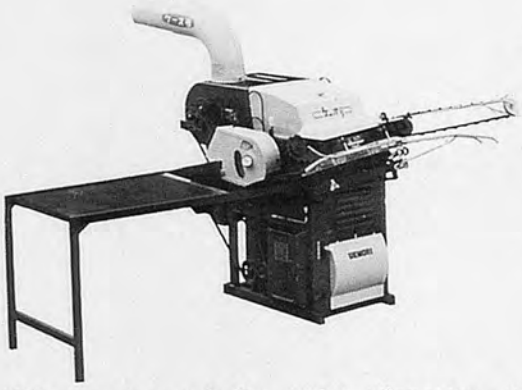
COMBINE HARVESTER CH60C

Efficiency is fifteen times to the traditional way.

Even the inclined stalks can be harvested.

Usable for both long and short stalks.

Needless for much head-land reaping.

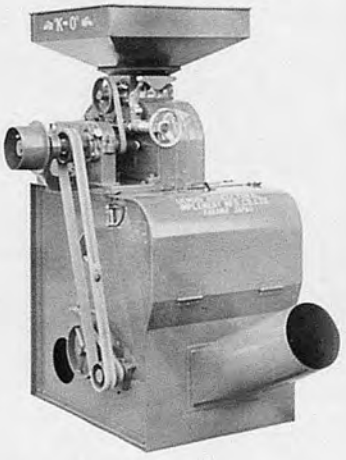


AUTOMATIC THRESHER JL55K

Double separating system assures beautiful separation.

Ceaseless-operation is possible owing to the smooth shaker system.

Simple method for exchanging concave, no need to detach the drum.



This type has a huller and a winnower combined in it, chaffs can be separated from hulled rice.

Another new feature is a suction fan which collects chaff. Therefore you need not worry about dusts and chaffs from operation.

COMBINATION HULLER MRT60

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The Satake Engineering Company of Japan has made a lifetime study of rice...every type of rice from every country. Therefore, when you purchase Satake rice milling equipment (a single unit or a complete plant), you are buying machinery designed specifically for the variety of rice you are handling. But more, the research laboratories of this pioneer firm have designed and tested each step in the total milling process to do a better job. If you want a higher quality finished product and would like to earn a higher profit, you should know Satake, because Satake really knows rice. Satake machinery and complete mills in more than 70 countries will attest to this.

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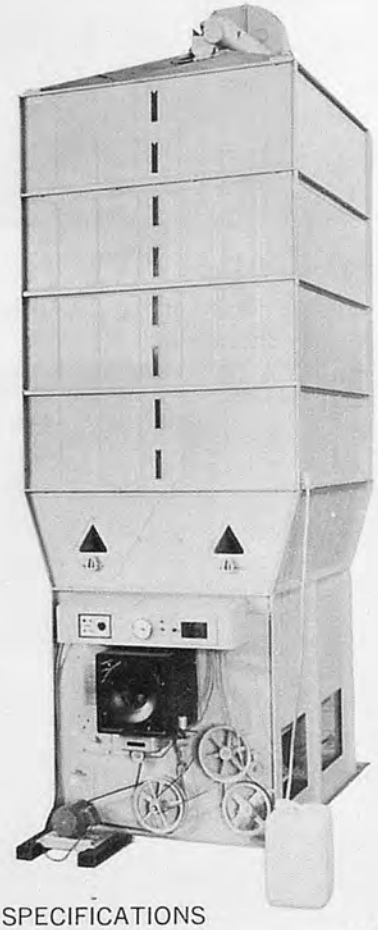
SATAKE SPEED DRYER

A thorough study of the drying process of paddy rice—what causes it to crack, the best temperatures, length of heating time, etc.—resulted in the Satake Type MDR-30 Speed Dryer. A short hot blast to dry the husk and then a gradual tempering to equalize the moisture in the kernel and husks, then repeating this process allows you to treat any wet raw paddy grain with perfect results. The MDR-30 is designed to handle large quantities at low operating cost. Can be driven by engine power where electricity is not available.

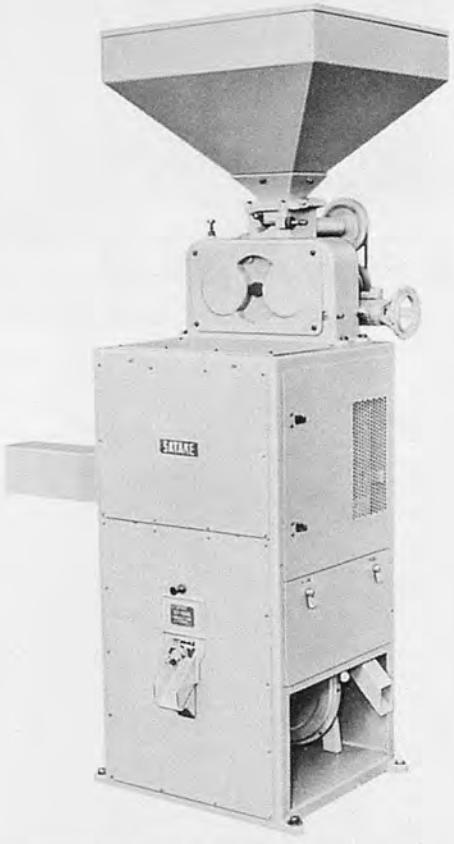
ONEPASS RICE PEARLER

Satake's Combine Onepass Rice Pearler SB-2B is the culmination of 70 years experience in rice milling. Gently is the best word for the action of this rice pearler. A rubber roll-type husker gently removes the husk without injuring the kernel and then gently polishes the husked rice to a gleaming, even whiteness. In the process, the husks and bran are separated and removed. All this in one complete cycle—from paddy to finished product with an hourly capacity of some 200kg. Economical to operate, the SB-2B requires very little space.



MDR-30 SPECIFICATIONS

1. Paddy holding capacity.....Approx. 3.0 tons
2. Drying speed 0.8%/hr
3. Drying capacity .....24kgs. of moisture/h
4. Dimensions .....L2.4 x W1.3 x H4.8m
5. Fuel consumption .....2.5~4l/h (kerosene)
6. Built-in motor .....2.2kW and 0.3kW



SB-2B SPECIFICATIONS

Type	Hourly Capacity on paddy		Required H.P.	Outside Dimensions					
				Length		Width		Height	
	kgs.	lbs.		mm	inch.	mm	inch.	mm	inch.
SB-2B	160~210	350~460	5	630	25	630	25	1,500	59

SATAKE ENGINEERING CO., LTD.
7-2, 4-chome, Soto-kanda, Chiyoda-ku, Tokyo, Japan

CABLE ADD.: SAHIKO TOKYO
TELEPHONE: 253-3111
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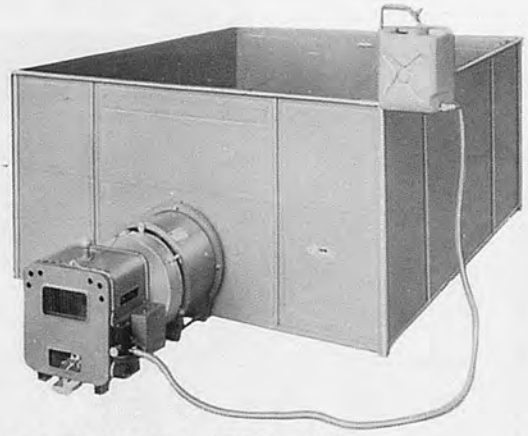
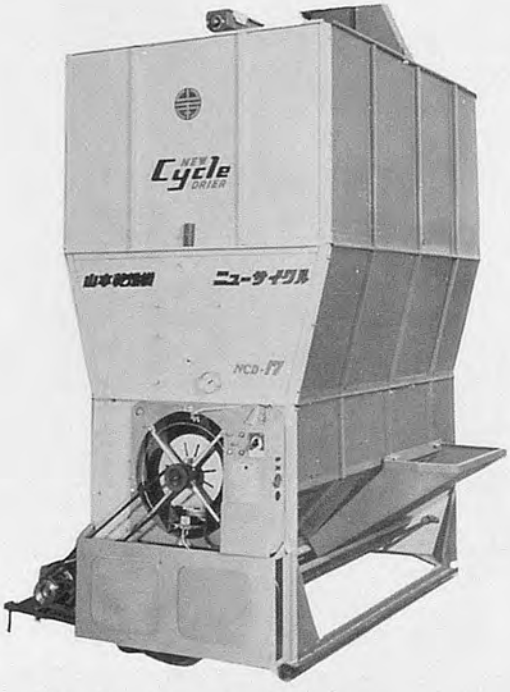
Yamamoto's
AGRICULTURAL MACHINES
Dryer Series & Implements

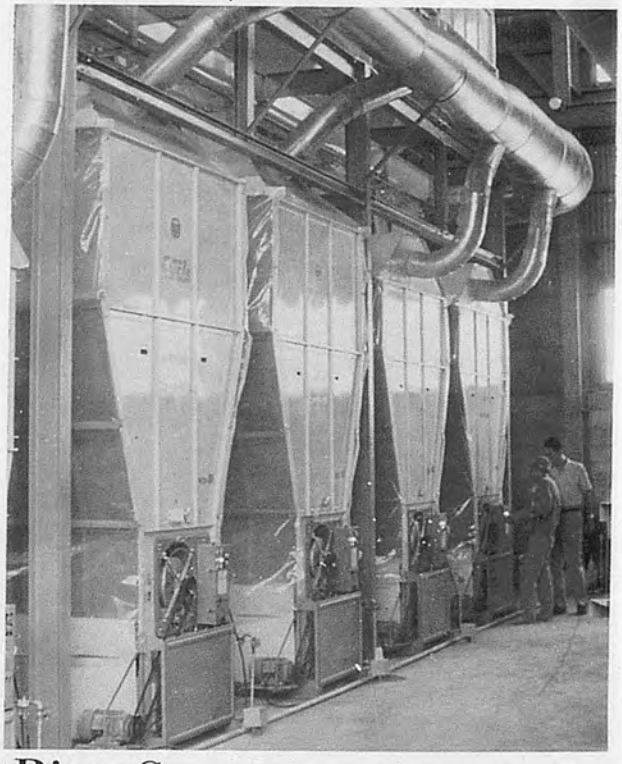


Layer type FD-58
for drying the small quantity of rice.

Rice Depot
for drying & storing the rice with low temperature.



New Cycle Dryer Series
for drying the large quantity of rice.



Rice Center
easy operation, excellent dryers, preparing equipment of high performance.

YAMAMOTO PROVIDE YOU NEW MACHINES AND HOW TO DEVELOP YOUR INDUSTRY

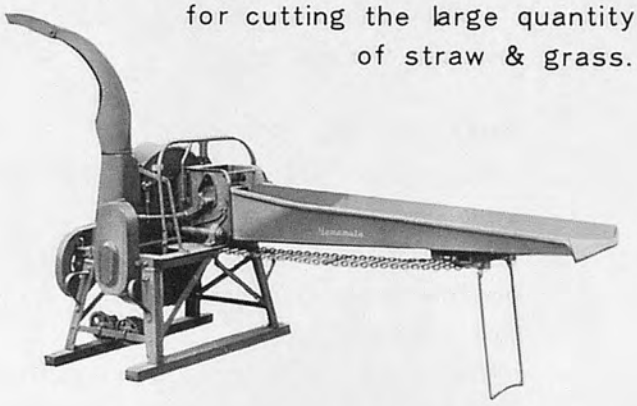
Cutter Series & Other Products

Cylinder type cutter

for cutting the straw & grass.

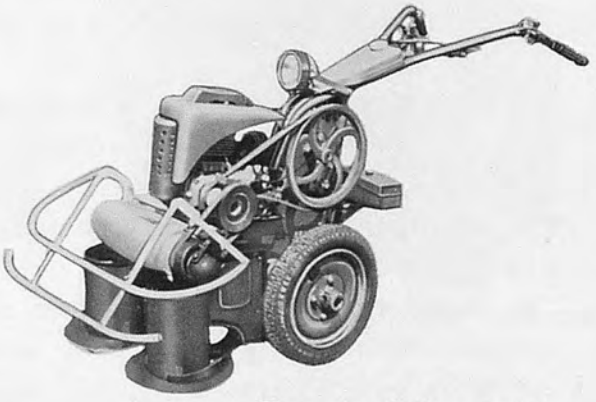
Wheel type cutter

for cutting the large quantity of straw & grass.



Moisture Meter

to measure moisture of rice.



Grass Mower

for reaping & mowing pasture or grass.

YAMAMOTO MFG. CO., LTD.

Head Office : Tendo-city, Yamagata, Japan

Branch : Oyama, Nagoya, Osaka, Fukuoka, Iwamizawa

KONMA ENGINEERING MECHANIZATION IN

LONG HISTORY

Konma Seisakusho Co., Ltd. has been developing new agricultural machines every decade for rice mechanization. (See the following table)

In Japan the system of small-scale mechanization is now established, so that the land less than 5 hectars is well managed by a couple.

KONMA with long history in the field of rice mechanization would like to promise you to cooperate with you for it.

WHAT WE ARE GOING TO DO

We are now thinking of the mechanization system for large scale management. We believe it the duty for the Japanese who livo on rice and the only contributable thing for the Japanese engineers of agricultural machinery to promote technical cooperation for rice mechanizathion with the foreign countries which need to increase more the production of rice as their main crop.

Our company is the specialized manufacturer of threshers, rice hullers, paddy cleaners and so on, and has the knowledge and engineering statts that can play as leading part in such the machine design and production in the world.

ENGINEERING CONSULTING & RESEARCH

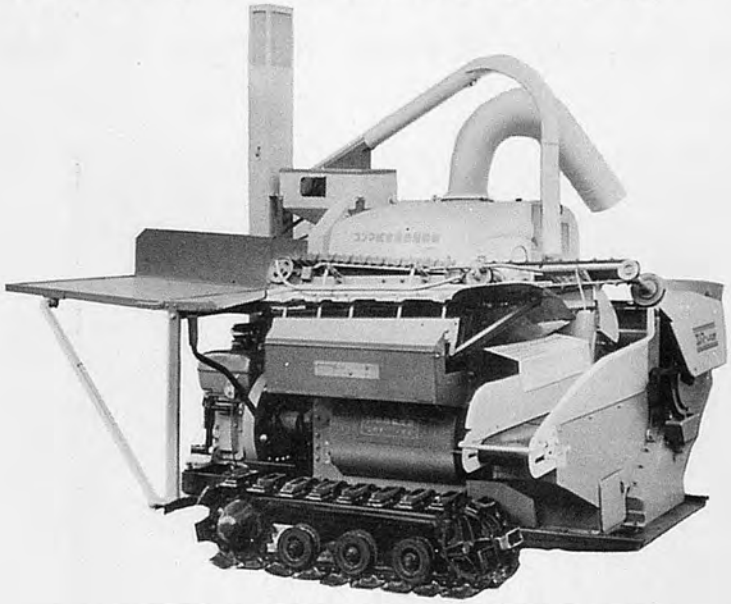
The most important thing what KONMA has understood through the long experience of developing agricultural machinery is the way of consulting the question whether the machine is suitable to the traditional agricultural method, cultural standard and the size of the land of the area. It is evident that a mechine such as acceptable to farmers will not be developed if we neglect to experiment and test them on the spot, because every agricultural machinery originally has the nature of variety and needs the fine service.

WE CAN HELP TO DEVELOP PRODUCTION

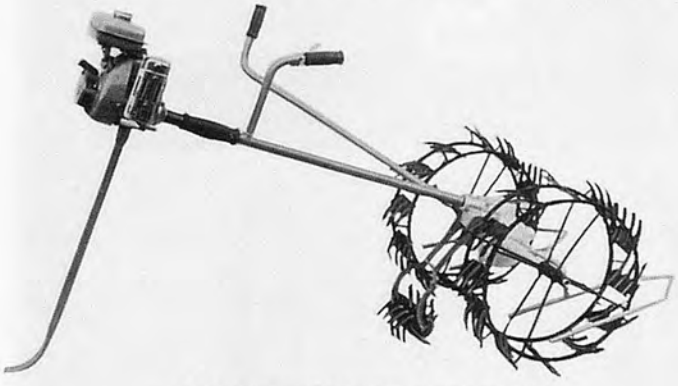
Tying-up with an agricultural machinery factory on the every spot in the world, we want to start manufacturing suitable machines that farmers will use with pleasure.

Our company is the specialized manufacturer of agricultural machinery with 1000 employees, and has 80 strong members of designer and researcher who have the positivity to challenge new problems and rich originality to develope new machinery. We assure that KONMA will be able to help a little to promote the rice-mechanization in Asia.

POWER PROMOTE EVERYWHERE



SELF-PROPELLED AUTOMATIC THRESHER



ROTARY POWER WEEDER

HAND FEEDING TYPE THRESHER

KONMA'S History of developement of main agricultural machinery

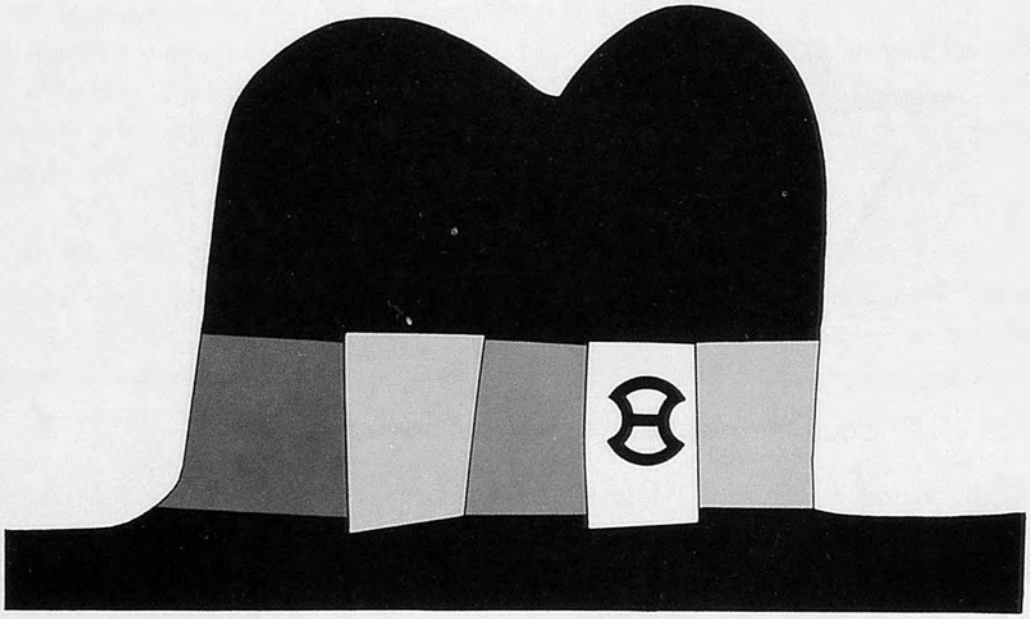
year	machinery
1928	BEEN OIL CAKE BREAKER
1930	WINNOWER
1932	RICE GRADER
1934	IMPACT HUSKER
1938	HUSKER WITH WINNOWER
1948	STROW ROPE MAKING MACHINE
1950	HAND FEEDING TYPE THRESHER
1952	AUTOMATIC RICE HULLER
1956	FORAGE CUTTER
1957	MECHANICAL FEDING THRESHER
1958	POWER TILLER
1960	BEEN HULLER
1963	WESTERN TYPE THRESHER
1966	SELF-PROPELLED AUTOMATIC THRESHER
1968	PADDY CLEANER
1969	ROTARY POWER WEEDER
1970	HEAD FEED COMBINE HARVESTER

KONMA SEISAKUSHO CO., LTD.

Head Office: Izumicho, Tsuruokashi, Yamagata Prefecture
Phone:; Tsuruoka 0235 (23) 1111

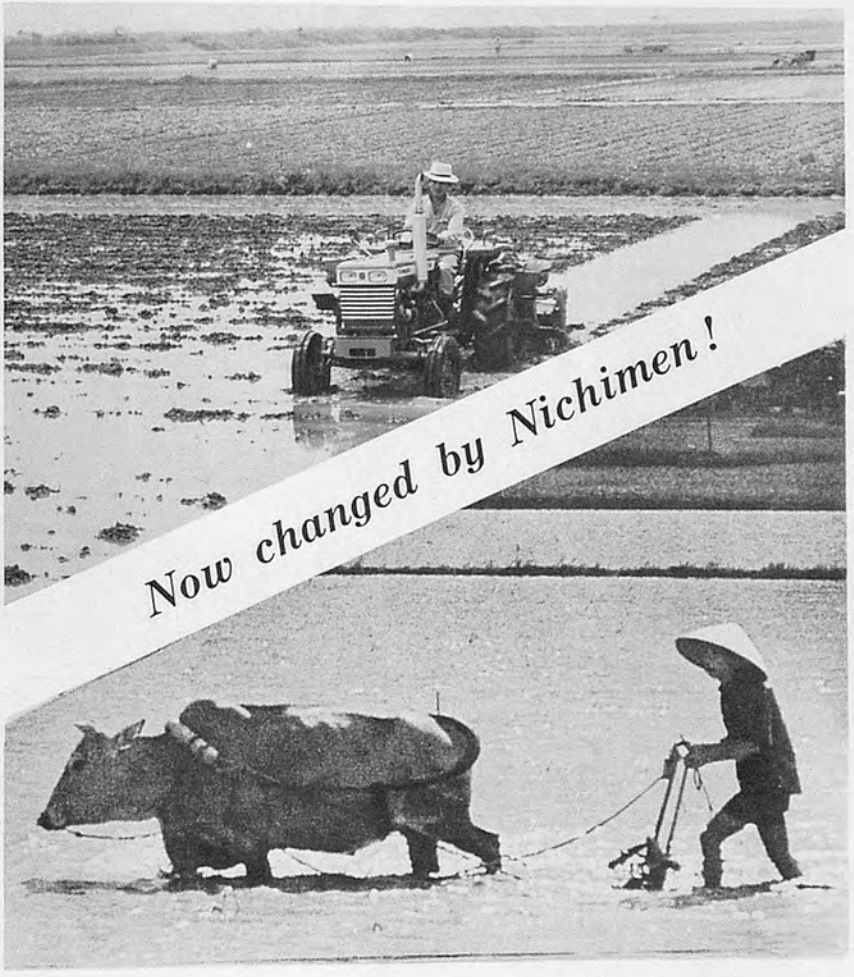
Tokyo Branch: 10-11-6 Okusawa, Setagayaku, Tokyo
Phone: 03 (701) 3381

Osaka Branch: 3-1 cho, Omachihigashi, Sakaishi, Osaka
Phone: 0722 (38) 0272



WHAT KIND OF MEN IS NICHIMEN?

For the happiness and prosperity of mankind, we NICHIMEN handle everything under the sun throughout world-wide net work.



Nichimen Co., Ltd.

6, Takaracho, 1-chome, chuo-ku, Tokyo
(Engines and Agricultural Machinery Section)
Offices: in main cities all over the world.

Basic Power to Advance Your Agriculture

SATOH TRACTOR FOR YEAR 'ROUND USE

Model	S−650	S−560	S−450	S−400
Output HP	25 Diesel	21 Diesel	17 Diesel	15 Diesel
Displacement cc	1246	992	824	760
Speed change	6F 2R	6F 2R	6F 2R	6F 2R
3 Point Hitch	Hydrauric	Hydrauric	Hydrauric	Hydrauric

The Satoh's wide range of attachments makes this a year 'round tractor . . . from mowing to tilling and from plowing to loading. Equipped with category 1—3 point linkage with stabilizers and built in hydraulic system. The easy to reach controls, full instrumentation and deluxe foam cushioned seat are designed for maximum operator comfort.

Satoh

SATOH AGRICULTURAL MACHINE MFG. CO.,LTD.

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No. 5, 4-chome, Nihondashi-Muromahi, Chuo-ku. Tokyo
Cable Address: SATOHZOKI TOKYO Telex: TOK 222-2567

Part II

REPORTS FROM ASIA

Sung Kum Han
Director
Institute of Agricultural Engineering and Utilization
Ministry of Agriculture and Forestry
Suwon, Korea

The Present and Future of the Farm Machinery Industry in Korea

1.Present status of Korean farm mechanization

THE Government urges farm mechanization due to the decrease of rural population (the annual average decrease is 1.1 %),wage increase (three times more than 3 years ago) and the necessity of the increased yield of crops and land improvement (the land of low productivity is 41.5% of the total paddy land).

Farm mechanization is vigorously promoted together with farm land readjustment such as plot rearrangement,improvement of irrigation and drainage,construction of farm roads,and development projects for the four large rivers,etc.But farm mechanization is no more than a beginning yet.

At present (1970), the status of staple farm implements and machines is as follows :

Number of Farm Household and Farm Population. (Unit : Household)

Year	Households			Farm Population		
	Total Households	Farm Households	%	Total Population	Farm Population	%
1960	4,337,973	2,349,506	53.7	24,989,000	14,559,271	58.3
1961	4,343,727	2,327,116	53.6	25,700,000	14,508,504	56.5
1962	4,589,071	2,469,453	58.2	26,432,000	15,096,779	57.1
1963	4,688,231	1,415,593	51.5	27,184,000	15,266,325	56.2
1964	4,769,533	2,450,308	51.4	27,958,000	15,533,019	55.6
1965	4,844,439	2,506,899	51.7	28,670,000	15,811,575	55.2
1966	5,118,053	2,540,274	49.6	29,207,856	15,780,706	54.0
1967	5,101,040	2,586,864	50.7	30,067,000	16,078,086	53.5
1968	5,233,958	2,578,526	49.3	30,747,000	15,907,664	51.7
1969	5,415,516	2,546,244	47.0	31,410,000	15,588,912	49.6

Source : Year Book of Agr. & Forestry Statistics. 1970.

Utilization of Cultivated Land in 1969

		Area(ha)	%
Area Cultivated		2,330,418.8	100
Paddy Field		1,293,709.1	55.5
Upland		1,036,472.7	44.5
Utilization land		3,574,472.2	153.0
Food crops	Total	3,065,323.8	
	Rice	1,229,662.2	
	Barley and Wheat	1,119,662.2	
	Miscellaneous	114,208.1	
	Pulses	379,699.9	
	Potatoes	193,067.2	
Special Crops		88,770.9	
Vegetables		226,332.3	
Tobacco		39,981.0	
Fruits		55,700.1	
Mulberry Fields		99,264.1	

Source : Year Book of Agriculture and Forestry Statistics, 1970.

Number of major agricultural machines in use.

	'66	'67	'68	'69	'70
Power Tiller	1,555	3,819	6,225	8,832	12,512
Tractor	20	34	68	99	131
Power Disease & Insect control Equipment	8,798	12,768	11,658	27,807	44,807
Pump	29,929	31,613	37,796	49,534	57,447
Power Thresher	22,338	25,474	26,675	33,878	33,878

Source: 1971, Year Book of Agriculture and Forestry Statistics.

Project and Results of the Arable Land Readjustment (Unit : ha)

	Area (ha)
Total	9,847,748
Agr. land Area	2,331,177
Accomplished till 1945	38,138
〃 〃 1969	135,450
1969	14,904
1970	14,100
Total Projected Area	588,000
Projected Area after 1970	452,550
1971	34,000
1972	50,000
1973	〃
1974	〃
1975	〃
1976	〃
1978	〃
1979	55,000

Data : Ministry of Agriculture and Forestry.

2. Plan of increased food production and farm mechanization

Nowadays, Korea imports nearly 700,000 tons of grain in a year and lays emphasis on the increase of grain production in the unit area. But it is not easy to increase grain production and it is making very slow progress.

In order to accelerate progress, the Goverment lays stress upon readjustment of farm land, that is, to settle the irrigation and drainage problems, to improve the fertility, and to control the disease and insect damages.

Details are as follows (next page):

To keep pace with these plans mentioned above, the direction of farm mechanization should be as follows:

1) As the hilly districts and destitute farmers are numerous. in Korea, comparatively small-size power machinery such as 5PS tiller and sprayer should be supplied. But the medium-size power machinery such as 35PS or so tractor should be supplied to the plain area which is readjusted, after due consideration that the plain area which abounds with granite soil, medium clayish soil, shallow marshes and deteriorated rice fields under go land improvement such as sub soil cultivation, deep plow and new soil (red soil).

2) The rice transplanter, combine, and dryer that must be used to settle the labor peak problem, should be supplied positively by taking account of improvement of farm systems, new plant varieties

Index of Prices, Wages and Charges (1965 = 100)

Year	Farm Implements	Wages and Charges in rural areas			
		Farm wages	Other wages	Grain Cleaning Charges	Charges for hired Cattle
1963	69.7	65.2	65.2	75.1	71.8
1964	82.4	88.5	82.8	102.2	91.7
1965	100.0	100.0	100.0	100.0	100.0
1966	112.4	116.9	113.2	106.7	113.5
1967	121.3	142.7	137.7	105.7	127.8
1968	135.5	178.3	170.9	115.2	156.5
1969	145.4	216.4	212.5	144.3	196.0

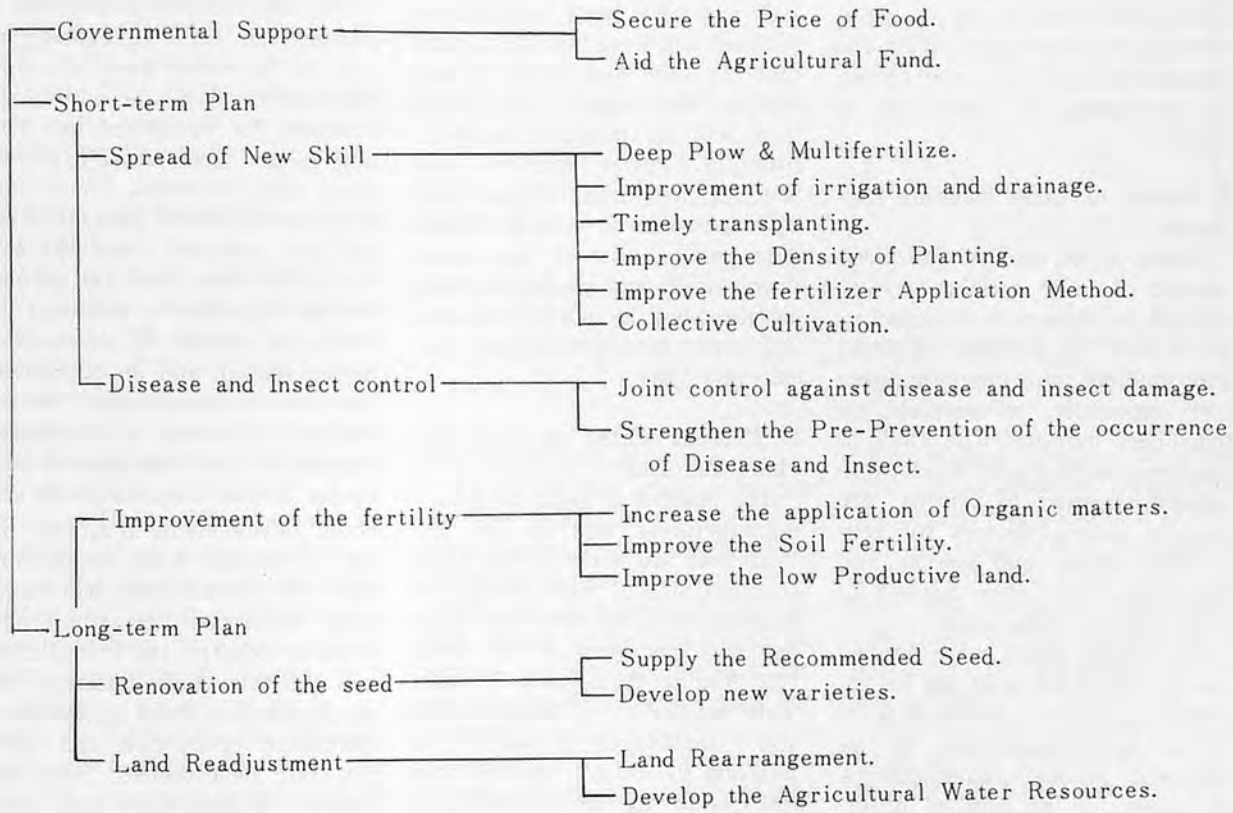
Source : Year Book of Agriculture and Forestry Statistics. 1970.

Number of Farm Households by size of Farmland under cultivation (Unit : Household)

Year	Total	Under 0.1ha	0.1to 0.3ha	0.3to 0.5ha	0.5to 1 ha	1 to 1.5ha	1.5to 2 ha	2 to 3 ha	over 3 ha
1960	2,349,506	—		545,209	706,689	485,933	—	141,391	6,889
1961	2,327,116	—		506,361	740,999	490,688	—	142,680	6,060
1962	2,469,453	—		522,986	803,162	505,093	—	140,598	7,265
1963	2,415,593	—		519,585	761,615	497,398	—	138,999	8,943
1964	2,450,308	—		512,689	782,499	525,672	—	147,835	15,515
1965	2,506,899	69,843	360,982	470,015	799,864	414,723	228,582	139,598	29,291
1966	2,540,274	72,654	357,577	463,154	818,121	434,923	222,034	136,713	34,598
1967	2,586,864	95,413	364,367	459,568	829,258	446,393	218,706	134,511	38,648
1968	2,578,526	57,457	352,926	447,820	820,173	453,529	215,768	133,156	40,626
1969	2,546,244	53,547	346,246	422,360	807,442	453,340	214,272	130,483	39,421

Source : Year Book of Agriculture & Forestry Statistics, 1970.

The plan of Increased Food production



and cropping systems, and should be maintained the integrated work system.

3) Small size Power farm machinery should be supplied to an individual, and size machinery must be used co-operatively so as to mechanize farm systems efficiently.

4) Farming with livestock raising should be encouraged positively in order to improve and maintain the fertility in mechanized regions.

5) In the beginning, manufacturers and consumers of farm machinery should be subsidized and financed by long-term and low interest loans by the government in order to promote farm mechanization.

6) Various farm machinery must be supplied with Korean-made machinery in principle (to develop the manufacturers systematically in accordance with the kinds of machinery), but the machinery would be imported from aborad if its domestic production is impossible.

3. Trend of the farm machinery Industry

For the balanced development in Agriculture, commerce and industry :

1) Make up self-supporting farms on a large scale (the land-ownership laws that prohibit ownership of the farm land more than 3ha, should be withdrawn)

2) Make the farm in the form of family Co-operation type on a large scale.

3) Encourages the farm to be group type and to be an enterprise form.

By such a general plan of Agriculture as remarked above, farm mechanization is in the stage of great conversion, On account of the supply and demand control plan of farm machinery which is contained in the governmental 3d 5-year development plan (started in 1972), the emphasis is on specialization, investigation of equipment, reformation of technique, systematization in sale and after-sale service.

The governmental development plan for farm machinery manufacture is as follows in detail :

1) Separation of manufacturers of partial items from the industry which aseembles them.

2) Separation of engine construction and frame construction.

3) Appointment of farm machinery manufacturers according to their kind.

4) Appointment of systemized manufacturers which produce the necessary items without distinction of kinds of machine. If possible, appoint two manufacturers.

5) Inspection of producted articles : partial items by the Ministry of Commerce and Industry, and assembled machines by the Ministry of Agriculture and For-

estry.

6) Investigation of the use of the applied funds which should be used in the development of partial items manufacture and saving the guaranteed funds in order to use in developing the machinery industry.

4. Result of farm machine factories

Funds, to be used in the development of farm machinery, were applied to deserved manufacturers in order to develop the small and medium size manufacturers and, especially, to develop the machinery industry. The kinds of machines to which the funds were applied in order of priority, are tractors, tillers, devices for controlling disease and insects, and havesters. They were applied to large scale manufacturers.

While such funds were applied readily, the returns of the investment were not so good because of unexpected competition in investment among manufacturers. Moreover, on account of difference in equipment and technique and the unplanned import of foreign-made farm machinery and lack of understanding about farm machinery, farms were not mechanized as it had been expected. Because of the reasons mentioned above, most of the manufacturers except a few were inactive and bankrupt.

Figures show the change in production of the main farm machinery. Figures show that numbers of power Tiller have increased in year by year.Tractors,at first,(in 1967 and 1968) were imported assembled and were tested,and after that (in 1969 and 1970) 40 percentage were made in Korea and they will be supplied negularly from 1972.Power sprayers have been supplied from 1966 and they have increased in number though their number,now is not great. Power mist and duster,also,have increased,but the number of pumps and powre threshers produce varied every year.

5. Present status of farm machine factories

The number of farm machinery manufacturers was 95 (in Sep. 1965) that had joined in the Cooperative Union of Farm Machinery Manufacture, but the total number was suspected to be about 170. Among them, only 3 manufacturers had over 300 employees and 7 manufacturers had 100 to 300, and the others had less than 100. Classifying them according to capital, only 5 manufacturers had over 100-million won, 15 manufacturers had over 30 million won, and the majority were small manufacturers wanting in eqipment and were out specialized in production yet.

So the government has tried to make changes from 1971, that is, considering the productive ability and numbers of production; there will be limit 2 manufacturers for one kind of machine, 5 engine manufacturers, 12 attachment manufacturers and 44 partial items manufaturers.

The development of national economy has been an average, of 11% or so every year. Personal expenditure has increased, investment for equipment has been active, and the amount of exports, also, increased. The quantity of production of general industry has increased especially and the G.N.P. has risen. On account of the increase in national income, the amount of consumption has increased, and on account of increase of consumption, the extent of production has expanded. Because of the repetition of such cycles, it has been dawn of economic development in Korea. Being connected with production, sale and consumption, such trends have developed the small and medium industry, the manufacturers, the wholesale business and retail sale, and they in turn have stimulated production and benefits. But, nevertheless, farm machinery manufacture was sluggish.

One of important reasons for this phenomenon is that : the farmers income and the farm machinery manufacture management were depending too much on government subsidy. In other words, they didn't adjust the capacity of production by the amount of sale, and so they depended on the government subsidy. If there had been no plan to support such manufacturers, they got into

"Change in production of the main farm machinery"

Year / Kinds	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Total
Power Tiller	30	63	305	266	340	677	2,616	5,371	5,900	6,300	13,858
Tractor	—	—	—	—	—	20	20	40	22	10	92
Power Sprayer	—	—	—	—	—	37	57	36	2,841	120	3,901
Mist & Duster	310	404	2,357	2,062	2,444	1,400	2,790	2,074	11,995	23,990	49,826
Pump	1,522	2,688	2,251	14,301	20,500	3,825	6,710	9,300	98,190	9,500	80,416
Power Thresher	—	—	738	918	1,430	1,470	1,570	1,800	337	—	7,926

trouble and couldn't choose the kinds of machine which farmers wanted to get. So farmers couldn't be supplied with what they wanted, and many farmers did not want farm machinery. Because of that, the benefit per capita ratio, was 5% or so murh lower than that of other business.

6. Price and marketing of farm machines

The price of commodities in 1971 jumped nearly 20-30percent over 1970 but the price of farm machinery showed slow rising. Meanwhile, the materials costs for the farm machinery-especiallly iron, rose suddenly and the pay of technicians increased excessively as the civil works and construction hit a boom. Additionally, in the case of the production of the heavy farm machinery, the problems here have been all the more serious as the heavy farm machinery can not be made perfectly in Korea and the imported farm machinery tend to be contorolled according to the price of the foreign-made accessories. Therefore, the selling price of the farm machinery has not been stabilized comparatively.

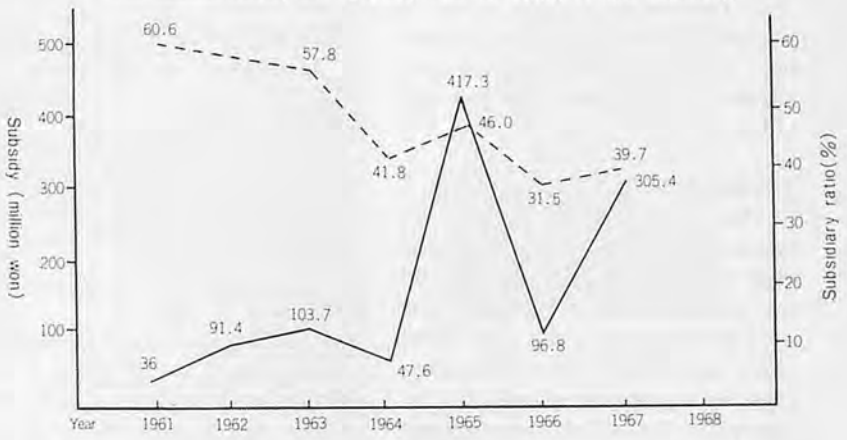
As you can see in the following graph, bfcause the national subsidy of farm machinery is not efficient and the subsidiary ratio changed sharply every year, the price was more unstabilized.

Because of this situation, the profit from this enterprise is still very little.

For the development of the farm machinery industry, it is hoped that after this modernization of facilities and efficiency of the work shoud be attained and at the same time pertinent authorities should finance efficiently in order to exploit the free market and maintain the proper price.

According to the domestic product plan, the production cost must be reduced by magnifying quantitively-(by the production of accessories and upgrading of

The national subsidy and subsidiary ratio for supply of farm machinery.



Source: Year book of Agriculture and Forestry statistics, 1969.

farm machinery factories).

There are two ways in selling the farm machinery to the farmers in Korea. One is selling to the farmers through a selling agency which belong to factory. The selling agency should guarantee the quality and accident during a certain period by contract with the farmers.

Another, if the government supplise farm machinery to the farmers as a subsidiary work, the Agricultural Co-Operative sells it to the farmers instead of the Ministry of Agriculture and Forestry, and the National Institute of Agricultural materials inspection inspects it thoroughly according to the regular rules.

Because the Agricultural Cooperative does not have an after service factory" for adjustment, accessories and repair of farm machinery, the selling of farm machinery by the Agricultural Co-operative is done by a selling agency of it under the responsibility of farm machinery factory.

Generally, because the dealer must effectively carry out selling works and service, the selling agency is required to be large scale.

Therefore a small scale dealer is included gradually to the part of a large scale dealer and they sell not only farm machinery which is made in one factory but also various things which are made in other factories, and take care of adjustment, accessories and repair. But because it is difficult to enlarge them, the government is going to improve as follows, the course of distribution and in the selling system for the purpose of reinforcement of after sale service from 1972.

1) The producing enterprise instead of the Agricultural Co-operative should sell directly to the farmers the farm machinery that farmers want during a cerain period with assurance of quality.

2) Every selling agency should carry out assurance of quality,after-sale service and supply of accessories by arranging some experts.

3) In the course of technical training by suppling farm machinery, the Office of Rural Development should deal with technical training about all the farm machinery except farm tractors. But it must carry out technical training of about twice as many persons along with the supply of the farm machinery to the unit of the cap.al, Do and Kun according to cooperation with the Institue of Agricultural Engineering and Utilization and the farm machinery producer.

Additionally, The corporation of Agricultural Development should take full charge of technical training about driving, operation and management of the

tractors.

4) The primary college that is established for the farm machinery in the existing educational system trains experts in farm machinery.

7. Plan of farm mechanization

The Government has tried to convert the farm that produced rice mainly to the synthetical farm in the process of Agricultural modernization. But the farm can't be changed from the rice--planting agricuture easily, because it is difficult to convert in a short time from the paddy farm to the dairy farm, horticultural farm, pomological farm, sericultural farm or multiple crop system. Moreover, in the state of importing food (rice in main), it seems to be very difficult to convert. According to such trend in agriculture, they selected the rice--planting farm machineries in the long-term plan, for example : tillers, tractors, pumps, rice-transplanters, sprayers, mist and dusters, combines, power threshers, dryers, cutters, etc. The long-term plan is explained as follows in detail:

Rice-Planting;

1) Tilling, Harrowing and Hauling.

Irrigated paddy filds will be mechanized preferentially, and tractors will be supplied in plain field among target areas of farm land consolidation and the largsized power tiller(8PS) will be supplied in the other.

2) Pumping

Pumps will be used for protecting against drought, and broken parts of existing pumps vill be replaced with new ones in every year.

3) Transplanting

The work of transplanting will be mechanized in target areas of farm land consolidation.

At first (from 1972), manual transplanters will be supplied to irrigated paddy fields in the central districts, and after that power transplanters will be supplied to whole land.

4) Disease and Insect Control

The target area of disease and insect control mechanization will be the total area of rice fields.

In the arable land readjustment plot, the highly efficient sprayer-(tractor attatchment) should be distributed to some areas and must be disseminated to the other areas. Therefore the days of disease and insect control at one time is eight days in 1971, but it will be shortened to four days in 1972.

5) Harvest

Combines should be supplied in the area that needs to do readjustment of arable lands for the purpose of mechanization, and binders will be supplied in the areas that need large-size power tillers.

6) Threshing

The remaining areas except the objective area in which combines will be supplied should be made the objective area of power threshers.

7) Drying

A mass cultivated area should be made the objective area to which dryers will be supplied.

Livestock Production:

Tractors (55-70 PS) should be supplied in the intensive forage that include a new exploitable region among the projected plot for the forage planting, and power tillers (10PS) and their attachments should be supplied in the rest.

Orchard;

Tractors (25 PS) should be supplied in the area over 3ha among existing cultivated areas, and power tillers(8 PS) and their attachments should be supplied in the area less than 3ha.

In accordance with the future prospect of farm mechanization as mentioned above, the factories which fall short of the techniques and facilities should be consolidated and specialized according to the kinds of machine parts.

Together with te adjustment of the system, farm machinery handling, farm management, farm machinery guidance and aftersale--service system should be strengthened so that the farmers might buy the farm machinery which is proper to their management, work system,and purchasing power.

The students attending Agricultural schools must be taught about farm machinery and implements in order to train capable leaders for dissemination of farm machinery information in the future.

For community development and security, a long or short term training plan for expert guides in farm machinery should be prepared. Information about exploiting the domestic market, organization of manufacturers and large scale farm machinery selling agency should be developed vigorously. ■ ■

Jeepney Manufacturing in the Philippines, A Model for Developing the Agricultural Machinery Industry

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IT can be gleaned from many articles in the first book of Farm Machinery Industrial Research Corp., *Agricultural Mechanization in South East Asia* that mechanization cannot be attained solely through the importation of machinery. To these I would like to add a few observations to establish a framework on which the development of an agricultural machinery industry may be based.

The average hp/ha in Southeast Asia[1] excluding Japan, Republic of China and Nepal is 0.327. Japan which we may consider has a well-developed agricultural economy has the highest average of 3.00 hp/ha. The Philippines has only 0.198 hp/ha. For it to attain a level of mechanization of say 2 hp/ha in 15 years and considering for the sake of estimation that the Philippines were to import machinery in the form of 30 hp tractors, the Philippines would have to import 21% of the number of tractors existing evry year; so that by 1985, the Philippines would have spent 750 million US dollars. On a straight line basis this entails an annual expense of 53.6 million dollars[2]. This amount is already 9% of the Philippines budget for 1971. Obviously, even if the Philippines had the dollars, an allotment of this size cannot be implemented. It is therefore imperative that the bulk of the machinery be locally manufactured.

That a developing country like the Philippines is short of capital and rich in labor resources cannot be overemphasized. It is only logical to envisage a production technology that is more labor intensive than capital intensive. "Incorporate the farmers" would be the retort of any student of business. But in a developing country like the Philippines where government administration is invariably hamstrung by political and bureaucratic bottlenecks, constraints and even corruption,[3] economy of size that can be gained by such collective efforts for manufacture is at best a dream.

Capital intensive manufacturing is a high volume concern. With a farm size distribution of 95.4% in the 0-10 ha range (60.8% in the 0-3 ha range)[4], it is doubtful that large volume production can be continuously supported. Furthermore, agriculture involves vast areas of land which implies miles and miles of roads. Distribution of the machines, if produced by just a few large factories, would entail transportation considerations that significantly increase costs to the farmer without improvement of machine performance.[5]

In this particular framework, it seems that a low-volume, labor intensive production method is the more viable alternative in agricultural machinery production.

Khan[6] has asserted that this type of production is quite possible by citing as an example the very successful jeepney[7] industry in the Philippines.

The preponderance of cheap surplus material and the great need for public conveyance were the two main ingredients that started the jeepney industry after World War II. As soon as the concept was introduced, small shops producing crude versions cropped up almost overnight. Now it is a flourishing industry that involves annual sales of at least seventeen million dollars.

Two companies, Francisco Motors, Inc. and Sarao Motors, Inc. will be described for illustration. Although differing drastically in business philosophy, the choice is based on the following characteristics which are common to both:

1) They are the largest jeepney manufacturers, with dealers all over the Philippines; one indication of their financial stability is their good credit standing with banks;

2) Both started literally from scratch 20 years ago, using simple

tools; the founders were highly skilled artisans with no college level education.

3) Low-volume production–each produces 5 to 6 jeepneys a day;

4) Labor intensive–employing more than 300 men in the factory alone;

5) Both firms have never had a strike, and have never laid off men.

Francisco Motors seems to be the more dynamic one since its concern is one of continuous development. It has been gradually "modernizing" its production methods by adopting the moving assembly line technique. Many manual operations are also being replaced by "transition" machines. The replacement by machines however is being made only to redistribute the men to other lines, of which they now have three: jeepney assembly, special make and micro-bus lines. Another assembly line for a Japanese car is not continuously operated. The micro-bus line is more of a diversification. These characteristics may classify this firm as a modern small industry specially in its outlook–in which "there is a continual search for improved ways and has ready adaptability.[8]"

Sarao Motors on the other hand upon attaining the present production level has stabilized activities. Aside from a few improvements, it has remained traditional. Its skilled workers today are still doing what they used to do when they were making only a few jeepneys a month. Production was increased mainly by adding more men and buying a few simple tools. Except for welding, absolutely no production machine is used, not even for cutting sheet metal. Without moving the assembly from its location, three men with hammer and die and welding equipment work on it until the body is completed. This is indeed very primitive; but some of the experts in the very modern car industry are now realizing that assembly for the sake of efficiency with people as a subordinate consideration may in the long run not be so beneficial. In the former type of assembly (traditional) the men gain a sense of accomplishment in their work while in the high capacity modern car assembly line, where specialization has been reduced to the tightening of bolts, men ask to be compensated for being bored (it would be tragic to discover in the end that mechanization has only transferred human drudgery from the farm to the factory!) The main reason for Sarao Motors remaining traditional is the belief that the jeepney will be the chief public conveyance of the Philippines. It is also the belief that although handmade, it's quality is comparable to that produced by machines. In the words of Leonardo Sarao, president and general manager:

> "I am not concerned about the future of my company. Selling jeepneys has never been my problem. The jeepney is here to stay. It will always be used for short-distance runs even if mass transit systems are developed in Manila. And it cannot be replaced in the provinces."

And upon one of his brothers being asked if the company was making money, "To tell you frankly, among us four brothers, we own the best and the latest cars in the Philippines." Pointing to a young man working in the shop, "That is my son, I am training him to work in the factory and know the men. He sometimes goes to school in his Torino, although he regularly uses a Sarao jeep." (At Francisco Motors, the key men stay in the office, and have taken management courses to keep pace with the company's development.)

It might be of interest to note that engineers were employed only after these companies had reached maturity–after most of the problems of machine design had been solved.

Although these two companies, together with four slightly smaller ones produce the bulk of the jeepneys in the Philippines, there are more than 100 jeep and jeepney body builders in the country. These are small shops with floor areas ranging from 200 to 500 square meters, employing about ten men. In these shops one will find about eight jeeps and jeepneys spaced one to two meters apart in various in stages of assembly. The majority of vehicles assembled in these shops are jeeps (not for public conveyance). Some of the grill, fender, tailgate and windshield frames are produced by other local manufacturers who have presses. The rest are formed in the shop with special forming frames and clamps. The cost of the material is about 50% of selling price.

The success of the jeep and jeepney can be attributed mainly to the following:

1) low cost–most of the engine and undercarriage are war surplus material. It is odd, though fortunate, that the Philippines government permits the importation of worse than second hand material while the import of second hand cars, which could also be imported at lower costs, is restricted. Engine reconditioning has given rise to other types of shops with precision machines (reboring, crankshaft grinding etc.) and has enhanced the development of highly skilled mechanics;

2) availability of spare parts –fast moving jeepney parts can be bought in almost all towns in the Philippines.

3) the jeep was designed by the US Army for strength and traction and as such is just the natural vehicle for country roads and rugged terrain.

Comprising 45.2% of the total car population,[9] there are 119,953 jeeps and jeepneys registered in the Philippines in 1970. Jeepneys alone number 43,283 units and these are managed by at least

15,000 operators. At the rate of peso 6.50 to the dollar, selling prices are as follows:

Jeepney (12 passengers)

Body only with upholstery and paint, chassis included···US$660.00
Complete jeepney with reconditioned surplus engine ·····1,920.00
Complete jeepney with brand new diesel engine ·····2,615.00
Ditto, deluxe model ·····2,880.00
Jeep (for private use) body only ····· US $ 310.00
Complete jeep (reconditioned engine) ·····1,600.00

A total of 9,585 units of chassis were produced by the three local chassis manufacturers in the period 1969–1970 and previous figures indicate that this number is no longer increasing.

Can we develop an agricultural machinery industry patterned after the jeepney experience? I believe, we can because it is so natural.[10] It is only necessary for us to determine the vital ingredients in the "mix" that promote growth.

1) Availability of enterprising artisans with small shops—In any developing country, there can be found a proliferation of individuals who have considerable skill with their hands. In the Philippines specially, because of the jeepney industry, many artisans in metal forming and welding have established small shops in the country. The local manufacture of hand tractors in Taiwan and Thailand is also done purely by artisan-businessmen. The agricultural machinery field offers good opportunity and challenge for engineers, and yet when I visited these manufacturers, I never met a single engineer! Considerable advances could have been achieved had there been some technical guidance in machine development. It is odd too that financial aid to small shop endeavors are so insignificant while, it is clear that it is these small shops that have the potential and, are making the machines. Financing for development in the Philippines is concentrated in large investments which are so top heavy that the effective use of this resource is inefficient. The interest rate at present is 12% but through commissions and services the borrower eventually pays 14-%. Imagine the difficulties the small enterpreneur in the artisan level must overcome to make the required project study to acquire a loan!

2) A simple product—not necessarily for production reasons but more to suit the technical level of the farmer is a major consideration. The hand tractor was introduced in the Philippines more than 10 years ago and has gained wide acceptance. Almost all types of hand tractor have been tried (4-speed, plate clutch, all gear drive, steering clutches, reverse etc.) but the farmer still prefers a machine that he understands. It is hard to measure in concrete terms the level of sophistication machines from the developed countries have reached -but one should try disassembling the latest Japanese hand tractor and see for himself. It is clear that the tropical farmer is paying for so many "extras". Furthermore, these machines are imported without adequate service backing. I believe the agricultural machine for the tropical farmer should just be a step higher than the bicycle but less comlicated than the motorcycle in the mechanism hierchy. This may be fortunate because local manufacturers cannot as yet manufacture with high degree of precision. A good gauge of the level of manufacturing skill available in the Philippines can be obtained by again looking at the jeepney industry. At present almost all the parts of the jeep are being manufactured locally except for the engine, transmission gears, differential gears, steering gear assembly and bearings. The casting of transmission and differential housings is starting in 1971. This implies that precision in the less than one thousandths of an inch measurements and finer than sandpaper finishing operations is still rare. The supposedly reliable machine shops in the provinces still fit ball bearings by "feel". This indicates that local manufacturing should avoid components that require accurate alignment, such as gears. The introduction of "go" and "no go" gages is timely. In the Philippines, as well as in many developing countries, casting is still an art, both in the pattern design and metalurgy aspects. Sheet metal forming can be accomplished by the artisan. More complicated shapes can be made by the proper design of forming frames and clamps as in the jeepney industry. Some re-orientation in design is

A jeepney running on the street

needed in this respect–there may be functional forms that are difficult to fabricate by machine but easy by hand.

3) Standardization of parts —this ingredient of the mix is rather difficult to achieve because artisans are by nature individualistic. However, parts such as chains, sprockets and bearings which are interchangeable parts may be used to cause standardization. A good example is the rugged hand tractor of Thailand: the use of 1" chains and the same sprocket sizes are common, thus ensuring the availability of spare parts. In the Philippines, many jeep parts can be used in agricultural machinery.

4) A product that is both functional and durable for tropical farming must consider not only specific purposes but other probable uses the farmer might think of and the machine should be designed to withstand abuse.

If the four basic ingredients are present, I believe the agricultural machinery industry will develop naturally–just like the jeepney industry.

1) Ceylon, India, Indonesia, Pakistan, Philippines, Thailand, and South Vietnam. Japan, Republic of China and Nepal are above the critical 0.5 hp/ha considered by McColly (Professor emeritus Michigan State University) as the least hp/ha of main crops area that should be available to expect some increase in productivity.

2) The figures are from an exercise made by Teddy Wikramanayake, senior lecturer in agricultural engineering, University of Ceylon.

3) It is difficult to ascertain the extent of corruption in the government but it will suffice to say that each and every candidate for election to the legislature vows to fight corruption during his campaign.

4) Agricultural Census of the Philippines, 1960.

5) I am reminded of a $3,600,000 10ton/hr rice processing complex located in the Philippines. The design was based on an exhaustive study and recommendations of a team of national and international experts. It is one of the most modern. And it is so highly automated that only 3 men are required to run it. The manager can control everything through a closed circuit TV system. Unfortunately, enough paddy cannot be found to operate it continuously. Even to operate it intermittently, their trailers have to travel up to 500 km to gather paddy. Viewed in the context of mechanization blunders of this type make one worry about the sincerety of expert advice.

6) Machinery Development for Tropical Agricultural Mechanization of Southeast Asia. Amir U. Khan

7) The jeepney is an adaptation of the US Army World War II 1/4 ton 4 x 4 jeep for public conveyance. (see picture)

8) Modern Small Industry for Developing Countries by Staley and Morse.

9) Public Service Commission, Department of Justice, Republic of the Philippines.

10) The word "natural" is vague but I want to imply that the jeepney industry is an industry that has grown with practically no prodding or constraints. ■ ■

SARAO MOTORS (left)

The chassis stacked in the yard of Sarao Motors are supplied by one of the three jeep chassis manufacturers in the Philippines. In the background is the body assembly shed. As one gets accustomed to the noise of hammer on sheet metal, one will recognize a loose arrangement according to activity.

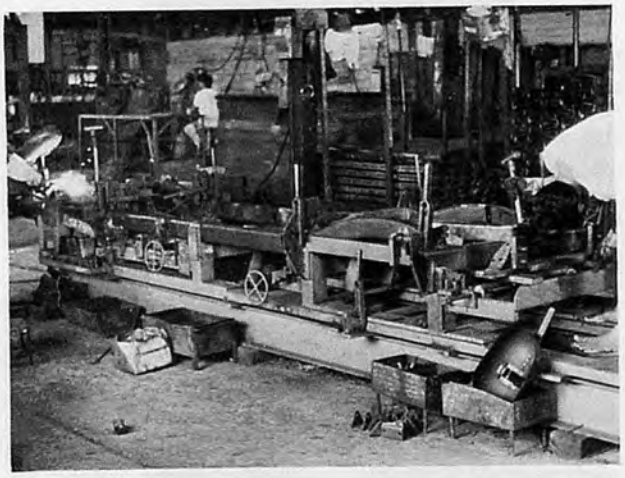
FRANCISCO MOTORS (right)

Conversion of the jeep axle from semi-floating to full-floating axle is one of the modifications made by the engineering and design department in order to reduce stresses on the axle and to facilitate disassembly. Another activity in this department is the fitting of the jeep transmission to the bell housing of a Japanese made engine. This requires precision work and the use of special welding material.

All parts are hand formed using indigenous tools. Sheet metal is still cut by hand shears. Above is shown a forming frame. By the shape of the frame it can be deduced that the quality of the part produced will depend to a great extent on the skill of the worker. Many forming frames are used in the industry in varying degrees of sophistication with the one shown as the simplest. In other small shops the blank is clamped between positive and negative forming frames. Relatively complicated forms are possible with this method.

The die for chassis forming was fabricated by hand from armor steel. The forming and fitting of the dies took them more than a month to complete by just heating and welding. Compared to dies produced in the industrialized countries, this is primitive, but structurally and functionally, the chassis produced is compatible with the load. The dies are mounted onto a 100 ton multi-purpose press. Cylinders and control box were imported from Switzerland. The cylinders can be operated simultaneously as a group or individually. The press is used intermittently for chassis forming according to demand. Down time is used for stamping the grill and other smaller parts.

The artisan hammering the jeepney grill into its final form. The design has not changed since the World War II days. This persistence in style has facilitated the setting up of relatively low cost manufacturing concerns using heavy duty presses.



Chassis assembly is done on an adjustable jig which accommodate different chassis lengths (for 10, 12 and 14 passengers). Components are fixed in position by home-made over center clamps for assembly by welding Quality of press formed parts are not as good as the imported ones (due to unequal bend radii) but compliance to pertinent dimensional specifications are strictly obseved. Good chassis appearance is a consequence of good die dimensions. However it does not add to performance.

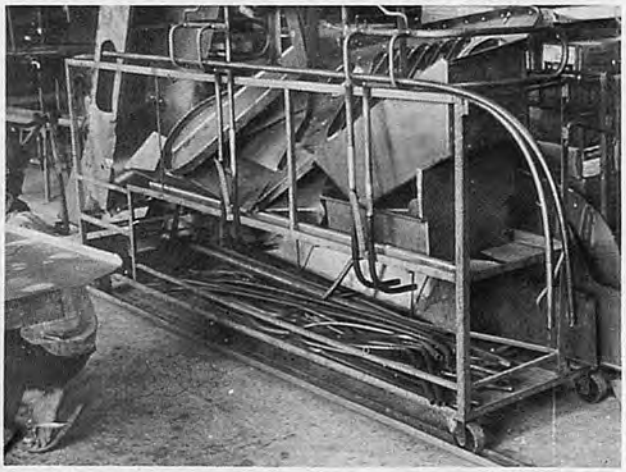
The rear fender is pre-formed by welding a strip at the edge where the curve will be sharpest. Final form is attained by hammering. Note shape of the almost completed fender held by artisan.

All cut forms are made from patterns developed through the years. This section of the shed has an earth floor because it is also used as a soft backing for the hammer. The ground also absorbs sound.

An interesting statement about men and machines is the following from Leonardo Sarao-president and general manager:

"Recently a Japanese equipment manufacturer tried to convince me to mechanize some of my operations. He offered to sell me a press for 200,000peso (about $-50,000 in 1969) and a sheet bender for 100,000peso. These two pieces would perform most of the work required to make a fender, grill, steel top, cowling flooring and engine cover. I could probably reduce my labor force by about 100 men with that equipment, but I do not want to lay them off. This would cause too many headaches. My entire labor force would resent this kind of lay off. I have never laid people off before. I do not want borrow either, to buy the equipment. I want to sleep at night. Suppose the machine breaks down? My entire operation would come to a halt. I could not rehire the skilled men I would have laid off. They would already be working somewhat else. Skilled workers are scarce. To be certain that I could produce constantly, I would have to buy two of each piece of equipment, a regular and a spare! No, the only time that I may purchase this kind of equipment will be if I am forced to expand in the future. Then I will consider it…"

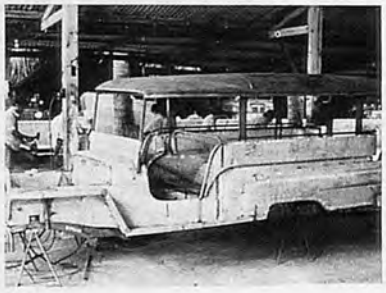
Sheet metal forming of the fender is done by a unique forming process. It is actually a mechanical adaptation of hammer and dolly. Reciprocating motion of the hammer is by cam action, and hammering force is controlled by an adjustable compression spring on the dolly side. The technique improves smoothness of curved sections and eliminates pre-forming operations by cutting and welding. The machine is also used to form the jeepney roof.



As soon as the jeepney parts have been formed, they are loaded into an open cart preparatory to assembly to the chassis. Notice the wheels on one side running on a channel rail which guides the cart through the assembly line. This cart always moves with the assembled chassis which is also running on another parallel rail. This procedure is followed because no two carts always contain identical parts due to differences in customer specifications.

Ernesto Sarao, one of the Sarao Brothers, considered to be the most skilled worker in the company, is now in charge of body assembly. Close contact with the men is one of the major factors for the absence of labor disputes in the company. Inside the assembly area are about thirty jeepney bodies being simultaneously assembled. Welding comprises almost all assembly operations even for making holes. At the time of the photograph there were 30 jeeps on the stationary stands and 140 men working on them. It takes about three days for the assembly to be completed.

The floor is assembled on the chassis also by welding. The main floor beam structurally takes some of the load from the chassis. Because the chassis metal locally available is not of the same strength as that of imported ones, without this strengthening, the chassis may collapse at critical loads. The lateral distance between rear spring brackets have been increased by relocating the brackets outside the chassis instead of under. This modification regains the lateral stability lost as a consequence of increasing the wheelbase.



The style of the jeepney may vary drastically from the usual product due to customer specifications. Note the rear fender of the jeepney shown above. Most of the special styling is patterned after American cars (tail lights of the original car are installed).

Body is assembled with hammer and dolly, minor adjustments are done to fit each part. At the time of this photograph there were about seven jeepneys along this line.

A finished jeepney body waiting for engine and undercarriage installation. The one shown above is the usual model. The deluxe models are more festive and elaborate. The styling also gives expression for customers individual taste preferences. This luxury which can be obtained at practically no extra cost is possible only in this type of production.

After a final body checking, the jeepney body is washed with chemicals and detergent. Body painting is done in an inclosure equipped with heater lamps. Then the final touches that give the jeepney its unique appearance are applied by painters who are given more or less a free rein.

MULTIPLE CHARACTERISTICS

of Farm Implement and Machinery Production

in Taiwan, the Republic of China

Tomotake Takasaka

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TAIWAN island,the most prosperous and peaceful province in the Republic of China, surely has distinctive character which looks quite different from that of other countries in South East Asia. Firstly, the most part of people living in Taiwan belong to the genuin Chinese, who are the successor of Chinese civilization in every respect, from philosophy to technology. Secondly, so called Taiwanese, the decendants of immigrants came from the continent during 18th and 19th centuries, is the owner of double phased character, conservative on one hand and full of pioneer spirit on the another. Due to this particular character, I believe, the pattern of development of the Farm Mechanization took place in Taiwan during last one quater century after War, has expressed itself to be the most distinctive one, which would scarcely be seen in another region of South East Asia.

In this report, the writer is going to describe two matters.

(1) Certain kind of homemade Chinese traditional farm tools are perfectly occupying the whole market in Taiwan exclusively, so that none of foreign made modern tool of same kind can enter into this market.

The writer is going to make a detailed description about the reason of above mentioned monopolizing phenomenon, because the principle used on these tools seems to be a very important key to open the new way of future development of the modern farm machinery.

(2) In the second part, the writer is going to introduce some episodes actually took place during past 15 years in Taiwan, adding some analytical explanations. There could be found something helpful to performers who are now struggling to manage such a hard and complicated problem as farm mechanization in several countries.

The writer, a Japanese, who has been teaching on Farm Implement and Machinery in National Taiwan University for more than 40 years, and who has been a consultant of China Agricultural Machinery Co. for more than 10 years, naturally be affectionately connected to the growth of Farm Mechanization in Taiwan.

The writer hopes that this strange styled report, which is the only form the writer can manage to relate, is accepted by readers as a anecdote suggesting something.

Introduction : General View of Farm Implment and Machinery Production in Taiwan

Manufacturers who's business is chiefly or halfly connected to the production of Farm Implement and Machinery can be devided into four classes;

(1) Group of black smith and plow makers. This is perfectly isolated from the Industry,making itself to be a part of agricultural society, spread all over the farming district and firmly keeps Chinese tradition both in techniques and in manner of living. Chief products of them,harvesting sickle and hoe, surely have distinctive superiority that let this group keep monopolized market in Taiwan.

(2) Group of family-sized machine shops spread widely in many towns which is the small center of farming plot. Mending is their chief job, no distinct product, but this is the chief origin of recently grown manufacturers related next.

(3) This is the group of specialized, privately carried, medium sized farm machinery factories. This group may be the most distinct existence among the whole industry in Taiwan, because of particular ability possessed by leading persons who are activating this group by their misterious power.

(4) Group of large scaled

Farm Machinery Companies operated on commercial base and cooperated with foreign country, both in financial and technical respects.

Farm Mechanization in Taiwan is carried on the cooperation of above mentioned four groups. There is no generalized manufacturer who can supply every Implement and Machinery that Taiwan agriculture needs. This concrete like construction, without clearance, could be the most distinguished character of Taiwan Farm Mechanization.

Part I Chinese traditional blacksmith and their chief products.

1. Particular point of Chinese traditional forge techniques, i.e. Chinese traditional forge welding method;

(1) Chinese blacksmiths never use Borax as the reducing or deoxidating agent. There can not be seen any white heated splash spreading from the red hot iron under forge welding treatment.

(2) From the particular constraction of furnace and bellows, and special treatment of fuel, we can deduce the reason as followed;

(furnase) Narrow and deep type, can be called "coffee-cup type"

(bellows) Hand drived, double action, long stroke, circular cylinder with piston typed wooden made air pump. Evidently the design means high pressure.

(fuel) Soft coke, crashed and sieved to be the uniform sized granular substance, which size is varied proportionally to the dimention of furnace. Approximate diameter of grain is 10-20 m.m. The object of above mentioned equipment and treatment would be the formation of high temperatured reduction layer, filled with carbon mono-oxide, formed at the top layer of coke in the furnace, where the things are heated.

2. Significance showed by their products;

(1) Harvesting saw typed Sickle;

If we use somewhat exaggerated expression, this sickle can be called "Ultra fine toothed saw-typed sickle".

One of makers of this sickle once declared in his advertisement like this, "used more, more sharpened then". Actually, farmer never sharpen them with whetstone, it looks to us as if the sickle can keep life-time sharpness.

When wheat or rice stem is the object of cutting, since it contains silicate in the skin, as everybody knows, none of ordinary knife blade can keep it's sharpness for long time. Then where the everlasting cutting ability of Taiwan harvesting sickle comes from? Actually the sickle isn't cutting anything, it is only pulling and breaking the fiber little by little through the hooking action that every individual fine tooth does.

To grasp the fiber with already dulled edge of tooth, the inclination of the working edge of tooth to the line of pull should keep proper angle, that is, within the right angle. If sickle is made of uniform material, since the point of tooth wears faster than it's foot, it is impossible to keep the inclination unchanged. To solve this problem, there used double layered construction on the Taiwan harvesting sickle, namely, very thin hard steel layer at upper side and mild steel layer at lower part.

Originally, the tiny tooth of sickle is formed by V-shaped grooves notched with chisel and hammer. Since the bottom line of V-notch always exists at deeper place, i.e. in the mild steel layer, so wearing speed of this spot is quite fast, at least it could worn out at the same speed with that of point of tooth, which is in a upper hard steel layer. Thus we can, not only let the inclination of working edge of tooth keep constant but also able to form a correct shaped tooth continuously. This would be the source of life time sharpness which is the most distinctive merit that Taiwan harvesting sickle surely has.

Approximate Dimension of sickle
Total length ..... 220 m.m.
length of toothed portion
..... 140 m.m.
width max. ..... 16 m.m.
thickness max. ..... 2 m.m.
approx. radius of curvature
..... 130 m.m.
pitch of teeth ..... 0.7-ϕ1.0 m.m.
weight ..... 20 g

Wooden handle
length ..... 270 m.m.
weight less than ..... 75 g

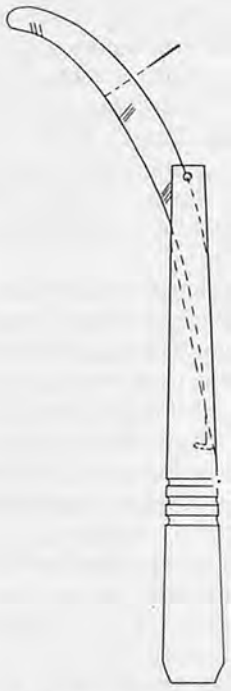


Fig.1 Taiwan Harvesting Sickle.

It is noticeable that every fine tooth which is less than one milimeter has it's own hard skeleton in it's body, and this hard but brittle skeleton is strengthened by rather tough mild steel.

These finest products are made by 100% hand work process. When they are notching fine V-shaped grooves with a small chisel and hammer, the movement of their hands and fingers is just wonderful,their skillfulness surely far overcomes beyond our commonsense.

They are very dilligent and cautious, for instance, sicklesmith who's shop is on the east side of road, finishensevery kind of heat-treatment before noon, on the contrary, west side shop does it in the afternoon. The reason is to avoid mistreatment caused by the interference of sun beam comming into their shop room.

(2) Hoe

Taiwan hoe belongs to the genuin Chinese type. There are two noticeable points concerning to it's construction and it's function.

(a) adjustable angle typed "eye". The angle between handle and blade, angle of hang, can be adjusted by farmers within a quite wide range in angle. This is the most remarkable distinction which is the "must" in this country, in the same time, this is a particular way of fixing handle scarcely be seen in another country.

(b) Self-sharpening fuction at the cutting edge of blade:Near the cutting edge of blade, there welded very thin hard steel plate on the upper surface of itself. Because only upper surface of blade has glass-hardness, so the blade can keep it's sharpe edge neverthless it may worn much.

This ingenious idea looks like of Chinese origin. During the period of world War II,since it wasn't easy to find hard steel material in the market, some of local hoe-smith brought out one of Chinese old method to harden the upper surface of the blade of hoe. This can be called as "big-iron surface hardening method". Firstly,uniform sized grain of big iron, of rice grain size, spread on the surface of preformed blade near the cutting edge, then heat it to the melting point of pig iron in a furnace, thus we can complete the crudest process of carburization. The hoe processed by this method naturally isn't so satisfactory. After a while, there comes out map like pattern on the surface.

(3) Revival and Key-hint, concerning to the principle applied to the Chinese old fashioned farm implements:

(a) It was a commonsense how to sharpen a worn disk plow, grinding or roller method, which was the formal description related in text books published before War. But at present, a certain kinds of disks imported from foreign country, surely own self-sharpening ability, so that they can keep sufficient sharpness during their whole life. This is the revival of Chinese old method commonly used on Taiwan hoe.

(b) Taiwan harvesing sickle was invented at the end of 19th century in Taiwan and continuously improved to be the present style. The fundamental principle applied to this sickle seems to be the very significant key point to solve many hard problems induced by wearing and dulling of blade, that inhibits theprogress of harvesting machinery, particularly of small sized machines.

Recent development of multiple layered steel plate production techniques, seems to me, is clearly indicating the possibility of industrialization of this old principle in future. This is the chief object of this article, why the writer has made detailed description onsuch a old fashioned Chinese farm tools as sickle and hoe, which scarcely been noticed by engineers.

Part II Farm Mechanization and Farm Machinery Production in Taiwan.

1. Short history about the early stage of power tiller and engine production development in Taiwan;

Just after World War II there developed new ideas concerning to the revolution of Chinese agriculture. Among many ideas, Farm Mechanization seemed to be the most attractive and easily understandable feature at that time. My first 3 students who came from the continent, were pioneers that were seeking the way to open the door of mechanization of their own agriculture. This could be the direct result of active propaganda made by American organizations, through films or actual display, driving newly developed farm machinery brought from America. There also came to Taiwan various kind of farm machinery such as small sized gasoline tractor and it's attachments. But after actually performed test during about one year, it was proved that tractor farming is not acceptable by Taiwan agriculture at that time because of several reasons, such as too small scale of individual farmers or lack of lanes among the small scaled muddy field,etc.

After this experience, there naturally came the second idea. This is an another kind of Farm Mechanization i.e. usage of very small sized power tillers which can be carried by two or three persons even when there is no road to pass.

At that time, there suddenly boomed out in Japan, super small sized power tiller named "Merry Tiller" which is an American origin and of simplest construction with no gear train nor complicated mechanisms that requires high grade accuracy to produce them. This was the most attractive feature, to both authorities and people who were seeking for a reasonable solution which can readily be applied to Taiwan agriculture.

In the year of 1954, small sized power tillers were imported from Japan under the aid of J.C.R.R.-(The Joint Commission on Rural Reconstruction). This is the very starting point of Farm Mechanization in Taiwan.

Though it was not openly announced in public, but according to many steps made by leading organizations, the fundamental conception kept by them looks like as follows;

(1) Farm Mechanization in Taiwan should firstly be promoted along the line of powered tillage problem.

(2) Power tiller production industry in Taiwan should be the perfectly independent enterprise in every respect in future. To do this, production of power tiller and promotion of farm mechanization should progress at the same pace. Mechanical industry in Taiwan is still very young, there is no much foundation immediately available, in the same time, Taiwan agriculture isn't suppressed seriously by the problem of agriculture population yet.

Under these circumstances, it will be the most reasonable way to promote the production of simplest type of power tiller at first.

Under these promotion earnesly made by J.C.R.R., there came out several manufacturers full of intelligence and pioneer spirits.

The type of persons can classified as follows;

(1) A person, full of pioneer spirit, who has plenty of experiences in repairing and production of machines, owner of a small machine shop, producing motor cycle concluding engine, designed by himself.

(2) A prominent person full of patriotic spirit, owner of middle class factory producing bicycle successfully, who recently has managed to produce motorcycle which is the true domestic product except carburetter and magneto.

(3) A few persons managing small or middle class factories, who have plenty of experience and industriousness in managing factory and actually have produced various kind of machines in the past. They are somewhat conservative and prudence in their character, in the same time, they know clearly how difficult the engine making is. These people prefered the way of purchasing engine from outside, when they engaged themselves in the production of power tiller.

(4) Company, one of the largest enterprise in Taiwan but chiefly dominated by the member of certain family who haven't much experience of managing machine production enterprise.

According to the report published by J.C.R.R. (Plant Industry Series No. 18) 1960, there were 7 manufacturers of power tiller by January 1959, but by the end of December 1959, there were 21 manufacturers in total. Thus we can surmise the outline of circumstances of power tiller production in Taiwan at that time. The report also shows us that there were 3,059 power tillers in Taiwan, one half imported and another half domestic made.

Though it may looks very flourishing situation to readers, but in fact, almost all domestic makers were under heavy load introduced by continuous service, forced by "one year non-limited guarantee" assured farmers by maker which was the only way to let their business carry on safely. In fact, most of makers were at the financial crisis in spite of their tremendous strive done day and night. Unfortunately, two of them who were producing gasoline engine with power tiller were bankrupted after another and the only maker who actually tried to produce the high grade power tiller, equiped with gear train, sank into the greatest financial crisis from which rescued by government in the way of fundamental reconstruction of the company itself.

If it be analysed from the stand point of pure techiques, which is the only way the writer dare to manage, there could find some reason why the matters went like this.

In general, the chief cause of above mentioned failure seems to be the problem of engine performance.

(1) At that time, almost all experienced mechanical technicians were belonged to the prewar group who have less idea about the modern precision technology., The conception owned by many technicians at that time was the classical and artist like one. They were proud of their plentiful experiences and of superior skillfulness, and ignored the absolute importance of accuracy of machine tools. For instance, a fact as follows actually occured in a engine maker's factory; A technician full of self confidence in making precision instrument, began to make assemble typed crank shaft of their motor cycle engine, with a worn old lathe. It was found after series of triance that alignment of the crank shaft is absolutly impossible under the circumstance. When a modern typed accurate lathe came from Japan, the problem just faded away.

(2) After War, there came "high compression and high speed" fashion in the engine field. Before War, there was a formula widely used in the field of motor cycle,i.e.1/100.Vc.c.=Php
That is, 150 c.c. engine called to be a 1.5 hp engine. Now 50 c.c. engine can generate 3--4 hp., then 150 c.c. engine should be the 9---12hp. engine. This surely is a revolutional change.

Under influence of widely prevailing new conception, it is very natural that power tiller producer could put their high speed typed motor cycle engine on their power tiller without any further consideration. In fact, the engines mounted on power tiller were like this; A-engine : 7.5 hp. at 5000 rpm……alleged by maker

4.0 hp. at 3500 rpm……by actual test

B engine : 7 hp. at 4500 rpm……claimed by manufacturer
6.8 hp. at 4500 rpm……by actual test

Originally, power tiller engine should have sufficient toughness equal to that of marine engine. But all of gasoline engine equiped on power tiller at that time were motor cycle engine or general purposed ordinary engine(like U.S. someone had bravely produced a big-sized slow-speed gasoline engine of heavy load type,

the history of development of power tiller in Taiwan could have showed another pattern.

In short, notwithstanding where the engine came from, farmers were disturbed by engine trouble endlessly, thus the feeling of non-confidence against gasoline powered tiller prevailed widely among farmers mind. There-after, none of orthodox gasoline engine of special design for power tiller use could be accepted by Taiwan farmer.

Ironically say, there were another group of persons who let gasoline engine fall to the ground. This is the group of half- educated local technical workers. They at least can let engine get temporary activity. This makes the situation worse.

Anyhow, Taiwan tillage mechanization directly entered into the Diesel engine era shortly after the failure of gasoline engine tiller by the year of 1960. Nowadays, even the smallest power tiller should be equiped with diesel engine.

2. Continuous growth of local private manufacturers:

In spite of forerunner's disastrous failure, there came endless procession of followers, just like the past colonization from the continent to Taiwan. Nowadays, local private manufacturers can produce various kind of high grade farm machinery which will be welcomed by farmers. For instance;

self made products purchased

1. *Diesel engine of Yammar type .....Bosch fuel pump and nozzle*
2. *Orthodox geared power tiller*
3. *Mist blower with gasoline engine .....carburetter*
4. *Powered high pressure sprayer .....gasoline engine*
5. *Hand sprayer*
6. *Simplest tiller mounted with diesel engine. ..... domestic made diesel engine*

etc.

Most of them have already got plenty of experience in every respect, in the same time, the number of high class machine-tool sin their factories is also increasing day by day. They aren't meer country like, out-of-date machine shop now.

There is a particular character commonly possessed by the heads of these small sized private factories. This is the conservative attitude in managing their enterprise. They never want to enlarge the scale of their business too much. For instance, the factory of largest scale among them, only produce 100-200 power tillers with diesel engine per year. Because of their conservative attitude, there scarcely occur any confusion concerning pattent problem, even if they produce 100% imitation model.

One thing particularly be noticed is the fact that most of leading persons of this group are non- or less-educated ones. For instance, the most eminent diesel engine maker among this group had been a wooden plow maker in the past. In fact, they don't know any theory or formula related in text books. But their natural intelligence is really wonderful, every theory which is conducting them would be made by themselves in their brain. Since they know the limit of their technical knowlege, so they always use 100% imitation method. Then how they can hadle the problem of material treatment? Here comes their natural intelligence, they miraculously solves many problems one by one.

Anyhow, this group is keep growing day by day and is acting as the supplementary units among the whole activity of Farm Mechanization in Taiwan.

3. Birth of a large scaled, modern typed Farm Machinery Company

(1) The policy appeared at earier stage of farm mechanization in Taiwan could be called the Sino-American Cooperation on political base. But, in spite of much effort made by leading organization, J.C.R.R..i.e.(The Joint Commission on Rural Reconstruction) and local manufacturers, the actual pace of progression was too slow and there couldn't be found any promissing outlook in near future. In other words, it has been proved that the foundation of mechanical industry in Taiwan is too weak to meet the rapidly changing agricultural environment in time.

When manufacturers in Taiwan were struggling for their existence, there came another movement in Japan which can be called "modernization and industrialization of power tiller production". This is the introduction of modern techniques into power tiller production which had recently developed in the automobile industry. Under the influence made by this movement, Japanese -made geared power tiller completely transformed themselves from country styled primitive state to the modernized and fully matured machine.

The news naturally be reported to Taiwan immediately, thus there brought out a new policy entirely different from the previous one. This is the Technical and Financial Sino-Japanese Cooperation Policy which is proposed by another group of persons who were managing the famous work of "Taiwan Land Reformation".

The first company organized under the new policy, in 1960, is China Agricultural Machinery Company (Agrima). It is invested by three units;

Taiwan Land Bank (R.O.C.).....monetary investment

Yammar Diesel Co. (Japan)...equipment investment

Iseki Agr. Machinery Co.(Japan)...equipment investment

At that time, there was no single company distinguished both as diesel engine maker and as power tiller manufacturer in Japan, so that somewhat complicated pattern as above mentioned was selected by the planners.

Firstly, the business started un-

der the knock-down system. Every machine was imported from Japan and began to assemble them under the instruction of consultant engineers came from Japan. This may had been the most comfortable and easy going period for Chinese technicians because of their excellent digesting ability. But immediately came harder time which is influenced by the policy of encouragement of domestic production.

Here, let me relate on a interesting and meaningful episode which actually occured at the starting period of domestic industrialization.

As everybody knows, power tiller should wear a pair of iron paddlewheel in a irrigated muddy field. The wheel looks like a simplest article which can easily be made by any ironwork without particular equipment. But the paddle wheel with angle-bar steel rim really was a trap that we were caught in at the first step. It was a great problem for us to make a correct shaped ring from straight angle-bar by bending procedure.

1. forge method; This method is very good for temporary use, but if quantity of production increase a little, it is too much uneconomical as a productive procedure.

2. forming under cold state; This could originally be a possible and proper method for these simple work. But we were disturbed by the irregularity of material of domestic production, that is, it was impossible to make a ring of correct cicular shape by simple bending process. If we correct it's shape by hammering,then there will appear many cracks, thus weakens it's strength. Actually many paddle wheels made by the second method were sent back to the factory shortly after delivery to farmers. Mostly reason were too week and easily breakable. This was the most serious crisis that the company firstly met.

Fortunately, the powered, automatic, continuous heating typed winding machine for 2 inch anglebar which is built up from various kind of used machine parts, carried on successfully, thus we could rescue the company out of difficulty.

This is a very good example of the situation that would suffer a commercial based enterprise going under cooperation with foreign country, particularly when the business is regulated by the policy of domestic industrialization. In general, since the amount of product isn't much, no one dare to equip a orthodox mass-production equipment spending lots of money, especially when the work belongs to the minor class such as paddle wheel making. Then they naturally are forced to use old and inefficient method with which reduction of production cost can not be expected. On the contrary, if we equip full of orthodox equipments, though it may be the best way to establish the true domestic industrialization, but we could fall into the financial crisis because of their too less chance of application to actual productive use. This is the dilemma, many enterprise of this type apt to get in.

(2) Now there are two major agricultural machinery companies in Taiwan. The basic situation of them is juste qual, i.e. Sino-Japanese co-operation, on commercial base.

During last 10years, the two have been a good competitors each other. But recently, there begins to appear distinct differnce between them.

The first company which have been under the guidance of a eminent statesman, has fallen into the serious financial crisis recently. This company has surely made plenty of work in the past, which originally is belonged to that of government organization. When some important problem couldn't be managed by authorities in time, the company promoted it by itself in place of them. It surely is inevitable, especially for the per-

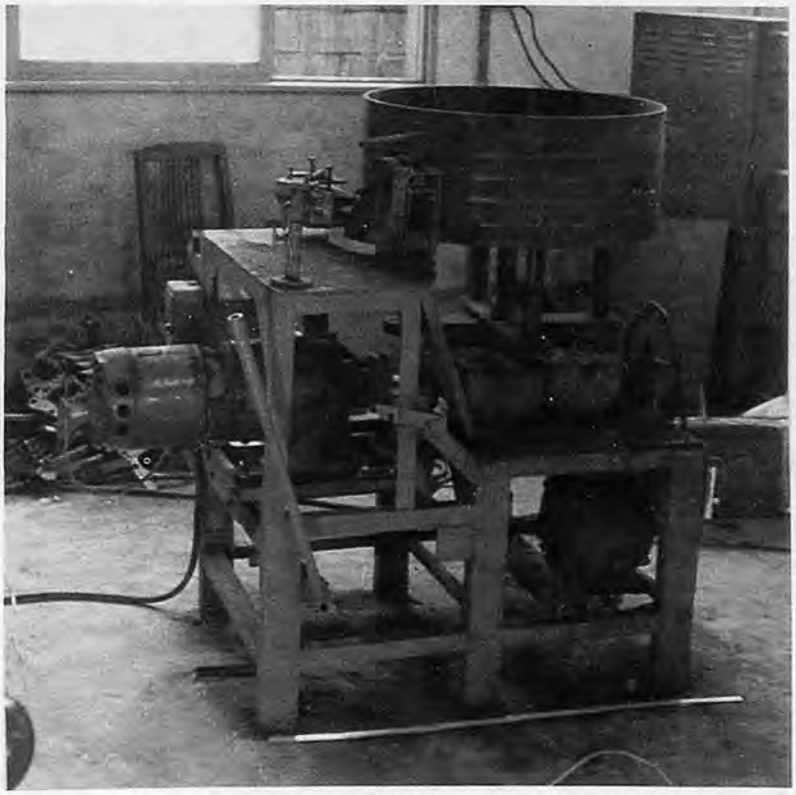


Fig.2 General View of Automatic Winding Machine

son of political standpoint, to be dragged into the heavy work of this kind. But the company originally is standing on the commercial base after all. This is the problem.

The second one, on the contrary, which has been managed under the pure industrial and commercial standpoint, kept apart from any political point of view, has grown to be a fully domestic industrialized and prosperous enterprise which has sufficient capacity able to meet the various kind of problems that Taiwan Agriculture want to be solved.

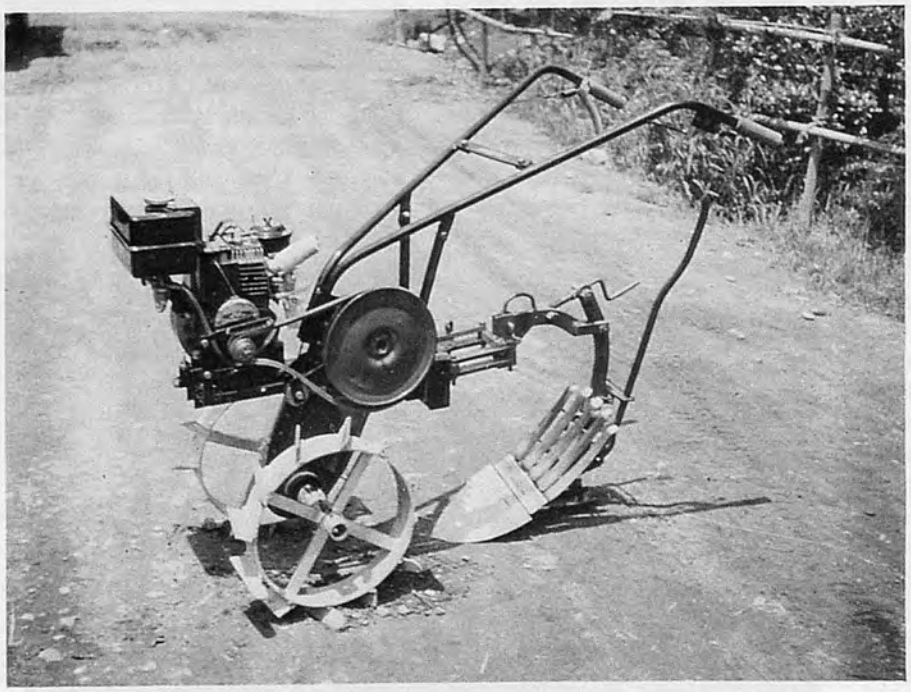
This could be the point which should be deeply preconsidered by the promoter of farm mechanization, notwithstanding what the situation of environment may be.

Conclusion

About 15 years ago, there planted a seedling of farm mechanization under the aid of J.C.R. R.(The Joint Comission of Rural Reconstruction) in Taiwan. This just coincides with the begining of industrialization of this country. At the begining,there naturally occured series of problems due to scarcity of experienced experts. Practically, almost evry thing has been managed by hands of non-experienced person in this field. It has been the parallel running of managing and learning then. There naturally occured lots of failures due to unreasonable management every where. But every penny spent on them wasn't the waste, it was the testing expences spent by intelligent but non-experienced persons in Taiwan.

Now they have grown and matured. The progression of real Farm Mechanization just has started now.

The writer is gazing at the march of Taiwan Farm Mechanization with full of confidence and assurance. ■ ■



This type of power tiller originally promoted farm mechanization in Japan. Power tillers are economical and convenient to use. They began to spread about in 1950, and now three million units are in use.

Production of Agricultural Machinery in INDIA

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THE modern agricultural machinery industry in India is quite young, though indigenous manufacture of agricultural implements has been an age-old practice. The last decade, the decade of the sixties, saw a beginning of the new farm mechanization era. The decade of the seventies will mean mechanization at an accelerated pace.

I have made an attempt to review the progress of some important items of the agricultural machinery industry. Important crops which require priority in the mechanization programme in India are wheat, paddy, sugarcane, cotton, groundnut and potatoes. Some important objectives of a farm mechanization programme in this country are to increase the power availability, to raise the cropping intensity and to improve the farm productivity. With 165 million workers engaged in agriculture, we produce only 105 million tons of foodgrains a year from 137 million hectares under cultivation. With a large work force —1.2 worker per hectare —the annual production is only 640 kilograms of foodgrains per worker or 720 kilograms per hectare.

President Johnson's Science Advisory Committee observed that the optimum power input for improved agriculture is 0.8 HP per hectare. This figure was arrived at after a world-wide survey of power availability on farms. For intensive agriculture under conditions in India, we should aim at an installed power capacity of 1 HP per hectare. The present power availability is only 0.2 HP per hectare. We are, therefore, required to multiply the power availability on our farms five times. The use of proper equipment would ensure a better job faster, accuracy and timeliness of agricultural operations and less drudgery to the farmer.

An important consideration from the mechanization point of view is the scale of our farming operations. We could divide the cultivated area into three categories of holding sizes each of which has different problems and requires a specific approach:

The large scale farmer, in fact, does not have such a large holding, but he will be required to take recourse to mechanical power like conventional tractors. Custom farming is becoming popular and will greatly benefit the small and medium holding farms. A pair of bullocks will continue to provide the primary power for small farms while the power-tiller may be an important source of power for medium farms.

Table 1 OPERATIONAL FARM HOLDINGS IN INDIA

ıtegory	Holding size (hectares)	% of households	% of area cultivated
Small ..	Under 4	86	36
Medium ..	4 to 10	10	29
Large ..	Over 10	4	35
	Total	100	100

Let us now this review of the Industry with the Farm Tractors.

TRACTORS

The Farm Tractor Industry is in its first decade. Indigenous production began in 1961-62 and today there are 88,000 indigenously manufactured tractors in the country. For a country of our size and for our needs and agricultural aspirations, this number is indeed small.

The break-up of annual availability of tractors is as **table2 :**

The five units which are in production have a sanctioned capacity to produce 45,000 tractors a year. By the end of the Fourth Five Year Plan period (1973-74), the annual indigenous production

Table 2 TRACTOR AVAILABILITY IN INDIA

Year	Wheel Tractors(Qty.) Indigenous production	Imports
1	2	3
1961–62	880	2,997
1962–63	1,414	2,616
1963–64	1,983	2,349
1964–65	4,323	2,323
1965–66	5,714	1,989
1966–67	8,816	2,591
1967–68	11,394	4,038
1968–69	15,427	2,508
1969–70	17,099	10,476
1970–71	20,099	14,888
Total for the decade :		
(a) Quantity ..	87,149	46,775
(b) Percentage ..	65	35

may reach 50,000 units.

There are a number of other proposals for indigenous trator manufacture, which are in various stages of processing by the Government of India.

Population

Estimates of current population of tractors in the country place them over 100,000. In 1946, there were only 4,524 tractors in India.

In a span of 25 years, the tractor population has increased 22 times. Below is a summary:

Table 3 TRACTOR POPULATION 1946-70

Year	No. of tractors	Rise since last census	Increase % in 5 years
1	2	3	4
1946·· ..	4,524	—	—
1951·· ..	8,554	4,030	89
1956·· ..	20,980	12,426	134
1961·· ..	30,931	9,951	47
1966·· ..	55,222	24,291	79
1970·· ..	100,000	44,778	81

Demand

Estimates of annual demand by the end of the Fourth Five Year Plan (1973-74) range from 52,000 to 90,000 tractors. A committee of the Indian Society of Agricultural Engineers (ISAE) in arriving at the figure of 52,000 tractors provides relevant background data for its calculations. This estimate is based on a study of area under 'large' operational holdings, area irrigation, cost-benefit ratio, pace of mechanization and command area for each tractor unit. Similar data, however, is not available for the figures of annual demand of 68,000 and 90,000 recorded by two separate study groups of the Government in the Planning Commission and in the Ministry of Agriculture respectively.

Tractors are in short supply at present, largely because of carry forward of unsatisfied demand in previous years. The gap is being narrowed down through increased production and imports, and the total tractor availability should soon match the requirements. The need is to create an infra-structure to sustain the demand.

In 1971-72, of about 65,000 tractors which may be made available through indigenous production (37,000) and imports (28,000), 60% may be in sizes ranging from 26 HP to 40 HP.Tractor demand according to size by the of the IVth Plan period is likely to be as table5:

Against an estimate of a sustained and practical demand of 52,000 tractors a year, various proposals already sanctioned /under examination for local manufacture of tractors add upto a total manufacturing capacity of 184,800 tractors a year by some 22 units. The installation of indigenous capacity should bear some logical relationship to the sustained demand.

For the proper development of the industry, services like education, extension, training, research and development, market research, analysis and surveys are essential. Profit margins to the industry should be adequate not only to cover expenses on normal sales and services but also on the promotional services.

Table 4 ESTIMATES OF ANNUAL DEMAND FOR FARM TRACTORS (for the IVth Plan period)

Year	ISAE Committee Estimates Annual demand	%-age rise over previous year	Annual demand as estimated officially
1969–70	31,000	—	70,000
1970–71	38,000	20	70,000
1971–72	43,000	15	75,000
1972–73	47,000	10	80,000
1973–74	52,000	10	90,000
Total for the IVth Plan period	211,000		385,000

Table 5 TRACTOR DEMAND SIZEWISE

Tractor size (Engine HP)	%of total requirements in 1971	1973–74 Official Estimates	1973–74 Likely range
1. 25 and under ..	11	28	15 to 20
2. 26 to 40 ..	74	50	60 to 70
3. 41 and above ..	15	22	15 to 20
Total ..	100	100	

Prices

Tractor pricing is at present controlled by the Tractors (Price Control) Order 196. of the Government of India.

Govt. of India also fix the pricing of tractors at present being imported from the USSR, East Germany, Czechoslovakia, Bulgaria and Rumania.

Bottlenecks

Some important bottlenecks in the tractor industry are:

1. Availability of *Components*

A study conducted by an ISAE Committee indicates the difficult availability of the following ancillaries/components:—

Piston, rings and liners

Puddling by a tractor with cage wheels.

Crankshaft bearings
Engine valves
Fuel injection components
Hydraulic pump and control vales
Electrical components
Steering gear
Taper roller and needle roller bearings
Rims, tyres and tubes
High tensile hardware items.

Though batteries at present are available, but with the steep rise in local production of tractors and automotive vehicles and the rising demand for replacement, a significant increase in their production should already be planned.

2. *Steel*

The ISAE Committee has also referred to a serious shortage of steel, particularly the following steels and related items:

CRCA sheets, 12G to 18G
Structurals
Billets
Pig iron
Coke
Malleable castings
Gudgeon pin steel
Circlip steel
Steel for duaflex ring
Special alloy steels.

3. *Implements*

While simple implements for seed-bed preparation such as cultivators, harrows and levellers are available, there is great scope for widening considerably the range of equipment for all farm operations from land preparation to harvesting and handling of produce. Priority areas equipment for sowing and harvesting operations.Better availability of equipment will result in greater tractor utilization lower and costs of production.

According to a recent Government decision, small-scale industry will be given all possible assistance to manufacture tractor –drawn mounted implements. The tractor industry, which falls in to the 'core' sector, will be licensed to manufacture manufacture PTO operated equipment and harvesting machines.

4. *Holdings*

The situation on ceilings on land holdings, field sizes and layout, holdings with scattered and small parcels of land, requires to be reviewed in the context of the mechanization of farm operations.

Logistics

To sustain and, in fact, to accelerate a successful programme in farm mechanization, stress will have to be laid on items like training, safety and insurance. After-sales-services, replacement parts, fuels and oils will have to be made available to the farmer at the point and time of use and in quantities required. Custom work is gaining popularity and should be encouraged.

Farm equipment institute

To accelerate the growth of the tractor industry, it is felt that a Farm Equipment Institute should be established in the country on the lines of the Farm and Industrial Equipment Institute (FIEI) in the U.S.A. The FIEI has rendered very useful service to the country, the consumer and the industry for over 75 years.

POWER-TILLERS

Power-tillers have aroused a lot of interest in this country. They have a place, to begin for puddling operations in small paddy fields. Indian farmers have been slow in accepting this source of farm power. The imported tiller, probably, has not answered most of their requirements. Some work is required in developing ground tools suitable for our own conditions. It will also be necessary to improve their haulage capacity (to a payload of 2-3 tonnes) since our farmers are used to a dual purpose source of power i.e., for haulage and tillage.

The present power-tiller population in the country may be around 10,000. 7,000 power-tillers have been imported from Japan. There is probably no backlog of orders. The demand will have to be developed. Indigenous industry licensed to make power-tillers has not made much progress, primarily because of promotional efforts required for such a new technology. Seven firms now have a capacity to produce 49,000 power-tillers annually. Two of the units have so far gone into production. Another two units are now making some progress in establishing facilities for indigenous production. The remaining units will require more time to get started.

By the year 1973-74, annual de-

mand may be around 32,000 power-tillers. It is not advisable to suggest breaking this source of power into many HP categories. We can standardise on two—a small tiller of 4 to 6 HP and a medium one of about 8 HP. A larger HP powertiller may bite in, directly or indirectly, into the small tractor market in the upto 25 HP range.

AGR. IMPLEMENTS

Under this heading, we include mostly bullock-drawn implements. These implements by and large are manufactured by small-scale industries. There are about 1300 manufacturers registered with the Small-scale Industries Commissioner of the Government of India. There is a severe competition for most of the items. Obsession with price affects quality, workmanship and after-sales-services. The areas in which smallscale manufacturers require support are selection and procurement of material, production techniques, marketing, research and development.

ENGINES

The Diesel Engine industry in the country is fairly developed. There are about 700 manufacturing units in the organized, small-scale and cooperative sectors. There cumulative output is placed at 250,000 engines a year, in different sizes valued apporximately at Rs. 700 million. Exports of diesel engines and spares have reached a turnover of Rs. 25 million. The industry has reached such an advanced stage of development that it can provide technical know-how to developing countries to set up their own manufacturing units. The industry is also geared to take care of requirements of advanced countries in sophisticated components and parts.

Engine population is estimated at about 1 million units. Most of the engines use diesel as fuel. 70% of the diesel engines are vertical and 30% horizontal. Size-wise breakup is:

Table 6 SIZE-WISE BREAK-UP OF ENGINE POPULATION

Size	Population–%
4 to 5 HP	66
6 to 10 HP	21
Other sizes	13
Total	100

PUMPS

The population of pumps in use in agriculture now exceeds two-milliom units. Of these, about 55% are electric motor driven. At present there are 12 power operated pumps per 1000 hectares of net cropped area. By 1974, this figure will rise to more than double, at 26 pumps per 1000 hectares of net cropped area. The share of electric motor driven pumps will then rise to 64%. Here again, like the engine industry the pump industry is also very well-developed. Estimates of demand are 300,000 units a year.

RICE

This treatise will not be complete without a reference to rice production in India. Rice is our staple food. We produce annually 64 million tonnes of paddy, valued at Rs. 32,000 million. Production is expected to rise to 85 million tonnes by 1974. Paddy is grown on 37 million hectares, of which 13 million hectares (36%) are irrigated. Average yield is 1613 Kgs. per hectare. Nearly 3 million hectares are now covered under High Yielding Varieties Programme.

Animals–buffaloes and bullocks –continue to be the primary source of power on the paddy fields. The power–tiller shows a great promise but this new prime-mover is in the introduction stage. Conventional tractors are also being used by paddy growers. For puddling, the owner installs a pair of either cage wheels or extension wheels on the tractor. Paddy is transplanted. Problem areas for mechanization are land levelling, efficient puddling, transplanting, harvesting and processing of the produce.

For better and faster puddling, in addition to cage wheels, farmers in South India use a disc harrow. Use of a rotavator for puddling has given good results on an experimental basis, but further work is required in this direction. Good puddling by a tractor re-

Pumping in to a paddy field.

quires at least 6 inches of water in the field. This is possible in areas covered by canal irrigation. High 'bunds' dividing the fields, insufficient water supply and improper care of land levelling do affect the efficiency of mechanical puddling operations by tractors.

We have 45,827 hullers, 2,121 shellers, 4,244 shell-cum-hullers and 15 modern rice mills in the country. The average recovery from the huller is about 65% of clean rice from paddy.

It is estimated that we lose 10 % of this crop through damage /loss with the traditional methods of processing, handling and storage. The establishment of a Rice Engineering Centre at the Indian Institute of Technology at Kharagpur to study the problems in rice processing greatly welcome.

Studies in country reveal that—

(a) an early harvest with higher moisture content of 21 to 24% results in increase of 14 to 25% of grain yield over the paddy harvested at a lower moisture content of 12 to 15%;

(b) milling quality at a higher moisture level (21-24%) is significantly superior to the paddy harvested at a lower moisture level (13 to 15%);

Table 7 ESTMATES OF ANNUAL INVESTMENT IN SOME IMPORTANT AGRICULTURAL MACHINERY INPUTS

Item	Annual requirements (quantity)	Unit cost (Rs.)	Estimated annual investment (Rs.million)
1. Wheel tractors	70,000	30,000	2100
2. Crawler tractors	1,500	200,000	300
3. Power-tillers	30,000	10,000	300
4. Engines	80,000	3,000	240
5. Electric pumpsets	250,000	1,200	300
6. Power-sprayers/dusters	30,000	1,500	45
7. Power-threshers	50,000	2,000	100
8. Water-well drills	100	600,000	60
9. Bullock-carts, pneumatic tyred	250,000	1,000	250
10. Improved bullock-drawn implements	300,000	100	300
11. Fuels and lubricants for farm prime-movers	2m.tonnes		2005
Total			6000

(c) milling quality is superior when grain is mechanically dried as compared to sun drying, if the grain has been harvested at a higher moisture level;

(d) optimum moisture content for milling and mechanical handling of paddy grain is between 14 and 16%;

(e) a modern rice mill yields 6 to 10% more rice with less broken, cleaner and more uniformly polished rice than the paddy handled through traditional shellers and hullers.

The work being done by the Agricultural Engeneering Department at the International Rice Research Institute for development of agricultural equipment for tropical rice cultivation is of great significance, interest and use to us.

Towards an Annual Investment of Rs. 6 Billion

By 1973-74, the end of the Fourth Plan period, the Indian farmer is expected to invest over Rs. 6000 million every year in some important farm equipment inputs: (Table 7)

The agricultural machinery industry in India, therefore, assumes great significance. The industry should be viewed in this perspective and size, and given due importance and encouragement for its faster growth. ■ ■

(This original paper was prepared for presentation at the International Rice Research Conference held in Manila, Philippines, April 19 to 23, 1971 under the aegis of the International Rice Research Institute.)

An animal-drawn puddler

NEED of National Farm Equipment Industry in PAKISTAN

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OF late, the Government has been putting great emphasis on the mechanization of agriculture in the country. It is now fully appreciated by the farming community that crop production operations with machines on those farms which can sustain such investments are more effective, timely and economical; and result in much better yields. So far, the country has depended on alien sources for such equipment, but this drain on our foreign exchange resources cannot be permitted for an indefinite period. The country must promote the establishment of a powerful national farm equipment industry in order to achieve perpetual farm mechanization.

Let us see what needs to be done to get this industry going in the country. Like many other industries, the farm equipment industry cannot be established in isolation, but has to be set up along with a series of other related and supporting industries. This is especially true of the manufacturing of agricultural tractors. In its composition, the agricultural tractor is quite a complex machine and is an assembly of such constituent units as the internal combustion engine, auto electrical components and instruments, transmission, hydraulic, and traction units, etc. Nowhere in the world are all these units manufactured by a single concern. Only a few of these constituent units are produced by the tractor manufacturers themselves. For the remaining components they depend on a host of other concerns which specialize in the production of such parts and a spectrum of industries engaged in the assembly and manufacture of tractors, cars, buses, trucks, scooters, etc.

At present, our country is spending crores of rupees in foreign exchange every year on the import of tractors, cars, buses, trucks, scooters and their spare parts. We would do better to spend this foreign exchange on the establishment of industries for manufacturing petrol and diesel engines, transmission, hydraulic and chassis components, auto electrical parts, and tyres and tubes which are required in the production of all of the aforementioned categories of machines. Of course, this would require a strong steel industry in the country. This does not mean, however, that we are unable to make a start in this direction with imported iron, steel and other material till the time our indigenous steel industry gets firmly established.

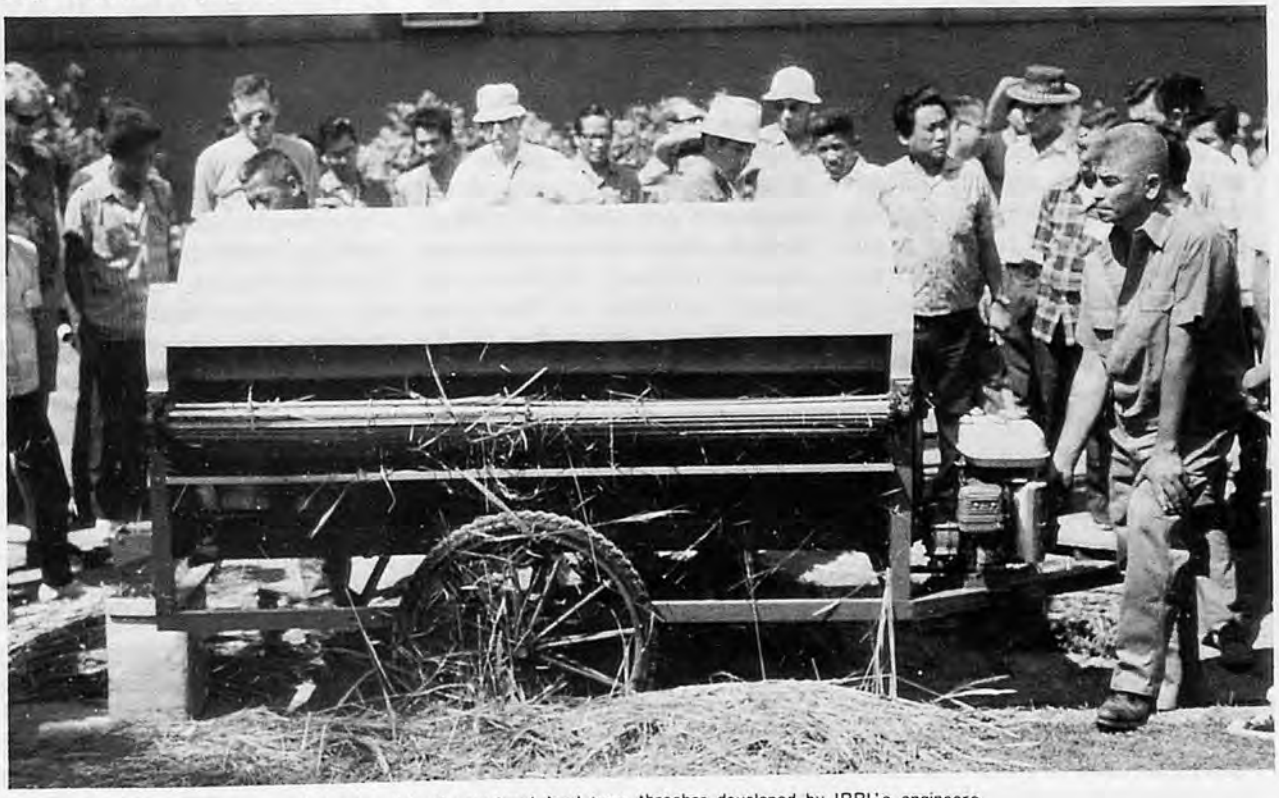
It is understood that the Government of Pakistan has sanctioned the establishment of five tractor assembly-cum-manufacturing plants of different makes and that each of these plants has a sanctioned capacity of a few hundred tractors per annum. But the question is : Would it be economically feasible to establish all the supporting industries for these five concerns separately? The answer would be definitely in the negative. These concerns, it appears, will only be assemblers of tractors with most components imported from abroad. The output of these plants will not be enough even to support their own establishment, what to speak of supplying tractors at world competitive rates to our farmers. There is still time for us to give a second though to this policy which might

result in disappointment later. In this connection we can learn a great deal from the policy adopted by our neighbour, India. India has by now all the supporting industries needed for the assembly and manufacture of tractors, cars, buses, trucks, etc. For each of these items, only one renowned make has been permitted to establish its plant in India. Certainly, there is no justification for making our country a museum of all makes and models of tractors, cars, buses, trucks and scooters manufactured in the world. On the other hand, our Government should, as soon as possible, enter into contracts with reputed foreign companies for the establishment of plants to manufacture components of tractors and other automotive vehicles.

Naturally, it will take some time before the tractor manufacturing industry, as visualized above, is fully established. For the interim period, i.e. the first five to ten years, dependence on imported tractors and some of the ancillary tractor equipment would, however, be inevitable. It is suggested that, during this interim period, not more than two world renowned manufacturers of tractors who will later on be permitted to establish their plants in Pakistan, should be allowed to sell their equipment in this country.

The manufacture of ancillary tractor equipment is a comparatively simple affair. This can be taken up by many concerns in the country if the raw material, to be imported in the begining and later to be supplied by the National Steel Industry, is made available for this purpose. Another useful step the government can take in this connection is to establish two exhibition halls of modern farm machinery located at convenient places, one is each wing of the country. These exhibition halls should be kept up-to-date with the latest types of farm machines manufactured in the world. This will keep our manufacturers and agricultural engineers abreast of what new developments are coming up in farm machines. This will also help them to select and adopt those farm machines which are suitable under our farming conditions. Our plant breeders are evolving new high yielding varieties of many crops after importing seeds of the promising varieties of such crops from abroad. Surely, we can follow the same approach in the case of farm machines by establishing farm machinery exhibition halls as suggested above.

In short, if we wish to have farm mechanization in the country, we should ourselves manufacture as many items of farm machinery as possible. To keep on mechanizing our agriculture from alien sources will amount to allowing those alien sources to harvest the fruits of this input in our agriculture. For obvious reasons, no effort and no investment would be too great to furnish a sound base for own farm equipment industry and to eliminate dangerous dependence on foreign sources. ■ ■



Demonstration of new hand-feed type thresher developed by IRRI's engineers

Present Status of Agricultural Machinery Industry in Thailand

Yoshikuni Kishida

Chairman
Shin-Norinsha Co., Ltd.
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1. Background

AGLICULTURAL machinery industry in Thailand is remarkably advanced recentry. It may be is surely one of the most advanced countries in Asia. Agricultural population is about 75% of the total. 70% of the cultivated land is oqupied by paddy field in which deep and wet field is up to 50%. According to the government survey in 1965, average cultivated land per one farmer is 3.2 ha. in which 80% is the land owner. They do not use fully agricultural machinery as production tools and the land forming is not yet enough. Therefore I can not say that agricultural mechanization in Thailand is advancing as modernized style like in developed countries.

Labor productivity and land productivity are both increased at the same time, when a farmer produces new spare time through mechanization with other factors of seed, fertilizer, water, chemicals and other cultivating technique. These factors are considerably improved in Thailand, but the high yielding variety is not yet broadly planted. Generally speaking, there is still much spare for improving technically agricultural production method. For example, average yield of paddy is still about 2 ton per ha.

Though rice is main product, they do not recently expand the rice production area and are going to produce other crops in which animal feed crops are most encouraged to increase the export. Corn is most marked, and which is cultivated in the central to upper area of Thailand where four wheel tractors are considerably used.

The demands for agricultural machinery are much different in area. It shows that manufacturers produce naturally different machinery according to their location which is sometimes in the midst of paddy production area or sometimes the corn area.

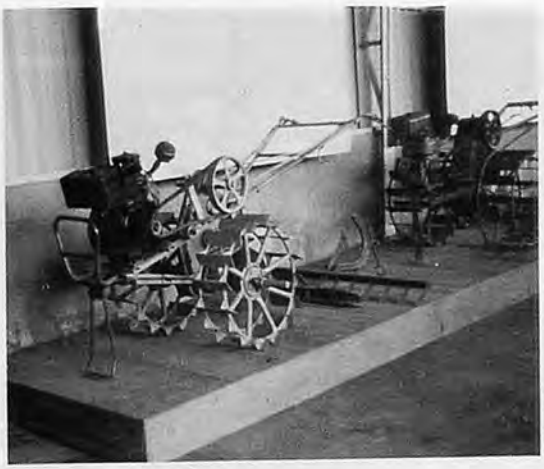
Among agricultural machinery, pumps are most neede mainly for paddy field. They are produced along the river or the lower reaches of it or near Bangkok.

The pumps for up-land farming are produced in the middle part of Thailand. It reminds me Japanese history of agricultural mechanization where its industry started from the pump production and then they were coming to produce rice processing, harvesting and tillage machinery. The present stage of agricultural machinery industry mainly consists of production of implements two and four wheel tractors, and domestic two wheel tractors and special riding puddling machine.

2. Tractor and related Machinery

As to domestic machinery for tillage, there are attachments for imported two and four wheel tractors, two wheel tractors and special puddling machines, which are ordinally designed in Thailand and which has great market in Asia. This is riding-type with rear puddling rator and front float which is directed by steering handle connected by a universal-joint. This was developed for paddy filed operation because they can not use the big four wheel tractors for puddling after plowing. In the irigated places and the area where big tractors are brought into paddy field frequently, it becomes very difficult to do puddling operation by heavy tractors because the paddy field becomes gradually deeper and deeper.

This machine use generally 7 ~8 hp. air cooled engines. Some-



Two-wheel tractors of Thailand make. Transmission is Chain type.

times they do not use tractors for plowing, in which case they use it in the paddy field with much water where plowing and puddling are finished at the same time in soft condition. We can say that it is the first tractor for soft paddy field, meanwhile usual tractor was originally developed in upland farming. The transmission is simple chain and sprocket type. The case is casted one and very thick and heavy because the casting engineering is still premitive.

The domestic price of this machine is about three and half times of engine price. It means that the retail price with 7 to 8 hp. is about less than $500.

Two-wheel tractors are also produced in Thailand, which is also simply designed with air cooled engine, belt tension cluch and chain type mission. This is used mainly for paddy field with a simple comb rake. This is also used as riding type with attached rotor rake below the operator seat. These machine is much used in the paddy field area near Bangkok. The production figure is not clear but it is rapidly increasing and the import of two wheel tractors get remarkably down after 1968. **(Table 1 and 2)**

These manufacturers are mainly doing welding jobs and assembly works. The mission case and sprockets are ordered to other subcontract factories. The chain is bought on the market which is mainly imported one. Of course casted parts come from subcontracts factories.

Machine tools like a boring machine or a lathe are not yet fully equiped. It can be said that these agricultural machinery industry is not yet invested big capital for production facility.

These machinery will be much more improved with improved production facility. It will be more light and compact. But present design is originally very simple and easy to produce and these machine will be broadly used for paddy fields in Asian countries. This machine shows us the importance of original design in each country which has to include every phase like agricultural conditions, farmer's level, after-service facility, available money for purchasing production technique and available materials.

3. Pumps

Pumps produced in Thailand are used for paddy field and upland farming irrigation, which are mainly small centrifugal and vertical pump of low lift.

This vertical pumps are called as "Debbharid" which is very simply designed with an inside auger and the simple cylindrical casing of tin plate. The lifting hight of water is about 1～1.5m. It is low lift but the water output per hour is pretty large.

The number of these manufacturers are not clear. There are

Table 1-A : Estimation of Wheeled Tractors Imported into Thailand (Units)

Year	Total	Two wheel (power tillers)	Four wheel (tractors)
1957	267	24	243
1958	384	19	365
1959	445	8	439
1960	885	25	830
1961	1,487	15	1,472
1962	1,353	22	1,331
1963	1,922	125	1,797
1964	3,446	124	3,322
1965	3,047	245	2,802
1966	3,872	585	3,287
1967	4,305	848	3,457
1968	3,616	–	–
1969	2,614	–	–

SOURCE: USOM, Department of Customs.

Table 1-B: Estimated Farm Tractor Population in Thailand

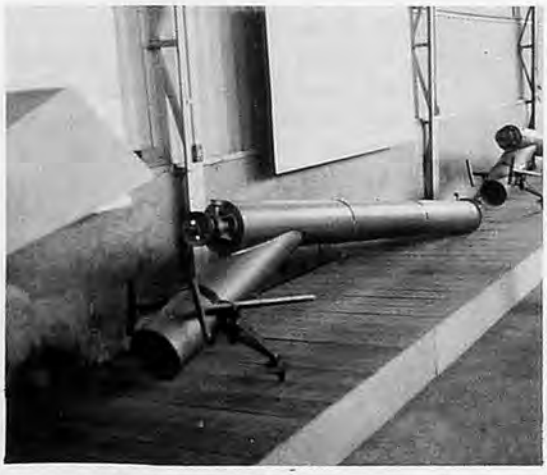
	1967※	1970
Four-wheeled	17,500	25,000
Two-wheeled	2,040	3,500
Total	19,540	28,500

※USOM

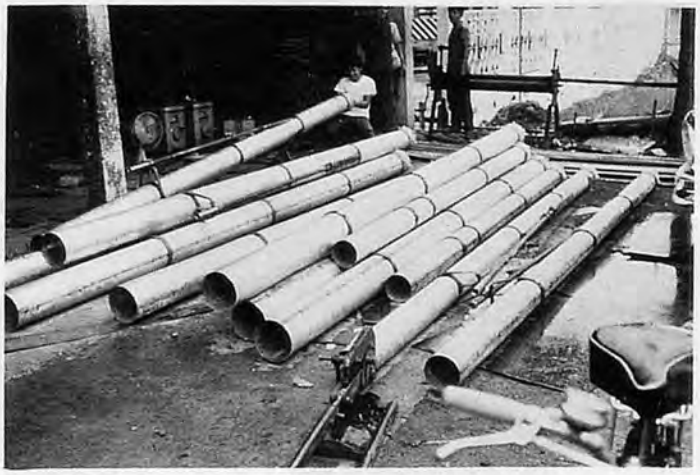
Table 2: Estimated Regional Distribution of Tractors in 1967

Regions	Four-wheeled		Two-wheeled		Total	
	Units	%	Units	%	Units	%
1. Bangkok-Thonburi)	2,975	17	594	29	3,569	18
2. Central Plain)						
3. West	1,400	8	230	11	1,630	8
4. East	1,575	9	70	4	1,645	8
5. Upper central plain	6,825	39	816	40	7,641	40
6. Horth	1,050	6	130	6	1,180	6
7. North & northeast	175	1	–	–	175	1
8. Near northeast	1,750	10	–	–	1,750	9
9. East northeast	175	1	–	–	175	1
10. South	1,575	9	200	10	1,775	9
Total	17,500	100	2,040	100	19,540	100

Source: USOM



Most popular vertical pumps for low elevation. They can be simply manufactured without bearings.



Casings of vertical pumps in a factory.

four main factory which produce about 3,000~4,000 units per year. There are also more than 20 factories which produce less than 1,000 units per year. This "Debbharid" pumps are all produced in Thailand.

Estimated 1969 market for water pumps are showed on **Table 3.** According to this table, the vertical type is now no more imported. Hand pumps also not imported. All is domestic made. Centrifugal pumps of big-size are still imported, but production of small type is increasing every year.

Turbine and rotary type pumps are still imported, but they will be also produced in Thailand in near future.

These pump-manufacturers are scattered in rural cities and the demand are expanding evry year. Their production facilities are very simple. Centrifugal pumps need casting factory. In the case of vertical pumps, welding tools are main facility. These factories can be easyly developed in every countries in Asia which will really help farmers.

4. Engines

It is most important for agricultural mechanization in every country whether he can support himself engines as energy source, or not. Different in the case of agricultural machinery like tractor implments, an engine can not be produced only by welding and assembly.

They have to still continue to import engine parts like a connecting-rod, a piston-ring, bearings, air-cleaners. valves and ignition plugs. Most of the other parts can be produced in Thailand.

I visited a factory in the suburbs of Bangkok where they produced 2-cycle gasoline engines of 5 to 40 hp. It impressed me that they made themselves most of their machine-tools like grinders, lathes and boring machines with a great efforts after they imported the samples of these machines.

Their processing accuracy of the engines were pretty fine according to my simple test. The body was made by casting of light metals.

The annual production volume is about 5,000 units. Their main market are general agricultural use and for small boats for transportations which is commonly used in rivers or creaks in Thailand. The demand for boats is rapidly increasing recently.

Of course they import many engines from other countries every year. The **Table 4 and 5** shows the statistics of Thailand impors of engines.

The total demand is every year increasing and the demand of gasoline engine in units is a little higher than diesel engines.

Main export countries are Japan and U.S.A. In the case of gasoline engines, Japanese share is 49 % presents and U.S.A. share is 37 percents. As to diesel and semi-diesel engines U.S.A. share is 70 % and Japanese share is 12 % in 1969.

The imports of engine will also continue in future, but domestic engines will also rapidly increase its share on the market. That factory has technical agreement with a german manufacturer and is go-

Table 3 : Estimated 1969 Market for Water Pumps

(Units)

Pump types	Local production			Imports	Total
	Total	Leading manufacturers.	Others		
Centrifugal	45,000	34,150	10,850	13,000	58,000
Debbharid	47,000	14,000	33,000	–	47,000
Hand pumps	9,000	4,500	4,500	–	9,000
Turbine	–	–	–	4,400	4,400
Rotary	–	–	–	11,000	11,000
Total	101,000	52,650	48,350	28,400	129,400

Source : USOM ※Estimated.

Table 4: Thailand Import of Internal Combustion Piston Engines and Diesel and Semi-Diesel Engines (No.of units)

Year	Total (711050) (7110508)	Gasoline internal combustion piston engines (711050)	Diesel and Semi-diesel engines (7110508)
1965	67,852	45,571	22,281
1966	74,989	45,016	29,967
1967	105,866	57,977	47,889
1968	124,104	79,275	44,829
1969	131,929	71,814	60,115

Source: Department of Customs

Table 5: Import of Internal Combustion Piston Engines and Diesel & Semi-Diesel Engines from Japan & U.S.A.

Internal combustion piston engines (Gasoline)

Year	Total import Units	%	U.S.A. Units	%	Japan Units	%
1966	45,016	(100)	25,372	(57)	11,468	(25)
1967	57,977	(100)	38,093	(66)	17,096	(29)
1968	79,275	(100)	38,466	(49)	26,225	(33)
1969	71,814	(100)	26,246	(37)	34,881	(49)

Diesel and Semi-Diesel Engines

Year	Total import Units	%	U.S.A. Units	%	Japan Units	%
1966	29,967	(100)	21,563	(72)	1,934	(6)
1967	47,889	(100)	28,385	(59)	587	(1)
1968	44,829	(100)	37,640	(84)	405	(1)
1969	60,115	(100)	41,495	(70)	6,930	(12)

Source: Department of Customs

ing to start the production of diesel engine besides of 2 cycle gasoline engines which production is also rapidly increasing towards the future demands for sprayers, dusters and other small machinery.

The possibility of self support of engine is realizing only with an technical agreement and import of several parts without big capital investment from the partners.

5. The Other Implements

Tractor attachments are at present produced much in Thailand. For example, disk plows are produced by assembling and welding of domestic casting parts and imported disks and frames cut in export countries.

This will be also produced in Thailand completly except of disks. Other attachments like cultivators or plows can be increase the rate of self sufficient with imports of several parts. Attachment for 2-wheel tractors can be almost expected to attain complete domestic production and it will be accelerated by development of agricultural machinery suitable for Thailand agricultural conditions.

Really they are developping new machinery like pumps, threshers or a special tractor for soft paddy field with floats and six wheels national research institute of agricultural machinery.

These design is very simple and easy to produce in Thailand. Chemical sprayers can also be made domestically with domestic small gas-engines. Hand-sprayers can completly be produced in Thailand. As to up-land farming, a maize thresher is developed, which is very high capacity and made by local manufacturers. This manufacturers produce in small scale like 10 units or 50 units per year.

This design is also very simple and mainly driven by tractor p.t.o. Required power is about 12 hp. Capacity and performance of this machine is very high. But several parts of it should be improved in future. There is already competition among manufacturers.

The power thresher for rice designed at national research institute for agricultural machinery is also very simple and which will be developed futher to many varieties like for independent engine power, for contractor's use, for a 4-wheel tractor p.t.o. or small type a 2-wheel tractor. It is the most important that these machinery are all simply designed to be made easily is Thailand.

Though there are many problems to improve futher, they will surely establish a system of machinery suitable for Thailand agricultural through their active experiences.

The base of production of these agricultural machinery will be still imports of several special parts and availability of suitable materials. I can say that they produce in near future most of agricultural machinery in Thailand with present welding technique, shearing machine of materials, some simple cutting tools like lathes and more improved casting engineering.

Table 6 and 7 show us the general view of major agricultural machinery market in Thailand.

6. Direction for Development of Thailand Agricultural Machinery Industry

This would be the common problems for developping countries in Asia rather an special problems only for Thailand.

So for the development of agricultural machinery industry essential is these conditions as follows;

1. To grow design engineers.
2. Cooperation with national or public research and development institute for agricultural machic
3. To get up-to-date technical information in the world.
4. To improve production engineering. The agricultural machinery industry will make rapid progress if techniques of casting, forging, press works, cutting process and heat treatment will be improved even a little by little.
5. To improve repairing techniques of users and dealers.
6. To improve the system to supply repair parts effectively.
7. To establish the right procedure from an idea to sales.

In Thailand these conditions are gradually improved. The re-

Table 6: Estimated 1967 Market for Tractors and Major Implements in Thailand

	Annual sales (units)	Population (units)
Implements		
Total	4,350	26,000
Plows	3,000	18,300
3-4 disc	2,000	12,200
5-8 disc	1,000	6,100
Harrows	400	2,300
Rotary tillers	150	700
Corn shellers	390	2,300
Trailers	410	2,400
Tractors	3,856	19,540
Four-wheeled	3,008	17,500
Two-wheeled	848	2,040

Source: USOM

Table 7: Import Statistics of Major Agricultural Implements (Unit: 1,000 Baht)

Year	Sprayers and dusters	Threshing machinery	Harvesting machinery	Seed distributors
1966	20,886	41 (41 units)	480 (12 units)	173 (31 units)
1967	25,763	881 (116 〃)	190 (4 〃)	215 (71 〃)
1968	40,088	716 (148 〃)	1,267 (42 〃)	545 (121 〃)
1969	27,349	149 (14 〃)	188 (37 〃)	243 (31 〃)

Source: Department of Customs

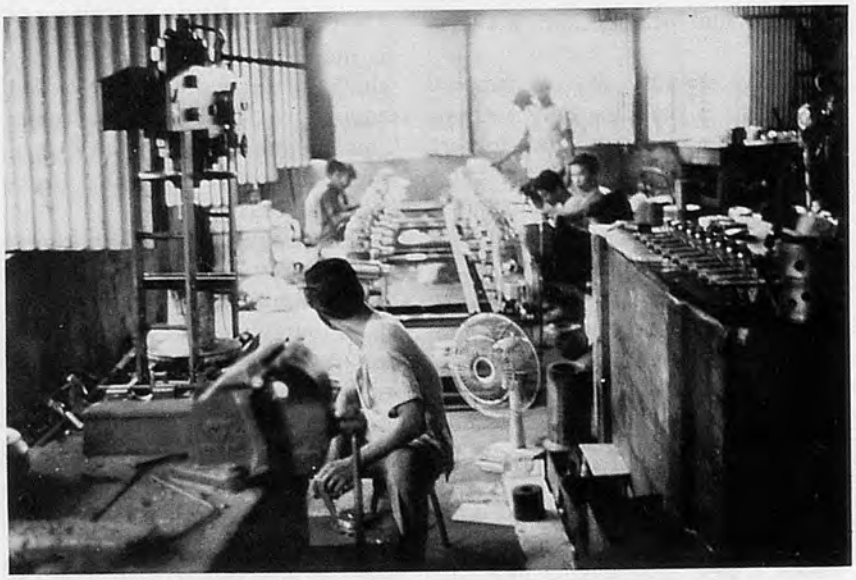
(References) 1. USOM &Thai Gov't. : *Thailand Farm Mechanization and Farm Machinery Market.* 1969
2. USOM : *Thailand Water Pump Industry.* 1970.

search activity and it result of national institute of agricultural machinery are stimulating present agricultural machinery industry and the effect can be much more expected in future.

It will be also needed that agricultural machinery manufacturers will have the discussion to improve above conditions or advice and request on essential matters for the government. They should adjust these problems not as an individual manufacturer but the public opinion of whole agricultural machinery industry. It means that they need to organize some association or union of manufacturers. At the same time it will be also needed to organize dealer's association. Cooperation and effective communication among the government and these association is essential to accelerate the development of agricultural mechanization.

As I simply wrote the out-line of present conditions of agricultural machinery industry in Thailand, I can say as conclusion of my short trip to Thailand that as follows.

Generally agricultural machinery industry in Thailand is rapidly advancing and there is already the fase for establishing more powerful machinery industry in the near future. After ten years. these conditions I mentioned will be considerably improved. ■ ■



Production of transmissions of power tillers

Part III

REPORTS FROM JAPAN

The Latest Mechanization of Rice Transplanting in Japan

Editorial Department. Shin-Norinsha Co.,Ltd.

Completion of Rice-Transplanter is a Great Work in the History

JAPAN has accomplished mecanization of rice-transplantation which was an old problem. This is an epoch making technique. It may fairly be said that completion of rice-transplanter is a great work in the world history of farm machinery as well as in the Japanese history. The history of developing rice-transplanter is long in Japan. The first patent for rice-transplanter was obtained in 1898. Therefore, we can say that dream of developing rice-transplanter continued for many years. But they have repeated trial and error such a long time, because it is only four or five years ago that they put rice-transplanters to practical use.

Diffused Rice Transplanters are over 200,000 Units

It is estimated that about 200,000 rice-transplanters are used in farm villages. That number will increase rapidly year by year as manufacturers improve their production system. The day will not be far distant, when rice-transplanters take the place of human power. Power rice transplanters for early seedling are most introduced at present. In the near future riding type will be put to practical use. Development of rice transplanters which spent some 70 years will be inscribed in the history of farm machinery. This period of development seems dreamlike nowadays. Japanese rice transplanters which accomplished mechanization of rice transplantation attract notice of the whole world. From the view point of actuality we introduce here "The latest mechanization of rice transplantating in Japan"

Rice Transplanters for Early Seedling with Soil Shares 99.3%

In the beginning we explain how much rice transplanters are introduced and utilized in farm villages. A survey by the Ministry of Agriculture and Forestry. "Introduction and Utilization of Rice Transplanters as of Aug. 1st, 1970", shows that 62,313 units have been introduced that is, three times as many as 29,627 units of the previous year. Since 190,000 units are produced on production plan of this year, total introduced rice transplanters as of Aug. 1971, are probably 200,000 units at the least.

These 62,313 units are classified into power rice transplanters for early seedlings with soil--33,253 units(53.4%), hand rice transplanters for early seedlings with soil--28,678 units(46%), and rice transplanters for seedlings without soil--338 units(0.7%). We can understand from this situation that rice transplanters for early seedlings with soil are introduced in overwhelming quantities.

78.9% of All Rice Transplanters is Owned Individually

As for ownership form, individual ownership occupies 78.9%

A power rice transplanter of early seeding with soil type can be easily operated by a woman (*Iseki PF-20*)

(49,142 units), joint ownership, 17.7%(11,061 units). Judging from this condition, individual ownership is so many. Such trend is also observed in other form machinery besides in rice transplanters, and evidently especially in new ones.

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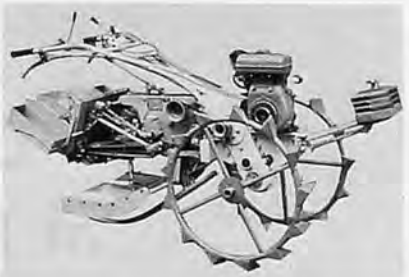


Mametora UP-2

Paddy Field Where a Rice Transplanters Worked a Year was 1.6ha

How much did rice transplanters work? It is estimated that they were used on 99,500ha of paddy field (total area of paddy filed is 3,441,000ha) in 1971, and 3,000,000ha in 1971. Paddy field where a rice transplanter worked a year was 1.6ha in 1970(1.1ha in 1969), and it exceeded probably that of the previous year a little in 1971.

As for regional mechanization of rice transplantation, farm villages on a plain are most progressed, and occupies 42.8% of the whole. Then follow farm villages among the hills, 30.3%, the suburbs of a town, 17.4%, mountain villages, 9.5%. Generally speaking, rice transplanters are utilized mainly in the areas where scale of farm size is large, or many works concentrate in short period on account of compound management of fruit culture and vegitable raising.

Farm Households Holding Less lha Arable Land Own 87.3% of All Rice Transplanters

Farm households that utilize rice transplanters consist of full-time ones, 58%, part-time ones, 42%. Farm households that hold less 1ha farm land under cultivation occupy 87.3%. There is no denying the fact that condition of utilization of rice transplanters is diverse, because it is a short time since they were put to practical use. As for their working days in a year, they work about five days on the average. Power transplanters work 4 days at the minimum, and 21 days at the maximum. Hand transplanters work 5 days at the minimum and 32 days at the maximum. Hand-type works a little more than power-type. It may be due to the fact that the farmer can make a small turn at the corner. But we can't always generalize it since working days are different in each region, still more in the case of cold-weather like that of this year. Rice transplanting ratio of rice transplanter per a farm household--ratio of rice transplanted paddy field with a rice transplanter to total paddy field--is almost 60~70%. There is little difference between hand type and power. As there are some cases where the ratio is 100%, it is not too much to say that rice transplantation with a rice transplanter is being stabilized as safe farm operation.

We add that popularized rice transplanters as of July lst 1971 were 78,000 units(hand-type 32,000 units, power-type 46,000 units) according to a survey by MAF.

Classification of Rice Transplanters by Mechanisim

Rice transplanters on the market are roughly classified into two types, seedling without soil type and seedling with soil type.

A rice transplanter for seedling without soil uses habitual seedlings, and soil which had adhered to their roots was washed off.

On the other hand, rice transplanters for seedlings with soil use seedlings with soil which were grown specially with seedling growing boxes and other implements and facilities. These rice transplanters are classified into pot-type, mat-type, belt seedling-type and serial belt seedling-type according to the seedling growing. They have different mechanism respectively.

Power rice transplanters for seedling with soil are most popularized in Japan, namely those which transplant early rice seedling with soil. As for transplanting mechanism they designed accelerating insertion way, grooving and hilling way, step in way, push-in way, and so forth. Nowadays push-in way occupies the general trend. A rice transplanter of push-in way holds root of seedlings with transplanting finger, and pushes it into soil. This way is called coercive transplantation way as well as push in way.

Efficiency per 10 ha is 1~2 Hours

Efficiency of rice transplanters on the market, which is shown on the added table, is 1~2 hours per 10ha on the whole. But it will be leveled up in future. Mechanized rice transplantation including carriage of seedlings takes 2~3 houres per 10ha. However, customary rice transplantation by hands takes about 24 hours. Therefore, it may be safely said that rice transplanters save much labor. Considering a decrease in population engaged in agriculture --in1971,810,000 persons flowed into other industries,--wage increase in rice transplantation--1,500~2,500 yen including sundries per head in a day--, and so forth, rice transplanters are fully paying in spite of few working days. Out of farmers utilizing rice transplanters, farmers, who have reported "I could have managed without even one employee after introduction of a rice transplanter while I had employed some laborers"

Mitsubishi MP -202

Minoru PT-2F

are becoming numerous more and more. It tells vividly that rice transplanters are profitable.

The Government Has Developed and Popularized Rice Transplanters in Earnest

Only four or five years have passed since rice transplanters were put to practical use. It may be typically Japanese feature that about 200,000 units have been popularized in such a short period. This is, of course, the fruit from the administrative leadership and encouragement of research study by cooperation of government and people. We have no such precedent in the world before whole nation developed rice transplanters. It is the Japanese own great work.

From this time on, active movement of test and experiment will continue for high efficiency and expansion of application of rice transplanters.

There are many factors which promoted popularization of rice transplanters. Among them a financial policy establishment of introduction principle, guidance and expanstion of test and experiment by the government, moreover supreme cooperation of private enterprises have greatly contributed to popularization of rice transplanters.

Financial Institution for Introduction of Rice Transplanters

In respect to financial measures there are two institutions--Agricultural Improvement Fund and Agricultural Modernization Fund. Especially the former is the most convenient one that is loaned to farmers under the condition of no interest and five years of repayment. They are loaned out of New Technique Introduction Fund(7.9 billion yen in 1971) to introduce rice transplanters.

On the other hand, the latter is loaned at 6.5% interest a year and the loan is increasing year by year (The loan is limited in 300 billion yen 20~30% of them is loaned for farm machinery. Loaning only for introduction of rice transplanters is still few, though, it is estimated to increase rapidly).

Guidance Based on a Introduction Principle of Rice Transplanters

The Ministry of Agriculture and Forestry made "Introduction Principle of Rice Transplanters" based on the result of test and research of many years in agricultural experimental stations of each prefecture. And besides they are making efforts to check wrong introduction and utilization by notifying all directors of Agricultural Policy Bureaus of "Introduction Guide of Rice Transplanters" every year, which shows matters that demand special attention in utilization of rice transplanters. "Introduction Principle of Rice Transplanters", which indicates seedling growing and types of rice transplanters suitable for climate, soil, irrigation, drainage and other conditions in each districts, is useful for farmers who utilize rice transplanters.

This principle has played an important part in the development of rice transplanting mechanization. Moreover, it may be safely said that mechanization of rice transplantation has advanced so and wide since that rice transplanters were introduced on that principle. It is the notification entitled "Gude for Mechanized Transplantation and Culture of a Paddy Field Rice" that incarnates that principle and indicates the matters which demand special attention suitable for each year.

Essential particulars which this notification produces are as follows:

①selection of variety ②preparation of seed bed(fertilization on bed soil, acidity adjustment of bed soil, disinfection of bed soil ③seedling growing(seed preparation, drilling or sowing, culture management) ④tillage and harrowing ⑤puddling ⑥transplantation(conditions of seedlings and time) ⑦fertilization(base fertilizer and additional fertilizer) ⑧weeding ⑨pest control ⑩water management, etc.

Recently that notification is being throughly understood. And serious failures are getting few except those by such natural disasters as typhoon, cold weather and so on.

The United Efforts of Government and People Have Brought on Good Result

Expansion of experiment and research doesn't mean an increase of experimental facilities and staffs, but concentration of experiment and research on rice transplanters. Namely, they picked up rice transplanter as an urgent countermeasure to develop techniques for agricultural mechanization. Then, they entrusted every agricultural experimental stations of the Ministry of Agriculture and Forestry, Institute of Agricultural Machinery and 16 Prefecture Agricultural Experimental Stations with research on rice transplanters three years running, and established measures for mechanization of rice transplan-

tation fitted in each district considering the result of experiment and research.

The People Endeavored Exceedingly to Develop Rice Transplanters

Last but not least manufacturers' efforts for developing rice transplanters are worthy of special mention. As stated in another section, there are more than ten manufacturers of rice transplanters, though, there were only a few four or five years ago. Mechanization of rice transplanting was more difficult than that of other farm works, since it was fairly influenced by locality. At first, they had to begin with ecological study of paddy land rice. Because they were too unfamiliar with this kind of job to decide whether they should subordinate rice transplanters to the traditional way of culture, or the contrary. Nevertheless, they have developed splendid rice transplanters in a few years. This effort deserves to be praised. It is needless to say that experiment and research organizations established by prefectures or the state gave a supreme support to this development of rice transplanters. Besides we may be able to state that very united efforts of government and people finished development of rice transplanters. We can't find out such united efforts in the past history of farm machinery development. The fact that government and people united and cooperated with each other to develop new agricultural technique will be added especially on a new page of history of farm machinery development.

A power rice transplanter of early seedling with soil type shown on this picture is most popular at present (*Kubota SPS-28*)

Owing to introduction of a popular rice transplanter, farmers' faces are bright in a busy rice transplanting season (*Yanmar FP2A*)

Rice Transplanters Became Paying

By 1971, rice transplanter will attain a circulation of some 200,000 units, which suggests, us bright future prospects. Demand for it will continue to increase for the time being. According to production plan of manufacturers, they intend to manufacture 190 thousand units in 1971. Rice transplanters fill up scarcity of labour force and are estimated to be paying. And then seedlings growing for rice transplanters took shape. Therefore, they are very hopeful, though there are not a few problems to be solved. They are not only those about mechanism, but also those about popularization and culture.

An outline of problems which agricultural improvement and propagation offices of each prefecture point out in behalf of farmers are as follows:

Problems about Utilization of a Rice Transplanter

①difficult seedling growing (simplification of seedling growing is eagerly desired) ②difficult acquirement of bed soil for seedling growing ③uneven plant growth and withering after transplanting ④excessive tillering ⑤selection of variety of a paddy field rice suitable for rice transplanters ⑥troublesome preparation of soil(ground leveling takes more labour than ever before) ⑦comparatively high-priced materials for seedling growing ⑧much miss-transplanting .

Above-mentioned problems are concerned mainly with seedling growing. Its simplification is desired strongly.

Problems about Mechanism of Rice Transplanters

①floating seedlings or their sinking ②improvement of adjusting mechanism to width of low dykes separating rice fields and seedling interval ③seedlings damaged by transplanting ④improvement of seedling belt and seedling releasing mechanism ⑤making weight of a rice transplanters lighter ⑥expansion of adaptability to condition of paddy field ⑦irregular planting depth ⑧indefinite number of seedlings ⑨simplification of handling ⑩high price, etc.

These problems, which were solved in some type of rice transplanters, are a general demand.

Problems about Popularization

①establishment of large seedling growing facilities ②necessity to promote joint utilization and group culture ③Making the standard of culture and guide principle in detail in the smallest unit of organization ④exhibition of experimental field, circuit guid-

ing on main districts ⑤development of suitable variety, and the others.

Since mechanization of rice transplantation is new technique, staffs of agricultural improvement and propagation offices are puzzling their head considerably.

Necessity of Large Facilities to Grow Seedling

Rice transplanters for early seedlings, which are equivalent to 99% of all rice transplanters, presuppose seedlings grown with seedling boxes and other materials. Joint seedling growing is needful by all means to stabilize rice transplanters technically because it is fairly difficult to grow such seedlings. When that joint seedling growing is realized and ideal seedlings which have been grown by veteran technicians to control temperature, moisture and light can be supplied, farmers' dream is realized in a sense. Therefor, it is needless to say that mechanization of rice transplantation is promoted rapidly.

The Ministry of Agriculture and Forestry Grants a Subsidy for Facilities

Herewith the Ministry of Agriculture and Forestry made a budget for establishment of large facilities to grow seedlings in 1971. The ministry intends to grant a subsidy for establishment of large facilities to grow seedlings(standard, 100 ha) in order settle mechanized farm technique fit for swiftly popularized rice transplanters. They made the plan for the sake of 100 facilities (240 million yen, subsidiary ratio is about 33%) and the standard of establishment. This plan will be realized continually for a while. We may say that the administration have undertaken establishment of facilities to grow seedlings on a full scale. People will take this opportunity to accelerate establishment of facilities. Though rice transplanters are being introduced increasingly, nowadays small facilities(according to circumstances seedlings are grown by a farm household) are numerous and they have many technical difficulties. Consequently establishment and increase of large facilities to grow seedlings will bestow great favors on farmers.

Machines for Growing Seedlings are being Developed in Rapid Succession

In relation to government's making budget for establishment of large facilities to grow seedlings, machines and implements concerned with seedling growing are being developed in rapid succession in unofficial side. Big manufactures of farm machinery have gotten to produce electric heating machines to grow seedlings, bed soil fillers, broadcasters, heating machines, soil sieves, fertilizer mixing machines, soil dryers, sprouting machines and so on, namely from seedlings growing houses to every facilities to grow seedlings. For the purpose of this, they have newly instituted special departments for facility which are called a facility department or plant department. Such trend will become more popular.

Rice Transplanters for Seedlings without Soil Need Reduction of Labour for Pulling up Seedlings

Reduction of labour for pulling up seedling is a big problem in rice transplanters for seedlings without soil. But a machine to pull up seedlings which is under research will be put to practical use in near fin that case, rice transplanters for seedlings without soil will be estimated over again. And besides there is much possibility of big change of their popuralizing ratio(0.6%).

Trial Machine for Pulling up Seedlings was Produced

There are several trial machines for pulling up seedlings. The most advanced one was produced by Institute of Agricultural Machinery. According to the result of its experiment in field rice nursely it could pull up seedlings at a speed of 0.1～0.5 meters a second and took one to one and half hours per ten hectare. Its efficiency is very high because man power takes about eight hours. They say damaging ratio of seedlings can be remained within 5%. That trial machine was designed for drilling rice nursely in field at the beginning, however, they are planning to expand adaptability to ordinary nursely and protected nursery.

There are three types of pulling up seedlings machine. They are ①seizing seedlings and pulling out them from rice nursely ②taking out seedlings together with soil and then taking away soil ③using implements and materials. The pulling up seedlings machine produced by IAM takes out seedlings together with soil and then take away soil. According to the result of experiment," there is considerable connection between damage of seedlings and separating seedlings from rice nursely and taking away soil. Therefore, less damage tends to cause inefficient separating and taking away. As quantity of seeding becomes plentiful and seedling density rises, damaged seedlings intend to increase." Holding so many problems, they are promoting improvement of a pulling up seedlings machine and have gotten a general aim. Farmers are expecting that machine is put to practical use as soon as possible.

Mechanization of Rice Transplantation are Reaching the Main Stage

Introduced Rice transplanters are about 200 thousand units at present and mechanization is reaching the main stage. Reports from each prefecture say "Rice transplantation with a rice transplanter is stabilized technically. Farmers' uneasiness to utilization of them is vanishing." Areas

where mechanized rice transplantation is popular, they say "Considering high wages for rice transplantation, a rice transplanters would be paying in utilization on two hectares a year." They also say "Farmers are expecting riging rice transplanters for seedlings without soil are put to practical use." Namely, farmers have entertained new opinions. Consequently those who visit agricultural experiment stations in prefectures are increasing recently. And so many farmers participate in the exhibition of rice transplanters and society for the study of them. Besides they are not only youth, but also women. The latter's participation is very popular in these days. Women who visit exhibitions of farm machinery often put pointed questions. In this way rice transplanters are becoming necessities for farm households.

An Outline of Rice Transplanters on a Market

We report here an outline of rice transplanters finally. At present, those for seedlings with soil are dominant. It is because they can transplant seedlings without injuring growth of seedlings in best condition. That is also because "Paddy field transplanted with them can yield as many as paddy field transplanted manually in fixed condition." according to the result of yiled test.

Regarding their types, walking-type for two or one rows is most popular. Riding-type for six or eight rows is in the stage of trial production. The most popular size are as follows: total hight:700 ~900㎜, total weight: 60~75kg and horsepower: 1~2ps. And rice transplanters of single purpose are more numerous than those used as attachment.

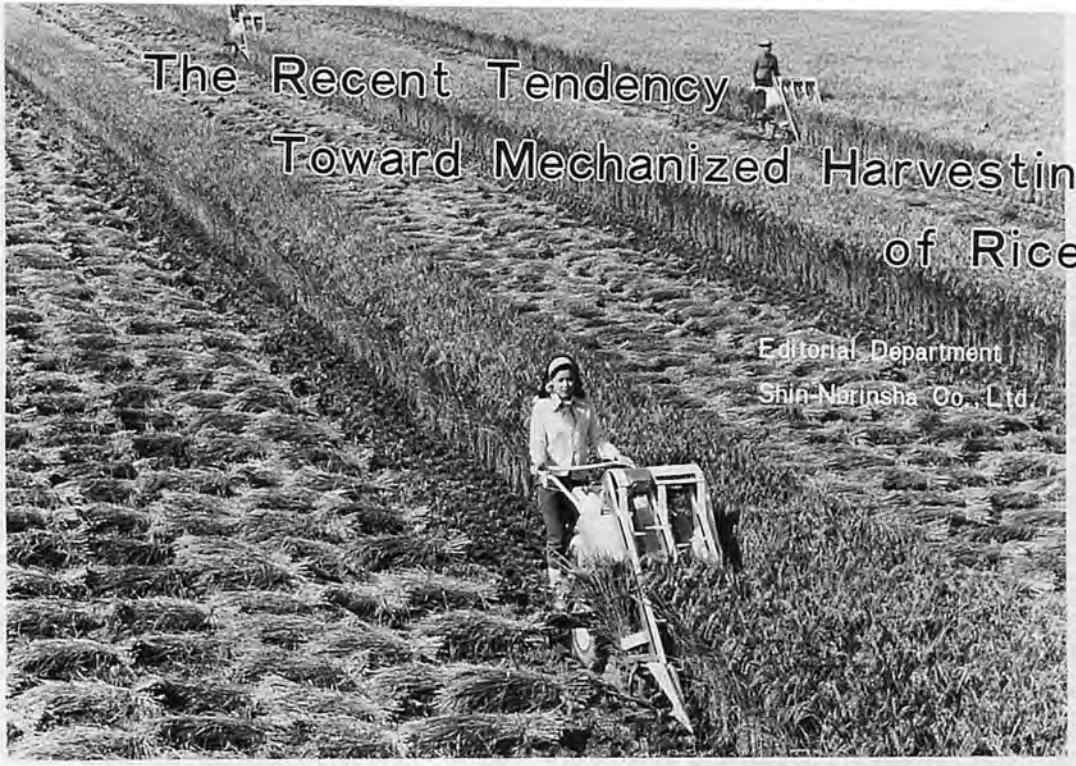
The number of manufacturing companies as of Aug., 1971 are 14(see attached table). Increase of types of rice transplanters per a manufacturing company will surpass that of manufacturing companies. ■ ■

=Manufacturer's Name and Address of Rice Transplanter=

Ishikawazima Shibaura Machinery Co., Ltd.
4, 2-chome Ote-machi, Chiyoda-ku, Tokyo.
Iseki Agricultural Machinery Mfg. Co., Ltd.
2, 2-chome Nihonbashi-dori, Chuo-ku, Tokyo.
Kanriu Industry Co., Ltd.
1526 Hirooka Shiojiri-shi, Nagano.
Kyoritsu Co., Ltd.
5-1, 7-chome Shimorenjaku, Mitaka-shi, Tokyo.
Kubota Iron & Machinery Works, Ltd.
22, 2-chome Funade-cho, Naniwa-ku, Osaka.
Sato Agricultural Machinery Co., Ltd.
101, 2-chome Minato-cho, Fukuyama-shi, Hiroshima.
Sato Zoki Agricultural Machinery Mfg. Co., Ltd.
Kinsan Bldg., 5, 4-chome Muromachi, Chuo-ku, Tokyo.
Suzue Agr. Machinery Co., Ltd.
144-2, Gomen-cho, Nangoku-shi, Kochi.
Nippon Beet Sugar Manufacturing Co., Ltd.
6, 2-chome, Kyobashi, Chuo-ku, Tokyo.
Noda Industrial Co., Ltd.
3-41, 5-chome Asahi-cho, Takamatsu-shi, Kagawa.
Mametora Agr. Machinery Co., Ltd.
9-37, 2-chome Nishi, Okegawa-shi, Saitama.
Marumasu Machinery Co., Ltd.
2 Wakasugi, Kamiichi-cho, Nakaniikawa-gun, Toyama.
Mitsubishi Heavy Industries, Ltd.
5-1, 2-chome Marunouchi, Chiyoda-ku, Tokyo.
Minoru Industrial Co., Ltd.
447 Shimoichi, Sanyo-cho, Akaiwa-gun, Okayama.
Yanmar Agr. Equipment Co., Ltd.
62 Chaya-machi, Kita-ku, Osaka.

〈Rice Transplanter〉

Brand & Type	Power Source	Efficiency (min./10a)	Number of Rows	The Standard Domestic Retail Price (yen)
(Seedling with soil type)				
Iseki PF-20	Engine Power	60	2	168,000
Kanriu TM1-4	Human Power	120	1	75,000
Kanriu TE2-2	Engine Power	45~60	2	171,000
Kanriu TES2-1	〃	60~90	2	171,000
Kyoritsu PT-2F	〃	60~90	2	178,000
Kubota SPS-28	〃	60~90	2	156,000
Kubota SPS-30	〃	60~90	2	165,000
Kubota SPS-33	〃	60~90	2	167,000
Sato PS-210	〃	50~90	2	168,000
Sato SP-901A	〃	50~100	1	98,000
Sato SP-901	Human Power	120~150	1	70,000
Suzue SH2	Engine Power	60~90	2	166,000
Suzue SB2	〃	60~90	2	165,000
Noda NTE2-2	〃	45~60	2	166,000
Noda NTM1-4	Human Power	120	1	72,500
Nitten Paper Pot PP2	Engine Power	60~90	2	200,000
Mitsubishi MP-202	〃	90	2	168,000
Minoru PT-2F	〃	60~90	2	185,000
Yanmar FP2A	〃	60~90	2	149,000
Yanmar FP2B	〃	60~90	2	166,000
(Seedling without soil type)				
Sato PL210		90~120	2	
Shibaura RP-2B	〃	60~90	2	195,000
Mametora UP-2		60	2	210,000
Marumasu MT-3	〃	90	2	198,000



The Recent Tendency Toward Mechanized Harvesting of Rice Plant

Editorial Department
Shin-Norinsha Co., Ltd.

Wide Spreading of Binders to the Level of 1,000,000 Units

WE can safely say that rice plant harvesting in Japan has entered the age of mechanization recently. In Western countries one could easily imagine the scenes where a fleet of giant combines having a large cutting blades more than two meters wide would be roaring in the fields. Things in Japan, however, are quite different. Walking type binders are starring in the agricultural Japan. These pedestrian binders were numbered about 600,000 units in 1970. It will be estimated at almost 1,000,000 population at the end of 1971. As no authentic data are available, we have regarded the machines shipped from the factories as the quantity spread.

Head feed combines, a peculiar hybrid between an automatic feeding thresher and a binder prevailed in this country, numbering 86,000 units in 1970. More than 130,000 machines will presumably have been used by the end of 1971. These two types of machines are playing an important part on paddy harvesting. In addition thereto, the so-called self-propelled head feed combines with a crawler are widely in combination with binders.

Why is it that a large number of binders, self-propelled head feed combines and ordinary types of head feed combines have extensively spread among Japanese farmers? We shall explain to the readers about that.

General History on Mechanization of Rice Plant Harvesters

Rice is a staple food for Japanese, which occupies a most part of Japan's agricultural production. The mechanization of rice planting was started in ordering from tilling to pest controlling, to threshing to hulling, to milling. It was often World War II that farm mechanization made a dramatic progress in this country. By the first-half of 1960's, agricultural mechanization here was completed except that of rice planting and rice harvesting. These two operations are so-to-speak the "Orphan" of mechanization. It seems that they will be mechanized rapidly with the development of head feed combines or rice transplanters for young shoots. Fullfledged introduction of rice transplanters, however, has been extremely behind the time-table. On the other hand, paddy harvesters have followed a favourable course of progress. In these several years, their annual production has exceeded the level of 300,000 units

Before head feed combines were developed, side delivery power reaper with a manual gathering and binding equipment had been introduced to a limited degree, which, however, had not spread widely. Why not? It was because such reapers demanded more labour and more time for gathering and binding···which meant the machines proved to be a less labour saving effect than we had expected. Another types of reapers were introduced, which had a throwing away intermittent binding attachment. They failed to prevail extensively, because they lacked in continuous binding installations.

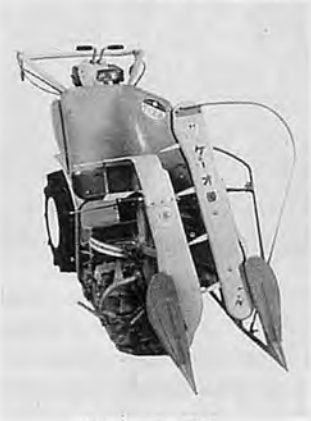
Nowadays one-row type binders are mostly introduced. (Yanmar YB-A600)

Oshima FB-30

Kubota HC-502

Honda T55

Mitsubishi KB251



Keo-go BH30C

Hinomoto UB-300

Explosive Boom for Binders

It was really in 1965~1966 that after such a process of development, the continuous reaping binding machines which are playing a ruling role in Japan's agriculture were developed and marketed. An explosive binder boom rose from them.

Head feed combines were developed almost simultaneously with the binders, too. They were, however, not introduced rapidly, as there was a difficulty involved. It was about a moisture-contained rough rice threshed with those combines.

Binders, on the contrary, have been smoothly accepted without any resistance from farmers. Why? It is because the binders are able to mechanize conventional reaping and binding and to allow drying by hanger pole.

Head Feed Combines Exceeded the Level of 100,000 Units

Let us glance at the spread number of binders and head feed combines based on the quantity shipped from manufactories, according to MAF of the Japanese government.

Binders

1965·····12,000 units
1966·····24,000
1967·····42,000
1968····· 117,000
1969····· 306,000
1970····· 603,000
1971··· 1,000,000(expected)

Head Feed Combines

1968·····15,000 units
1969·····46,000
1970·····86,000
1971····· 100,000(expected)

The above statistic figures indicate the fact that the increasing rate of binders has been about 100 per cent every year, while that of combines has barely maintained the same percentage every two or three years.

Harvesters hold a No. 1 Position, 35% of Total Farm Machinery Production

Very conspicuous is an increasing rate of output of small harvesters! The rate is 35 per cent, the highest outturn of all farm machinery, which has driven out small tractors that had wielded the scepter in Japan in 1950's. Small tractors' days were gone.

It is not an exaggeration to say that today is the heyday of small harvesting machines, as far as the outturn is concerned.

Before the introduction of such harvesters, all harvesting were forced to rely on human labour. What are the distribution percentages of harvesters to the Japanese farmers? How many working hours have been reduced with these machines? Let us evaluate these facts.

Binders have spread to such an Extent that there is One Unit per Every Five Farm Households.

The total number of Japanese farm housefolds in 1970 was 5,341,800(approximately 5,340,000), according to the investigation of MAF of the Japanese Government. The aggregate quantities of binders shipped from manufactories (the machines spread) are 600,000 units, an 11.2% spreading rate over the total agricultural families. The prevalence rate of head feed combines, however, by far lower than that of binders. While the spreading rate of binders was one unit per every ten farm households in 1970, it is expected that by the end of 1971, the rate should become one unit every five. The models which had

been introduced in the largest quantity were power threshers (including both a hand feeding type and an automatic type).

These power threshers reached 3,000,000 units in 1964 and since then their rate of increase has been nearly moving sideways. The model that appeared following power threshers was small tractors (both tillers and power tillers) and 3,000,000 machines were introduced by 1968. Since then, however, they have been marking time, just as in the case with power threshers.

Thus at present, only binders are spreading at a rapid pace. When one compares binders with the afore mentioned two machines, one can find a remarkable feature. What is it? It is a difference in the spreading speed. Take an example of power threshers. It took seven years for the threshers from the year when 100,000 units were used to the year when 1,000,000 introduced. Then, what's about small tractors? It took six years for the tractors. Things are completely different in the case of binders, however. Binders reached 100,000 units in 1968 and it is estimated that a target of 1,000,000 machines be attained most probably by the end of 1971. If this goal is reached, it will be only three years! You will realize how fast its spreading pace is!

Why is it that such a rapid tempo has been achieved? There are so many commentators, so many comments. Some of them are cited as under:

Even a woman can operate conveniently a one-row type binder (*Iseki RS-250*)

Background to the Explosive Boom for Binders

1. The decrease in labour force in the agriculture has been so drastic that 34,410,000 farming population in 1960 dropped off to the level of 26,228,000. To fill in this keen labour shortage, there has been no alternative but to the introduction of labour saving machinery.

2. Among mechanized rice planting operations, both rice-transplanting and harvesting were kept isolated from the mechanized current. The development of binders has prompted the mechanized harvesting.

3. More than half of today's farmers' incomes are deriving from the source other than agriculture. This necessitates farmers to squeeze out time from farming by way of mechanization. The time thus saved will be earmarked for an income-earning labour other than farming.

4. The introduction of binders has met no resistance from farmers, because they have been able to replace conventional handoperated farming with mechanized method.

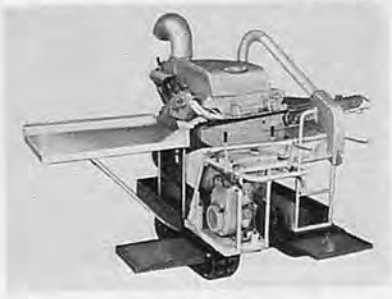
5. The price for binders are moderate and yet the machines are very efficient. These merits, combined with each other, have caused the today's explosive boom for the introduction of binders.

How much influence are such small harvesters (both binders and head feed combines) exercising on the reduction of the time for rice planting?

How much Labour Saving in Harvesting was realized with the Introduction of Small Harvesters?

MAF of the Japanese Government makes it a rule to conduct

Kubota HR-5CR



Fuji

Yanmar

It's a charming point of a self-propelled automatic thresher "to be able to thresh paddy while traveling freely on paddy field" (*Konma MT*)

the annual investigation on the production cost of rice, before the Ministry announces the official rice prices. The Ministry disclosed the nationwide average figures that in 1956 it took 184.71 hours to produce rice in a paddy field of a 0.1 hectare area and in 1967, 128.10 hours in the same area.

When the basic figure in 1956 is fixed as 100%, that in 1969 is 69.4%, a dramatic decrease of about 31 per cent. This 31% labour saving, although it involved every kind of farm operations from pre-seedling to hulling, is indeed an epock-making achievement. Let us review the labour saving contributed to the mowing and drying of rice plant. The average time spent in these two operations was 37.19 hours in 1956 and 29.3 hours in 1969, a reduction by about 21 percent.

In other branches of farm operations, the comparison of time spent in 1956 with that in 1969 is shown as below:

Kind of Operation & Decreasing Percentage	
Plowing for Paddy Field	71%
Weeding	54%
Rice Hackling / Rough Rice Drying	42%
Irrigation & Drainage / Spraying & Dusting	31%
Hulling	25%
Mowing & Drying of Rice Plant	21%

From these statistic figures one can learn that widely-used small tractors are contributing much to the labour saving for plowing of paddy field, power threshers for rice hackling and power sprayers and dusters for spraying and dusting.

Why is it that labour has not been saved so much with binders or combines as with small tractors? This is because the quantities used by farmers are still less than those of small tractors. It is, therefore, within a few years that these two models will bear fruit as a result of an extensive spreading rate.

Technological Forecast a Decade Hence by MAF of the Japanese Government

The following statistics are quoted from "The Forecast on Agricultural Technology" published by MAF in 1967, in which the Ministry clarified a prospective view on the technological progress a ten years hence.

When 139.68 hours per 0.1 hectare in 1967 is fixed as a basic figure, the total working hours ten years hence will be reduced to the level mentioned below:

A) Under overall process with small-scale mechanization system:
   1. With rice transplanter for seedling without mud··· 89.1～106.0 hours
   2. With rice transplanter for muddy seedling··· 73.6～87.46 hours

B) Under the grouped system of medium-sized mechanization:
   1. With rice transplanter for seedling without mud··· 73.3～90 hours
   2. With rice transplanter for muddy seedling··· 58.8～71.0 hours

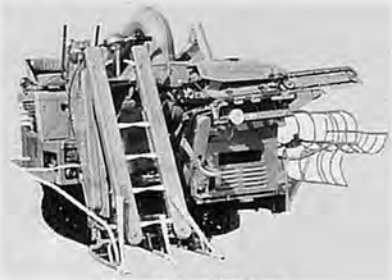
C) Under the grouped system of large-scale mechanization:
   1. With rice transplanter for seedling without mud··· 40.0～47.4 hours
   2. With rice transplanter for muddy seedling··· 24.5～28.4 hours.

Of the total working hours mentiond above, how many hours were spent for harvesting? The following are breakdowns of harvesting hours per 0.1 hectare in 1967:

1. Mowing of rice plant ··· 20.57 hours

A self-propelled automatic thresher, which can thresh rice while traveling on paddy field, reduces labour for farm work (*Yanmar PTC*)

Sato H-120



Mitsubishi MC951-D

Yanmer TC500A

2. Drying of rice plant ··· 15.74
3. Rice Hackling ····· 12.67

Total: 48.98 hours

The total labour hours in these three operations ten years hence will presumably be reduced to the level stated under:

A) Under the comprehensive process with a small mechanization system:
Total: 17～22 hours

B) Under the grouped system of medium-sized mechanization:
Total: 58 hours

C) Under the grouped system of large-scale mechanization:
Total: 1.5～1.7 hours

Although this forecast period has not expired, the statistic figures presumed above are very much interesting to us, when compared with those in 1967.

The Japanese Government's Policy on the Introduction of Harvesting Machines

What is the guiding principle of the Japanese Government to introduce small harvesters? "Law concerning the Promotion of Agricultural Mechanization" was proclaimed in 1943. The Law aims at the encouragement and prompting of the favourable introduction of farm machinery. In pursuant to the Law, the Minister of MAF has made public in his name the basic principle on the introduction of highly efficient farm machinery. The Minister announced the new basic principle on April 20, 1971.The only four models are specified in his principle:

1. Riding-wheel tractors having 20 ps or more.
2. Head feed combines having a blade width of 0.8 meter or more and ordinary combines having a blade width of 1.5 meters or more.
3. Running power spreader for spraying and dusting.
4. Harvesters for field work.

As a result, binders which have been and are playing an important role to mechanize harvesting are kept out the legal target.

In Japan, the subsidy is granted only to the farm machine whose price is not less than ¥500,000 according to the Law. Small binders, of course, are not privileged. The purchase money for those binders, therefore, are forced to be paid either with the funds borrowed from a monetary institution or with owned capital.

The Basic Principle on the Introduction of Combines

Let us explain to you briefly about the basic principle on highly efficient farm machinery derived from "Law concerning the Promotion of Agricultural Mechanization" In pursuant to the basic principle of the central government, each local government, each local government must map out the plan to introduce the specific models suitable for the local conditions. Take an example of combines. The models in which the following four groups:

1. Joint and individual use by grouped farm households.
2. Joint use by grouped farm households.
3. Grouped use by public enterprises such as agricultural cooperative association and joint use of grouped farm households.
4. Grouped use by private enterprises such as farm incorporated association and joint use of grouped farm households.

Under these four classifications, the combines to be introduced are fully specified as below:

Classification 1:

A) Head Feed Type—Blade width ··· 1.08 meters～less than 1.2 meters
Continuous (10 hours) rated horse power of a prime mover; 10 ps or more

B) Ordinary Type—Blade width ···1.5 meters～less than 2.5 meters
Continuous (15 hours) rated horse power of a prime mover; 20 ps or more

Classification 2:

A) Head Feed Type—Blade width ··· 1.2 meters or more
Continuous (15 hours) rated horse power; 15 ps or more

B) Ordinary Type—Blade width ···2.5 meters～less than 3.5 meters
Continuous (20 hours) rated

There are many types of head feed combines. Most of them can do central harvesing (*see this picture*) and harvest fallen rice perfectly (*Suzue Cooper CP 730*)

Central harvesting work by a three-row type combine which is most efficient among all head feed combines (*Kubota HT90*)

horse power; 50 ps or more

Classification 3:

Blade width; 3.5 meters or more

Continuous (30 hours) rated horse power; 80 ps or more

Further, the following specified conditions, in parallel with the above conditions, should be fulfilled, prior to the introduction of such models:

1. Field conditions fully specified by MAF
2. Cultural conditions fully specified by MAF
3. Facilities conditions fully specified by MAF.

Furthermore, the four points mentioned below should be carefully taken into consideration, prior to the introduction of such models:

1. The scope of project under which machines are to be used.
2. The system under which machines are to be operated.
3. The population of machines to be introduced in terms of models and sizes.
4. Any other point that is related to the introduction of machines.

The Purchase of Binders are Financed mostly by Owner's Capital

The basic principle aforementioned is applied to the introduction of machinery, as long as they are used under the government-sponsored projects.

Machines out of this category are also to be introduced along such line as may be appropriate to the purpose of the respective projects. Things are different in the case of binders, however, since no consideration concerning the basic principle on the introduction of machines has been given to binder by MAF. Why not? This is because the prices for binders being much lower than those for highly efficient machines, the Government can not help leaving the purchase of binders to farmers' discretion. This may indicate the fact in a sense that real demands for binders created by farmers have outrun the steps taken by the Government.

Of course, binders can be bought with the money financed from "Farm Mechanization Funds" or "Farm Improvement Funds". The fact is, however, that almost all binders depend farmers' owned capital for the purchase thereof.

Head Feed Combines are partly under Joint Use

The introduction of head feed combines are on the increase due to a small-scale common use and the financing from "Farm Mechanization Funds". On the other hand some of these combines are introduced under custom harvesting or by small-scale contractors.

Over-majority of Ordinary Combines are Imported Machines

Let us jot down the spread of ordinary combines, according to the statistic figures from MAF. The first machine of its kind was imported in 1959. Since then, imported combines have been on the increase year after year. The total population so far brought about from abroad is 1,038 units including 302 machines in 1970. Of the combines imported in 1970, 201 units are a semi-crawler type having a cutting width of 3 meters or more, 76 units are a crawler type, majority of which having a cutting width of 1.5~3 meters, and 19 units are a wheel type.

Ordinary combines so far introduced are owned by the following proprietors:

Agricultural Cooperative Associations ……169 units

MAF-sponsored Hachirogata Reclaimed Land Project Group ……68

Public Utility Association……75 units.

The combines owned by agricultural cooperative associations and public utility associations include such 157 units as were specially introduced to the project for the improvement of agricultural structure. The above figures prove the fact that ordinary com-

bines are mostly either group-owned or for joint use. Most of them vere imported. Very few were home-made models.

Efficiency of 1-row Cutting Binders, 30～90 Minutes per 0.1 hectare

Let us explain about various types of binders, before we evaluate their efficiencies. The major type in Japan is a 1-row cutting binder, which originated from a 3-row cutting type. It evolved itself to a 2-row cutting machine and to a 1-row attachment of today. This evolution has corresponded with the changing operating scales of farms where binders had been introduced. Namely, as the unit farm area has been on the decrease gradually, farmers demanded less row-cutting attachment. The less the number of cutting rows, the more they are economically advantageous to the farmers, because the unit price of binders becomes the lower. Another advantage to the farmers is the fact, that regardless of the number of cutting rows having diminished, the mechanical efficiency has remained almost unchanged.

Take a typical example. That is about "KUBOTA" binders, which has the largest population in this country.

Classification of "KUBOTA" Binders

3-row cutting type…
cutting width : 750 mm
50～70 minutes per 0.1 hectare
2-row cutting type…
cutting width : 500 mm
55～85 minutes per 0.1 hectare
1-row cutting type…
cutting width: 280 mm
70～110 minutes per 0.1 hectare

The foregoing figures indicate the fact that the less the number of cutting rows, the higher the efficiency is getting. Next, let us examine the standard retail prices in the local areas:

3-row cutting type……	¥435,000
2-row cutting type……	¥275,000
1-row cutting type……	¥165,000

Thus, it is obvious that the difference in mechanical efficiency is not so big as in the price gap.

Efficiency of Head Feed Combines …1～1.5 Hours per 0.1 Hectare

Why is it that 1-row cutting types of binders is starring in mechanical harvesting in Japan? Let us review the efficiency of these binders. The 1-row cutting binder has an average capacity to harvest a 0.1 hectare farm in 60～120 minutes. The newest model has the performance to harvest the same area in 30～90 minutes. The catalogued capacity being usually overvalued, their correct performance should be 20～30% off the catalogued figures.

The time to harvest a 0.1 hectare area with a 2-row cutting binder is 20～30% shorter than that with a 1-row machine. A head feed combine has a capacity to harvest a 0.1 hectare farm in 40～120 minutes, which means of no big difference from a binder, as far as time is concerned. The time spent by the former, however, includes that for threshing, which must be borne in mind.

Advantages and Disadvantages in the Introduction of Various Types of Harvesters

To be able to neatly satisfy the conditions under conventional farming is the greatest advantage

=Manufacturer's Name and Address of Binder and Combine=

Iseki Agricultural Machinery Mfg. Co., Ltd
2,2-chome Nihonbashi-dori, Chuo-ku, Tokyo.
Uemori Agr. Implement. Mfg. Co., Ltd.
Kanonji, Kanonji-shi, Kagawa.
Oshima Agr. Machinery Co., Ltd.
10, 3-chome Tera-machi, Joetue-shi, Niigata.
Kubota Iron & Machinery Works, Ltd.
22, 2-chome Funade-machi, Naniwa-ku, Osaka.
Konma Mfg. Co., Ltd.
26, 4-chome Izumi-cho, Tsuruoka-shi, Yamagata.
Sato Zoki Agricultural Machinery Mfg. Co., Ltd.
Kinsan Bldg.,5, 4-chome Muro-machi, Chuo-ku, Tokyo.
Suzue Agr. Machinery Co., Ltd.
144-2 Gomen-cho, Nangoku-shi, Kochi.
Toyosha Co., Ltd.
16-5 Joshoji-machi, Kadoma-shi, Osaka.
Noda Industial Co., Ltd.
3-41, 5-chome Asahi-machi, Takamatsu-shi, Kagawa.
Fujii Noki Mfg. Co., Ltd.
285-Koike, Tsubame-shi, Niigata.
Fuji Robin Co., Ltd.
8-1, 1-chome Nishishinjuku, Shinjuku-ku, Tokyo.
Honda Motor Co., Ltd.
5, 5-chome Yaesu, Chuo-ku, Tokyo.
Mitsubishi Heavy Industries Ltd.
5-1, 2-chome Marunouchi, Chiyoda-ku, Tokyo.
Yanmar Agr. Equipment Co., Ltd.
62 Chaya-machi, Kita-ku, Osaka.

A head feed combine of riding type is being introduced increasingly (Iseki HD660R)

to binders, which we already pointed out. This is especially the case in relation to the drying of rough rice. Dryers hitherto widely used by Japanese farmers are suitable for drying rough rice containing a 20% or less moisture. These dryers, however, are inadequate for the drying of paddy harvested with combines. Accordingly, farmers are unable to use any combines without purchasing new types of dryers which are corresponding to the performance of combines. On the contrary, they can use any binders in combination with conventional dryers. This is the greatest advantage that binders are able to boast of. Herein does lie the fact that binders have extensively prevailed.

A self-propelled thresher is, of course, a thresher equipped with a running device, which has the advantage that the device is to be mounted on a conventional automatic thresher. The aggregate price for a binder plus a self-propelled automatic thresher is usually lower than that for a head feed combines. This is another advantage to the former, too.

Aa to models or descriptions of various machines, please refer to an attached sheet. In the next chapter we wish to examine the trend of harvesters and the tendency toward the development thereof.

The Debut of 2-Row Cutting Binders Having High Efficiency

The prevailing 1-row cutting binders, as aforementioned, have their origin from a 3-row cutting type. Needless to mention that a 2-row cutting binder has more capacity than a 1-row cutting type. It is a noteworthy fact that low-priced 2-row cutting binders with a simplified mechanism are beginning to make debut in the market. These binders have such improvements as a two-side-throwaway structure instead of a one-side mechanism or as a central-throwing attachment.

〈Binder〉

Brand	Number of cutting Rows	Cutting Width (mm)	Efficiency (*min*/10a)	The Standard Domestic Retail Price(yen)
Iseki RS-250	1	250	60～100	178,000
Iseki RS-550	2	500	30～60	252,000
Oshima FB-30	1	330	90～120	190,000
Oshima HR-500	2	500	60～90	310,000
Kubota HD-300	1	280	70～110	165,000
Kubota HC-502	2	500	55～85	275,000
Kubota HC75F	3	750	50～70	435,000
Keo-go BS60A	2	570	50～90	270,000
Keo-go BH30C	1	330	70～110	180,000
Konma KBD300	1	240	70～110	170,000
Konma KB502	2	500	55～85	280,000
Sato B301	1	370	80～120	175,000
Sato B501	2	600	60～90	279,000
Suzue B2-30	1	300	70～110	180,000
Suzue B2-60	2	600	50～90	270,000
Suzue B60	2	570	50～90	290,000
Noda RT302	1	290	90～120	170,000
Noda RT500N	2	500	70～100	280,000
Hinomoto UB-300	1	300	60～90	148,000
Hinomoto UB-550	2	550	60～90	258,000
Honda T55	2	500	70～100	275,000
Mitsubishi KB251	1	250	90～120	173,000
Yanmar LB300-T	1	320	60～90	177,000
Yanmar LB600-A	2	580	50～80	279,000
Robin RH55	2	500	55～85	280,000
Robin RH35	1	280	70～110	170,000

〈Head Feed Combine〉

Brand	Riding or Working Type	Harvesting Width(mm)	Efficiency (a/h)	The Standard Domestic Retail Price (yen)
Iseki HD550	Walking	500	4～6.7	460,000
Iseki HD650R	Dual purpose	500	6.7～10	603,000
Iseki HD650	Walking	500	6.7～10	590,000
Iseki HD660R	Dual purpose	600	8.3～12.5	700,000
Iseki HD660RW	〃	600	8.3～12.5	775,000
Oshima SC-400	Walking	400	5～7	455,000
Oshima SC-500	〃	500	5～7	519,000
Oshima RC-850	Riding	850	8～10	820,000
Kubota HT90	〃	900	8～15	870,000
Kubota HX-55	Walkinga	550	7～11	598,000
Keo-go CH60C	Riding	550	8～10	580,000
Keo-go SH70A	〃	730	6～10	620,000
Sato HL50	Walking	600	5	525,000
Sato H500	Riding	500	10	623,000
Sato H120	〃	1250	10～15	1,500,000
Suzue KC60	〃	550	8～10	580,000
Suzue Comper CP730	〃	730	6～10	620,000
Noda HC60	〃	500	10～15	602,000
Fujii FK-50	Walking	600	3～5	525,000
Fujii FS-500	Riding	500	8～10	620,000
Mitsubishi MC 651	Walking	600	3～5	525,000
Mitsubishi MC 951-D	Riding	500	8～10	623,000
Yanmar TC500A	Walking	500	7～10	600,000
Yanmar TC450A	〃	500	5～7	510,000
Robin GH52	Riding	500	10	610,000

=Manufacturer's Name and Address of Self-propelled Automatic Thresher=

Iida Mfg. Co., Ltd.
1377 Toyota, Suwa-shi, Nagano.

Iseki Agr. Machinery Mfg. Co., Ltd.
2, 2-chome Nihonbashi-dori, Chuo-ku, Tokyo.

Uemori Agr. Implement Mfg. Co., Ltd.
Kanonji, Kanonji-shi, Kagawa.

Oshima Agr. Machinery Co., Ltd.
10, 3-chome Tera-machi, Joetsu-shi, Niigata.

Katakura Kiki Kogyo Co., Ltd.
7160 aza Matsumotodo, oaza Imai, Matsumoto-shi, Nagano.

Kubota Iron & Machinery Works, Ltd.
22, 2-chome Funade-cho, Naniwa-ku, Osaka.

Konma Mfg. Co., Ltd.
26, 4-chome Izumi-cho, Tsuruoka-shi, Yamagata.

Sato Zoki Agricultural Machinery Mfg. Co., Ltd.
5, 4-chome Muro-machi, Chuo-ku, Tokyo.

Chikuma Plow Mfg. Co., Ltd.
356 oaza Yoshikawakoya, Matsumoto-shi, Nagano.

Noda Industrial Co., Ltd.
3-41, 5-chome Asahi-cho, Takamatsu-shi, Kagawa.

Fujii Noki Mfg. Co., Ltd.
285 Koike, Tsubame-shi, Niigata.

Yanmar Agr. Equipment Co., Ltd.
62 Chaya-machi, Kita-ku, Osaka.

〈Self-propelled Automatic Thresher〉

Brand	Efficiency (a/h)	The Standard Domestic Retail Price (yen)
Iida SR600	10～15	275,000
Iseki HM20	10～20	390,000
Iseki HS3	10～15	171,000
Oshima KH-460	5～10	
Katakura FC	5～12	228,000
Kubota HR-5CR	15～20	391,000
Keo-go JH60A	5～12	357,000
Konma MT4D1	5～15	395,000
Konma MT5D1	10～20	400,000
Konma MT1D	10～20	389,000
Konma MT2D	10～20	430,000
Konma MTJ	5～15	297,000
Konma MTJA	5～12	250,000
Chikuma SH	10	240,000
Noda HB5AC	8～12	425,000
Sato F55	7.5～10	360,000
Sato G55S	10	370,000
Fujii HM-5	10～15	298,000
Fujii FHC-7	10～20	398,000
Yanmar PTC-1BCA	12～22	398,000
Yanmar PTC-2A	20～30	415,000

The purpose of developing such low-priced, simply mechanized binders is to introduce them to a wide range of users, to supply them with the same price as that for a 1-row cutting type and yet with the the same efficiency as a two-row cutting machine.

Binders with a one-side thrower are unable to perform operation other than a round cutting. On the contrary, when binders are equipped with a two-side thrower or a central throwing attachment, they are to perform a reciprocal cutting. This is an advantage. Thus, such types of binders have been developed and marketed recently.

Introduction of Head Feed Combines with Four-Side Cutting Attachment

Almost all conventional head feed combines have a threshing drum, the width of which is larger than the cutting width. Being a side cutting type, these combines are unable to operate until a manual pre-cutting has been made along the outside of the field. Such preparatory work is by no means a trifle, because the precut area reaches a 10～20% of the whole dimention where operation is to be done. This, in addition to the inability of operation other than round cutting, has extremely reduced the value in use of head feed combines.

To overtide such week points, a new type of head feed combine with an all-round cutting equipment has been developed to make a full-fledged debut in the fall of 1971. This brand-new machine not only can eliminate the preparatory manual cutting and perform a reciprocal cutting, but also will have a straw-discharging cutter. These strong points, it is anticipated, will permit the machine to rapidly become a good companion with a number of farmers.

Advant of Zenith of Mechanized Harvesting of Rice Plant

The foregoing report, although brief and concise, are to describe the status quo and tendency of the mechanized harvesting in Japan. We can again safely say that Japanese agriculture is now in the zenith of mechanized harvesting, as far as rice cropping is concerned. ■ ■

Transportation Manual in a Steep Slope Land developed by Japanese Technology

(Small Self Propelled Track Carriers)

Editorial Department Shin-Norinsha Co., Ltd.

"New Trunk Line" for Orchards, Hilles or Fields

FARMING mechanization in a steep slope land, especially mechanization of transportation, has been a long-cherished target not only for Japan, but also for almost all countries in the world. Researches and experiments there on have been made for a long time. There are, however, many problems left to be solved, before such a machine has been put into practical use.

To our delight, such types of machines have been successfully developed in Japan quite recently. As a result, steep hilly land farming in this country has undergone a remarkable change. Why? This is because new models of self-propelled carries, the so-called "New Trunk Line" for orchards, hills, or fields have been developed into practical use.

This monorail car is available even on a slope land of over 45° when a load is light (*Orange-Porta Model 3*)

Success in Most Efficient Track Carriers for Use in a Steep Slope Land

The manufacturers of these facilities of transportation are unanimously boasting that they are epock-making carriers motivated by a pioneer's spirit. Indeed it is worth boasting. Really, the development of these carriers should be hailed. The utilization of these machines has eliminated such human drudgery as farmers engaged in steep hilly land farming would otherwise have to continue to carry tens of kirograms of load on their shoulders along an unbeaten lane both at present and in the future. That is why all users have given a high assessment to these carriers.

Judging from increasing reputation among users, therefore, the carrier will widely and rapidly accepted by farmers in general.

Easy-to-Operate in a Steep Slope Land at a gradient of 45 Degree

What are these track carriers that have revolutionized transportation in orchards in a steep hilly land? It is jotted down as under: The structure of the machines is illustrated as per an attached figure. The mechanism is never much complicated. In short, it is a carrier operated by a short of monorail system, although different makers are manufacturing so many carriers.

The carrier run the monorail with the aid of a prime mover equipped with a special device. Engines are mostly an air-cooling type and their normal output is usually between 3-4H.P. The greatest advantage of this carrier does lie in its performance, able to run at a speed of 0.6 meter per second in a steep slope land at a gradient of 45°, transporting 150 kilogram of load

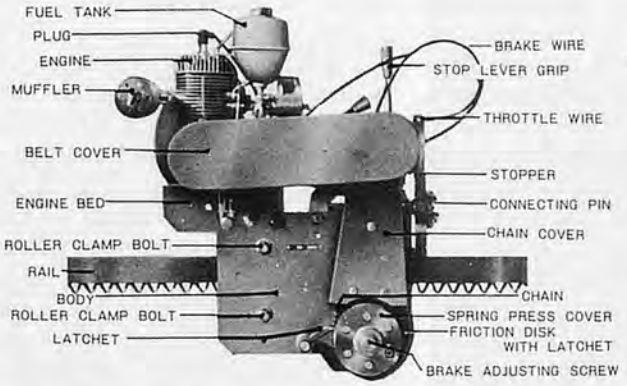
Characteristics of Track Carriers for a Steep Slope Land

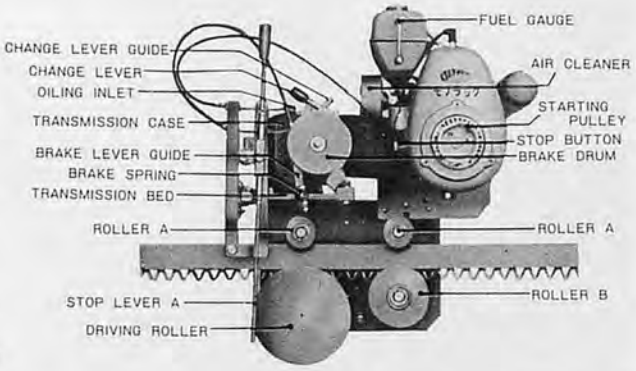
What are the points that feature these carriers? The following are the characteristics common to the respective models:

①Being self-propelled, it may save an operator a valuable time. Time thus saved can be shifted to other operation.

②The carrier can run, either forward or backward, by means of a change lever alone. Equipped with a centrifugal clutch, the engine can be started with the lever on, either forward or backward.

③Absolutely, there may be no





accident of derailment, because the rail structure is so safely designed as to be completely sandwitched in between rollers.

④Safe Braking! Because a brake has a double mechanism, which is interlocked with a stop device which can be damped proportionately to any load or gradient.

⑤It is very easy to remove a truck from the rail. Accordingly, one can operate the carrier, wherever railed.

⑥No wiring is needed, nor any horse power is wasted, however long the transportation distance may be.

⑦Racks being installed at the bottom of rail (or on top of rail), there can never be any slipping at all.

⑧Joint the rail and one can extend track distance, as one wants to.

⑨Rail can be laid easily in any narrow passage, because one can find it enough and necessary, only if one has fixed a single rail with stays.

⑩Not a single tree in the orchard is to be cut for the construction of track. Why? Because rail can be laid in any directions.

⑪Rail can be stretched in all directions by way of the switchover of a point.

⑫The carrier can stop in any place, because it is equipped with an automatic stop device which has a lever for stopper.

⑬Ground clearance of the struck being no higher than 25-30 cm, loading or unloading operation is fool-proof.

⑭Coupling device of a trailer and a truck is quite safe and strong, because it is of a double structure composed of connection pins and chaines.

⑮The carrier can run at a speed of about 0.6meter per secooned in a steep hilly land at a gradient of 45°, transporting 150-kirograms of load.

⑯No horse power is wasted. Traction power is kept stabilized. This is because the engine is so instabled as to keep proportionate to the gradient of track.

The Carrier featured by a Lot of Special Mechanisms

A number of special mechanisms other than those stated above have been introduced. A few examples are:

Automatic Brake

Even when an engine brake is in a state to work by means of the revolution of the engine, which being out run by that of the rollers, the travelling speed of the carrier can be checked by an automatic brake so as to keep it constant. Although models of engines mounted on the carriers are different in many cases, the introduction of this automatic brake has made it possible for an operator to keep a running speed constant and to apply proper braking, whenever and wherever necessary.

Roller Supporting Device

The more traction power increase, the more firmly the roller can hold the rail. Why? This is because the holding power of rollers can be adjusted automatically against the load with the aid of mutual holding power between traction power and spring pressure.

Special Kind of Synthetic Rubber Rolls

A special kind of synthetic rubber rollers having a strong antifriction power with a property of being weather tight and abrasive-proof has been introduced. Some of such rollers have scotches thereon which are easily visible to users who can judge therefrom an abrasive state of the roller.

Covered Installations Protecting Themselves Against Outside Dangers

Gears, V-belt, Chains are covered to protect themselves against outside dangers such as grits, muds, sloshed water, etc. Most safty guarded are rollers and gear boxes, which are carefully protected against winding weeds, flying or sloshing muds.

P.T.O. Pulley

A universal joint is applied for the coupling of a trailer and a truck so that the carrier may run smoothly on the curb in all directions, which may prevent a load from being damaged or collapsing.

Automatic Oil Supply Device

Automatic oil supply device is applied to rail to protect the surface and back thereof as well as to strengthen its durability and abrasive hardness.

Utility of Track Carriers

Track carriers for use in a steep slope land have various advantages as mentioned above. The utility thereof couers the following areas:

a) Transportation of materials necessary for cultivation and harvesting in an orchard, a tea fieled, a mulberry tield, etc. in a hilly land.

b) Sapraying of agricultural chemicals by means of a spreader in a slope land.

c) Transportation of protoxylems of Cortinellus *shiitake,* nursery plants for forestation, fertilizers, etc. in a hilly land.

d) Transportation of products cultured in a greenhouse in a flat land.

e) Transportation of replaced floor soil, agricultural chemicals for distribution, various kinds of materials for golf links, pastures, civil engineering projects, etc. in a flat land.

f) Transportation of hazardous objects such as gun power and dangerous machinery in a flat land.

Thus, the utility of track carriers is extending itself to a wide range of industries other than agriculture. The more is their horse power, the more the scope of their utility is becoming extensive.

The debut of track carriers for use in a slope land has caused a dramatic change to transportation in a hilly land. Once there was a time when transportation by means of cableway was popularly accepted by the pepole in orchards and forests. This means of transportation, however, has been gradually replaced with track carriers. Why? Because, in the cableway service, to select a starting place as well as terminus is virtually restricted topographically.

Track Carriers meeting with many Requirements

A lot of models for use in a slope land were marketed in the past, including cableway for farming. From a long-range point of view, it is economically more advantageous to transport by automobile rather than by cableway where the construction of farm road is feasible. For this reason, a number of farm roads have been built in hilly lands since 1963-1964.

Thus, track carriers for mechanized transportation in a slope land farming were successfully developed several years ago. This success has been motivated by a keen desire of farmers who were badly in need of a more effective carrier that can run fast at any gradient and operate efficiently in a hilly land. And at last the time has come when the present types of track carriers have made their debut.

Track Carriers are highly hailed. Why and Background?

Ministry of Agriculture and Forestry has been trying to modernize the operation in a orchard, horticulture and forestry as one of the structural improvement projects in pursvant to both Agricultural Basic Law and Forestation Basic Law. The Ministry, however, is fully contended with the construction of farm roads or forest roads, as far as the rationalization or modernization of facilities of transportation is concerned.

It is one thing to rationalize or modernize transportation on the flat farm road or the gently slope forest road, but it is quite another to do so in a steep slope land. Why? It is because things in the latter case are extremely different from ones in the former. It is not until track carriers has made debut that the Ministry has been able to do something about the modernization or rationalization of transportation in a steep slope land. This is not too much to say.

Legally permissible Gradient of Farm Road-Maximum Angle of 10°

Too much steep road is unavilable to conventional carriers on account of their insufficient performance of gradeability. Therefore, maximum gradient angle of the road in a slope land shall be 10°, according to Road Structure Act. This being a maximum degree, it is desired that such level be held down to 8-9° to perform safe operation. For example, in pursvant to "Fundamental Policy on the Introduction of High Efficient Farm Machinery" mapped out by MAF, maximum gradient for running type pest control machines is prescribed as follows:

a) In case of such machines

This two-wheel type transporter runs along guide rail (*Wamulass Line carrier DW-10*)

trailed by a pedestrian tractor ·····about 6°

b) In case of such machines trailed, loading, or self-propelled ·····about 8°

Track Carriers Gainning Advantage over Transportation on the Farm Road

Thus it is evident that to rationalize transportation with the aid of building roads has a limit in itself. In order to rationalize transportation in a steep hilly land, the best solution does lie in the introduction of the track carrier system. Even if farm roads were built in a steep slope land for use in some carriers (such as automobiles) having a safe performance to grade up or down thereupon, it would tremendously cost us the development of such models. Accordingly, such a project is utterly impracticable. This impossibility will even more be endorsed by the rigid fact that to construct farm roads, a number of fruit trees, shrubs and non-fruit trees are doomed to be felled down. Under the circumstances, the most economical and effective transportation in a steep hilly land in the present stage is nothing but transportation of track carriers themselves.

For this resons, the rationalization of transportation in Japan's slope land farming is being pushed powerfully to introduce, as its basic line, the most economical method suitable for land conditions, where both the construction and improvement of farm roads and utilization of carriers in a steep hilly land co-exist. It is needless to mention that the agricultural administrative policy is going in parallel with this target.

Steep Slope Land is defined as the Hilly Land with Gradient of not less than 15°

In Japan there is no established rule by wich to classify the so-called "Slope Land", nor have we any definite terminology thereof. The following are some of the examples indicating the classifications of slope lands that are prevalent in this country:

a) A hilly land in contrast with a flat land.

b) A slope land within the category of agricultural zone (at a gradient of less than 8°, 8°-15° or more than 15°).

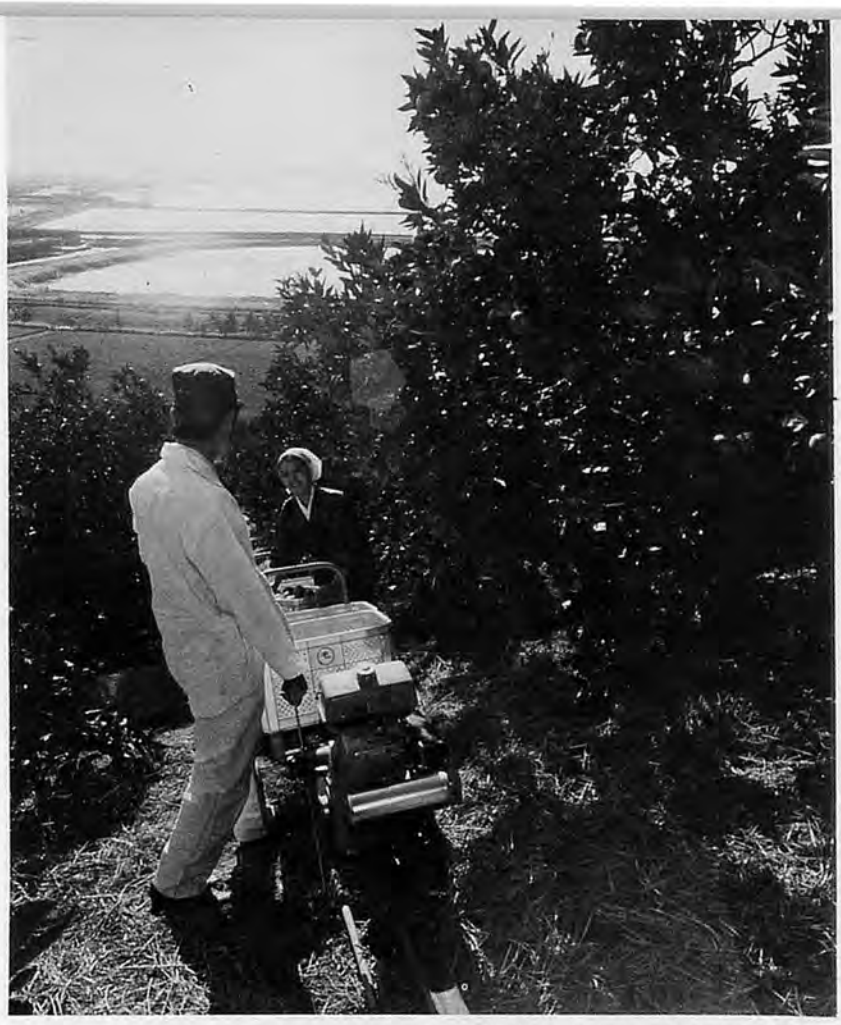
c) A hilly land in a strict sense of the word classified by a gradient alone as 8°-15°.

The following nomenclatures, however, are most popular in Japan:

a) A gentle slope land ·····5°-15°

b) A steep slope land ·····more than 15°

c) A very steep slope land ·····This terminotogy is sometimes applied to 20° or more.



Many horticulturists utilize a monorail car which they can start and stop as they like it (*Nikkari Mono-Rack M-70*)

Steep Slope Fields occupy at least 20% of Total Field Area in Japan.

The following are the percentages of the field area in Japan by gradient angle, according to the investigation made by MAF in 1964:

a)Less than8°·····55%-(664,000hectares)

b)15° or- more·····20.5%-(554,000hectares)

The total field areas are 2,712,000hectares. Thus, we have come to know that steep slope fields occupy 20.5% of the total field areas. The percentage of land utilization against the whole land areas in this country is about 16%, a considerably low level in the world. The land utilization percentage in the world is shown as below:

European countries·····50-70%
South America, North America (excepting Canada which is 6%) ·····50～60%
Oceania·····50～60%
Asia(excepting India which is 54%)····· 2 0 ～30%

The above figures prove how low the land utilization in Japan is.

Zenith of Track Carriers is around the Corner

Why is it that we have explained about the gradient angle and the land utilization? Because the increase in the land utilization in Japan does depend on the positive use of a steep slope land, which-in turn, does rely on the prompted mechanization of a hilly land farming. The mechanization of a gentle slope land farming has made a remarkable progress recently. Tractors, combines or pasture machinery have also been introduced there. Research and experiment to propel the mechanization of hilly land farming become more and more fruitful year by year. Joint and overall study on farm machinery between crop raisers and scholars have been conducted more closely. To our regret, however, the mechanization of farm land at a gredient of 15° or more is still in embryo. Under this environment, track carriers, farmers' long-waited-for dream for a steep hilly land transportation, have been developed and put to practical use. Imagine, therefore, how great the farmers' repercussions are! Transportation in a steep slope land still depends much on human labour, however. Viewed from various angles, it is likely not too distant future when track carriers will be made the best use of.

In order to push through mecanization in a steep hilly land, we have such an unsolved basic problem as "Which is more effective, to cut off a slope or to develop a machine to run on? Still more, there is a pipe dream to flatten a steep slope land. This, however, is unrealistic in terms of economy. As a matter of reality, mechanization itself seems to be a royal road to solve transportation in a steep hilly land. The track carrier will play an starring rall on what is expected of.

Automatic Device for Safety

The rudimental causes for decrease in mechanical performance in a slope land, are ascribed, in a nutshell, to the following facts:

a) Both machines and crops have a propensity to incline downward.

b) Machines have a property to side-slip.

These phenomena are the underlying causes for tumbling-down, reckless operation or decrease in the capability, of machines. The best solution thereof is to introduce automatic device. Track carriers have been developed aiming at this target. The track carriers that have been put use since several years ago are a kind of movable power source. The carriers have had a wide acceptance as a power source in a steep slope land, because it needs only a small land it requires a less construction cost than farm road. This does not mean, however, that the track carriers avilable now are everything. The future model to be hoped for should be much lager and stronger with a hydraulic mechanism. The research for such model is still in the process of preliminary experiment. It seems, however, that the development thereof will be prompted faster than we expect.

The Sales Price:¥300,000～¥400,000 (Japanese Currency:Yen) Including 180 Meters of Rail Track

This noteworthy track carrier is locally sold at ¥300,000 including 100 meters of rail track material. The prices are slightly different, according to the made of painting of rail (plating or red painting). Take an example of "N" Company in Japan.Its local sales price in 1971 stands at ¥322,500(except for freight and wages for construction). It is breakdowned as under: Main Body (with a 4HP engine and a centrifugal clutch) ……¥137,000
100Meters of Rail(with stays and metal tools) ……163,200
One unit of truck ……¥22,000

Total ¥322,200

The above sales price is estimated at C.O.D. It will be somewhat higher, installment or by note.

Please refer to the enclosed "List of Manufacturers", lf you are interested in the purchase (import) of these carriers. Any markers who have received your enquiry will be ready to serve you to the best of their ability by sending you their price list, literature, catalogues, etc.

How to Operate Track Carriers

How to operate track carriers in a steep slope land? If we give this a title "Operation Manual on Track Carriers developed in Japan in Steep Slope Land", it will really sound a dramatic one. The mechanism thereof, however, is too simple to require full explanations.

Orderring of operation is as under:

① Push down or full down the starting lever, as the case may be.
② Keep the change lever neutral.
③ Open the fuel cock.
④ Shut the choke lever in full.
⑤ Start the engine with the starter.
⑥ Open the choke lever in full, upon engine's starting.
⑦ Push the change lever forward. Pull it bacward.
⑧ Put the starting lever into its position.

The drive vehicle will start, according to the above order. The vehicle, then, will stop automatically by means of the rail stopper. This stop, however, is in a state of keeping the engine running slow. Push the switch button therefore, to halt the engine completely.

This manipulation can also apply either to the operation of grading-up or grading-down. The automatic device, as already explained, is equipped for grading-down operation. The carrier is safe at all! The operation is fool--proof for those who some knowledge about the engine. Two or three time practies will make it easy for those who are only a beginner on the engine to manipulate the carrier on a steep slope land. Its mechanical structure is

so simple, handy and safe that even a child can operate it.

Everybody can easily gain the Mastery of Operation

These track carriers for a steep hilly land can be used not only in this country but also everywhere in the globe where there is a hilly land at gradient of 45° or less.Soil conditions are not a vital factor. Only sufficient supply of engine fuel is a prerequisite to the mechanization of transportion in a steep slope land. Isn't this as happy a story as a dream? No, it's no longer a dream. In Japan, it is already a happy reality-a reality in which such mechanization is progressing at a rapid pace.

There is a proverb saying "Seeing is beliving!" As the proverb goes, please come and see our Track Carriers for use in a steep hilly land. For those who could not spare time to visit Japan, several pictures are introduced here to illustrate transportation operation.

The Background of Developed Machines and their Future Challenges

Now we are entering into the last stage of this report where we think it necessary to explain to the readers about the background of the introduction of and the future challenges to track carriers.

Japan, as explained already, has too many slope lands. Farming in such a field could not be done without a heavy drudgery. To mechanize farming in a steep hilly land was a long-cherished dream of hundreds of thousands of farmers who had had to work there. Among the rationalization farming operations, what was most keenly desired for was to mechanize transportation.

Take an example of orange cultivation in Japan. Not less than the 60 percent of total labour requirements were spent for harvesting and transportation. These two operations have hither to depended almost an human labour. We could not, therefore, appreciate too much the hardships thus experienced by those who were engaged in such hard labour.

As a means of transportation, various kinds of facilities such as trucks, cableways, wheel barrows, etc. were introduced in their own ways. They have terefore had their merits and demerits, respectively.

It was four or five years ago that the preasent models of track carriers for a steep hilly land were at last developed, which have successfully eliminated such defects as conventional machines had. This is the reason why our track carriers are most efficient for transportation in a hilly land.

The fundamental concept of the development of such track carriers for a steep slope land is this: "A safe-guarded carrier which is capable of running at a speed of 40-50meters per minute in a steep slope land at a gradient of 45°, transporting 150 kilograms of load." Along such basic concept, a number of carrying devices have been developed including a geartype track (synonymously, a rack system), a roller-type and a pin-rack system. Only two types, however, have outlived the rest for reasons of expenses, economy and safety, they are the gear-type and the roller-type. In Japan there are 10 and odd manufacturfrs of these two types. At the end of 1970, Japan had about 11,300 units of these two models.

Increase in Safety and Improvement of Performance

Roughly speaking, we are confronted with two main challenges toward the future. One is the improvement of mechanical performance and the other the increase in the safety of machine operation.

Utilization of track carriers has been year after year spreading itself not only to a steep slope land, but to a flat field as well. Voices from full-time farmers in orchards, however, are more and more loudly mounting, "Develop and give us more efficient carriers!." To meet with their requirement, the improvement of basic specification of machinery is necessary. For the expansion of utility, more and more models should be introduced.

What is very important for any models is a problem of safety. Therefore, every and each track carrier for a slope land transportation now under sales is equiped with a safety device. The intro-

Carrying work by a monorail (Kyoritsu KMR-1) in an orange Orchard.

duction of large carriers has necessitated them to be equipped with a more precise safety device such as hydraulic system, although this installment has already been introduced partially.

As one of important measures to increase safeguard, some enlightenment not overload a carrier should be more intensively campaigned to user in general. In the early stage of the introduction of the machines, we had some cases of accidents, which were due entirely to the overloading or misloading on the carriers. Such a case as to have a person get on the carrier, is of cours, a matter of taboo.

Do not forget that loading capacity has much to do with an angle of inclination. To safeguard men against danger, all manufactures have unanimously decided on tacking the following label to their carriers, warning "No person is permitted to ride on". The some effect is to be printed in their catalogues or literature.

Export of Track Carriers will be gradually on the Track

We have the firm conviction that it will not be long before the day comes when track carrier service will be extended every where in a steep slope land in Japan. The export of track carriers will also gradually be on the track, we are firmly convinced.

■ ■

Manufacturer's Name and Address of Monorail Car

Eruta Machinery Industries Co., Ltd.
4–722 Asagayakita, Suginami-ku, Tokyo.

Kyoei Industrial Co., Ltd.
485 Higashiishii-machi, Matsuyama-shi, Ehime.

Kyodo Seiko Co., Ltd.
2059 Miyoshi, Okayama-shi, Okayama.

Kyoritsu Echo Bussan Co., Ltd.
379 Shimorenjaku, Mitaka-shi, Tokyo.

Koei Industrial Co., Ltd.
779 Miyashita, Iyo-shi, Ehime.

Sekisui Koji
32, 1-chome Dojimanaka-machi, Kita-ku, Osaka.

Sekiya Agricultural Machinery Co., Ltd.
10–4, 8-chome Sanban-cho, Matsuyama-shi, Ehime.

Chigusa Sakudo Co., Ltd.
4–27, 2-chome Kosaka-machi, Matsuyama-shi, Ehime.

Nagata Mfg. Co., Ltd.
3–1, Sanada-machi, Tennoji-ku, Osaka-shi, Osaka.

Nippon Reaper Industry Co., Ltd.
482–1, Otami, Okayama-shi, Okayama.

Nippon Industrial Macinery Co., Ltd.
1, 2-chome Ningyo-cho, Nihonbashi, Chuo-ku, Tokyo.

Nerita Shoten
78, 4-chome Goike-dori, Kita-horie, Nishi-ku, Osaka.

Fuji Robin Co., Ltd.
8–1, 1-chome Nishi-shinjuku, Shinjuku-ku, Tokyo.

Marunaka Mfg. Co., Ltd.
11 Nishi-machi, Mukada, Kichishoin, Minami-ku, Kyoto.

Monorail Industries Co., Ltd.
440–3, Fukuonji-machi, Matsuyama, Ehime.

Uniper Industries Co., Ltd.
989 Sasashita-machi, Minato-minami-ku, Yokohama, kanagawa.

Monorail Car (including 100 meters of rail)

Brand	The Standard Domestic Retail Price (yen)
Eruta Line Carrier KC–10	325, 000
Eruta Line Carrier RC–10	350, 000
Eruta Wamulass Line Carrier DW–10	260, 000
Eruta Wamulass Line Carrier SW–07	200, 000
Orenge–Porta Model 3	300, 000
Kyoei Auto–Coaster GH107	310, 000
Kyoritsu KMR–1	280, 000
Koei Monorail	310, 000
Seiko Auto–Wagon GM3	320, 000
Sekisui Mono–Rator	394, 000
Sekiya Roll–Power	300, 000
Chigusa Roll–Power	300, 000
Nagata Monocar CM–2	400, 000
Nikkari Mono–Rack M–70	322, 000
Nerita Roll–Power 1KD–2	330, 000
Hope MH–110	320, 000
Marunaka Royal–Raicar R–1	360, 000
Uniper Hydrau–Coaster UP 205	350, 000

Agricultural Mechanization in Japan

"Yanmar Farm Village Factory"

Masazo Kanazawa
Managing Director
Yanmar Diesel Co., Ltd.
Osaka, Japan

1. Preface

YANMAR Diesel Co., Ltd, as a specialized manufacturer of diesel engine, produces more than 3,000 kinds of diesel engines of 2~2,000H.P. for agricultural, industrial and ship building use. The monthly production amounts to 38,000 pieces in number, which comes up to 312 million a year in terms of H.P.. Based on our motto "Customer First", we have been engaging in developing Yanmar diesel engines and other related working machines in order to supply users with satisfactory goods of quality.

For the industrial purposes, our engines are used in many fields such as civil engineering and construction (generators, welding machines, compressors, hand-dozer, and suction and draining pumps), telegraph, telephone, micro-ware for relaying T. V. broadcasting, emergency generation of electric power for hospitals, schools, buildings and have gained popularity.

For ship buildings they have won public confidence for the use of boats, cruisers, ferry boats, cargo vessels, tunkers, working boats and other boats for special purposes as a main engine or a supplementary one.

For agricultural purposes, our engines are applied to the motors of many agricultural machines which are indispensable to promote agricultural rationalization and mechanization. They have also been put confidence to and used habitually in many fields not only in Japan but also in more than one hundred foreign countries along with other agricultural machines such as tractors, hand tractors, rice planters, harvesting machines (binder combined harvestor and huskers), rice-cleaning facilities and riceplant manufactured in local specialized factories.

In the future, too we will make further efforts to develop excellent diesel engines and other relevant machines by technological innovations under strict quality control, which, we trust, will con-

Nagahama Parent Factory

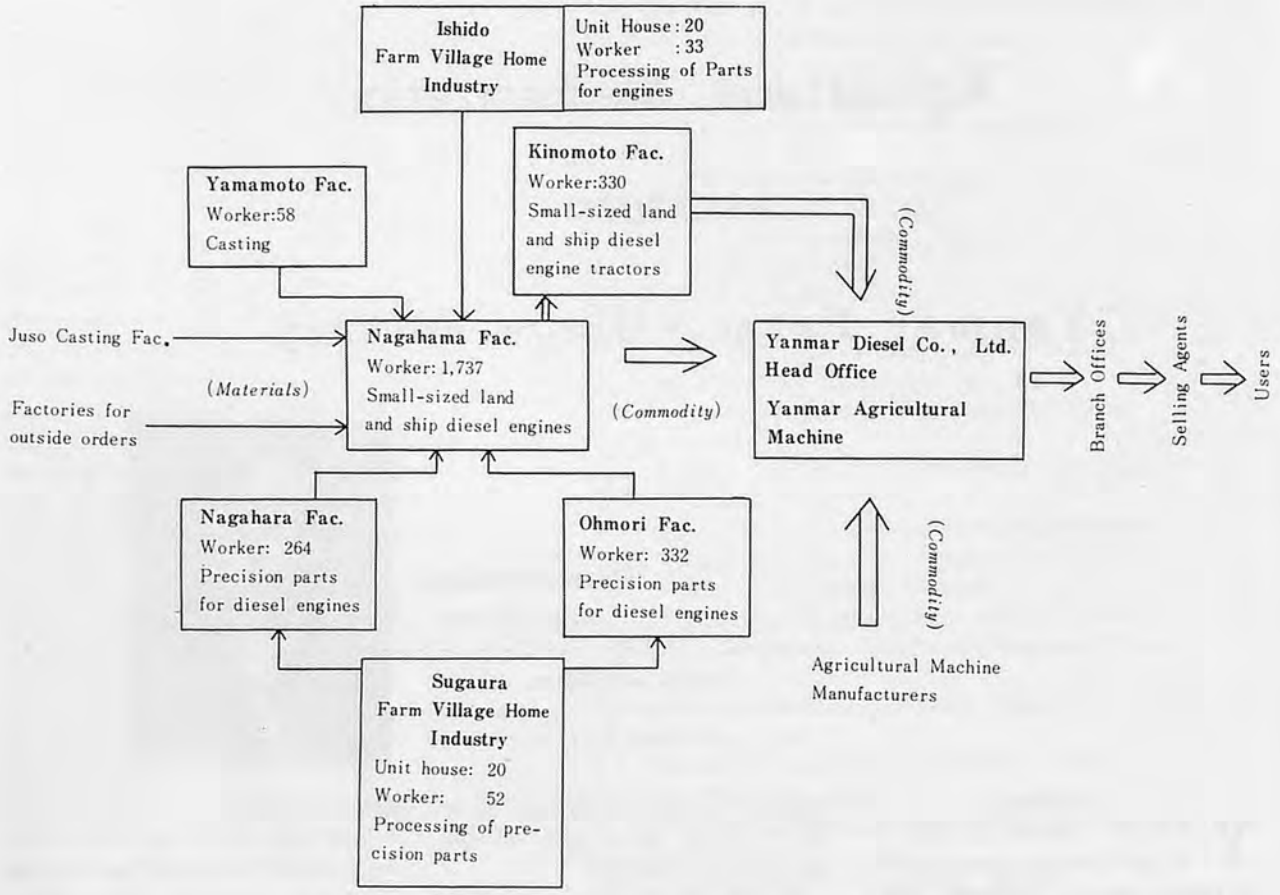


Illustration 1. Relations between parent factory and village factory

tribute to the development of our community both in culture and industry.

We manufacture our large and middle sized diesel engines at several factories in the vicinity of Osaka city.

"The Yanmar Diesel Farm Village Factory" we wish to introduce here is responsible for the production of parts of Nagahama parent factory which mass-produces small-sized diesel engines. It is a group of satellite factories which have been successfully managed by many unique points of their own.

"Switzerland has the precision machinery industry of watches" whereas " Japan has village industry of Yanmar diesel engines". It was an ideal deeply engraved to the mind of president, Magokichi Yamaoka, founder of Yanmar Diesel Co., Ltd. who was born near Biwa Lake, Shiga prefecture and is a self-made man. He succeeded after several years of strenuous work, in making small-sized diesel engines of less than 5 h.p., the worldmost small engine, in 1933 though it had been considered impossible in those days. Among many people who advocated that agriculture should be mainstay of Japan, President Magokichi Yamaoka volunteered and promoted it in order to raise the cultural level of farm villages by agricultural mechanization and industrialization. His ideal was finally realized to be "Yanmar Village Factory".

We would like to introduce here some factors which brought about the success of the village factory from the standpoints of control and management.

1.1. Outline of Shiga Production Office

Yanmar Diesel's Shiga Production Office as a specialized factory for small-sized diesel engines, consists of four village precision factories and two "Village Home Industries" belonging to Nagahama parent factory which has the ability to make 35,000 engines a month. The items produced include smallsized diesel engines for agricultural, land and ship building, rotary engines, tractors as main products. The parts of fuel sprayers, die-casted aluminum items are also produced here. This group of factories has 2700 people who works there and 2,000 machine tools.

1.2. The relations among Nagahama Factory and its branch factories

You may see the relations among the parent factory and its branch factories from the illustration.

Four branch factories and two Village Home Industries, which

Ohmori Village Precision Factory

are under the control of the parent factory are scattared in the villages within 30 kilometers distance. This group of factories are called "Yanmar Village Factory".

2. Village Factory and its Features

"Yanmar Village Factories" are run in the two manners that follow. The one is "Village Home Industry" and the other is "Village Precision Factory". From **illustration 1,** Ishido and Sugaura Village Home Industries belong to the former and Ohmori, Nagahara, Yamamoto and Kinomoto belong to the latter. Those four factories are called "Village Precision Factory"

2.1. Farm Village Factory

"Farm Village Home Industry" is a small workshop attached to the yard or vacant lot of farmers. 10 ~15 square metters of Unit House and a couple of machine tools will be enough for working whenever farmers find time. On the other hand, "Farm Village Precision Factory" supply young people with employment opportunity in precision industry which requires special technique although there is unlikely to be much difference from other similar factories.

There is some difference in that the former can be grasped as "utilization of surplus time" while the latter as "utilization of surplus population" of farm villages.

2.2. Features and difference of Farm Village Factory

These two kinds of factories could be briefed as below.

(Farm Village Home Industry)

1. Scores of shops scattered in a community are directly connected to home.
2. Each farmer has ownership.
3. Free work regardless a worker's age or sex or day and night.
4. Payment against actual production.
5. Utilization of surplus labour time. Improvement of income.
6. Processing of single parts so efficiency and quality can be expected.
7. Extention of home. Control charges are comparatively small.

(Farm Village Precision Factory)

1. Managed as collective factories.
2. Workers are ordinary employee.
3. Mainly young people. There is limit to working hours.
4. Time wages.
5. Utilization of surplus population for the production of precision parts. Promotion of industrialization.
6. There are good enviroments, home, age and human relations so efficiency and quality are good.
7. Saving of commuting time, and charges. There is financial stabilization in the future.

3. Management of Village Factory

Nagahama Factory introduced a quality control system, rationalized testing system of the products, and promoted the standardization of manufacturing process in 1954 when applied for the use of JIS mark. Since then, we have pursued the completion of management control system, the mass production system to produce good machines at reasonable cost and the grasp of creative ideas of employees under the keen increase in the production amount resulted from the agricultural mechanization as well as the intensification of market competition. Since 1966, we have bee promoting "YQM (YANMAR QUALITY MANAGEMENT)", or comprehensive quality control. During that period, we won Deming prize for 1968. Especially in standardizing of manufacturing process, which was done with the emphasis on the guarantee of quality, we promoted standardization from "written form of detailed and fixed standard" to "standardization which is helpful for the control of routine works as well as for the prevention of errors". This shows the development from "standard which should be observed" to "standard which could be observed".

In the village factories, too, the principle of standardization of Nagahama Factory has always been practiced. The control and management is however, somewhat different from that of the outside factories other than Yanmar group with which Yanmar places orders. We are also trying to level the quality, cost and delivery time with the outside factories but this is, at any means, done on the basis of the relations between independent enterprises. Farm village factory is originally one of the departments of ours in respect of control and management. But when one is aware of its geographical conditions and working environment of a farm village, one can see more difference from those of ordinary outside factories. On the other hand,

a farm village home industry is substantially an independent factory. But it should be managed as a department of ours when we consider the close relations with us. In any manner, the group of factories can not give full play to their production capacity without making the most of the precision or home factories in the farm village while Nagahama parent factory is responsible for every function for the production and management of the group.

The relations viewed from the standpoints of Q (quality), C (cost) and D(delivery time) are illustrated as **illustration 2.**

We would like to explain the relations between the parent factory and farm village industry on the quality planning and daily control.

3.1. Quality planning of parent factory

It is needless to say that whether importer relations among the quality, cost and delivery come out or not depends on how preparatory investigation is done and how production preparations are made. The parent factory is completely responsible for these points in deciding the production items by farm village factories, that is,

(1) Check on the blueprint for production

(2) Check on the function and efficiency of products.

Check on the relations between the processing ability and the quality planned.

(3) Completion of production working standard (processing plan, production method, facility, jig and tools, standard time, etc.) and the decision of standard for test.

These matters are adopted by any factory apart from their preciseness. But especially in the case of our system, "A parent factory must make analysis of processing troubles ahead of actual production through trial processing of the products which are to be trusted to form village factories with its facility planning". This is a rigid principle which we have observed so far though we are now enjoying much improved techniques and quality nowadays. The only exception is when we make a product with which we have the experience on a similar

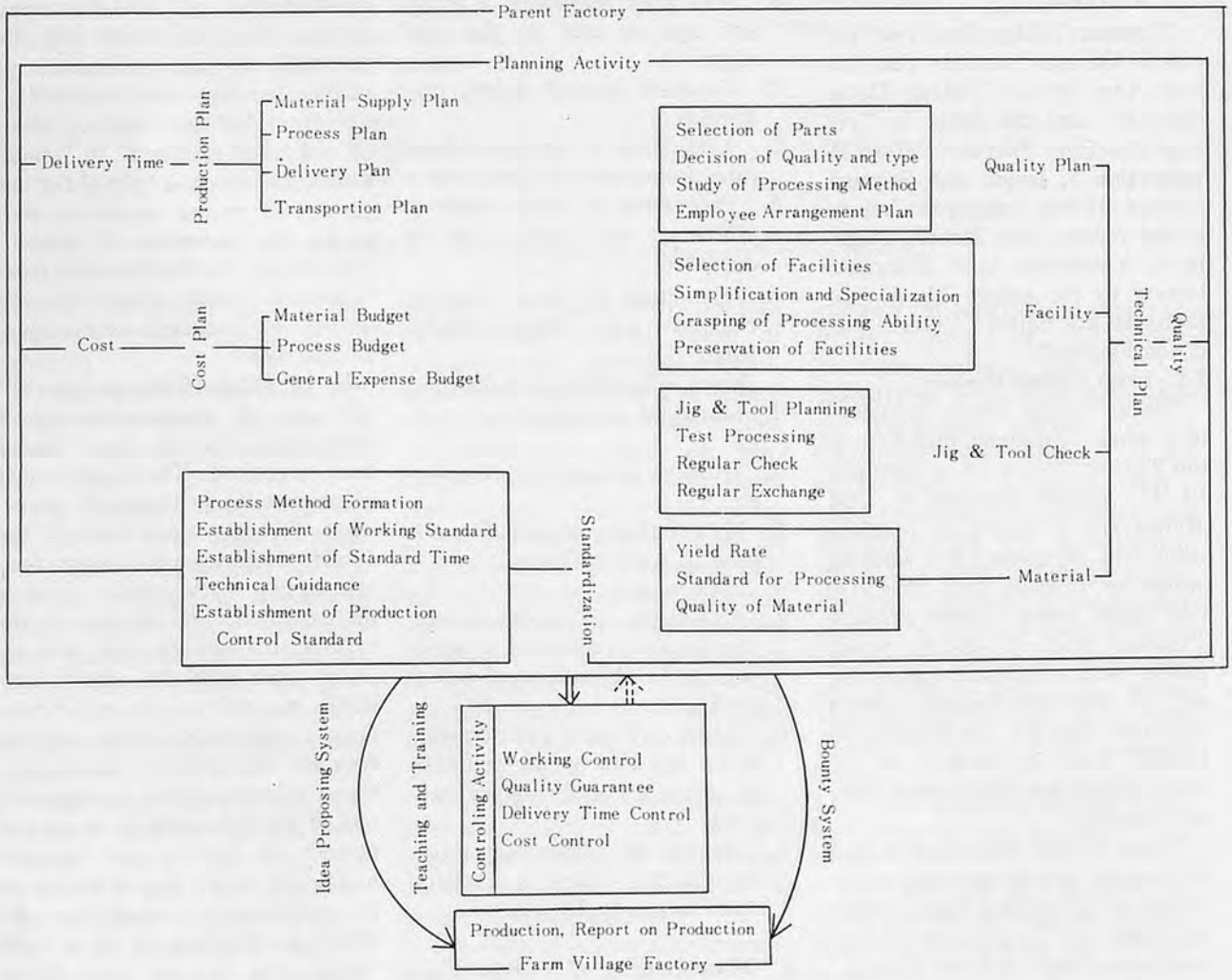


Illustration 2. Relation between parent factory and farm village factory on control activity

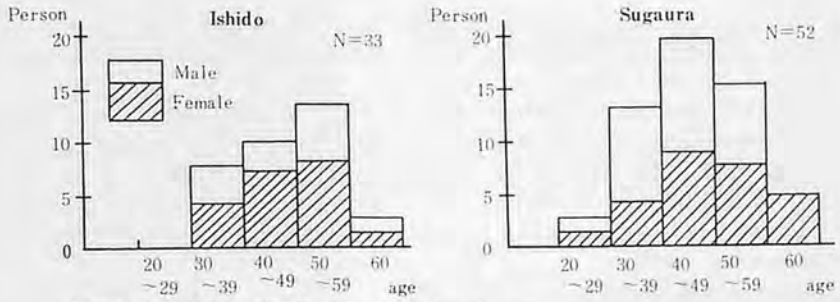


Illustration 3. The distribution of workers by age

one.

The production by farm village factories is different from a parent fachin that it is carried orand standardization. The assignment of the according to the ability of each worker, facility and processing method are examined before the decision of quality planning. The solution of the primary troubles, which are often seen in the case of the orders placed to outside factories, are left to the staff of a parent factory, thus enabling farm village factories specialized in the maintenance of quality, cost and delivery on time as well as the raise of productivity.

3.2. Daily control at farm village factory

The points of daily control at farm village factory are, as the main point of control like production preparation is available from the parent factory as mentioned above, confined to the ability of workers (ability and will). The composition of workers of farm village factories include the young and old, and males and females as is seen from **illustration 3.** So a system designed to have them understand the high-level technique from a parent factory and have them make the use of it must be established while efficient utilization of labour is carried out through the frequent exchange of workers or aid of labour.

The daily control activity, therefore, consists of the control by a technical guide from a parent factory and the volunteer control by workers themselves. A technical guide is a graduate of a technical training school attached to a parent factory. He must be from the country and a man of character and ability. He also must have experience of various sections. He is sent to farm village factory to assume the position of management. The main managing activities are as follows;

(1) Guidance of working
(2) Check on the quality and progress of production by patrolling
(3) Preservation of facilities-(check, light fixing and plural workers, the processing fee is even pplication of fixing to the parent factory)
(4) Feedback of quality information to the parent factory
(5) Planning and control of processing, arrangement of work and transport of materials.

The daily control activities volunteered by workers are as follows;

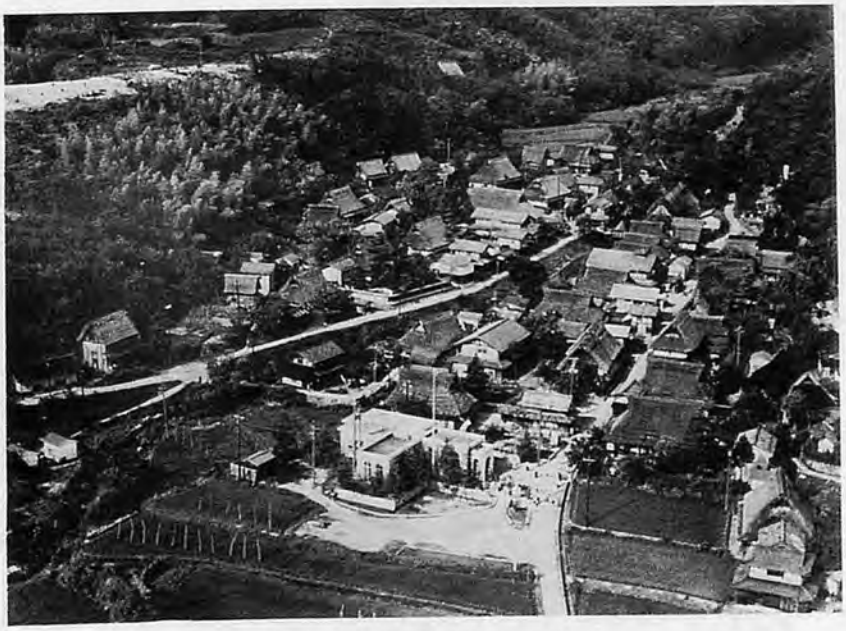
(1) Makeup of "my working standard". Quality examination by check sheet when they start working and exchange tools.
(2) Formation of a small group according to each parts. Collective study of problems about their parts and processing.
(3) Volunteer arrangement of time shortage against production as well as labour-aid planning and control.

These are basic points to promote minute control.

3.3. Co-existence and mutual prosperity with community

We have already explained that farm village home industry is managed on the principle of "Cultural Improvement of Farm Village by Industrialization" by the First President, Magokichi Yamaoka. In addition to the increase in income, it can contribute greatly to the community through the close daily control of production.

According to the principle of the co-existence and mutual prosperity among a private enterprise, farmers and community, "Mutual Prosperity Society" has been maintained even since the farm



Ishido Farm Village Home Industry

village home industry was introduced in 1952. The opinions have been exchanged between the workers and parent factory through this society. There is also a wire broadcasting facility, which was introduced in 1953, so as to make the community functions as well as business of factory go smoothly. We have also been giving aid to the welfare of workers, which has close effects on the benefit of company, either.

Especially in the farming busiest season, we give aid to the rationalization of farming by lending them our machines like a hand tractor, which is helpful to spare their time in home industry to secure the punctuality of delivery.

Generally speaking, farmers are not so sensitive to time, so it requires an accumulation of efforts for control and management, based on the proper understanding of characteristics of human relations and community, to standardize them into "farmer as a worker processing iron".

3.4. Bonus and penalty system

A processing fee was paid by the simple calculation of "Unit price × Quantity of passable product" when Farm Village Industry was introduced first. But in order to meet the changing social situation, we have adopted a bonus system talking the processing amount and working years into consideration and a penalty system in order to improve quality and delivery. Nowadays, the payment is done according to the following formulae.

Processing Fee Paid = (Total Quantity-produced − Total Unpassable Quantity) − Improper Processing Quanity + Quantity by Inferior Matbrials/2

Unit Price + Bonus Money

(1) The more the production and working years, the higher is the bonus rate.
(2) The standard bonus rate will be increased according to how he gave labour aid to the other workers and how he cooperated with the technical guide.
(3) Joint liability system is adopted. In the case of a factory with plural kinds of processing and plural workers, the processing fee is even paid according to the quantity passed.
(4) Great importance is put to the responsibility for quality. The decrease in the price is doubled in the case of inferior processing.
(5) Standard bonus rate is decreased against the delayed delivery.

The standard time, which forms the basis for a processing unit price, is set according to PTS formula. So it is calculated on the same level with Nagahama factory.

A Farm Household's Workshop in Ishido

4. Closing Remarks

The reason why "Yanmar Farm Village Factory" have attained the success of today, as we have just explained above, can be briefed into:

(1) We had good time, management policy and guides for the establishment of farm village factory.
(2) We had a good geographical conditions.
(3) It has a nature of independent enterprise.
(4) There were repleted facilities in the parent factory, tec.

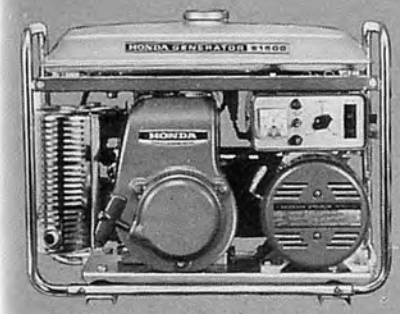
The success, however, ows greatly to the love for home of First President, Yamaoka to promote agricultural mechanization, the characteristic harmony supported by the deligency of farmers and the basic principle of co-existence and mutual prosperiry. We consider that the achievements of farm village factory could not be realized under its special condition without that principle and our consistency to make the standards meet those of a parent factory.

Recently quite a few enterprises have come out from cities and advanced into the country to seek labour population while surplus population in the country are becoming smaller. We have faced now the time when we must make study again on the farm village factory.. We will promote the standardization of quality and the raise of technical level further. The raise of ratio to process high class parts is necessary for increasing in income.

We hope that this factory will be developed further to the benefits of farmers and ours. ■ ■

Ever See a Wheelless Honda?

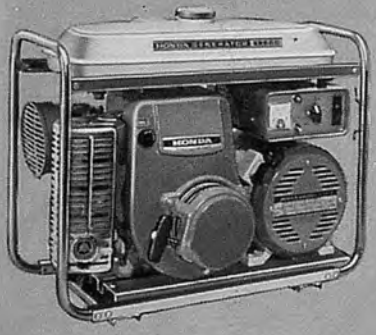
The world's largest and most advanced motorcycle maker has applied its renowned 4-stroke engine technology to a multitude of non-automotive uses. You get the same Honda high quality and meticulous workmanship in each of these power products.



E1500 Portable Generator
4.5 hp gasoline engine.
120-240V 1500W AC
and 12/24V 100W DC.
Weight: 53 kg.

E300 Portable Generator
1.1 hp gasoline engine.
117-240V 250/300W AC
and 12V 70/100W DC.
Weight: 18.2 kg.

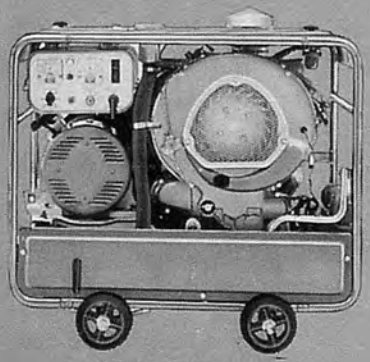
F28 Garden Tiller
2.8 hp gasoline engine.
Complete series of
tilling implements for
every agricultural need.
Weight: 37.9 kg.



E2500 Portable Generator
6.8 hp gasoline engine.
120-240V 2500W AC
and 12/24V 100W DC.
Weight: 79 kg.

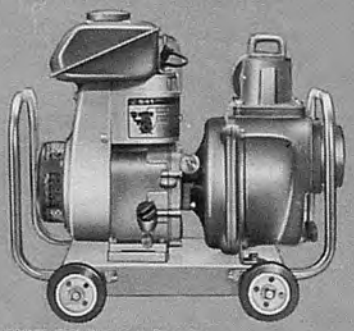
E800 Portable Generator
2.8 hp gasoline engine.
120-240V 800W AC
and 12V 100/120W DC.
Weight: 35 kg.

G41/G65 General Purpose Engines
171 cc (G41) or 240 cc (G65)
gasoline engine.
Output: 4.5 hp at 4,000 rpm (G41);
6.8 hp at 4,000 rpm (G65).
Weight: 17 kg (G41); 29.1 kg (G65).



E4000 Diesel Generator
10 hp diesel engine.
120-240V 4000W AC
and 12/14V 100/200W DC.
Weight: 183 kg.

EC1500/EG1500 Portable Generators
4.5 hp gasoline engine.
120-240V 1500W AC.
Weight: 37 kg (EC1500);
40 kg (EG1500).



W20/30 Water Pump
4.5 hp gasoline engine.
Self-priming aluminum pump.
Suction capacity: 0.65m³/min. (W20);
1.00m³/min. (W30).
Weight: 48kg (W20); 53kg (W30).

HONDA
HONDA MOTOR CO., LTD. TOKYO, JAPAN

ADVANCE YOUR FARMING WITH VARIOUS ROBIN PRODUCTS !!

Suitable for women use, It weight is only 7 kg lighter than a human power sprayer !!

Robin 3K shoulder type power sprayer Model RS02IIR

World most renowned Robin Dust & Mist Blower!!
Model NF32ADM

Robin Combine
Model GH52

Robin Binder
Model RH35

Robin Tiller
Model L6

Robin Power Rotor
Model RC05II

Robin Power Sprayer
Model AS25

Robin Pump
Model S15A

Rabbit Chain saw
Model CL60

Rabbit Fire Pump
Model P406S

MITSUBISHI ENGINES

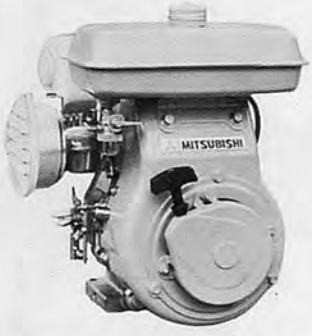
Our advanced engineering skill and well-equipped facilities offer you a variety of small-and medium-sized engines covering 0.8-1100 HP output range. Their excellent performance outstanding durability and remarkable fuel economy have gained us a solid reputation in unlimited application agricultural machinery, stationary power plants, generators, construction machinery, fishing boats, etc. Various types are available: 2-or 4-cycle, air-or water-cooled clockwise or counter clockwise rotation, and gasoline, kerosene or diesel fuel system

Mitsubishi MEIKI Engine Series (0.8－11HP)
Air-cooled Gasoline (4 cycle, 2 cycle)
Air-cooled Kerosene

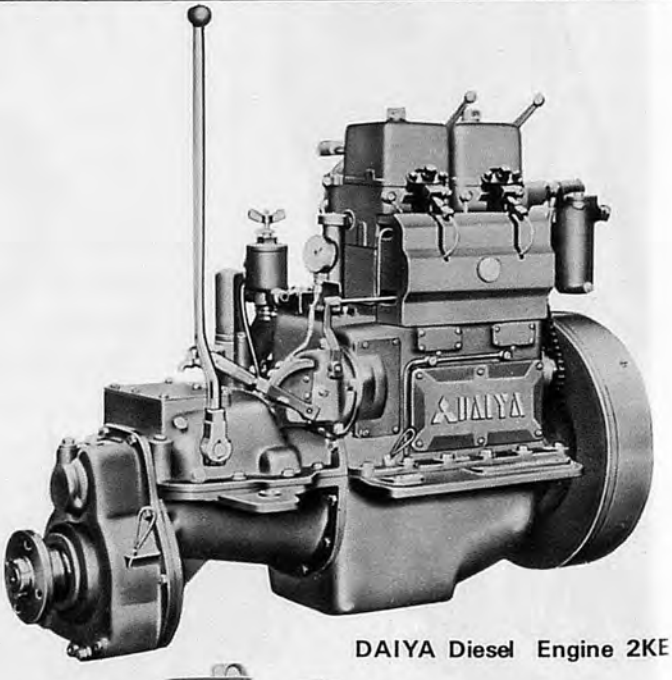
Mitsubishi KATSURA Engine Series (4－16HP)
Water-cooled Diesel
Water-cooled Kerosene

Mitsubishi Diesel Engine Series (12.5－1100HP)

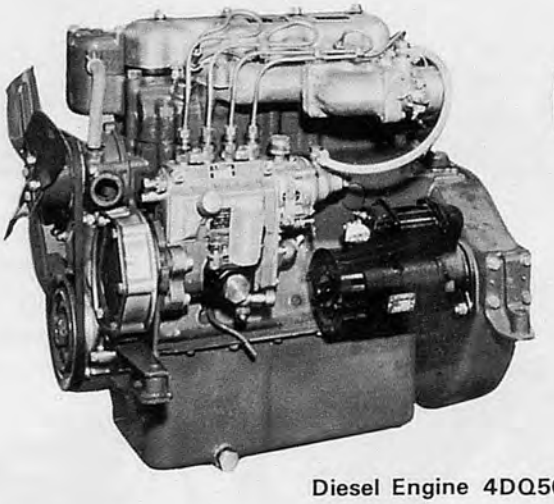
Mitsubishi DAIYA Diesel Engine Series (4－1000HP)



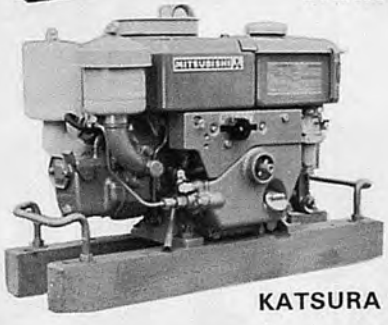
MEIKI Engine G450



DAIYA Diesel Engine 2KE



Diesel Engine 4DQ50



KATSURA Diesel Engine M4H

Manufacturer
MITSUBISHI HEAVY INDUSTRIES, LTD.
5-1, Marunouchi; 2Chome, Chiyoda-ku Tokyo, Japan.

Exporter
MITSUBISHI CORPORATION
(MITSUBISHI SHOJI KAISHA, LIMITED)
6-3, Marunouchi 2-Chome, Chiyoda-ku, Tokyo, Japan.

Mitsubishi Overseas Offices (Southeast Asia)
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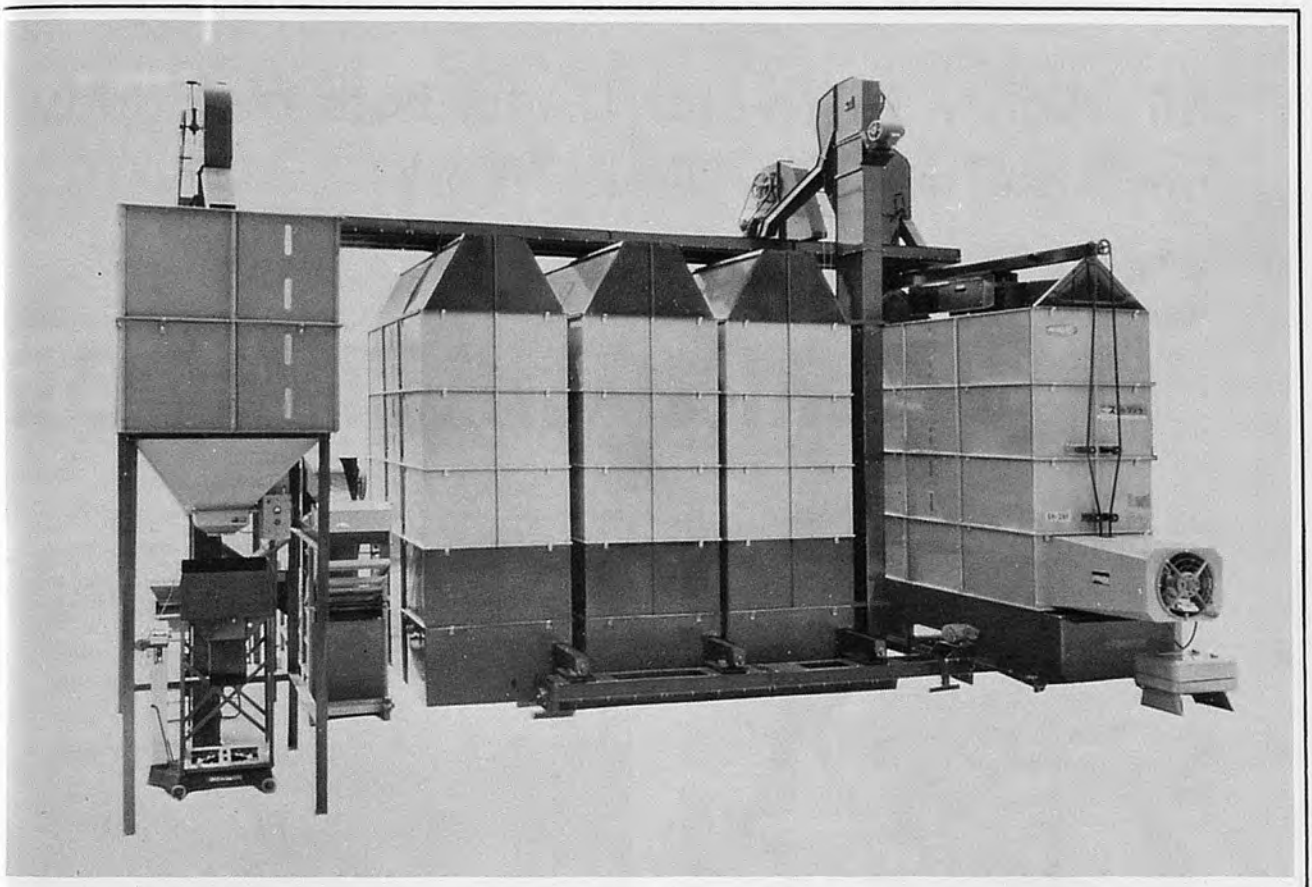


ISSIN-GO RICE CONDITIONING SYSTEM

Drying and Processing System to Make Good Rice

Two stage drying systems keep rice in good quality.

The two stage drying systems mean processing of pre-drying → tempering by natural air → drying for finishing. The features of the system are as follows.

* Using this system it takes so long tempering time that drying of rough rice is naturally performed without cracking.
* Rotation of rough rice prevents uneven drying and can get live and better quality rice.

This ideal two stage drying system is one of the features of the Ricecon System.

Full mechanization and automation of the equipments save your money and lavour.

Sanitary working environment with no dust and noise.

Many of us were used to belive that dust and noise are not avoidable in drying workshops. But this unpleasant dust and noise are removed by the Ricecon System to make clean and quiet working environment.

The Ricecon System consists of equipments produced by mass-production.

This makes the System reliable and inexpensive. Therefore cost of facilities can be repaid for short period.

KANEKO AGRICULTURAL MACHINE CO.,LTD.

Hanyu, Saitama Pref. Japan
Cable Address : KANEKO GYODA (JAPAN)
Telephone 0485−61−2111
Telex 2942−462

All Mighty Cultivator Useful Both for Paddy Field and for Dry Field Work!

OHTAKE MINI-CULTIVATOR

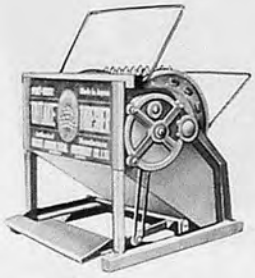
Usable for various purposes

1. Cultivating, weeding and puddling of paddy fields.
2. Cultivating, weeding, hilling in dry fields, Also useful in slope lands, orchards, greenhouses and tea fields.
3. Cutting vines of potato.

HOEING ROTOR FOR PADDY FIELD

The Ohtake Mini-Cultivator is the definitive model of an extremely light portable machine for management operation which is useful both to paddy field and to dry field works. It was developed by the Ohtake engineers group by referring to a power paddy weeder which was developed by Dr. Khan of IRRI, the Philippines.

LIGHT. SIMPLE. HIGH CAPACITY



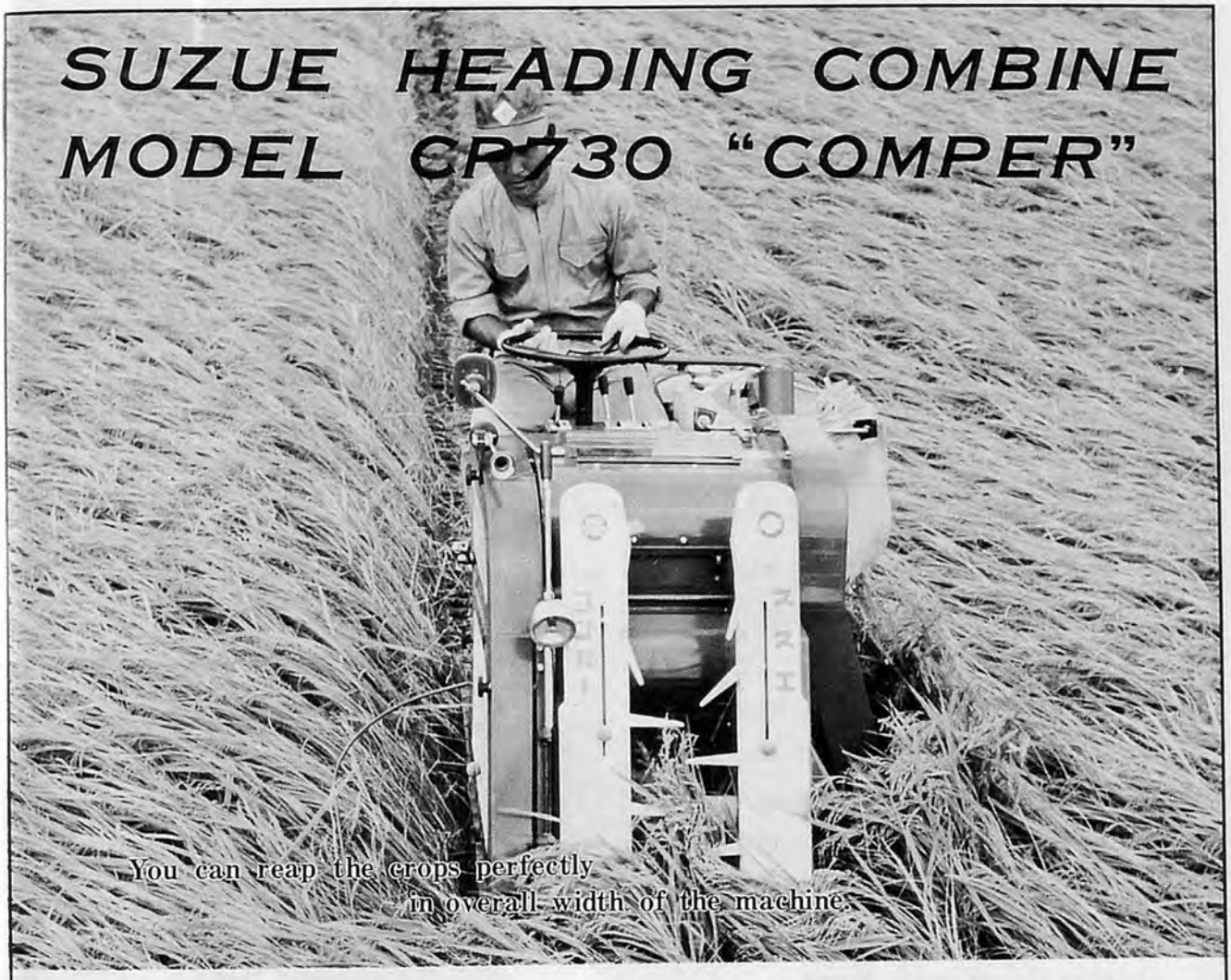
FOOT-DRIVEN THRESHER
MODEL Y-1 · MODEL Y-2

ALL OHTAKE THRESHERS are so small type, light and easy operation, produced and used most large quantities in Japan.

POWER THRESHER
MODEL KS-20

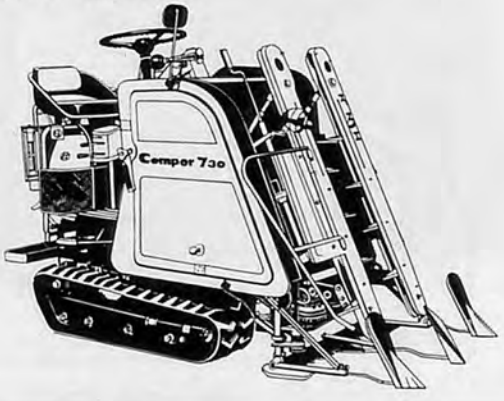
OHTAKE AGRICULTURAL MACHINERY CO., LTD.
NO. 265, NAKAJIMA, ŌHARU-MURA, AMA-GUN, AICHI, JAPAN

SUZUE HEADING COMBINE MODEL CR730 "COMPER"



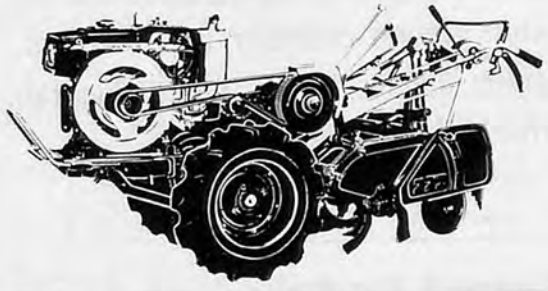
You can reap the crops perfectly in overall width of the machine.

You can start reaping from the center or the corner in the field in compliance with your job.
The exclusive heading thresher is used, so you can thresh completely without damaging the grains of the rice and the wheat relative.



POWER TILLER MODEL "C"

Easy Operation!
Durable Life!



SUZUE

SUZUE AGRICULTURAL MACHINERY CO., LTD.

144-2, Gomen-cho, Nankoku-shi,
Kochi-ken, Japan

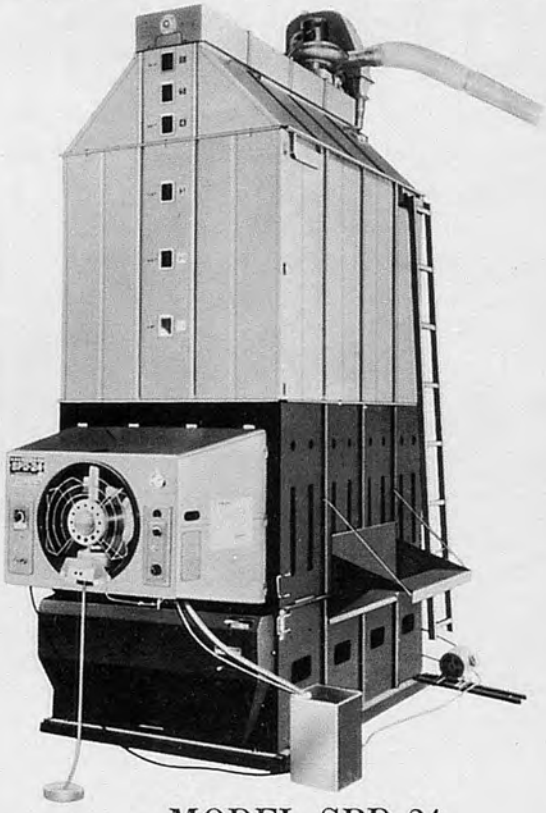
Cable : SUZUE NANKOKU/JAPAN
Telex : 5882-118 SUZUE KOC
Phone: (08886) 4-2121 (Key No.)

SHIZUOKA AUTO-DRYER

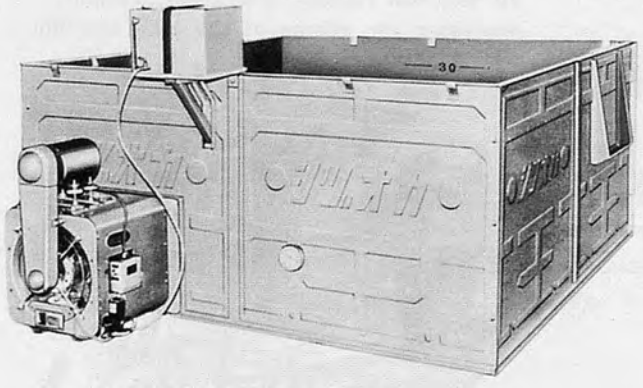
In 1959, our company first sent ventilating dryers to the market, which have been widely used in farm households.

We are now one of the biggest manufacturers of Japan in output and market share.

Applying the basic technology of the dryer, we have developed the heater, fruit storage room, high frequency moisture meter and are now contriving the automatic control system for them. We hope we can be of any service to mechanization of your farms.



MODEL SPD-24



MODEL NB SET

Products

Dryer, moisture meter, electrical heated growth chamber for seedlings, green house heater. ventilating fan, fruit storage installation.

SHIZUOKA SEIKI CO., LTD.

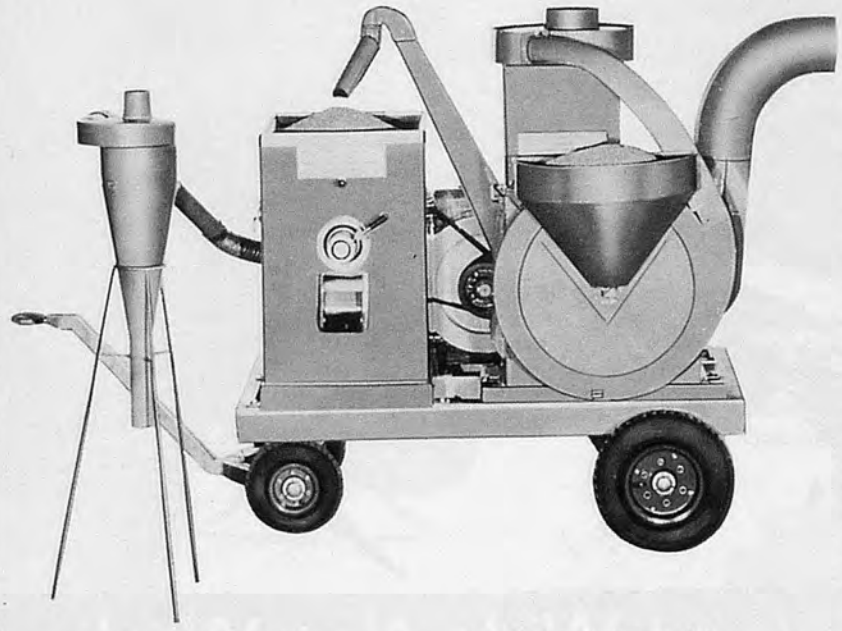
4-1 YAMANA FUKUROI CITY SHIZUOKA JAPAN

TEL 05384-2-3111 TELEX 4263-707

Sanriku
RICE MILLING MACHINE

KAKU MARU SAN

A miracle of rice milling
An epoch-making machine patented in various countries
Now in world-wide sale



● PERFECT HULLER

Perfect Huller has been completed after the many years of study and efforts by Sanriku-noki Co., Ltd.. It is an epoch-making huller of wind pressure type. This has been patented in 18 countries in the world including the United States, Soviet Union, Viet Nam, Formosa, Korea, Thailand and Japan etc.

● JET POLISHER

This polisher produced beautiful and delicious rice by the rotation of fan with low temperature wind pressure system. The capacity is 600kg per hour white rice. Needless to say, the whiteness can be freely adjusted.

‹FEATURES›

1. Highly efficient capacity to produce 900kg hulled rice per hour.
2. Produces polished rice 10 seconds after putting the paddy rice into the machine.
3. The husking efficiency is high and broken will be very few.
4. We are applying for patents not only in Japan, but also in eighteen other countries.
5. Compact and low in price.

‹SPECIFICATION›

	Type	Height/Width/Length (mm)	Weight (kg)	Fan/rpm	REQ. ENGINE	CAP/HR PADDY RICE
Huller	604	1100/920/830	110	1600rpm	9–12 HP	1000 kg (approx.)
Polisher	ML50EX	790/500/850	126	800rpm		

Technical Advice : SHINOMIYA NOKI CO., LTD.
HOKKOKU NOKI CO., LTD.

SANRIKU NOKI CO., LTD.

NO. 11, HIROMACHI NISHIKUBO, SHIBA MINATOKU, TOKYO JAPAN.

Shall we Help Each Other To Develop Agriculture?

Kinsho's World Wide Net Work

KINSHO-MATAICHI Corporation one of the leading exporters, importers and general merchants in Japan originated under the name of KINSHO TRADING CO., LTD. in 1947.

We have increased our capital successively for coping with the remarkable growth of our business and are now capitalized at ¥ 1,070,000,000 with some 1,000 employees and our expanded network of offices covers the important trading centers.

We always try to realize peaceful and prosperous world through our business. Agriculture is also one of the most imoportant fields.

Especially we can at any time co-operate with you to promote agricultural mechanization. Whenever you will have problems related to agricultural mechanization, Please contact us !

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Manila Office: Room No.1003 Sikatuna Bldg. 6762 Ayala Ave, Makati, Rizal, Philippines
Rangoon Office: No. 359, Maha Bandoola Street, Rangoon, Burma
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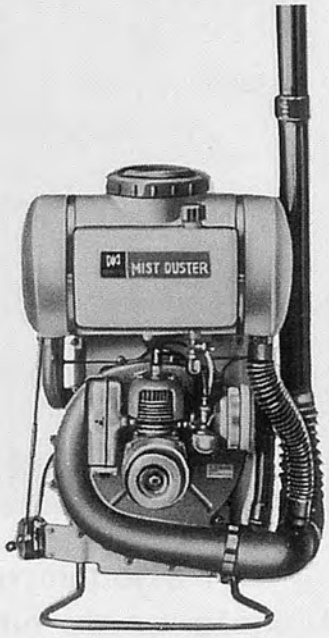
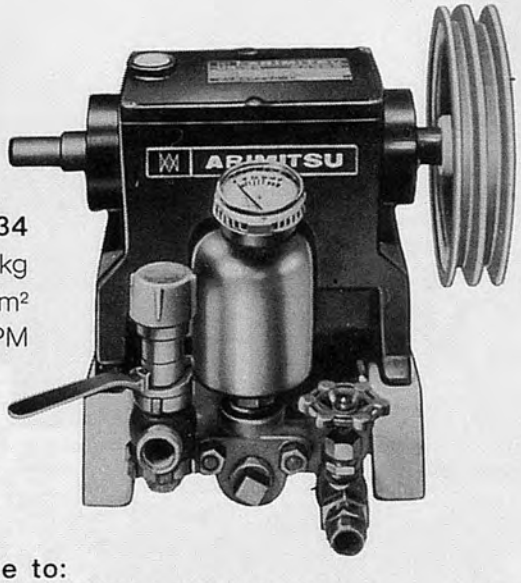
Arimitsu power does the hard jobs efficiently !

ARIMITSU MIST DUSTER AND POWER SPRAYER

**Introducing two powerful, portable labor savers.
Reasonably priced, they save you time and money
by quickly and easily eliminating pests.**



Features of MIST DUSTER MD 35B
Engine capacity: 35cc 2.8HP/7500 RPM
Tank capacity: 10ℓ
Air velocity: 90 m/sec.
Air Volume: 15 m³/min.
Weight: 8 kg



Features of POWER SPRAYER US-34
Weight: 15.0 kg
Maximum Pressure: 35 kg/cm²
Suction capacity: 34 ℓ/1000RPM

For further information, write to:

ARIMITSU INDUSTRY CO., LTD.

No. 3-21, 2-chome, Fukaekita, Higashinari-ku, Osaka, Japan
Cable Address: "ARIMITIND OSAKA"

KOKUYO-KARUI PUMPS

IMPROVED FOR TROPICAL AGRICULTURAL PURPOSE

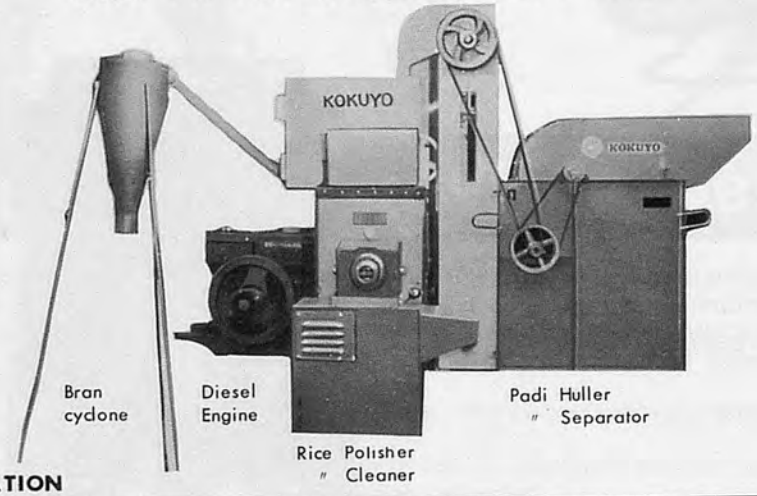
APPLICANTS

1. For pumping up water to Padi Fields and Farms
2. For Factories supplying Industrial Water and Small Scale Water Supplying
3. For Civil Engineering Water Supplying & Draining in heading Construction

KARUI INDUSTRIAL CO., Ltd.
YAMAGATA PLANT

KOKUYO RICE MILLING UNIT

JUST FIT FOR TROPICAL PADI / RICE



Bran cyclone
Diesel Engine
Padi Huller
〃 Separator
Rice Polisher
〃 Cleaner

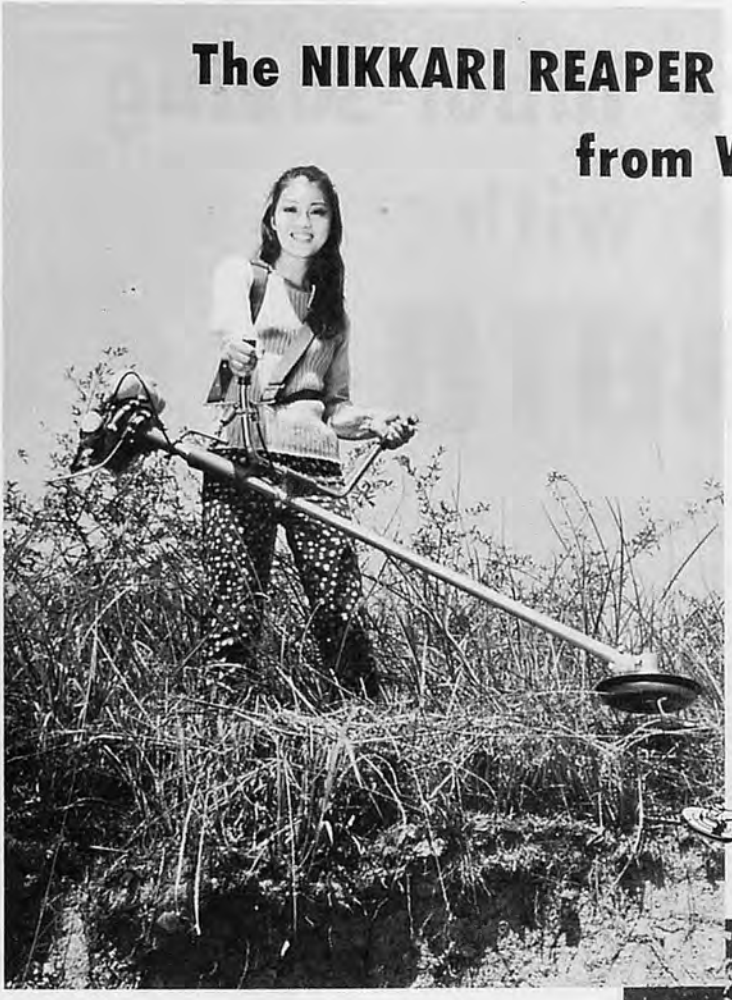
SPECIFICATION

Unit Model	Padi Huller	Rice Polisher	Bucket Elevator	Total One set (Approximate)			
				Capacity/hr	Power Required		Cubage
	Type	Type	Inch	in Padi kg	Engine ps	Motor hp	cft
KY-B	M F	P-10	3 1/2 〃	600	14	10	90
KY-C	L F	P-15	4 1/2 〃	900	20	15	150

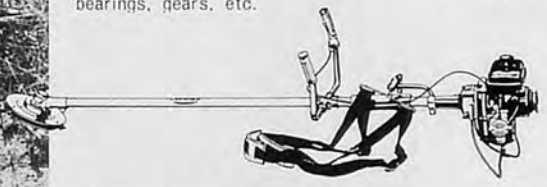
AS-AF CORPORATION, LTD.

4-14, MIDORI 4-CHOME, SUMIDA-KU, TOKYO, JAPAN

The NIKKARI REAPER Performs All Jobs from Weeding in a forest to Rice Reaping



* The weight of the NIKKARI REAPER is the lightest among all portable reapers making reaping easy and fast.
* The NIKKARI REAPER is carried on the shoulders with a strap, therefore, vibrations and heat are not transmitted to the worker making work fatigueless over prolonged periods of work.
* The operation is simple due to the incorporation of an automatic centrifugal clutch.
* The saw blade and mowing blade are easily exchangeable in accordance with the work.
* The NIKKARI REAPER is highly efficient and is entirely trouble-free, especially over prolonged periods of use, due to top quality material being used for bearings, gears, etc.

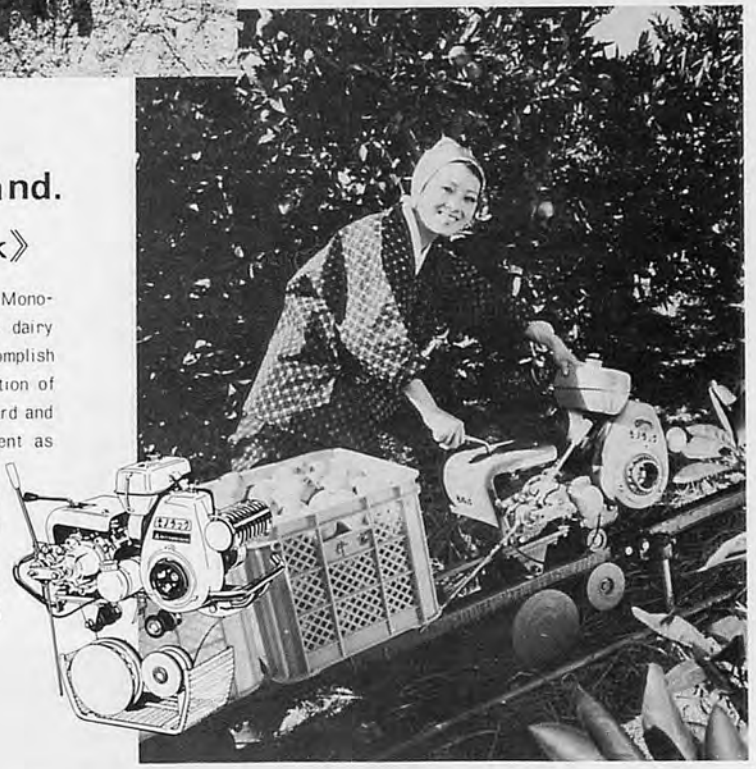


For transportation on the steep slope land.

NIKKARI 《Monorack》

A convenient means of transportation, the "Nikkari Monorack", is fit for use in orchards, poultry farms, and dairy farms. Only a single rail enable the equipment to accomplish all farm transportation services. The simple manipulation of the change lever effects quick shift between the forward and reverse travels. The equipment is free from derailment as the rail is held fast by the upper and lower rollers.

The rail can freely be curved right and left as well as up and down, thus eliminating necessity to cut down a tree. The automatic stop motion enables this equipment to stop at any desired point. Even at a steep slope of 45 ▯ the Monorack can climb with a load of 150 kg at a speed of 0.6 meters per second.



ニッカリ **NIPPON REAPER INDUSTRY CO., LTD.**

Head Office: 482-1, Otami, Okayama, Japan Tel: Okayama (79) 1291 (rep.)

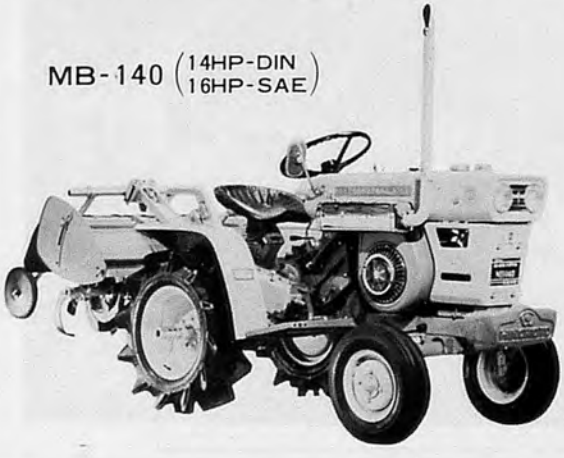
much more labor-saving rice culture with HINOMOTO®

No tillage No Wet paddy field puddling, No harrowing, No levelig!

The unit opens four recessed, longitudinal strips of cavities, deposits fertilizing material and seeds therein, covers those seed rows with loose soil, and presses the furrows moderately in one continuous operation.

The machine introduced in the MEETING OF EXPERTS ON THE MECHANIZATION OF RICE PRODUCTION AND PROCESSING. Surinam, 1971.

MB-140 (14HP-DIN / 16HP-SAE)



This nimbie compact tractor is an all-rounder on small and medium acreage farms where it really comes into its own on heavy-duty farm operations. It proves its worth as the main player in confined spaces, and as the supporting player in vast spaces.

TOYOSHA CO., LTD.

55, Joshoji-16, Kadoma City, Osaka, 571 Japan.
Cable: TOYOSHA NEYAGAWA JAPAN

THE SOONER, THE BETTER!

MARUYAMA being the oldest and largest sprayer manufacturing company in Japan with the latest developments in engineering has untill today made a great contribution in making progress for Japanese plant protection.

We in MARUYAMA has been firmly determined to work together with our neighboring South East Asian Countries for increasing their food production.

Therefore we would be happy and honored to receive any inquiries you may have to ask us, and we can assure you of our full cooperation.

The sooner, the better! You should take the advantage of this opportunity so that you may have more crops.

"MARUYAMA" produces everything about SPRAYERS & DUSTERS

Products

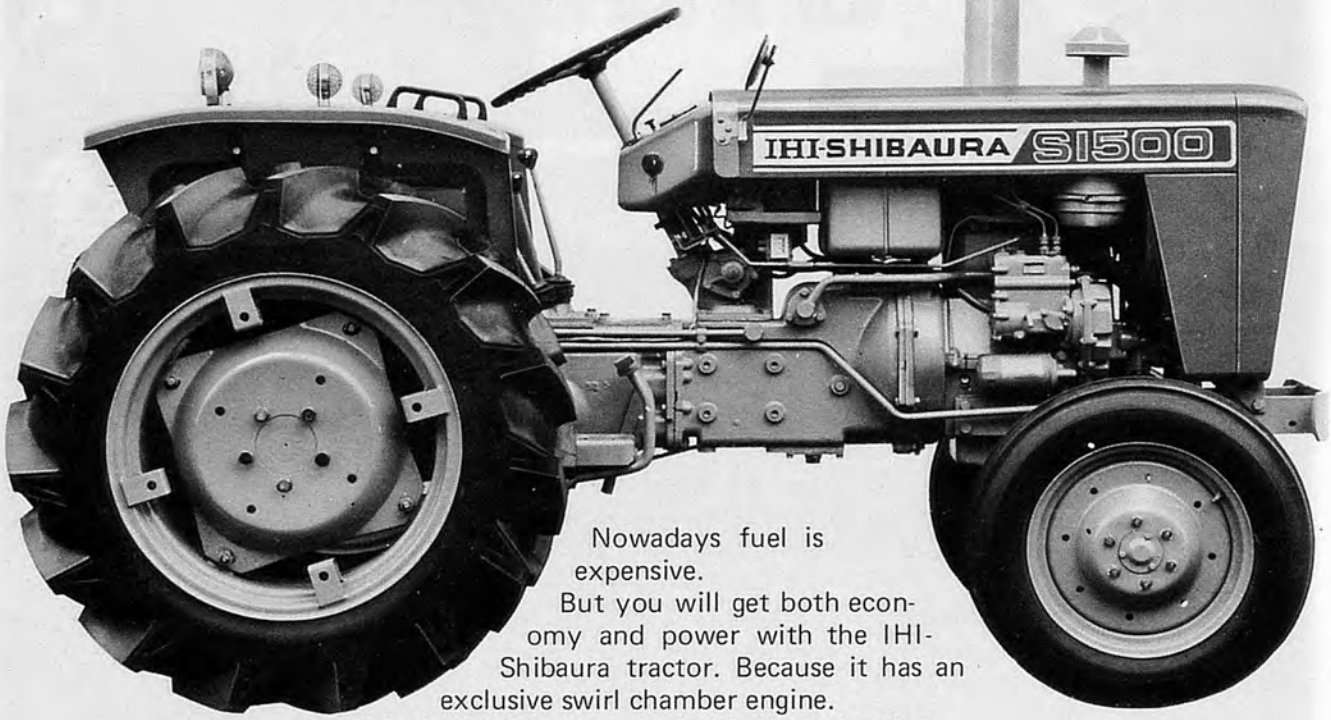
* TRACTOR MOUNT SPRAYER
* TRAILER SPRAYER
* POWER SPRAYER
* MIST DUSTER
* HAND SPRAYER
* BUSH CUTTER

MARUYAMA MFG. CO., LTD.

4-15 San-chome, Uchi-kanda, Chiyoda-ku, Tokyo, Japan
Cable Address: MARUYAMAPCA TOKYO

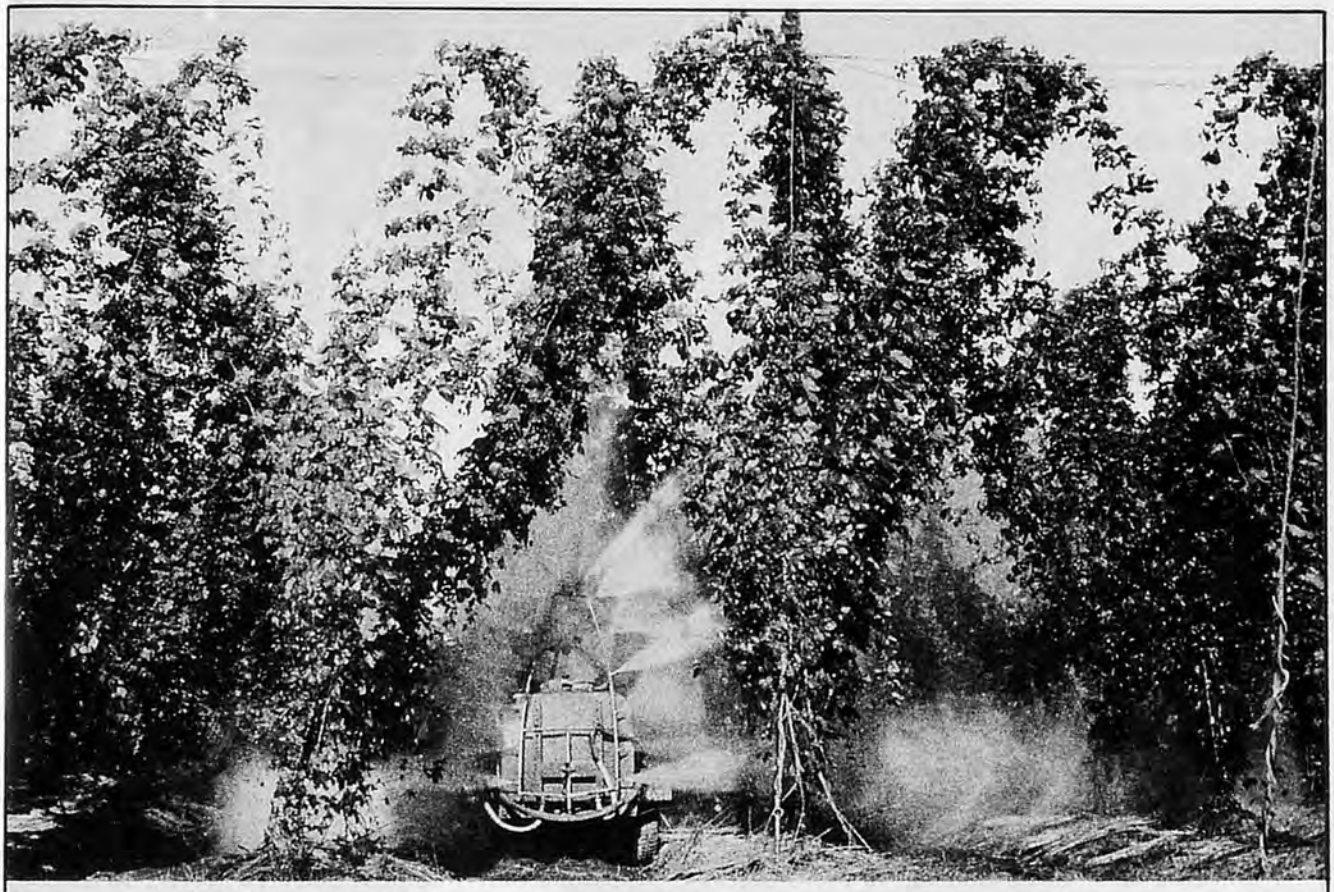
The IHI-Shibaura S1500 Tractor

Its exclusive swirl chamber engine solves the fuel problem!



Nowadays fuel is expensive.
But you will get both economy and power with the IHI-Shibaura tractor. Because it has an exclusive swirl chamber engine.
It is designed to give you full fuel combustion.
And thanks to its powerful "dynamo", the engine sparks into power everytime. In any weather.
You won't have to worry about mud, muck, rock, dirt, dust or rust, either.
Because the tough engine and mechanisms are air tight. Which makes it quiet, too.
Yet the S1500 is easy to operate. It is compact, too.
Plus, it is backed by our technology in heavy industrial equipment.
May we solve your fuel problem?
New tough compact farm machinery: Tractors and their implements/power tillers/dryers/forage cutters/air cooled gasoline and kerosene engines

Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan IHI
HEAD OFFICE: New Ohtemachi Bldg., 2-chome, 2-1, Ohtemachi, Chiyoda-ku, Tokyo 100, Japan Tel: Tokyo (270) 9111 Telex: J22232 Cable Address: "IHICO TOKYO"
NEW YORK · SAN FRANCISCO · MEXICO CITY · RIO DE JANEIRO · BUENOS AIRES · LIMA · SYDNEY · LONDON · ROTTERDAM · OSLO · GREECE · DUESSELDORF · JOHANNESBURG · BEIRUT · BANGKOK · SINGAPORE · DJAKARTA · HONG KONG · TAIPEI · MANILA



Do you know what's going on there?

Yes, we are spraying hop trees in cooler area of the earth in order to help brewers get better quality hop to add their beer with more attractive and fascinating taste.

This is just a part of our job to protect plants from various insects and disease.

Thus not only in the tropical area where more spraying job is required, but also even in those cooler area our spraying equipment is at work all through the season.

Wide range of our sprayers will meet various requirement of spraying job, for larger area powerful coverage, for a piece of land handy spraying, for severer environment spraying job, and even for 20 meters (66 feet) high vertical Spraying.

Dial our local distributors for further information.

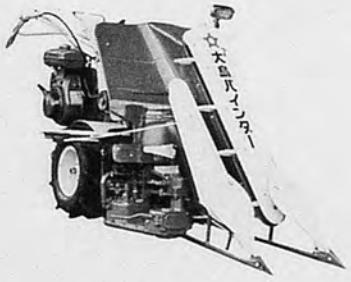
HATSUTA INDUSTRIAL CO., LTD.

59, 1—chome, chibunehigashi, Nishiyodogawaku, Osaka, Japan

OSHIMA is the only manifacturing company that can provide you with machines which cover all the operations, from harvesting to hulling.

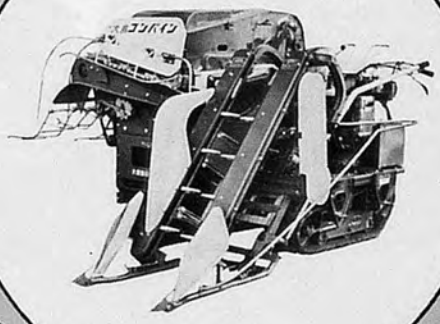
Oshima AGRICULTURAL MACHINES

BINDER



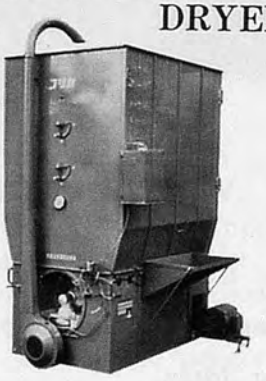
Model FB-30

COMBINE



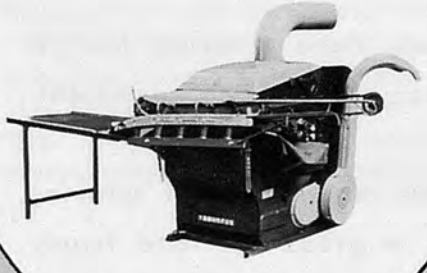
Model SC-500

RICE AUTO DRYER



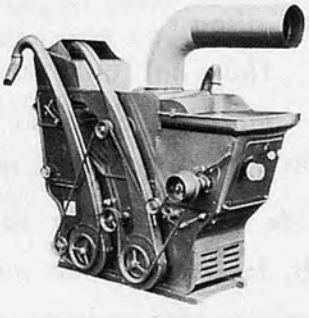
Model TV-36

POWER THRESHER



Model JD-50

RICE HULLER



Model MS-350

OSHIMA AGRICULTURAL MACHINRY CO., LTD.

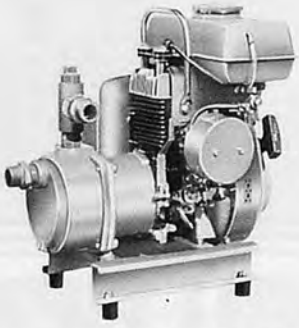
Head Office : 3-chome, Tera-machi, Takada City, Niigata, Japan

THE FIRST PUMP OF THE JET AGE

PORTABLE CANAL PUMP

CANAL PUMP SS-25

Feather-light but most rugged and of longer life. Only 51 lbs. (23 kgrs.)
Very fast priming. Lightest and most versatile as a contractor pump. The volute and semi-open type impeller constructed of tough abrasion-resistant malleable iron treated against rusting. Most economical fire fighter, Maximum portability. Could turn 6000 rotations per minute for emergency purpose to get more volume of water at a higher pressure. 48.5 imperial gallons per minute at 55 lbs. per sq. inch.
As powerful as a big pump. Can drive a big gun sprinkler or our "Econset" for irrigation. Delivers 200 litres at 3.3 kgrs. per sq. cm.



CANAL ENGINE PUMP SSE-40

5000 ROTATIONS PARMINUTE,
GIVING MOST AMAZING
PERFORMANCES. SELF PRIMING

OREGON SPRINKLER

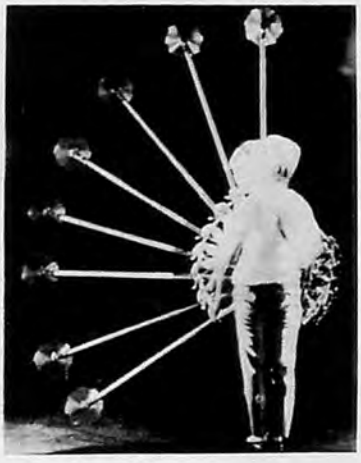
Complete lines for agriculture, golf courses, athletic fields, turfs, lawns, small gardens, etc. available.

WE ARE THE PIONEER IN THE CONTROLLED IRRIGATION IN JAPAN,
KEEPING UP-TO-DATE OF THE WORLD FOREMOST STANDARDS.

OREGON FARM EQUIPMENT CO., LTD.

Y·P·P·O·BOX. 295
HAED OFFICE : 14-15 MINAMIKARUIZAWA, NISIKU, YOKOHAMA

KAAZ Bush Cutter Model BCD



A female operative is sufficient for this bush cutter owing to simple handling and light weight. An operative on a slanting plane manipulates this cutter at all positions with its wide range uses and compactness. Branch, grass, and weed cutting will be performed by means of the shoulder hanging system with the variable handle arrangement which is engineered as a result of the ergonomics.

Specifications; Type: BCD. Displacement; 22.5 cc. Rating output; 0.8 Ps. Max. output; 1.2 Ps. Transmission; Automatic centrifugal clutch with spiral bevel gear. Starting system; Recoil starter. Carburetor; Floatless system. Capacity of fuel tank; 0.5 litre. Weight; 5.0 kg.

KAAZ Reaper Model HA-HC

The KAAZ Reaper is so light as to perform swift and easy reaping. Its application include from weeding in a forest to rice harvesting. It has been developed through the advanced technology of the specialist reaper manufacturer.

EOP A7-100 <24AH>

Machine weight ····· 3.05kg
Length of cord ····· 30m
Battery weight ····· 16kg
Battery voltage ····· 24V
Variable speed rate and revolution
····· 16:1 (H) 330~400
19:1 (L) 280~350
Time of use ····· 12~16hours

EOP Branch Picking Machine, D 3 type

Weight ····· 4 kgs
Length of blade ····· 50cm

OCHIAI Tea-Picking Machine, EOP Deluxe type appeared in tea industry.

OCHIAI CUTLERY MANUFACTURING CO., LTD.
KIKUKAWA SHIZUOKA-PREF JAPAN.
TEL. KIKUGAWA 05373-5-2163.

Large-sized Tea Picking Machine C-6 (with blower)

Length of blade ····· 820mm(R)
Machine weight ····· 19.5kg
Reduction gear ····· Belt type
Power source ·····
Engine (Meiki 30cc.)

Swing-ace

Form ····· Motor attached
Voltage ·····
24V battery DC generator
Cutter ····· 8 inches
Revolution ····· 6,500r/M
Machine weight ····· 4.6kg

LIGHT/LOW-COST/EASY TO USE,

BEAVER PATENTED POWER MOWING MACHINE

●Angle of blades can be freely changed during operation, a feature patented in 19 countries. ●Engine is supported at only two points and can be rotated 360° ●Special device is built in to prevent low lever and shoulder vibration. ●Anyone can use BEAVER and its TEA-PICKER, CHAINSAW, DIBBLER PUMP and LAWN-MOWER attachments to a wide range of jobs very well.

YAMADA MACHINERY INDUSTRIAL CO.,LTD.

No.10, 2-Chome, Ashihara-dori, Hyogo-ku, Kobe, Japan CABLE ADDRESS "BEAVER YAMADA" KOBE PHONE 078 (681) KOBE 2175

KOBASHI'S Original, Tough Blades

Kobasbi offers more than 600 types as the specialist of Tine Blades With a monthly capacity of 1 million pieces.

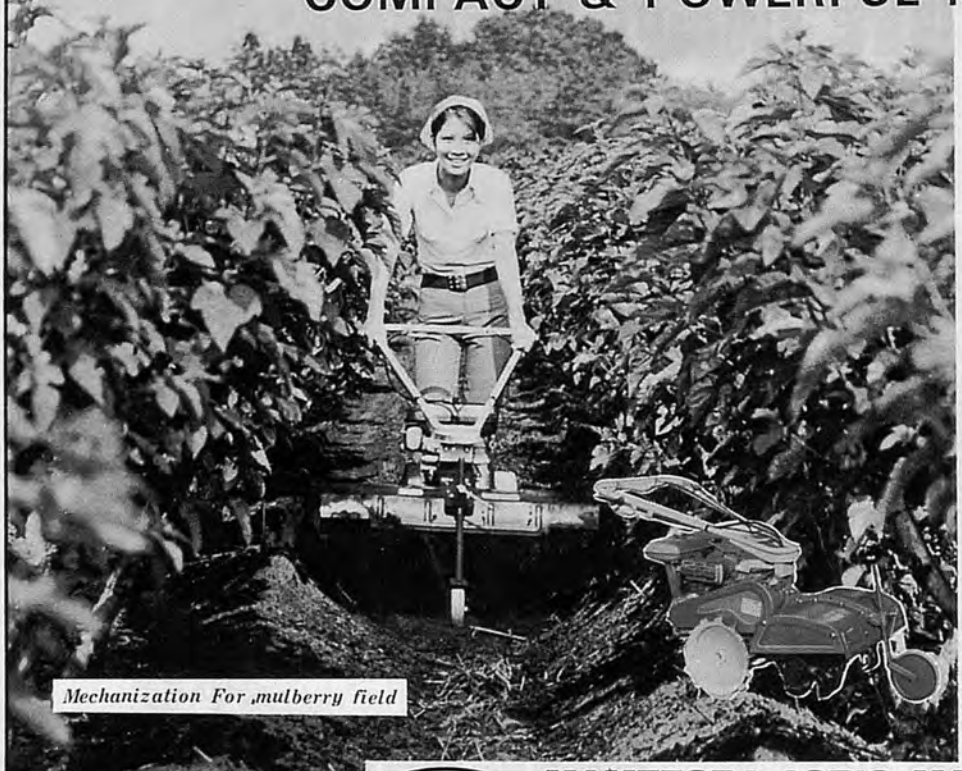
KOBASHI ROTOR moclel RBS-1600

The RBS Series KOBASHI ROTORS represent the latest mechanical advances in rotary cultivation.
Designed not only for heavy duty but for normal cultivation on the farm orin the paddy. The series comprise various sizes to fit any tractors of up to 75 h. p.

Please wrte for full details and illustrated catalog to:

KOBASHI KOGYO CO.'LTD.
2-1491, Yoshino-cho, Omiya City Saitama Pref., Japan Phone: 0486-64-1545

COMPACT & POWERFUL MAMETORA!



MAMETORA promote every phase of mechanization especially in small & middle sized farming.
MAMETORA always develop new mechanization systems by crops, areas and each operation.
MAMETORA is known as the top manufacturer of its unique **RETERNCULTI**—it is used for soil cultivation, weeding, transportations and etc. in enery farming like orchards, tea, slopes — which return the soil & weeds easily. **MAMETORA** also serves a complete series of powertillers and original rice transplanters.

MAMETORA AGRIC. MACHINERY CO., LTD.
9—37, NISHI—2 CHOME, OKEGAWA, SAITAMA, JAPAN Tel : 0487—71—1181

PMB PORTABLE MOWER

Specification

1. PMB PORTABLE MOWER is lightest and strong enough. Long time operaton with it scarecely causes any fatigue.
2. Applying both the reduction gear and the unique centrifugal clutch, there is no waste of engine output.
3. PMB PORTABLE MOWER is useful for every reaping work, rice and wheat plant reaping, pasture mowing, weed mowing in the forest, and so on.
4. It applies the unique transmission shaft and bearing to avoid troubles caused by vibration.

SU—35 TILLER

specitications

1. SU-35 TILLER--4 sicle 3. 5ps--is a small and light general-purpose tiller.
2. It is handy in a narrow place because the handle turns in every direction at an angle of 180 degrees.
3. Various kinds of rotary, rotor, traction machine, rotary mower and many other attachments are available.

KYOEISHA CO., LTD.
MIYUKI-CHO, TOYOKAWA-SHI. AICHI-KEN, JAPAN
TEL. 〈05338〉 6-3121

UCHIDA POWER TEA PICKER

■ CUTTEALOR BABY with the Hair-Trimmer Type Blades which does not damage tea leaves has the plucking ability of 90 times to hand plucking, 8 times to a hand tea-leaf shear. It is siutable to a small sized tea field.

■ The KIRISHIMA is the large type shearing machine designed for earge scale tea field. It takes 1.5~2 hours to shear 10 ares. And this can pick about 1,300 kg a day.

UCHDA'S POWER TEA PICKERPAT.
■ CUTTEALOR BABY

AUTO. TEA-LEAF PIKING & TEA-FELD SUPERVISING MACHINE.
■ UCHIDA'S "KIRISHIMA" PAT.

UCHIDA HAMONO KOGYO CO., LTD.
KIKUKAWA SHIZUOKA-PREF JAPAN.
P.O.BOX. NO.3 TEL. KIKUGAWA 05373-5-2261~3.

News Letter

INTERNATIONAL FARM MECHANIZATION RESEARCH SERVICE

c/o SHINNORIN-SHA 2—7 KANDA NISHIKI-CHO CHIYODA-KU,
TOKYO, JAPAN., TEL. 03—291—5718, 3674

Dear friends

International Farm Mechanization Research Service was established in 1968 with the pourpose of promoting efective communications and researches on agricultural mechanization especially in developing countries.

We will gladly welcome everybody to join us who want to promote free and vital communications on agricultural mechanization over many barriers like sectionalism.

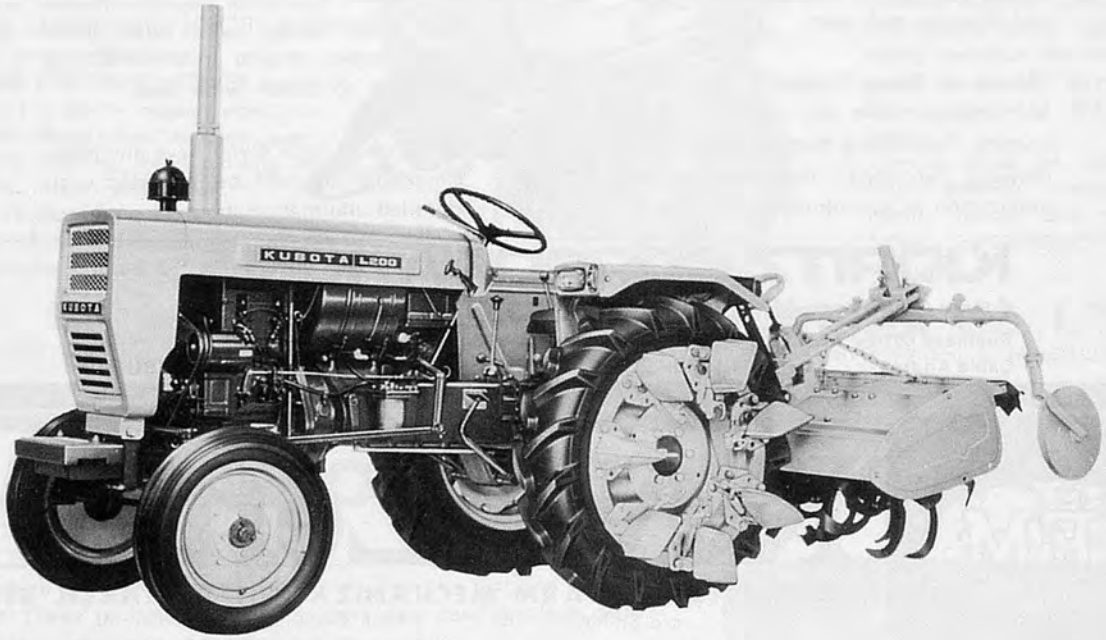
Our body is really independent one supported by every member's free and active mind to make better world.

Whenever you need more informations, please write me!

Yours Sincerely
Yoshikuni Kishida
Head of Directors

MARUBENI-IIDA...

...a beginning



All developing countries have to start somewhere. And most wise countries usually do by calling on Marubeni-Iida. Just like these products which meant a start towards higher productivity, less labor and more income. It and thousands of others just like it were supplied by us because we're the biggest exporter to all over the world.

Maintaining the latest technology, and extending a helping hand are two very basic features of our corporate structure. Supplying both to Asian countries has kept us very busy. Because Southeast Asia was also a beginning for us... the beginning of our worldwide network which now includes some 99 offices.

Marubeni-Iida Co., Ltd.

Tokyo: C.P.O. Box 595, Tokyo 100-91, Japan Cable: MARUBENI TOKYO
Osaka: C.P.O. Box 1000, Osaka 530-91, Japan Cable: MARUBENI OSAKA

Transportation & Construction Machinery Export Dept.
Agricultural Machinery Export Sec.

Here, a power tiller helps develop Malaysia's Agriculuture.

KUBOTA
AGRICULTURAL MACHINERY

Just about any machine that can be conceived for use on farms is made by Kubota. And made with a degree of perfection rarely found anywhere. From planting to harvesting, they are helping to raise both the quantity and quality of food in many parts of the world.

Asia's largest manufacturer of agricultural machinery, Kubota makes each part of its machines. Kubota engines, powered by diesel, gasoline or kerosene, are noted for dependable service. Two factories, at Sakai and Utsunomiya, are devoted exclusively to the manufacture of agricultural machinery. Kubota not only makes the machines, but trains personnel from around the world in their proper care and use.

Intensive and thorough research, with the highest level of technological skill, have resulted in many innovations in Kubota products, making them easier to use and more effective. Presented here is only a part of the long list of fine machinery manufactured by Kubota.

Head Office

Sakai Plant

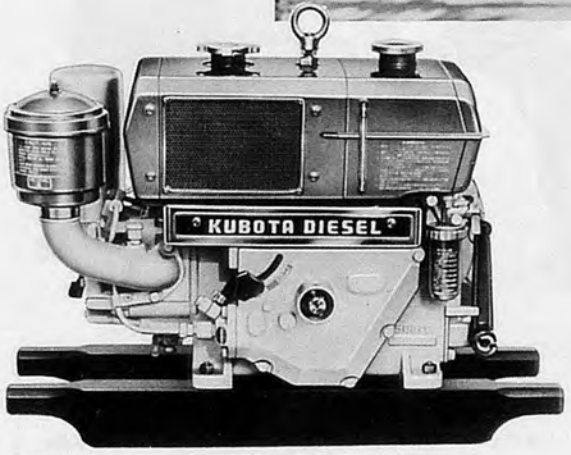
Tractor assembly line

Utsunomiya Plant

KUBOTA Kubota, Ltd. 22, Funade-cho 2-chome, Naniwa-ku, Osaka, Japan

DIESEL ENGINES

With pumps for irrigation, disposal, etc.

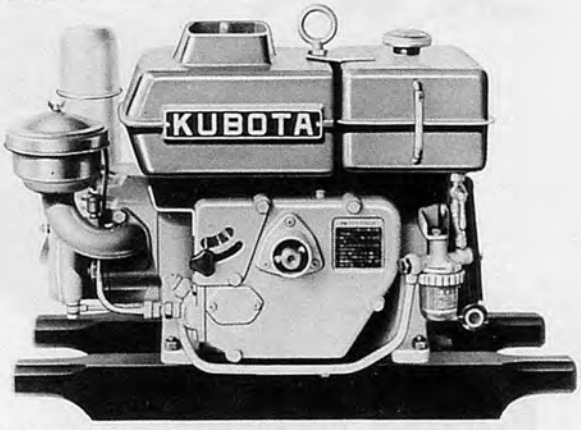


ER Series, ERN Series

(without head light)

* Unique radiator cooling for continuous operation without adding water.
* Spherical combustion chamber and double accelerating handle for fast starts.
* Perfect balance eliminates vibration.
* Completely sealed to keep out dust and water.
* Magnetic oil filter for clean lubricating oil.

Model	Output	r.p.m.	Net Weight
ER30	3 ~ 3.5HP	2,000	55kg/121lbs
ER40	4 ~ 5 HP	2,000	60kg/132lbs
ER50(N)	5 ~ 6.5HP	2,200	65kg/143lbs
ER65(N)	6.5 ~ 8 HP	2,200	75kg/165lbs
ER75(N)	7.5 ~ 9 HP	1,800	108kg/238lbs
ER90(N)	9 ~ 12 HP	2,000	145kg/319lbs
ER100(N)	10 ~ 13 HP	1,800	153kg/337lbs
ER150N	15 ~ 18 HP	1,800	247kg/543lbs



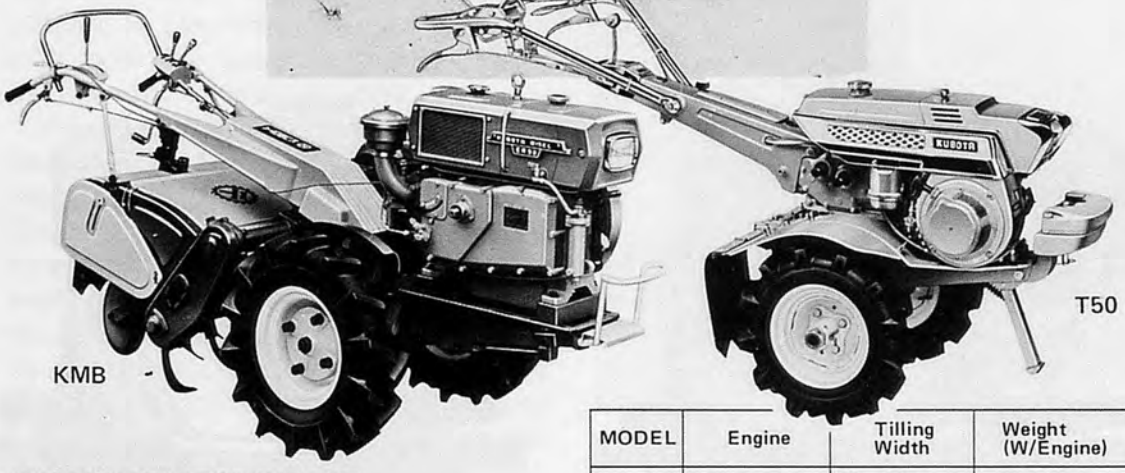
KND Series, KNDR Series

* Lightweight for many industrial and farm uses.
* Automatic feeding of lubricating oil for fast starts.
* Convenient hopper cooling.
* Magnetic filter in lubricating oil system keeps out dust and foreign matter.
* Totally enclosed engine.

Model	Ouptut	r.p.m.	Net Weight
KND3	3 ~ 4 HP	2,000	60kg/132lbs
KND40	4 ~ 5 HP	2,000	65kg/143lbs
KND5B	5 ~ 6.5HP	2,200	75kg/165lbs
KND70	7 ~ 9 HP	1,600	112kg/246lbs
KND90	9 ~ 12 HP	2,000	135kg/297lbs
KNDR70L	7 ~ 9 HP	1,600	100kg/219lbs
KNDR90	9 ~ 12 HP	2,000	145kg/318lbs

KUBOTA Kubota, Ltd. 22, Funade-cho 2-chome, Naniwa-ku, Osaka, Japan

Kubota power tiller in paddy field



KMB

T50

POWER TILLERS

* Highly efficient Kubota radiator cooled diesel engine.
* Weight of tiller and engine well blanced for easy operation.
* Wide selection of models for many types of work and conditions.
* Works efficiently in wet paddy fields as well as dry land.
* Many attachments for all kinds of work.

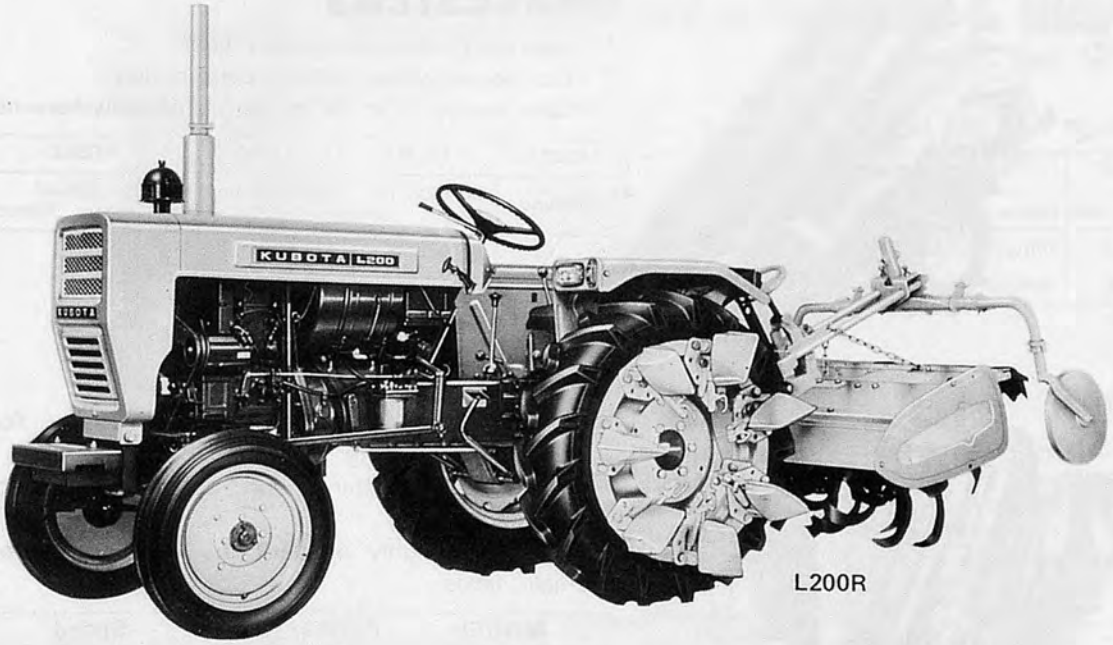
MODEL	Engine	Tilling Width	Weight (W/Engine)
KR850	ER65	48 - 60cm (19"-23.6")	286kg/630lbs
MP2	ER75/ER80	54 - 75cm (21.3"-29.5")	330kg/725lbs
KME	ER90/ER100	60 - 66cm (23.6"-26")	480kg/1055lbs
KMB	ER90	60cm (23.6")	395kg/869lbs
KMF	ER100	60 - 66cm (23.6"-26")	465kg/1023lbs
K500	ER50-2	48 - 60cm (19"-23.6")	264kg/581lbs
K700	ER65-2	48 - 60cm (19"-23.6")	324kg/714lbs

TWO WHEEL TRACTORS

* Highly efficient air cooled Kubota gasoline engine.
* Ruggedly built for long, effective use.
* Simple to operate for everyone.
* Compact for work in small areas.
* Lightweight for easy transporting anywhere.

MODEL	Engine Output	Speed Changes	Weight (W/Engine)
PC	1.8 ~ 2.5PH	F1 R1	43kg/951lbs
T50	3.5 ~ 5.0HP	F6 R2	120kg/264lbs
T40	3.0 ~ 5.0HP	F4 R2	90kg/198lbs
T410	2.2 ~ 3.5HP	F2 R1	49kg/107lbs
T510	3.0 ~ 4.5HP	F4 R2	96kg/211lbs
T710	3.5 ~ 5.0HP	F6 R2	126kg/277lbs

KUBOTA **Kubota, Ltd.** 22, Funade-cho 2-chome, Naniwa-ku, Osaka, Japan



L200R

FARM TRACTORS

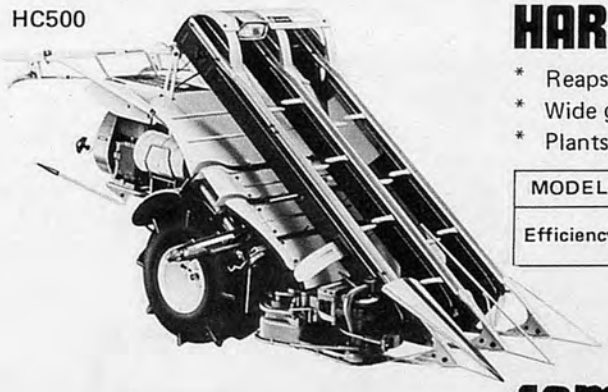
* Highly efficient Kubota water cooled diesel engine.
* Rotary tilling implement available for simultaneous plowing, harrowing, weeding.
* Complete hydraulic system for handling many implements.
* 3-point hitch system in DIN Categories.
* Adjustable wheel tread for versatility.
* Wet paddy field or dry field work.

Kubota tractor leveling in paddy field

MODEL	Engine Output	Ground Clearance	PTO r.p.m.	Weight
L140R	14 HP	33cm	694/1,253	700kg/1,543lbs
L170R	17 HP	33cm	642/1,252	790kg/1,741lbs
L200R	21 HP	34cm	650/990	910kg/2,006lbs
L120	12 HP	28cm	400/606/864	600kg/1,323lbs
L260	26 HP	37cm	172/222/313/404	1,000kg/2,205lbs
L270	27 HP	49cm	505/728/1,136	1,320kg/2,910lbs
L350	35 HP	48cm	560/1,062	1,440kg/3,175lbs
ST22	23 HP	47cm	663	1,050kg/2,315lbs

KUBOTA **Kubota, Ltd.** 22, Funade-cho 2-chome, Naniwa-ku, Osaka, Japan

HC500

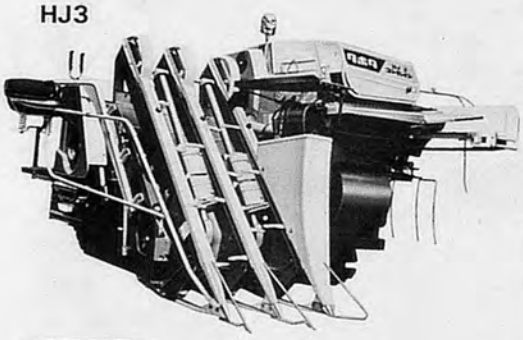


HARVESTERS

* Reaps and binds in one simple process.
* Wide ground contact with low pressure tires.
* Plants leaning up to 75° or wet plants easily harvested.

MODEL	HC75F	HC500	HC302
Efficiency	50~70min/ 10ares	60~90min/ 10ares	90~120min/ 10ares

HJ3

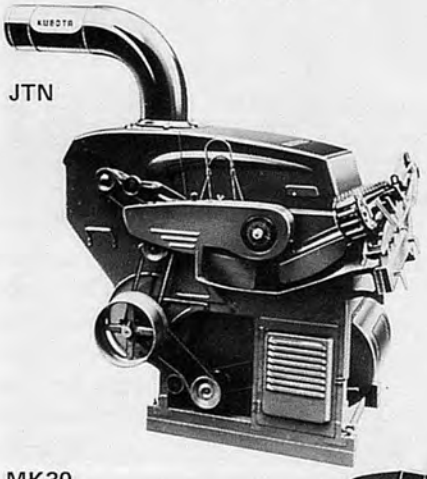


COMBINE

* Reel and cutter table operate precisely for complete harvesting of leaning plants.
* Almost no threshing and screening loss or damaged rice.
* Crawler is highly efficient in wet paddies or small fields.

MODEL	Cutting Width	Speed
HJ3	50cm 20″	31m/min
HJ4	54cm 21″	31m/min
M200R	230cm 92″	2~3km/h

JTN

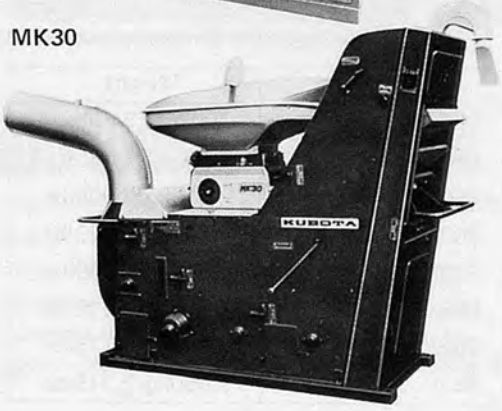


POWER THRESHERS

* Light weight and easy to carry.
* Efficient screening.
* Easy to operate.

MODEL	Threshing Width	Required HP
ATA54	540mm/21.3″	1.0 HP
LT42	420mm/16.6″	1.0 HP
JR3	460mm/18.1″	3.0 HP
JR4	540mm/21.3″	4.0 HP
JTN480	480mm/19″	3.0 HP
JTN540	540mm/21.3″	4.0 HP

MK30

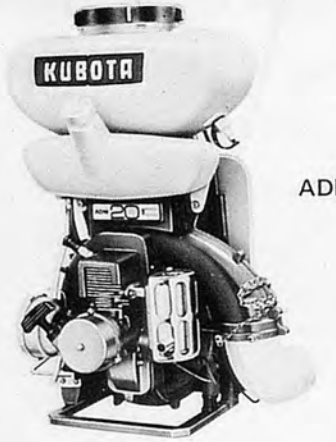


HULLERS

* Rubber rolls protect rice from damage.
* Automatic grain screen makes screening very simple.
* Equipped with precise tachometer.

MODEL	Capacity	Required HP
MK30	780kg/h	1.5 HP
MK40	1,400kg/h	3.0 HP

KUBOTA Kubota, Ltd. 22, Funada-cho 2-chome, Naniwa-ku, Osaka, Japan



ADM20

POWER MIST BLOWER & DUSTER

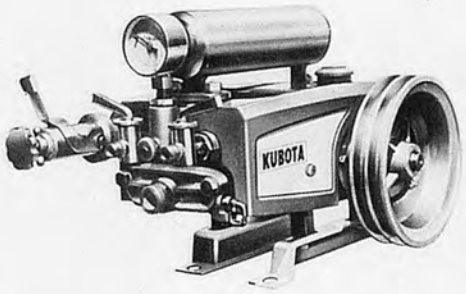
* Various attachments let them be used for liquid, powder, flame throwing.
* Strong engine for high speed and large air quantity.

MODEL	Net dry Weight	Max. discharge capacity			Engine
		Powder	Mist	Granules	Max. output
ADM20	7.5kg	4.5kg/min	3.2ℓ/min	7kg/min	2.0 HP
ADM30	9.3kg	6.5kg/min	3.6ℓ/min	6kg/min	3.2 HP

SA2

POWER SPRAYER

* Light and compact for easy installation and portability.
* Complete draining of tank very simple.
* The corrosion proof special alloy used in various parts and a perfectly sealed oil bath type lubrication system assure out-standing durability.



MODEL	Discharge Capacity (Standard)	r.p.m.	Max. Pressure	Net Weight
SA2	29ℓ/min	1300	35kg/cm²	10kg/ 22Lbs
SB	29ℓ/min	1200	35kg/cm²	17kg/ 37.4Lbs
SC	49ℓ/min	1050	40kg/cm²	22kg/ 48.4Lbs
SE	94ℓ/min	800	50kg/cm²	54kg/ 118.8Lbs

HI-PERFORMANCE SPRAYER

* Spraying can be done from the levee.
* Divided tank for simultaneous supply and spraying.
* Self-priming pump for faster supply.

HSC400

MODEL	Tank Capacity	Spraying Distance	Engine
HSC400	200ℓ×2	15m	LG250
HSP600	300ℓ×2	25m	Tractor P.T.O.