

PN-AAU-761

ISN 44525

PAPER NO. 82-5005

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FARM MACHINERY DEVELOPMENT IN THAILAND

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For presentation at the 1982 Summer Meeting
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

University of Wisconsin-Madison
June 27-30, 1982

SUMMARY:

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Farm mechanization in Thailand is expanding, but many farmers are unable to afford mechanical power. The THAI-IRRI Cooperative Project pursues the test and development of appropriate technology manual, animal and engine powered machines primarily for the small rice farmer. Fourteen machines are presented.



American Society of Agricultural Engineers

St. Joseph, Michigan 49085

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Farm Machinery Development in Thailand

by R.C. Fischer

Introduction

Thailand is more advanced in farm mechanization than most countries in Southeast Asia. Progress varies by region, and within regions depending principally on the economic position of the farmers. The central region has made the most progress, with power tillers and axial flow pumps in common use by paddy farmers. Axial flow threshers, manual sprayers and small four wheel tractors are becoming more abundant. Trailers for power tillers and one cylinder engine powered farm trucks are popular for transportation. Machinery is also gaining in acceptance in the northern region. Except for tillage, the south is just starting to mechanize and the northeastern paddy farmers are less developed than in any other region. Mechanization should be compatible with industrial growth, to avoid excessive unemployment. Thailand is fortunate in having an expanding industrial sector.

Tillage for upland crops is typically done with 70-80 HP tractors. An exception is corn, much of which is grown on deforested slopes too steep for mechanical tillage. Those areas are hand tilled and virtually all of the row crops are hand planted by dropping seeds in a shallow furrow made by a buffalo plow, or in holes made with a stick. Rice constitutes 75% of the land under cultivation and paddy rice is over 95% of the total. During the 1979-80 crop year, 4% of the rice crop was irrigated. The field area utilized by major crops was compiled from Agricultural Statistics in Thailand 1979/80 crop year. Smaller amounts of other crops are peanuts, castor & sesame oil seed, kapok, tobacco, fruit and vegetables.

Planted Area, 1979-80 Crop Year

| <u>Crop</u> | <u>Hectare</u> |
|-------------|----------------|
| Rice | 9,435,360 |
| Rubber | 1,532,160 |
| Corn | 1,524,640 |
| Cassava | 845,790 |
| Sugar Cane | 436,840 |
| Mung Bean | 424,360 |
| Coconut Oil | 414,560 |
| Kenaf | 226,840 |
| Sorghum | 189,050 |
| Cotton | 120,000 |
| Soybean | 108,700 |

Farm machinery manufacturers vary in size from a family operation of three people to over two hundred employees. Very few of them can afford to hire a graduate engineer. Over 100 firms are in production of one or more products. Power tillers are equipped with 8 HP or larger diesel engines. Steering clutches are presently provided on about 45% of the production and some new models employ a gear reduction rather than chain and sprockets. Axial flow threshers are the IRRI design. However, the trend is to larger machines with capacities to 4 T/hr, since most of the paddy threshing is done by custom operators. Small four wheel tractors to 20 HP are increasing in popularity and sophistication, with provision of a hydraulic lift. Some of the larger producers have assembly lines and improved plant layout. Disk plows are universal for upland use with small and medium size tractors. Known producers and estimated quantities of certain machines for 1981 follow.

| <u>Product</u> | <u># Firms</u> | <u># Units</u> |
|---------------------------|----------------|----------------|
| Power Tillers | 24 | 59,700 |
| Axial Flow Threshers | 26 | 13,000 |
| 4 Wheel Tractors to 18 HP | 9 | 11,200 |

The Agricultural Engineering Division (AED) of the Ministry of Agriculture and Cooperatives has been developing and promoting farm machinery since 1957. The International Rice Research Institute (IRRI) provided assistance since 1971 with the AED functioning as a cooperator. The THAI-IRRI Cooperative project in farm machinery is a joint effort of AED and IRRI, which has been active since 1974. The IRRI contribution to the project is financed by USAID. The principle responsibilities are to test and develop appropriate technology small machines for the rice farmer and to provide technical assistance to manufacturers. Human, animal and engine powered tools are pursued. Approximately half of the activity was directed to engine powered machines in 1979 and 1980. At present this category receives about two thirds of the effort. Simplicity, low cost and ease of fabrication with minimal tooling are important criteria in design. Most of the machines in the cooperative project originate in the Agricultural Engineering Department at IRRI headquarters in Los Banos, Philippines. Other farm machinery agencies cooperating with the AED are the ESCAP Regional Network for Agricultural Machinery and the FAO/UNDP Agricultural Machinery Production Project. The farm machine developments that follow are those of the THAI-IRRI Cooperative project.

Farm Machinery Developments

1. Hand Powered Tools

- A. Paddy Seeder. A new light weight manually operated six-20 cm row spacing paddy seeder has been under development over the past year. It weighs 14 kg with empty hoppers.

The pull required is about 10 kg with full hoppers. The pregerminated seed is metered by a rotating cylinder with seed cells in the bottom of each hopper. A brush cutoff minimizes the application of extra seeds. The field capacity is 11 man hours/ha.

The seeding rate required in Thailand varies from 50 to 95 kg/ha, depending on quality of seedbed and locality. Four cell sizes have been developed to provide a range of seeding rates. Manufacturers will need to provide the proper metering cylinders for their sales area. Good land preparation, preferably leveled and water control at planting time are required for good performance. The plants are less dense and less vigorous where the water was deeper. A row seeded plot yielded 79% more than a hand broadcasted plot in the same paddy.

- B. Cyclone Seeder. This simple and popular U.S. tool has the capacity of spreading rice seed more uniformly and faster than by hand broadcasting. The Ministry is promoting broadcasting as a low cost alternative to establishing a crop. Limited tests have been conducted with dry seed in upland conditions and with pregerminated seed in paddy. The seed rate is adjustable up to 100 kg of dry seed per hectare, either dry or pregerminated. It has also been used to broadcast sorghum and fertilizer. Ministry officials, manufacturers and farmers have shown considerable interest in this seeder and blueprints are released to interested manufacturers. Until a local source for die cast gears develops, they would be a problem for small firms. A sewing machine belt drive and repositioning the crank to eliminate bevel gears is being investigated.
- C. Manually Operated Transplanter. An IRRI five row, 20 cm row spacing transplanter is designed for use with mat type seedlings. The seedling culture requires frames to control the mat size and seeds should be spread uniformly for good machine performance. The labor requirement is lower than for traditional root washed seedlings; however there is resistance to the new seedling culture in Thailand.

In operation, the operator pulls the transplanter a distance equal to the hill spacing in the row, stops, and pushes the handle downward. This action rotates an assembly of five picker forks that engage some seedlings, through slots in the front sheet, and push the roots into the mud. The trays index 13 mm (1/2") laterally on each cycle and automatically reverse when the mat edges align with the slots. The field capacity is .25 ha/day.

One machine has been modified by providing trays for root washed seedlings and was tested in the 1982 season. For mechanically transplanting either type of seedling, it is desirable to have the field leveled with a maximum of 5 cm (2") of water. Seedling age is about 20 days at planting time compared to 30 day traditional seedlings. Excess water increases the probability of hills washing out.

- D. Upland Hand Weeder. This simple device consists of a lateral cutting blade, gage wheel and handle. The blade is pushed along between the rows just below the soil surface, to cut the weeds and grass. It is more productive than hoeing or hand weeding. Blueprints have been furnished two interested firms.

. Animal Powered Implements

- A. Improved Buffalo Plow. Typically a farmer with buffalo power waits for some rain before he starts to plow. When the rainy season starts very late he may not get all his ground into production. A program to reduce the draft of the buffalo plow so a wider plow can be used has been quite successful. It resulted in a moldboard with a larger radius of curvature; a more gradual attitude relative to the soil was obtained by rotating the moldboard and point 20° clockwise about longitudinal axis, and the point suction angle was reduced in comparison with a plow manufactured in Khon Kaen. The depth was controlled at 127 mm (5") by using gage wheels and skids, respectively in upland and paddy comparative trials.

The average specific draft (kg per sq.cm of furrow slice) in three upland and four paddy tests was reduced respectively, 39% and 32% relative to the Khon Kaen plow. The results generated two recommendations which have been released to three manufacturers. A wide moldboard, with 47% more projected area at 127 mm plowing depth, is intended for use in paddy. This should require about the same total draft at a depth of 127 mm as the Khon Kaen production plow and reduce the time required for plowing by nearly one third. The timeliness benefit should assure that the northeastern farmer will get all of his land into production in a year when the rainy season starts late. A similar but smaller moldboard, equivalent in size to the Khon Kaen plow, is intended for upland use. The total draft should be about 65% of the draft required by the Khon Kaen plow. Except for size, both recommended moldboards have identical geometric features, as follows:

| | |
|--|-------|
| Point suction angle | 18° |
| True moldboard radius | 26 cm |
| Approx. radius at middle of moldboard | 38 cm |
| Attitude angle of moldboard | 20° |

The Department of Extension at Pitsanuloke tested the two recommended plow moldboards and a locally used plow in paddy. The depth was not positively gaged but the hitch was adjustable vertically to facilitate comparable depth for each moldboard. The plowing depth was reported at 12-13 cm for all tests. Each plow was pulled by the same buffalo on successive days, from 6:00 to 9:00 and 15:00 to 17:00. The area plowed was measured. The recommended narrow moldboard also produced a timeliness advantage. The buffalo apparently increased his velocity, with a lighter load.

| | Pitsanuloke Trial | |
|-----------------------|-------------------------------|------------|
| | Area Plowed m ² | % increase |
| 1. Commercial Plow | 1,980 | - |
| 2. Recommended Narrow | 2,480 | 25 |
| 3. Recommended Wide | 3,290 | 66 |

- B. Plow Sole Fertilizer Applicator. An IRRI design attachment for applying fertilizer during the plowing operation is available to manufacturers. The fertilizer is metered, dropped in the furrow, and covered by the next furrow. It is adaptable to plows pulled either by buffalo or power tiller. The plowing capacity is decreased by 10% because of stops for filling the hopper. Results of IRRI tests with four other methods of application conclude that the plow-down placement of fertilizer results in more efficient use of the chemical. There has not been much interest in the attachment because most Thai farmers apply fertilizer once, during the growing stage. When fertilizer use includes an earlier application, this attachment should be in demand.

- C. Three Row Upland Seeder. A three row version of the IRRI five row upland seeder has been built and tested. It is specifically for use with a buffalo and to provide a low cost seeder for the northeastern farmer. The operator walks and indicators are provided to align with the prior row. It will accommodate three 20 cm or two 40 cm row spacings. Operational information given in section 3A, paragraph 1 and 2. 5 row upland seeder, is applicable to the three row model.

3. Engine Powered Machines

- A. Five Row Upland Seeder. Seed plates for the IRRI design upland seeder are available for rice, wheat, corn, sorghum, soybeans, mungbeans and peanuts. The plates are oscillated forward by an arm that can be readily aligned with 2, 3, 4 or 5 lobe cams to provide 50, 33, 25 or 20 cm spacing of seed drop in the row. The plates are returned by extension springs. The hopper has two compartments and each plate has two metering holes so fertilizer and seed can be alternately dropped in the row. Seed metering is not satisfactory with a wide variance of seed size such as ungraded seed corn. By screening such seed in two size grades and using appropriate seed plates, satisfactory performance is obtained.

Thai farmers typically do not produce seedbeds that result in acceptably uniform seed depth and adequate coverage for 20 cm row spacing. Excess trash in the soil surface may accumulate on the furrow openers. When used with 40 cm and wider row spacings, most of the seedbeds are acceptable without leveling and trash problems are minimized.

The five row seeder has a platform for the operator. A power tiller is recommended although a buffalo may be adequate under light draft requirements. A double marker is readily reversed by the operator at field ends. The openers are raised or lowered by a conveniently located lever. The press wheels have flat rims with traction lugs to operate the seed plate linkage. A semi mounted coupling to a power tiller, and a 3 point hitch for small tractors are used without the castor wheel.

- B. Land Leveler. A triangular land leveler two m wide has been developed primarily for use with narrow row upland seeded crops. One pass prior to seeding is effective in leveling and some clod size reduction results. The Land Development Center at Lampang obtained 45% higher wheat yields with a leveling operation prior to seeding in a controlled test.

- C. Two Row Planter. This IRRI design machine has performed satisfactorily in limited testing. It will effectively plant a variety of upland crops over a range of conditions from typical seedbeds to zero tillage. The minimum row spacing of the present design is 30 cm.
- D. Cutterbar Reaper, 1.6 m. IRRI has completed a test and improvement program at Los Bancos on the Chinese design cutterbar reaper. One unit was received in Thailand, was mounted on an IRRI PT-3 power tiller, and was initially tested in August, 1981. The machine worked well but a higher cutting height was requested. This unit has a capacity of 1/2 ha per hour. The cut crop is transferred in a vertical position to the right side of the machine. It is laid on the stubble in a neat windrow which is gathered and bundled by hand. This machine will replace a net of approximately 25 hand harvesters after bundling and tying. The following features were incorporated:
- a. The maximum cutting height was increased to 60 cm, to reduce the straw length in tall crops and maintain the axial flow thresher capacity.
 - b. The cutting height is adjustable on the go.
 - c. The drive from engine to reaper was simplified by using one belt.
 - d. The skid shoe was relocated rearward because when cutting high it tended to run over the crop.
 - e. A counterbalance spring capacity was incorporated to reduce the height adjusting lever force to a reasonable value.

The revisions have had limited field test. After additional trials, blueprints will be issued to eighteen interested firms. An estimated 6,000 Chinese reapers were in Thailand by 31 December, 1982; most of them were imported and some were produced locally. The IRRI design may be readily attached to an IRRI power tiller and perhaps to some of the Thai tillers, because of the belt drive to the reaper. This results in a cost advantage compared to the Chinese design which requires a power tiller with a power takeoff outlet.

- E. Cutterbar Reaper, 1 m. A cutterbar reaper with 1 m cutting width but otherwise similar to the 1.6 m machine has been developed in Los Banos. One unit mounted on a new 3 HP power tiller that was designed specifically for the small reaper, was received in February. It is being evaluated relative to Thailand conditions and needs. The smaller reaper is easier to handle and is more maneuverable. This machine may have application for smaller paddy fields and in areas where a lower cost machine is desirable. The IRRI design power tiller is also intended for tillage and transport use on small farms.
- F. Axial Flow Thresher. Production of this machine increases annually. A new model TH-8 rice thresher has several new features and the capacity in rice is above 1.5 T/ha for the four foot cylinder. A manufacturer has developed a simple solution to the panicle problem that exists with some native varieties, which should further expand the use of this machine.

Good results have been obtained in limited testing in sorghum and soybeans, by incorporating some modifications. Seventeen stationary pegs were installed and a 3/8" perforated sheet was wrapped outside the concave rods at the feed end of the cylinder. The cylinder speed was reduced, and fan speed was increased to improve cleaning. These adaptations will be released pending successful long run tests, to be made during the coming season.

- G. Two Ton Batch Dryer. This IRRI design has a one ton bin on either side of an air plenum. Vertical partitions are available so four different batches or varieties can be dried simultaneously. The outer sides of the bins consist of removable slats that extend downward and inward at 45°. A metal bagging chute can be attached and a slat removed to unload the upper half of the bins by gravity. The overall length, width and height of the bins assembly is 344, 173, and 158 cm (11.3, 5.7 and 6.2 ft), respectively. The weight is 364 kg. It can be truck loaded by 8 men or it can be disassembled readily for moving.

A kerosene burner or rice hull furnace is available. The heated air is circulated by a fan that is powered by a 3 HP electric motor or a 6 HP engine. With the air temperature at 43° C (110° F) and 1.7 m³/sec (3600 cfm), two percentage points of moisture can be removed per hour. There is increasing interest in dryers and blueprints have been issued to three firms.

The Future of Farm Mechanization in Thailand

Thailand is ahead of most countries in the region relative to production and use of farm machines, and will continue to progress. Combine harvesters will not be uncommon in perhaps 10 years. Already, over ten small Japanese and a small number of large U.S., combines are in operation in paddy by custom operators and on commercial farms. However, in the interim there is a large market for reapers as a companion tool to the stationary thresher.

Tillage tools, weeders, seeders, transplanters and chemical applicators will continue to be improved, with capacity gradually increasing. The future for the development of farm machines is bright because it is a never ending evolutionary process.