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NERAD PROJECT TECHNOLOGY DOCUMENTATION SERIES

WORKING PAPER NO. T1*

# DIRECT SOWN RICE: A CROPPING SYSTEMS TECHNOLOGY FOR THE UPPER PADDIES IN NORTHEAST THAILAND

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Other papers in this series are listed in Appendix 1 of this report and are available on written request from the Project Director.

DIRECT SOWN RICE TECHNOLOGY DOCUMENTATION (FIRST DRAFT)

## I. Background and objectives:

Up to one third of the paddy land in Northeast Thailand remains unplanted each year due to insufficient water for transplanting. This unplanted area is mainly on the higher elevation 'upper-paddy' where it is difficult to accumulate water due to topographical and soil factors. In addition, up to 20 per cent of the land actually transplanted to rice is destroyed by periodic droughts. Average rice yields are low in the Northeast: 228 kg per rai compared to 361 kg/rai in the Central Plains (OAE, 1985). These low yields are caused by erratic rainfall with long interspells, low soil fertility and poor soil-water-holding capacity.

Many agronomic experiments throughout the Northeast (Anonymous, 1980) have shown that direct seeding of ungerminated rice into moist soils can help to overcome these problems by meeting the following objectives:

1. Ensure a rice crop every year on land that does not always receive sufficient rainfall for transplanting.

2. Reduce the risk associated with transplanted rice in conditions of erratic rainfall.

3. Increase rice yields when transplanting is delayed due to late rain.

4. Reduce labor requirements and remove labor bottle-necks at transplanting time.

5. Remove some of the more marginal upper-paddy land from rice production by guaranteeing subsistence requirements from a smaller acreage thus enabling the land to be put into field crop production for which it is more suitable.

NERAD's approach in the development of direct sown rice has been to take an agronomically sound technology and develop it through on-farm trials into a form appropriate for local farmers. The breakthrough was achieved through cooperation with the Engineering Division of DOA in the development and testing of a simple and relatively inexpensive 2-row-seeder that enables farmers to direct seed rice in a simple, efficient and timely fashion with evenly spaced hills.

Dry-seeded, direct sown rice involves early direct seeding of rice into a moist seed bed utilizing rainfall from the first rainfall peak of the bimodal rainfall pattern common to most of

the Northeast (See Figure 1). It thus allows the timely establishment of a rice crop during a period when rainfall is often insufficient for transplanting thus guaranteering a rice crop and also reducing the yield losses often associated with late transplanting of the photo-sensitive varieties used in rainfed areas in the Northeast. Early, direct seeding also ensures adequate root development and thus produces a rice plant better able to withstand the water-stress periods common between the 2 rainfall peaks. This is because a deeper root system is established than in transplanted rice where root development is adversely affected by:

1. Pulling seedlings from the nursery breaks off much of the root system and retards root development.

2. Transplanting rice seedlings into a water-logged, puddled soil does not stimulate root penetration to deeper soil horizons.

Rice is sown in well-prepared land by means of the two-row-seeder described in Figure 2. This machine is now produced commercially in Thailand* and currently retails for 2,500 Baht. It optimally requires 2 people to pull it (although 1 strong man can use it himself) and 1 rai can be seeded per hour. Consequently direct seeding by this method not only greatly reduces the labor requirement for transplanting but because the timing of direct sowing can be staggered, labor bottlenecks at planting time are also significantly reduced.

## II. Technology Description and Recommended Practices:

- Good land preparation is essential, plow 2-3 times and harrow to remove weeds, further hand removal of weeds is recommended. Land preparation by two-wheel tractor is recommended if available owing to the higher draft requirements of early plowing, but buffalo can be used successfully.

- Seed should be sown immediately after completing land preparation in order to conserve soil moisture.

- RD6 or RD15 are recommended varieties depending on local market and eating preferences and should be sown with the 2 row seeder set at a spacing of 25 x 25 cms at a seed rate of 7-8 kg/rai (5-6 seeds per hill).

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* Available from: Khunasin, 107-108 Srisachanalai Road, Amphur Sawankalok, Changwat Sukothai.

- Rice bunds should be left open to permit free run-off until seedlings are approximately 20 cms. high and able to tolerate water-logging. After this time bunds should be closed and conditions of standing water maintained once sufficient rainfall is assured.

- 16-16-8 should be applied at 20-30 kg per rai depending on soil test values when the rice is 5-10 cm. tall and when there is sufficient soil water. Broadcasting or furrow application 10 cm from the plant rows followed by incorporation can be done according to standing water and farmer preference.

- A top-dressing of 20-0-0 at 5-10 kg/rai is recommended at panicle initiation if soil moisture is sufficient. Over-fertilization with N can exacerbate blast problems in periods of drought stress.

- Furadan (carbofuran) granules should be applied at 4 kg/rai at first fertilizer application. Further pest and disease control practices are the same as for transplanted rice.

## III. Results Summary:

Direct sown rice has been tested for 2 years in farmers' fields in Chaiyaphum. In 1984 trials were implemented in Ban Bua Phak Kwian, Tambon Kwang Jon, Amphur Phu Khiaw in 5 farmers fields. RD6 seed was sown by hand dibbling in early July and an average yield of 154 kg per rai was obtained:

| Direct Sown Rice, 1984 | Mean | Min | Max |
|---|---|---|---|
| Yield (kg/rai) | 154 | 60 | 247 |
| Control plot yield-transplanted (kg/rai) | 0 | 0 | 0 |
| Selling price (Baht) | 2.0 | 2.0 | 2.5 |
| Cash input costs (Baht/rai) | 184 | 168 | 200 |
| Net returns (Baht/rai) | 127 | -48 | 294 |

Yields were rather low, but in every case the transplanted control could not be planted due to insufficient water. Weed competition reduced yield significantly as land preparation was poor. Rat damage was also severe as the trial plots were the only food source for rats in the area and hand dibbling resulted in shallow planting depth and poor seed coverage. Despite the rather low yields obtained, farmer acceptance and interest was high as in most cases rice from the trial plots was all that the participating farmers produced this year. The inconvenience and time-consuming nature of planting and difficulty in controlling weeds were the biggest draw-backs of the technology reported by the farmers.

In 1985 cooperation from the Engineering Division of DOA was

obtained to test a two-row-seeder to make planting easier and to ensure a correct and uniform planting depth. Ten trial plots were conducted on farmers fields in Amphur Chatturat and Amphur Phu Khiaw and RD6 and RD15 were direct sown in mid-June. Transplanted control plots were also implemented wherever possible but in most cases these could not be transplanted until September due to insufficient water. Results obtained were as follows:

Direct Sown Rice Yields (kg/rai), 1985

| | Amphur Chatturat | | Amphur Phukhieo | |
|---|---|---|---|---|
| Farmers | Direct sown | T.P. check | Direct sown | T.P. check |
| 1 | 416 | 302 | 415 | 268 |
| 2 | 830 | 0* | 454 | 484 |
| 3 | 436 | 336 | 137 | 178 |
| 4 | 542 | 476 | 392 | 247 |
| 5 | 508 | 578 | 117 | 0* |
| Mean | 507 | 339 | 303 | 235 |
| Std.Dev. | 86 | 219 | 162 | 174 |

* Insufficient water for transplanting control plot.

Economic Analysis

| | | |
|---|---|---|
| Current cost of seeder | (Baht) | 2500 |
| Real annual cost (assuming 12% interest and machine life of 12 years) | (Baht/year) | 450 |
| Cost per rai (assuming 8 rai/day and a 2 week planting period) | (Baht/rai) | 4 |
| Other additional costs of direct sowing (extra seeds, insecticide, etc.) | (Baht/rai) | 52 |
| Total cost per rai | (Baht/rai) | 56 |
| Increase in rice yields | (kg/rai) | 118 |
| Cost per kg of increased yield | (Baht/kg) | 0.47 |

The results obtained come a long way to meeting the objectives as stated in section I of this document:

1. In all cases a rice crop was established and satisfactory yield obtained even in instances where there was insufficient water for transplanting.

2. In both amphurs the standard deviation of yields for direct sowing was reduced compared to transplanted controls indicating less variability and therefore less risk.

3. Direct sown rice yields were higher than controls in both Chatturat and Phu Khieo (in both cases yields were significantly higher at the 85 per cent level of probability). This is attributed to timely planting as most transplanted controls could not be planted until September due to late rains.

4. Actual costs of the technology to farmers are low and at current prices it achieved a benefit cost ratio in excess of 4:1.

## IV. Adoption to date:

As this technology has only been tested in its present form for 1 year, it is not yet possible to guage farmer adoption. Although this coming rice season will give a true indication of adoption, after only 1 season of testing farmer interest is already significant. A number of farmers seeing the trial plots have contacted project officials for further information and a number of farmers who participated in last year's trials have already made orders to purchase the two-row-seeder.

## V. Potential adoption and benefits:

Because of its ability to guarantee a rice crop every year and the way it reduces the risk of crop failure caused by drought, adoption of the direct sown rice technology is expected to be greatest in extreme poverty areas. In these areas where the risk of producing insufficient rice for family subsistence requirements is a major concern, the benefits are likely to be through increased rice production. The area of upper paddy land in the Northeast for which this technology has been developed has been conservatively estimated at 10 million rai (NERAD, 1986). If increased rice production due to guaranteed and timely planting is assumed to be 100 kg per rai (118 kg/rai increase in NERAD trials) then, if the adoption rate is 25 per cent, increased subsistence rice production will amount to a quarter of a million tons per year. Because of the nature of subsistence farming, this increased rice production may have a welfare impact on the families concerned considerably greater than the cash value of the rice.

In areas where farmers are already consistently producing sufficient rice to meet subsistence requirements, adoption of this technology is not expected to lead to increased rice production at the regional level. In this situation, increased rice yields per rai will enable farmers to reduce their rice-planted-area and diversify part of their land into a variety of upland crops for which cash returns are higher. In fact, much of the upper paddy land is more suitable for upland crops but farmers continue to plant rice due to subsistence constraints.

## VI. Conditions and limitations for successful implementation:

(i) Direct sown rice can be used on any paddy land where reliable rainfall regularly delays or precludes transplanting. Either glutinous or non glutinous varieties can be used with comparable results.

(ii) Direct sowing should not be done in periods of high probability of heavy rainfall as the newly germinated seedlings will be killed if the field is inundated immediately post planting or at the eary seedling stage.

(iii) Satisfactory weed control is essential for the success of the technology and direct sowing should not therefore be attempted in conditions of especially heavy weed infestation. In this respect, thorough land preparation is essential in order to achieve a good seed bed and consequently heavy clay soils are not considered appropriate for direct seeding.

(iv) Direct sown rice is especially appropriate in conditions of labor shortage at transplanting time as it significantly reduces labor requirements at this time. However, at least two persons are required to pull the seeder.

(v) Use of the two row seeder is considered necessary for the successful implementation of this technology. Consequently sufficient capital or adequate credit facilities to purchase the seeder are essential prerequisites for farmer adoption of the technology, however a number of farmers can satisfactorily share one machine and thus reduce costs.

(vi) Isolated pockets of adoption of the direct seeding method may lead to severe pest problems. If these are the only fields planted in that area, vertebrate and insect pests are likely to be attracted to this sole source of food.

## VII. Further research and technology development required:

Research at IRRI concludes that even in conditions of sufficient rainfall for transplanting, the direct seeding of rice does not significantly reduce yields (Morris, 1982). This hypothesis has yet to be adequately tested in Northeast Thailand and further research is required to determine whether guidelines based on rainfall probabilities can be established to recommend whether to transplant or direct sow according to date and rainfall received.

Further variety suitability testing for the direct sowing method is also required. Upland rice varieties may be appropriate for this technology owing to their better root development characteristics. In addition, photo-period insensitive varieties should also be tested because planting date is stabilized by direct seeding and as a consequence adequate growth duration can

be guaranteed.

Soil nutrient levels and pH's of the trial soils in Chaiyaphum are higher than in many areas of the Northeast. Consequently an assessment of direct sown rice on some of the poorer soils should also be a high research priority.

Weed control remains one of the most serious problems in direct sown rice and although herbicide use is probably not justified under the subsitence conditions in the Northeast, further research on weed control is needed. Adjustment of plant-spacing, seeding-rate and inter-row and post harvest cultivations should be investigated to determine their effect on weed populations.

As yet there is no commercial production or marketing of the two-row-seeder in the Northeast and this limitation is already beginning to seriously constrain farmer adoption in the region. There is a need for the Engineering Division of DOA to give technical assistance to farm-machinery manufacturers and their agents in the region in production engineering of the seeder. This will ensure that commercial production of the machine will keep pace with the anticipated increase in demand.

If widespread adoption of direct sown rice occurs in the Northeast then it is likely that significant areas of the more marginal upper-paddy land will no longer be needed for subsistence rice production. In this event, research to find alternative, appropriate cropping-systems for this land will also be necessary if the full potential benefits of the direct sown rice technology are to be realized.

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FOR FURTHER DETAILS AND INFORMATION PLEASE CONTACT


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4. Iain A. Craig, NERAD Project, Northeast Regional Office of Agriculture and Cooperatives, Tha Phra, Khon Kaen 40260.

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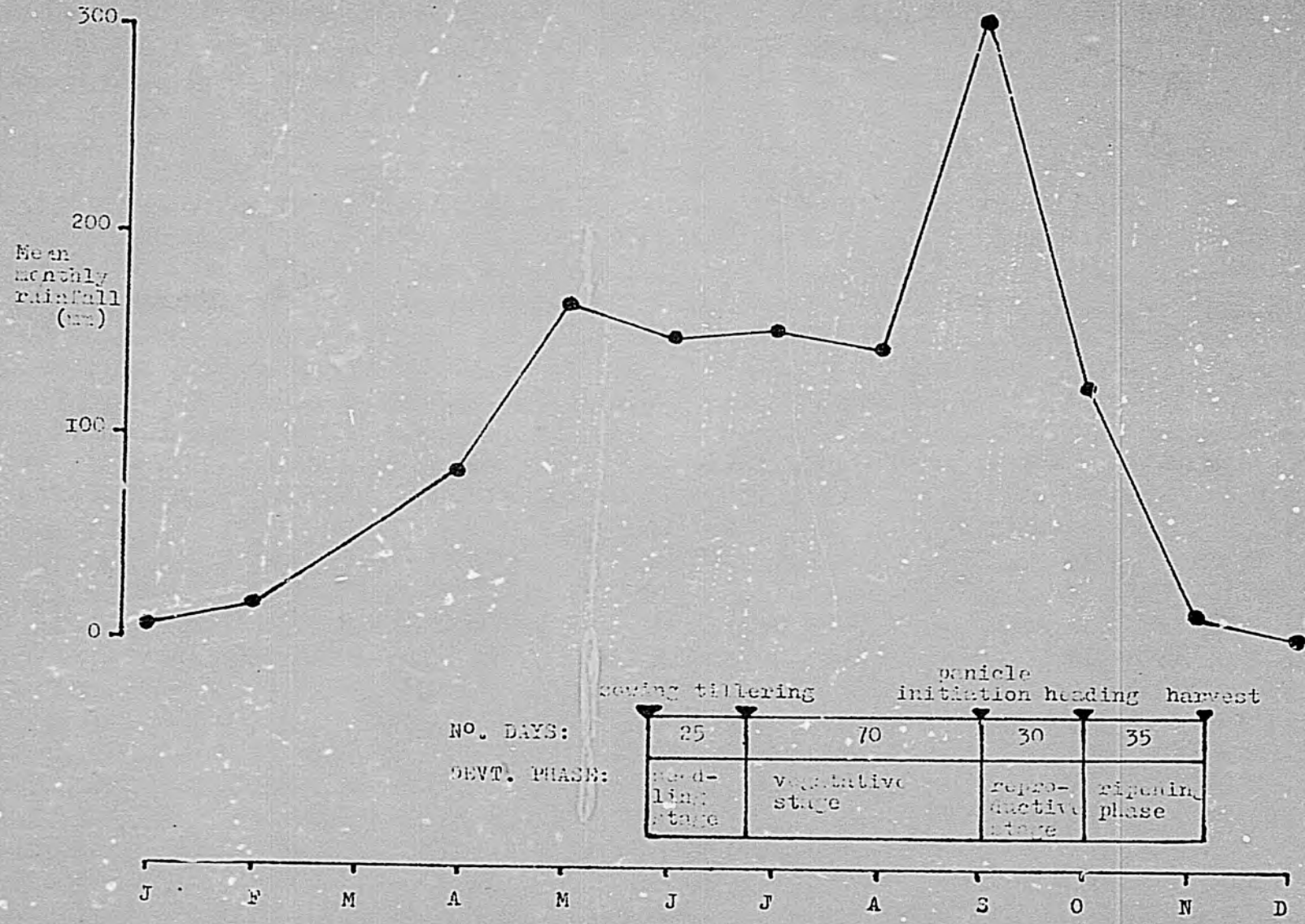
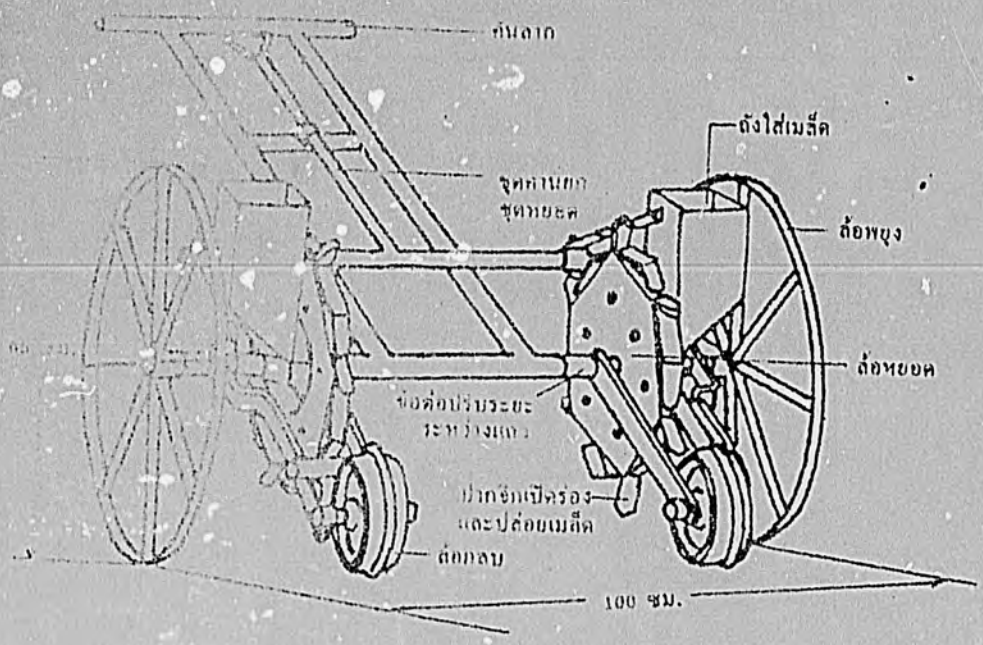



Figure 1. Rainfall pattern and direct sown rice growth stages, Chaiyaphum. Source: Anon. 1982.

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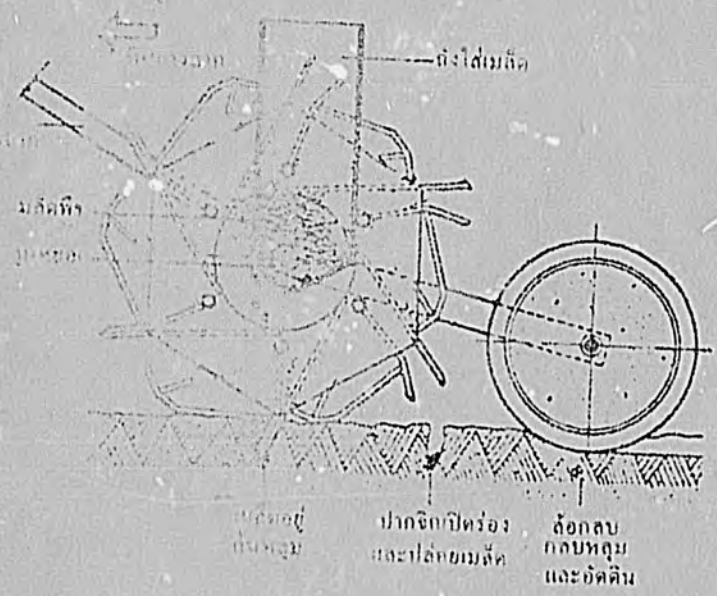


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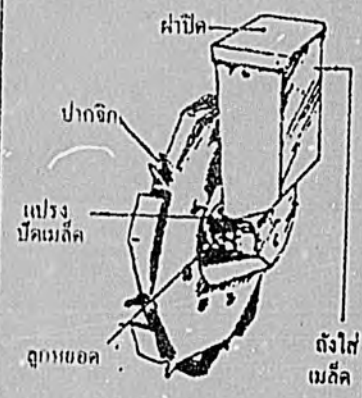


รูปที่ 3 ล้อหยอด

APPENDIX 1

The following NERAD Working Papers are available on request from the Project Director:

NERAD Methodology Documentation Series

M1. A cropping systems technology development process: the NERAD model. Craig, I.A. et al., 198[illegible].

(Thai and English)

M2. Triage: a methodology for screening agricultural technologies and prioritizing research and extension activities. Craig, I.A. and Sukapong, C., 1987.

(Thai and English)

M3. Northeast Regional Agricultural Development Information and coordination system (NERADICS). Pisone U. and Hopkins, J., 1987.

(English)

M4. Rapid Rural Appraisal: the NERAD experience. Alton, C. 1987.

(English)

NERAD Technology Documentation Series

T0. Executive Summary of the NERAD promising technologies. Thamabood, S. (Editor), 1987.

(Thai)

T1. Direct sown rice technology documentation. Craig, I. A. et al., 198[illegible].

(Thai and English)

T2. Modified shallow well technology documentation. Ragland, J.L. and Thamabood, S., 198[illegible].

(English)

T3. Demonstration farmer buying groups: a technology documentation. Meyer, L., 198[illegible].

(English)