Field Experiences with the AIT Solar Rice Dryer*

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ABSTRACT

The dryers tested on farms had a capacity of one tonne of paddy. They were made of bamboo poles and clear plastic sheet, and cost about US$150 to build. The drying time was one to four days, depending on the weather. Shortcomings of the dryers revealed by the field tests included degradation of the plastic sheet and the need for a higher capacity than one tonne per batch. In the off-season, the farmers often used the dryers for other products besides rice.

BACKGROUND

The idea of developing a simple solar rice dryer to provide the poorer farmer with a method of drying second crop paddy during the wet season arose from discussions between R.H.B. Exell and Sommai Kornsakoo in 1977. The first prototype was tried out at the Asian Institute of Technology (AIT) the same year.

In 1978, a research project was initiated under the sponsorship of the International Development Research Centre (IDRC), Canada, to make comprehensive tests of the concept on the AIT campus and to develop a dryer suitable for use by ordinary farmers. In 1980 the project was extended into a second phase during which the dryer was field tested on a number of farms in the central plain of Thailand. Full details are contained in AIT Research Report No. 171.[1] A notable feature of the report is a verbatim transcription in English of the opinions of the farmers themselves expressed in a workshop held at the conclusion of the field tests.

An evaluation of the project was made for IDRC by J. Amyot.[2]

THE DRYER

The idea underlying the dryer is to heat a body of air in the sun and let this air pass through a flat bed of threshed paddy by natural convection. The principal parts are a solar air heater, a box for the rice bed, and a chimney giving a tall column of warm air to increase the natural convection. Clear plastic sheet covering the rice bed allows it to be heated from above by the sun and protects it from rain (Fig. 1).

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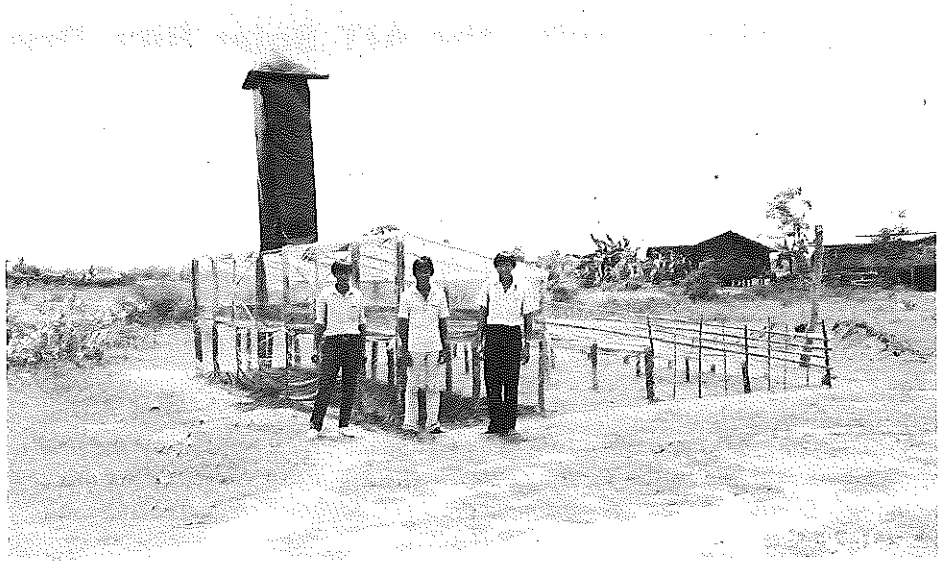

Fig. 1 Photograph of one-tonne rice dryer in the field.

The dryer constructed at the field test sites was designed to dry one tonne of wet paddy from a moisture content 22% wet basis to 14% wet basis in two days under average weather conditions in the wet season.[3] Accordingly, based on previous calculations and experiments on the AIT campus, the following sizes were chosen for the various components of the structure:

Rice bed depth	150 mm
Rice bed area	10.6 m^2
Solar collector area	32 m^2
Air inlet area	0.7 m^2
Chimney cross-section area	0.3 m^2
Height of chimney top	4 m
Overall length (end to end)	7 m
Overall width (front to back)	6 m

FIELD SITES AND TESTS

In the first instance, the Governors and Agricultural Officers of eight provinces were approached for the selection of field test sites. District and local Agricultural Officers appointed at the provincial level were then visited, and farm selection was made according to their recommendations in cooperation with local farmers. Eventually, eleven dryers were built in five provinces (Fig. 2).

The construction of the dryers was done by farmers jointly with the three-man AIT project team. The field testing was carried out partly by the AIT team and partly by the farmers themselves. Paddy for the tests was provided by the farmers.

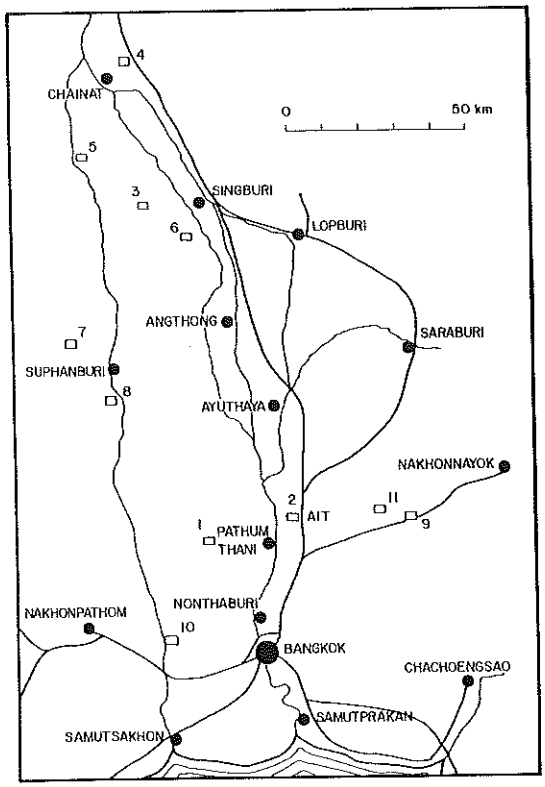

Fig. 2 Locations of field test sites.

ECONOMIC CONSIDERATIONS

One method of economic analysis is to estimate the break-even point in order to decide whether the dryer is worth introducing. Since the dryer must pay for itself in one season, discount methods need not be applied.

The cost of the materials for the one-tonne dryer was ฿2500+. When the cost of the bamboo poles could be disregarded, because bamboo was available growing on the farm, the cost of the materials was only ฿1300. The labour used varied widely, 20 to 30 man-days being typical. One man-day was worth about ฿50. The cost of the dryer could thus vary from ฿2000 to ฿4000, depending on circumstances.

The market price of the paddy fluctuated considerably during the project. In the wet season of 1981, it was ฿3700 per tonne, and the value added by drying was ฿600 to ฿700 per tonne. In 1982, the price was only ฿1800 per tonne when harvested, and the value added by drying was only ฿100 to ฿200 per tonne. Consequently, the economics of the solar dryer seemed attractive in 1981, but not in 1982. These figures show that the number of batches of paddy that must be

+US$1 = ฿27

dried to recover the cost of construction can vary from 3 to 40. It is therefore difficult to give a simple statement regarding the feasibility of the dryer.

Notwithstanding these remarks, Amyot has expressed doubt as to whether farmers can actually receive any benefit from the drying of their paddy. Improvements in the quality of the paddy, such as increased head yield, do not enter into the bargaining process in Thailand. On principle, the value of 10 kg of paddy is deducted from the value of one tonne to compensate for excess weight due to assumed moisture content. Again, if the paddy is wet from rain, a deduction of ฿200 to ฿300 is made from the value of one tonne. The general price level, however, depends on the export price and on government price policy; these factors are beyond the control of farmers and local traders.

THE OPINIONS OF THE FARMERS

At the end of 1982, a questionnaire survey was conducted and a workshop was held to study the experiences and opinions of those who had been involved in the field tests. The persons who participated included government officials at two rice research stations, five local agricultural officials, twelve farmers, and one local merchant.

The sizes of the rice farms on which the tests were made varied from 2.4 ha to 16 ha, the average being 7 ha. Productivities were from 2 to 4.5 tonnes per ha, and total yields were from a few tonnes to over 30 tonnes per harvest. Two thirds of the farmers had storage facilities, the capacities varying from 10 to 20 tonnes.

After the rice has been cut it is usually dried in the field for two days before threshing, and after threshing it is sun dried on a terrace for 1 to 3 days. Wetting by rain was a serious problem for the second crop: it occurred on all the farms.

All the farmers were able to construct the dryer by themselves. Bamboo was easily available everywhere, but not the plastic sheet, except in Pathumthani province near Bangkok. In all cases the plastic sheet needed repairing after a few months due to damage or deterioration in the sun.

The extent to which the dryers were used varied greatly, depending on the initiative of the farmers, and the scale of the rice crop. Most of the farmers said that the capacity of the dryer was too small; it should have been from 2 to 5 tonnes in most cases. When asked whether they could stagger their harvest and bring in one tonne of paddy every two days, the farmers said they could not for a variety of reasons. The cost of the dryer was considered by the majority of farmers to be acceptable. They also thought it would have been an advantage if the dryer could have been dismantled and put away when not in use, or moved from one site to another to reduce transportation of the grain to be dried.

CONCLUDING REMARKS

An alternative to the PVC sheet has recently become available in Thailand. This is low density polyethylene sheet, which is manufactured locally, costs half the price of the PVC sheet, and does not deteriorate in sunlight. We have also designed and built a new dryer in three separable parts (collector, bed and roof) that can be moved from one site to another instead of being fixed in position like the dryers used in the field tests (Figs. 3, 4 and 5).

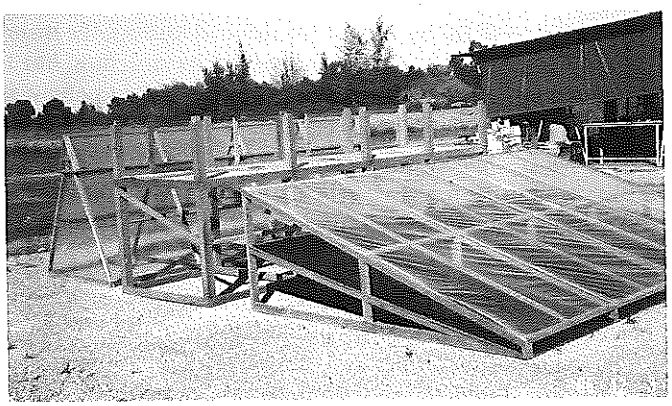

Fig. 3 Three separate parts of the portable solar dryer – solar collector, bed and roof.

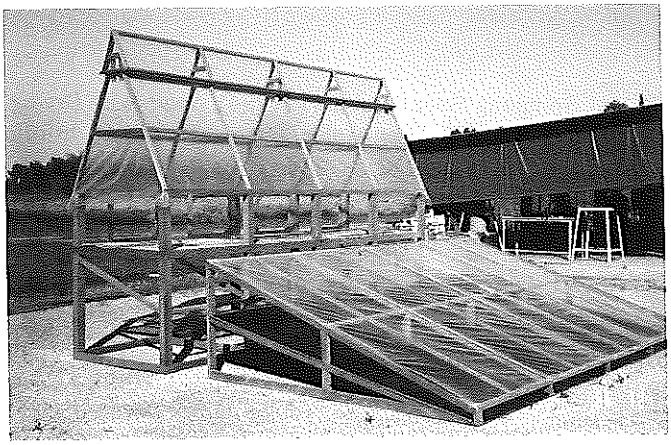

Fig. 4 The roof on top of the bed.

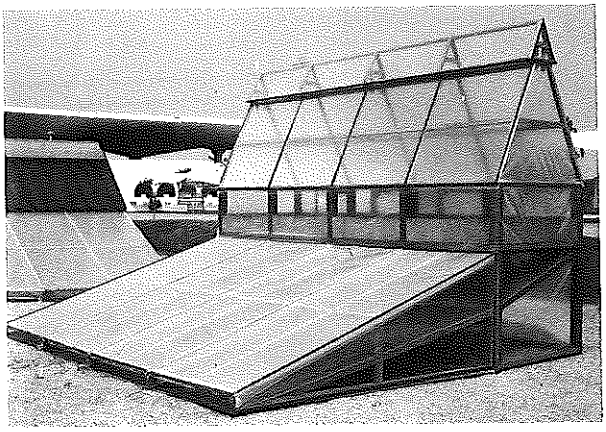

Fig. 5 AIT portable solar dryer.

According to the report to IDRC by Amyot (mentioned earlier), the main reason for the low acceptance of the dryer by farmers is not the flimsiness of its structure, but the inability of the farmer to stagger his harvest to conform to the size of the dryer, or to obtain substantially higher prices for the dried paddy. Amyot also observed that the farms on which the dryer was tested were larger than average, which explains why the dryers were said to be too small. Another factor could be the competition with other designs, particularly the flat bed dryer using a blower and rice husks as fuel to produce heat, as developed by the Agricultural Engineering Division of the Department of Agriculture, Thailand.

Finally, we mention that the dryers tested in the field had often been used to dry other products, such as bananas, fish, etc. Another promising use appears to be maize. The average farmer grows about ten tonnes of maize per year and harvests about one tonne per day in the wet season. Dried maize may be stored for about one month, but if it is not properly dried it will rot within one week. Another product for which the dryer could be used is soy bean; this is now being studied by Kasetsart University at their Kampaengsaen campus.[4]

REFERENCES

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